Technical Appendix: Motivation for Postponement of the compliance timeframes of Regulation 11 of the Section 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 outlined in the MES.

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 emission limits informed by all these inputs.
- For ease of reading, this technical appendix also includes a summary extract for the applicable listed activity taken from the detailed AIR, illustrating predicted ambient impacts of the process for the current emission baseline, compliance with existing plant standards, compliance with new plant standards, and a scenario depicting emission levels continuously at the requested alternative emission limits. This was included to assist readers in concurrently navigating the technical appendix and the associated AIR.

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 Secunda motivation report, and also informed the alternative emission limits requested.

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.
- The upstream and downstream impacts of implementing a technology.
- Operability of the technology.
- Implementation considerations including process safety risks, construction risks, production risks and general overhaul (GO) 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.

Table of Contents

List of Tables

Glossary

Definitions of terms as per GN 893, which 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 of NEM:AQA.

Priority area air quality management plan - means a plan referred to in Section 19 of NEM:AQA.

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 public commenting process, Sasol has been directed to rather seek postponement from the compliance timeframes in the MES to address its challenges. Sasol now 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 to be incorporated as a licence condition with which it must comply during the period of postponement. The alternative emissions limits are specified as *ceiling emissions limits* or *maximum emission concentrations*, 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 limit 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. Whereas average emission values reflect the arithmetic mean value of emissions measurements for a given process under all operational conditions, the ceiling emission would be the 100^{th} percentile value of emissions measurements obtained. Hence, ceiling emission values would be higher than average emission values, with the extent of 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 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 does not seek to increase emission levels relative to its current emissions baseline through its 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 environmental 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 ($PM_{2.5}$), and 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.

Initial postponement applications – Consequent upon the first round of public participation which took place in September 2013, Sasol's draft applications for postponement in terms of Regulations 11 and 12 of GN 893 were made available for public comment in April 2014. These applications are referred to in this motivation report as *initial postponement applications*, and the final versions have been submitted to the National Air Quality Officer (NAQO). Copies of these documents are also available on SRK's website.

Listed activity - In terms of Section 21 of NEM:AQA, the Minister of 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 are required 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 titled '*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; and detailing the requirements for applications for postponement of stipulated compliance timeframes.

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

Sasol Oil – Sasol Oil (Pty) Limited.

Sasol Solvents – The entity now known as Sasol Chemical Industries (Pty) Limited operating through its Secunda Chemicals Operations, including the operating division formerly known as Sasol Solvents, a division of Sasol Chemical Industries (Pty) Limited. To avoid unnecessary confusion, the name "Sasol Solvents" has been retained in this report.

Sasol Group Services – The entity now known as Sasol Chemical Industries (Pty) Limited operating through Sasol Group Services, formerly known as Sasol Group Services (Pty) Limited. This particular application pertains to Logistics Operations Centre ("LOC") within Sasol Group Services. To avoid unnecessary confusion, the name "LOC" has been retained in this report.

Special arrangements – Any 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

AIR	Atmospheric Impact Report
CO	Carbon Monoxide
CO_2	Carbon Dioxide
CTL	Coal-to-liquid
ESP	Electrostatic Precipitator
FCC	Fluidised Catalytic Cracking
GO	General Overhaul
MES	Minimum Emission Standards
NAAQS	National Ambient Air Quality Standards
NEMA	National Environmental Management Act (Act No. 107 of 1998)
NEM:AQA	National Environmental Management: Air Quality Act (Act No. 39 of 2004)
NO_2	Nitrogen Dioxide
NOx	Oxides of Nitrogen
PM	Particulate Matter
PM_{10}	Particulate Matter with a particle diameter of less than 10 µm
RTO	Regenerative Thermal Oxidiser
SAS™	Sasol Advanced Synthol
SCC	Superflex Catalytic Cracker
SO_2	Sulphur Dioxide
t/h	tons per hour
VOC	Volatile Organic Compound; equivalent to TVOC (Total Volatile Organic Compounds)
VRU	Vapour Recovery Unit

1 Due diligence obligations – project development and governance framework

Sasol has an established project development and governance framework to manage an extensive portfolio of capital projects, which is a "stage-gate" model.

The importance of this model to Sasol's capital projects is two-fold, namely:

- From a project development perspective, bringing learnings from previous project experience to bear, the model provides a framework to carefully guide the solution design process towards successful projects. Among the many important aspects guided by the model, are detailed investigations and design considerations required to address the additional complexities of interfacing new (or altered) equipment into an integrated and operational brownfields facility. For example, such considerations would include whether additional steam or power is needed for the new piece of equipment, and whether the equipment changes the throughput or capacity requirements of other process units upstream or downstream of it.
- From a governance perspective, the model prescribes rigorous project development quality standards and business requirements to be met at each successive stage of project development, before a project is approved to proceed to the next development stage. This governance process is aimed at assuring the robustness of solution development, towards implementation of successful projects that achieve their objectives and are aligned with business intent. Good project governance means that all projects need to be properly motivated, evaluated and approved in a systematic and consistent manner. The need for good governance is heightened further by the fact that Sasol is a listed company on two stock exchanges.

The duration of the various development phases (the "stages") is typically linked to the solution's complexity, including its number of interfaces with surrounding processes, and upstream and downstream process impacts. The governance processes (the "gates") serve as a crucial quality control to ensure that effective projects are ultimately successfully implemented and integrated into the facility's business model.

The Sasol stage-gate model is a sequential process, and upon successful completion of governance requirements for each stage, a project is formally approved to enter the next stage. Project schedules are driven by a number of considerations, among which key constraints include:

1 Technology complexity: including managing upstream and downstream impacts, as well as key plant infrastructure interfaces that result from integrating new equipment into an existing process.
2 The level of operational risk incurred by introducing new equipment to Sasol's unique commercialised Coal to Liquid (CTL) fuels manufacturing process, which often requires extensive piloting time to confirm a new technology's performance within the context of Sasol's process, and any unintended consequences that may arise from this.
3 Installing new equipment within a plant that is continuously operational requires careful planning for implementation during opportunity windows provided within the highly coordinated, complex-wide integrated General Overhaul (GO) schedule. This is particularly important to minimise impacts on production, and to carefully prioritise and plan over a fairly long-term horizon for cases where multiple different projects require implementation within the same portion of the plant.

Given these considerations, it is Sasol's experience that timeframes for implementation of capital projects on its brownfield sites very often exceed five years and frequently also exceed ten years.

The essence of the stage-gate process is summarised in Table 1.

Table 1: Overview of Sasol's stage-gate project governance model

Project Phase	Purpose
Idea Generation	Formulate a project's "opportunity statement", to crisply explain the driver for the project. In so doing, articulate the nature and scope of a project.
Prefeasibility	Identification of possible operational improvements and technology options to address the opportunity statement, and initial assessment of each option's applicability/feasibility, to narrow down a sub-set of prioritised solutions. Depending on the project, this phase could require extensive piloting to ensure identified options are operationally feasible.
Feasibility	Identify the most feasible technology option following appropriately detailed technical, business and operations investigations; evaluate potential technology providers; obtain necessary authorisations and approvals from authorities for the preferred solution.
Engineering	Detail design of the identified technology including design of the interfaces with the rest of the existing facility, including upstream and downstream process impacts; detailed resource planning including sourcing equipment and other project resources.
Construction	Execution of the project; construction of the required technology; physical integration of the new technology with existing equipment and systems. The construction phase for new equipment within an operational facility is coordinated within plant maintenance schedules, to mitigate against production impacts.
Commissioning	Commissioning of the installed equipment and ensuring the technology operates in accordance with the equipment's design basis; modifications to equipment or plant operating philosophy if required to reach equipment's design basis.

2 Steam Plant: Postponement request for PM (Sasol Synfuels)

2.1 Applicable standards

Table 2: 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

(a) The following special arrangement shall apply -

(i) Continuous emission monitoring of PM, SO_2 and NO_x is required, however, installations less than 100 MW heat input per unit must adhere to periodic emission monitoring as stipulated in Part 2 of this Notice.

(ii) Where co-feeding with waste materials with calorific value allowed in terms of the Waste Disposal Standards published in terms of the Waste Act, 2008 (Act No.59 of 2008) occurs, additional requirements under subcategory 1.6 shall apply.

2.2 Description of the plant

Steam is a critical industrial process requirement across the Sasol Synfuels operation. 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.

The Sasol Synfuels East and West operations have a fleet of 17 pulverised coal fired boilers, each with a maximum production capacity of 540 tons per hour (t/h) of 40 bar superheated steam. The superheated steam is fed into common steam headers from where it is routed to the various users. The layout of the entire facility is based on minimise the distance over which the steam has to be moved with the largest steam users placed closest to the steam plants, to minimise the loss of heat from the system. In addition to process demands, steam is supplied to generate 'critical power' which is needed in the event of a loss of power from the national grid. That critical power allows for safe plant shutdown without damage to the plant. Excess steam is used to generate additional electricity, which offsets some of the facility's electricity demand from the national grid.

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. Not only is the GO schedule coordinated internally within the Secunda complex, but also with other fuel refineries to avoid inland

fuel shortages, and the national electricity supplier to avoid possible regional power shortages. 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 17 boilers takes several years.

In addition the steam plants are integrated with the sulphur recovery plant. Two tall stacks (301 m on the East factory and 250m on the West factory) serve to co-disperse emissions from the steam plant and the sulphur recovery plant. The high boiler outlet temperatures from the steam plants provide essential lift to the much cooler off-gas stream from the sulphur recovery plant, significantly improving atmospheric dispersion of the latter emissions. That requirement for high boiler emission temperatures constrains boiler operations, such as constraining further improvements in boiler efficiencies. Atmospheric emissions from the boilers include the greenhouse gas, carbon dioxide (CO_2), as well as SO_2, NO_x and 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/Nm^3, through flue gas conditioning, Sasol Synfuels is able to currently achieve average emission concentrations of approximately half that, at an additional operating cost of R5-R10 million each year. Continual maintenance is performed on the ESPs to maintain this performance.

2.3 Technology options for compliance with existing plant standard: PM

Sasol Synfuels has investigated various options for PM reduction and has identified that the most suitable technology to implement would be to replace the ESP internals as they reach end of life. The renewal of the ESP internals is expected to reduce emissions to below the existing plant standard of 100 mg/Nm^3 consistently. As the performance of the ESP deteriorates over time, to keep the emissions below the existing plant standard of 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.

2.4 Project schedule

Regarding the Sasol project governance process outlined above, Sasol has completed idea generation and is currently within the feasibility stage, with feasibility, engineering, construction and commissioning to follow subject to successful completion of these sequential project stages.

The particular schedule constraints for the project schedule relate to the construction phase. Boiler availability is essential for process steam and critical power requirements, since this directly affects the production stability of Sasol Synfuels. Any additional outage time on boilers creates the risk of loss of critical power (which could result in plant-wide equipment damage), and has a direct impact on the electricity demand and fuel production levels of the facility, with significant financial implications. Thus, any boiler work, including maintenance, retrofits of compliance technology and any renewals or upgrades of equipment components, is planned to take place during a strictly adhered to general overhaul (GO) schedule, with planned boiler outages. This GO schedule is closely coordinated with the shutdown activities of other fuel refineries (to avoid an inland fuel shortage) as well as the power generation sector (to avoid possible regional blackouts, since Sasol is a comparatively large private power producer integrated into the national grid). It is furthermore aligned with other regulatory inspection requirements prescribed for pressure vessels. To minimise negative impacts of boiler outages on production, the boilers are shut down individually in a routine,

sequential manner, which means that a single cycle through the entire boiler fleet takes a number of years to complete.

In order to limit unscheduled downtime of the boilers, the ESP internal renewals have to be completed within the planned boiler GO schedule. In order to complete a cycle of renewal investments on critical boiler components, Sasol Synfuels is currently planning a sequential GO schedule with longer renewal outages of 150 days per boiler, as opposed to the normal GOs with a duration of 50 days. An integrated schedule has been developed, allowing for a GO sequence of 50 day outages for mandatory boiler inspections and routine maintenance, and a GO sequence of 150 days for renewals. The renewal of ESP internals will take place within the 150 day outage GO schedule, and hence this cycle on 17 boilers will be completed after April 2020, but possibly before April 2025. Current indications from the GO schedule are that the construction phase would require approximately a decade to complete.

2.5 Postponement request

Sasol, on behalf of Sasol Synfuels, applies for a five-year postponement from the existing plant standard for PM emissions, as illustrated in Table 3.

Table 3: Alternative emission limit request for Sasol Synfuels steam plant

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			
Particulates	100	50	From now until 1 April 2020: 130 A further postponement application on existing plant standards will be lodged closer to 2020, to allow for full implementation of the compliance technology.	Daily average

[(a)] *Note, these are prescribed as ceiling emission limits, or maximum emission concentrations, as described in Chapter 5 of the Motivation Report.*

Sasol Synfuels commits that it will be able to comply with existing plant standards within the period 1 April 2020 – 1 April 2025. A second postponement of the compliance timeframe will therefore be required to facilitate full compliance, and an application for this purpose will be made closer to 2020.

With implementation of the ESP internals upgrade on each sequential boiler, improvements in average emission concentrations are expected to realise. The second postponement request will inform its requested interim limit on this basis, since some improvements in ceiling emissions limits may be realised by April 2020, although not to the extent that they conform with the existing plant standard.

The separate motivation report outlines Sasol Synfuels' additional postponement requests for the steam plants, including additional postponement on meeting the new plant standard for PM emissions.

3 Superflex™ Catalytic Cracker stack: Postponement request for PM (Sasol Synfuels)

3.1 Applicable standards

Table 4: Category 2: Petroleum Industry, the production of gaseous and liquid fuels and well as petrochemicals from crude oil, coal, gas or biomass, Subcategory 2.2: Catalytic Cracking Units

Description:	Refinery catalytic cracking units		
Application:	All installations		
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	100
		Existing	120
Sulphur dioxide	SO_2	New	1 500
		Existing	3 000
Oxides of nitrogen	NO_x expressed as NO_2	New	400
		Existing	550

This postponement application pertains to the existing plant standard for PM of 120 mg/Nm^3.

3.2 Description of the plant

The SCC facility was commissioned in 2006 to enable compliance with the then-Department of Minerals & Energy's Clean Fuels 1 fuel specification requirements. The SCC is a Fluidised Catalytic Cracking (FCC) process incorporating a reactor and regenerator. The SCC converts low molecular weight molecules to feedstock for petrol and olefinic gases used for plastic manufacture, and is integral to the refinery operations.

The need to introduce FCC into the unique Sasol Synfuels CTL fuels manufacturing process means that the SCC is the only commercial catalytic cracking unit in the world to use this particular technology. The cracking method of the SCC is different to the FCC of a traditional, crude oil refinery due to the significant differences in the feed to the unit. The SCC processes synthetic low-to-medium molecular weight, low-to-medium boiling point, heavy metal-free hydrocarbons which derive from the synthetic gas produced from coal. This contrasts with the feed to traditional FCC processes, namely high-boiling, high-molecular weight, heavy metal-containing hydrocarbons derived from crude oil. Due to the differences in the feed material, the SCC requires a different catalyst to that normally used in a refinery FCC. The differences in composition of the catalyst and the nature of the chemical reactions mean that abatement equipment has to be specifically designed for what is a unique application.

The SCC regenerator contains a set of five cyclones to remove catalyst particles (a form of PM emissions) from the flue gas, before it enters a stack. Further flue gas clean-up is effected via a third stage separator system consisting of a number of small cyclones, which remove more PM. This abatement equipment was installed as part of the original plant configuration when it was commissioned in 2006. Furthermore, an online opacity meter is installed to monitor PM emissions from the SCC stack.

3.3 Technology options for compliance with new plant standard

Various studies and operational improvements have been implemented in an attempt to reduce PM emissions to achieve the Minimum Emission Standards (MES). The conclusion of these studies is that full compliance can only be achieved by upgrading or replacing the current abatement equipment with a different technology. Technology assessments indicate that certain identified solutions employed on typical FCCs may also reduce emissions on the SCC process, although by an unknown quantum on this unique facility. Work is ongoing to assess the abatement potential of a narrowed-down set of viable solutions. The following technologies are available:

- Electrostatic Precipitators.
- Wet Scrubber.
- Bag houses.
- Gas Solid Separation (Pulse back filters).
- Third and fourth stage cyclones (Already installed).

A full technology evaluation is being conducted to identify the most appropriate technology suitable to the unique conditions of the SCC plant.

3.4 Project schedule

Regarding the Sasol project governance process outlined above, Sasol is currently in the idea generation stage, with prefeasibility, feasibility, engineering, construction and commissioning to follow subject to successful completion of each sequential project stage.

The particular schedule constraints for the project schedule relate to the construction phase, due to concurrent compliance projects and the shutdown schedule.

The SCC undergoes a planned maintenance shutdown once every alternate year. Major tie-ins required for projects to integrate existing and new equipment are completed during these shutdowns. The April 2015 and 2017 shutdowns are currently dedicated for the implementation and commissioning of other major compliance projects, namely the Department of Energy's Clean Fuels 2 programme. That project has benefits for ambient air quality too, since air pollutant emissions from vehicle exhaust gases will be reduced as a result of the changes in refinery fuel specifications.

Any further major tie-ins for a SCC emission reduction project can only be implemented during the following shutdown opportunity in April 2019 at the earliest, if no further optimisations are required on equipment installed for Clean Fuels 2. If further optimisations are required for Clean Fuels 2 in the April 2019 cycle, then tie-ins for PM emission reductions would only be able to proceed in the April 2021 cycle, with commissioning to follow thereafter. Thus, a total of more than five years extension on the compliance timeframe for the existing plant standard (and some extension of the new plant standard compliance timeframe) would be required. Successive postponement applications would therefore be required to accommodate the compliance project schedule.

3.5 Postponement request

Sasol, on behalf of Sasol Synfuels, applies for a five-year postponement from the existing plant standard for PM emissions, as illustrated in Table 5.

Table 5: Alternative emission limit request for Sasol Synfuels SCC plant

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			
Particulates	120	100	From now until 1 April 2020: 330 A further postponement application on existing plant standards will be lodged closer to 2020, to allow for commissioning and optimisation of the installed compliance technology.	Daily average

[a] Refer to the content of the motivation report for an explanation of why ceiling emissions limits are specified.

The existing plant standard, which takes the form of a ceiling limit, cannot be complied with in the interim. Hence, postponement of the standard until a technology solution is implemented to allow compliance with the new plant standard in one abatement step is requested. An interim alternative emission limit, specified as a ceiling limit of 330 mg/Nm^3, is requested.

4 Storage Tanks (Sasol Synfuels and Sasol Oil)

4.1 Applicable standards

Category 2.4 prescribes special arrangements that apply for control of VOCs from storage of raw materials, intermediate and final products with a vapour pressure above 14 kPa at operating temperature. The special arrangement stipulates that alternative control measures that can achieve the same or better results as the prescribed abatement technologies may be used.

Table 6: Category 2: Petroleum Industry, the production of gaseous and liquid fuels and well as petrochemicals from crude oil, coal, gas or biomass, Subcategory 2.4: Storage and Handling of Petroleum Products, special arrangement (4)(b)(i)

Storage vessels for liquids shall be of the following type:

Application	All permanent immobile storage facilities at a single site with a combined storage capacity greater than 100 cubic metres
True vapour pressure of contents at product storage temperature	**Type of tank or vessel**
Type 1: Up to 14 kPa	Fixed roof tank vented to atmosphere, or as per Type 2 and 3
Type 2: Above 14 kPa and up to 91 kPa with a throughput of less than 50 000 m^3 per annum	Fixed-roof tanks with Pressure Vacuum Vents fitted as a minimum, to prevent “breathing losses”, or as per Type 3
Type 3: Above 14 kPa and up to 91 kPa with a throughput greater than 50 000 m^3 per annum	a) External floating-roof tank with primary rim seal and secondary rim seal for tank with a diameter greater than 20m, or b) fixed-roof tank with internal floating deck/roof fitted with primary seal, or c) Fixed roof tank with vapour recovery system
Type 4: Above 91 kPa	Pressure vessel

Sasol Synfuels and Sasol Oil intend to comply with this special arrangement, but requires additional time to implement the necessary measures to do so, and hence applies for postponement of compliance timeframes.

4.2 Description of the plant

The Sasol complex in Secunda has various process units producing a range of different fuel and chemical intermediate and final products. The products from these units are stored in tanks at the tank farm area, according to their contents. These intermediate and final products are stored in tanks operated by Sasol Synfuels and Sasol Oil. The contents are either sent to downstream production units for further processing or dispatched to the customer after quality control.

Tanks falling under Type 1, Type 2 and Type 4 classifications comply with the MES. This postponement application pertains to certain Type 3 tanks.

4.3 Technology options for compliance with new plant standard

Most storage tanks at the Sasol Secunda complex are fixed-roof tanks, and all those tanks with vapour pressure between 14 kPa and 91 kPa have pressure vacuum vents installed as a measure to abate VOC emissions.

Tanks which may fall into MES Category 2.4's "Type 3" classification, as shown in Table 8, have been identified. This was established by initial studies conducted by independent parties to identify the number of tanks exceeding the 14 kPa vapour pressure limit. The results are presently being verified through further measurement campaigns on VOCs, as well as vapour pressure simulations.

As indicated in Category 2.4 of the MES, "Type 3" tanks must be external floating roof tanks, or tanks retrofitted with internal floating roofs or vapour recovery units, or tanks retrofitted with alternative control measures that can achieve the same or better results.

Sasol Synfuels has made air quality improvement commitments contained to the gazetted Highveld Priority Area Air Quality Management Plan, as described in the motivation report. As part of that commitment, Sasol Synfuels has begun implementation of a pilot study to test the effectiveness of abatement equipment in the form of floating devices which are placed on the surface of the tanks' contents, as an alternative to the stipulated internal floating roof technology. The reason for the selection of floating devices over the installation of floating roofs, are the following significant advantages:

- **Comparable emission reduction:** The floating devices are expected to achieve similar abatement results to internal floating roofs, with other significant operational advantages outlined below. Internal floating roofs are estimated to achieve reductions of 90-98% on tanks designed and constructed according to the needed specifications, but efficiency losses are experienced on older tanks retrofitted with internal floating roofs, due to out of roundness and wall roughness factors. Supplier claims of floating devices indicate reduction of VOC emissions by 86-92%. Initial pilot test work conducted suggests that the results are promising, and piloting is nearing completion to assess the emission reduction potential of these floating discs under different operating conditions, in order to confirm the suitability for different applications of the technology.
- **Reduction of storage capacity:** An estimated period of 16 weeks is required to install a single floating roof. To meet production schedule during the time of retrofit, additional storage capacity is required. In addition to this, internal floating roofs reduce the working capacity of a tank by 10-25%. Therefore, additional tanks would be required to be installed to replace the lost storage capacity. The installation of floating devices or similar technology for emission abatement will not require any additional tanks to be installed, since it does not have material impacts on the working capacity of the current tanks. This is beneficial to Sasol Synfuels from a total project cost and plot space requirement perspective.
- **Costs:** The very rough order of magnitude total cost to install floating devices is estimated to be 10-15% of the costs to install internal floating roofs, This is due to savings in the technology itself, avoidance of building additional storage tanks to make up for lost working capacity, and the avoidance of associated additional utilities that would be required for new tanks.
- **Plot space requirements:** The installation of new tanks will be required to replace unavailable working capacity of existing tanks, if internal floating roofs are installed. These additional tanks would require significant plot space. The positioning of additional tanks must take existing equipment and tanks into consideration to ensure compliance with safety regulations and guidelines, such as explosion safety areas extending beyond the perimeters of the Sasol facility. The installation of internal floating roofs has a significant impact on already constrained plot space, while the installation of floating devices does not require any additional plot space.

Sasol Synfuels and Sasol Oil therefore seeks postponement in order to finalise its studies to confirm technology effectiveness, thereafter to obtain the competent authority's approval on the use of the alternative technology, and, subject to its approval, implement the solution on the applicable tanks. Subject to their approval and installation, the efficiency of the floating devices would be monitored as part of the Sasol Synfuels fugitive emissions monitoring program to ensure that the floating devices remain effective over time.

4.4 Project schedule

Regarding the Sasol project governance process outlined above, Sasol is currently in the prefeasibility stage, with feasibility, engineering, construction and commissioning to follow subject to successful completion of each sequential project stage, including the required approval of the National Air Quality Officer.

The particular schedule constraints for the project schedule relate to the construction phase, due to the shutdown schedule for the storage tanks.

As for the rest of the Sasol Secunda facility, which operates for 365 days of the year, tanks are taken out of service according to a carefully planned GO schedule to avoid disruptions to production.

Retrofitting of a compliance solution requires the tanks to be decommissioned in accordance to this schedule, since the installation of any abatement equipment requires the tanks to be clean and free of vapour for safety and occupational health reasons. Current indications from the GO schedule are that the construction phase would require approximately a decade to complete. Thus, a total of more than five years extension on the compliance timeframe for the special arrangement would be required. Successive postponement applications would therefore be required to accommodate the compliance project schedule.

4.5 Postponement request

Sasol, on behalf of Sasol Synfuels and Sasol Oil, applies for an initial five-year postponement of compliance timeframes from special arrangement (4)(b)(i) of Category 2.4.

In light of the project schedule, a second postponement will be sought closer to 2020. In the interim, the VOC emissions from these units will be managed as part of the site fugitive emission monitoring plan.

Should the results of the pilot study on the floating disc technology not prove successful, or should the technology not be approved by the National Air Quality Officer as a suitable alternative control measure, Sasol Synfuels and Sasol Oil will use the postponement period to evaluate the compliance implications of the prescribed technologies.

5 Loading Stations (Sasol Group Services)

5.1 Applicable standards

Category 2.4 prescribes special arrangements that apply for control of from the loading and unloading of raw materials, intermediate and final products with a vapour pressure of greater than 14 kPa at handling temperature. Alternative control measures that can achieve the same or better results as the prescribed abatement technologies may be used.

All installations with a throughput of greater than 50,000m^3 per annum of products with a vapour pressure greater than 14 kPa must be fitted with vapour recovery or vapour destruction units. The emission limits which must be achieved following installation of the abatement equipment are outlined in Table 7.

Table 7: Category 2: Petroleum Industry, the production of gaseous and liquid fuels and well as petrochemicals from crude oil, coal, gas or biomass, Subcategory 2.4: Storage and Handling of Petroleum Products, special arrangement (4)(c)(i)

Description	Vapour Recovery Units		
Application:	All loading/offloading facilities with a throughput greater than 50000m^3		
Substance or mixture of substances		**Plant status**	**mg/Nm^3 under normal conditions of 273 Kelvin and 101.3 kPa**
Common name	**Chemical symbol**		
Total volatile organic compounds from vapour recovery/destruction using thermal treatment	N/A	New	150
		Existing	150
Total volatile organic compounds from vapour recovery/destruction using non-thermal treatment	N/A	New	40000
		Existing	40000

5.2 Description of the plant

The Loading facility has road and rail loading facilities that load, amongst others, chemicals and fuel products. The fuel products have a vapour pressure above 14 kPa and contain TO14 VOC components. At the road loading facility, fuel products in excess of 50 000 m^3 per annum is loaded and vapour recovery is required. Similar fuel products are loaded by rail loading at a throughput of less than 50 000 m^3 per annum.

All loading stations where fuel products are loaded, therefore both road and rail loading facilities, are connected to a Vapour Recovery Unit (VRU). Sasol has demonstrated its intent to comply with the special arrangements by installing a VRU at the road and rail loading facilities. In order to ensure compliance with the special arrangements, modifications are required to the VRU. The modifications required to ensure safe and reliable operation of the unit have been identified and capital approved for the necessary modifications, and are in the process of being implemented.

5.3 Identified technology for compliance with special arrangement

A VRU is installed at loading facilities that load products containing TO14 VOC products and have a vapour pressure above 14 kPa. Due to operational and technical challenges, the VRU is not currently operational. The modifications to the unit that are required to ensure safe and stable operation have been identified and relate to the process safety system, changes to the catchment area of the bunded area as well as improvements to the control systems and control instrumentation of the VRU.

5.4 Project Schedule

Regarding the Sasol project governance process outlined above, Sasol in currently in the engineering stage, with construction and commissioning to follow subject to successful completion of each successive project stage. The project schedule indicates that compliance is likely to be achieved by 1 April 2016.

5.5 Postponement request

Sasol, on behalf of Sasol Group Services, applies for a one-year postponement of compliance timeframes from special arrangement (4)(c)(i) of Category 2.4.

In the interim, the VOC emissions from these units will be managed as part of the site fugitive emission monitoring plan.

6 Tar Value Chain Phase 1 (Sasol Synfuels)

6.1 Listed activity compliance requirements

MES Categories 3.3 and 3.6 prescribe emission limits applicable to point sources in Sasol Synfuels' Tar Value Chain.

Table 8: Category 3: Carbonization and Coal Gasification, Subcategory 3.3: Tar Processes

Description	Processes in which tar, creosote or any other product of distillation of tar is distilled or is heated in any manufacturing process.		
Application:	All installations		
Substance or mixture of substances		**Plant status**	**mg/Nm^3 under normal conditions of 273 Kelvin and 101.3 kPa**
Common name	**Chemical symbol**		
Total Volatile Organic Compounds	N/A	New	130
		Existing	250

Table 9: Category 3: Carbonization and Coal Gasification, Subcategory 3.3: Tar Processes

Description	The production and clean-up of a gaseous stream derived from coal gasification, separation and clean-up of a raw gas stream through a process that involves sulphur removal and Rectisol as well as the stripping of a liquid tar stream derived from the gasification process.		
Application:	All installations		
Substance or mixture of substances		**Plant status**	**mg/Nm^3 under normal conditions of 273 Kelvin and 101.3 kPa**
Common name	**Chemical symbol**		
Hydrogen Sulphide	H_2S	New	3 500
		Existing	4 200
Total Volatile Organic Compounds	N/A	New	130
		Existing	250
Sulphur Dioxide	SO_2	New	500
		Existing	3 500

This postponement application pertains to the existing plant standard for VOC emissions of 250 mg/Nm^3 for point sources falling under Category 3.3 and Category 3.6.

6.2 Description of the point sources

The tar value chain is downstream of the gasification process and consists of various units that process a liquid tar-containing product stream. The liquid tar condenses out of the syngas when the syngas is cooled. The tar value chain includes various units, among them being:

1. *Gas Liquor Separation*

   In the gas liquor separation unit, various gaseous, liquid and solid components are separated from the gas liquor streams. Separation is achieved by gravity separation at controlled temperatures.

2. *Coal Tar Filtration plant*

   In the coal tar filtration plant excess solids and water are removed from the tar and oil streams before these streams are further processed in the downstream tar distillation units.

3. *Tar Distillation Units*

   In the tar distillation units, the crude tar feed (crude tar, residue oil, phenolic pitch and slop material) from the coal tar filtration plant is separated (fractionated) into different product streams using distillation processes. The product streams include light and heavy naphtha, medium and heavy creosote, residue oil and pitch.

4. *Feed Preparation Plant*

   The feed preparation plant comprises a waxy oil train and a tar train, which clean tar and waxy oil products so that these products can be recycled back to other production units where they are used as a feedstock.

Within the tar value chain, sources of fugitive VOC emissions have been identified at a number of processing units. These emission sources were identified as part of a broader Sasol initiative of reducing VOC emissions by 80% by 2020, off a 2009 baseline. In developing VOC emissions abatement strategies it is judicious to group the sources so that synergies can be realised in developing and implementing abatement solutions. The first of these groupings is referred to as Tar Value Chain Phase 1 and includes the processing units described above. The second grouping, Tar Value Chain Phase 2, is described in the following section.

A number of VOC emission abatement projects have been approved in the Sasol Synfuels tar value chain, with Sasol in March 2014 announcing additional capital approvals to complete these complex projects, bringing the project approvals to more than R5.3 billion. Included in this total, are capital approvals for the Tar Value Chain Phase 1 project, which is well advanced and nearing completion in the next few years.

6.3 Identified technology for compliance with new plant standards

In order to address emissions from these four plant units, the Tar Value Chain Phase 1 project was initiated to collect VOC emissions from equipment, tanks and pits. The collected VOCs will be routed to seven regenerative thermal oxidisers (RTOs) that will reduce emissions from these plant units to comply the MES new plant standards. Sasol has included all potentially significant sources in the project, regardless of whether the sources are regulated by the MES or not, to ensure sustainable air quality improvement on the Sasol site and beyond the plant boundaries; in line with a Group internal policy to reduce VOC emissions by 80% by 2020, off a 2009 baseline.

The basic operation of an RTO consists of passing a hot gas stream over a heat sink material in one direction and recovering that heat by passing a cold gas stream through that same heat sink material in an alternate cycle. RTOs are used to destroy VOCs that are discharged from various processes, by oxidising them to carbon dioxide, a greenhouse gas with no direct health impacts.

The seven RTOs will be installed as follows:

1. *Gas Liquor Separation*

   The Gas Liquor Separation Unit is divided into 2 factories, one on the West and one on the East Sasol Synfuels plants. Two RTOs will be installed on the West plant and two RTOs will be installed on the East plant.

2. *Coal Tar Filtration Plant*

   The current vapour collection system at the coal tar filtration plant uses a forced draught extraction fan to route vapours to atmosphere, via a water scrubber. Vapours routed to the vapour collection systems from the unit will be fed into the same RTOs as for the Gas Liquor Separation plant applicable to West or East factories.

3. *Tar Distillation Units*

   The two Tar Distillation Units will be connected to two RTOs placed adjacent to each other.

4. *Carbotar Feed Preparation Plant*

   One RTO will be constructed for the treatment of this plant's emissions.

6.4 Project schedule

The Tar Value Chain Phase 1 project was initiated as a result of Sasol's internal policy to reduce VOC emissions by 80% by 2020, off a 2009 baseline. It goes beyond the compliance requirements of the MES, since non-regulated VOC emission sources have also been included, to meet the Sasol policy.

The collected VOCs will be routed to seven RTOs where they are thermally destroyed to carbon dioxide. In order to minimise downtime of the operating plants and ensure the safety of construction crews, construction and tie-ins are conducted during scheduled plant shutdowns. The installation of the seven RTOs is semi-staggered to allow for tie-ins to be completed during plant shutdowns and the expected completion date for the installation and optimisation of all seven is in advance of the 1 April 2020 compliance date for new plant standards.

Regarding the Sasol project governance process outlined in Chapter 1, Sasol is currently completing the engineering stage, and has already begun the construction phase for certain of the RTOs. Construction will be completed following approval of additional capital to overcome integration complexities between the new equipment and the existing plant, where after commissioning will follow. The project schedule indicates that compliance will most likely be achieved by 1 April 2017.

6.5 Postponement request

Sasol, on behalf of Sasol Synfuels, applies for a two year postponement of compliance timeframes for existing plant standards for the VOC emission limits for Category 3.3 and Category 3.6 for the five plant units specified. While existing plant standards will not be achieved by 1 April 2015, the new plant standards will be reached before the 1 April 2020 compliance date.

The postponement on the existing plant standard is required to accommodate the implementation schedule for seven semi-sequential RTOs. This will allow for dedicated focus on the complex integration of each new RTO with the existing plant infrastructure, while achieving concurrent optimisation of the RTO technology once it is installed, to ensure all units operate at design intent. The project is designed to reach new plant standards before the required compliance timeframe of 1 April 2020. The project has entered the execution phase, with construction and detail engineering concurrently taking place, and commissioning of the first of seven RTO units to follow in the near future.

In the interim, the VOC emissions from these units will be managed as part of the site fugitive emission monitoring plan.

7 Sources in Tar Value Chain – Phase 2 (Sasol Synfuels)

7.1 Applicable standards

MES Category 3.3 prescribes special arrangements that apply for control of VOCs from storage of raw materials, intermediate and final products with a vapour pressure above 14 kPa at operating temperature. The special arrangement stipulates that alternative control measures that can achieve the same or better results as the prescribed abatement technologies may be used.

Table 10: Category 3: Carbonization and Coal Gasification, Subcategory 3.3: Tar Processes, special arrangement (3)(b)(i)

Storage vessels for liquids shall be of the following type:

Application	All permanent immobile storage facilities at a single site with a combined storage capacity greater than 100 cubic metres
True vapour pressure of contents at product storage temperature	**Type of tank or vessel**
Type 1: Up to 14 kPa	Fixed roof tank vented to atmosphere, or as per Type 2 and 3
Type 2: Above 14 kPa and up to 91 kPa with a throughput of less than 50 000 m^3 per annum	Fixed-roof tanks with Pressure Vacuum Vents fitted as a minimum, to prevent “breathing losses”, or as per Type 3
Type 3: Above 14 kPa and up to 91 kPa with a throughput greater than 50 000 m^3 per annum	j) External floating-roof tank with primary rim seal and secondary rim seal for tank with a diameter greater than 20m, or l) fixed-roof tank with internal floating deck/roof fitted with primary seal, or l) Fixed roof tank with vapour recovery system
Type 4: Above 91 kPa	Pressure vessel

Sasol Synfuels intends to comply with this special arrangement, but requires additional time to implement the necessary measures to do so, and hence applies for postponement of compliance timeframes.

7.2 Description of the point sources

As per the Tar Value Chain Phase 1 description, the tar value chain is downstream of the gasification process where coal is transformed into a synthetic gas. The tar value chain consists of various units that process a liquid tar-containing product stream. The tar value chain includes various units. The Gas Liquor Separation plant separates tar from other chemicals, while the Coal Filtration plant separates tar from the solids. The tar distillation units fractionate crude tar feed received from upstream units into various cuts that will after further processing end up in the final blending components for the petrol and diesel pools. Feed streams include crude tar from Coal Tar Filtration and Feed Preparation plant, residue oil, phenolic pitch and slop material. The product streams include light and heavy naphtha, medium and heavy creosote, residue oil and pitch.

Within the tar value chain, point sources of VOCs were identified at a number of plant units, for the purposes of meeting a Sasol internal policy of reducing VOC emissions by 80% by 2020, off a 2009 baseline.

The Tar Value Chain Phase 1 project is described in the previous chapter. The scope of the Tar Value Chain Phase 2 project is to address VOC emissions from three storage tanks.

7.3 Technology options for compliance with new plant standard

After promulgation of amended MES in November 2013, the capital project governance process required that the project re-enter the idea generation phase, to re-confirm scope in light of regulatory changes. As described above, this phase of the project governance model is the inception of a project, with the next phase to identify technology options that may be feasible solutions for compliance with new plant standards.

7.4 Project schedule

The governance process necessitates that the project re-enters the idea generation phase, in light of amendments promulgated in November 2013, requiring re-confirmation of the project scope and optimal compliance solution.

At this early stage of the project, it is assumed that a project of this nature will take a realistic timeframe of 5-6 years to reach beneficial operation. It is estimated using assumptions on the plant shutdown schedule, vendor capacity and internal resources availability. Any unforeseen changes in any of these factors could result in changes to the project schedule.

Given the early stage of the project and the governance process to be followed to identify, approve, construct and commission the selected compliance solution, a postponement of five years is requested.

7.5 Postponement request

Sasol, on behalf of Sasol Synfuels, applies for a five-year year postponement of compliance timeframes for existing plant standards for the VOC emission limits for Category 3.3 for the emissions from three storage tanks falling under the scope of the Tar Value Chain Phase 2 project. While existing plant standards will not be achieved by 1 April 2015, it is intended that the new plant standards will be achieved by no later than 1 April 2020.

The postponement on the existing plant standard is required to advance the project through the various development and governance phases, aligning the scope with the recently promulgated MES amendments of November 2013.

In the interim, the VOC emissions from these units will be managed as part of the site fugitive emission monitoring plan.

8 Phenosolvan (Sasol Synfuels)

8.1 Applicable standards

MES Category 3.6 prescribes emission limits applicable to the Phenosolvan plant.

Table 11: Category 3: Carbonization and Coal Gasification, Subcategory 3.6: Synthetic Gas Production and Clean-up

Description	The production and clean-up of a gaseous stream derived from coal gasification, separation and clean-up of a raw gas stream through a process that involves sulphur removal and Rectisol as well as the stripping of a liquid tar stream derived from the gasification process.		
Application:	All installations		
Substance or mixture of substances		**Plant status**	**mg/Nm^3 under normal conditions of 273 Kelvin and 101.3 kPa**
Common name	**Chemical symbol**		
Hydrogen Sulphide	H_2S	New	3500
		Existing	4200
Total Volatile Organic Compounds	N/A	New	130
		Existing	250
Sulphur Dioxide	SO_2	New	500
		Existing	3500

This postponement application pertains to the existing plant standard for VOC emissions of 250 mg/Nm^3 for the Phenosolvan plant falling under Category 3.6.

8.2 Description of the plant

The Phenosolvan plant, like the tar value chain described above, is a process located downstream of the gas cooling and separation step in the CTL fuels manufacturing process. Whereas the tar value chain processes a liquid tar-containing product stream emanating from the gasification process, the purpose of the Phenosolvan plant is to extract valuable products from a water stream also emanating from the gasification process. At the Phenosolvan plant, carbon dioxide gas (CO_2) is passed through the water stream in saturation columns, in order to alter the pH of the stream. The pH change promotes the extraction of products from the water stream, and entrains or entraps a portion of the VOC components in the CO_2 gas as that passes through the water stream. This results in VOCs exiting the column with the CO_2 gas.

8.3 Technology options for compliance with new plant standard

Various options have been investigated to reduce VOC emissions from the Phenosolvan plant.

These include:

- **Flaring to combust the VOC emissions to carbon dioxide**: Flaring was found to be an infeasible technology option due to the low heating value and high oxygen content of the stream exiting the saturation columns.
- **Membrane separation**: Investigations identified that this is unlikely to be a feasible option, due to the large amount of CO_2 present in the gas stream. CO_2 is a large molecule which will permeate with the hydrocarbons.
- **Catalytic oxidation**: Catalytic oxidation creates a significant operations risk, since compounds are present which may render the catalyst used in the process, ineffective. On this basis, this solution is considered infeasible.

- **Absorption**: This option was considered in order to recover the VOCs. Absorption was found to be undesirable due to negative cross-media environmental impacts, since this will generate an additional effluent stream which would increase the site's waste footprint, and would require additional waste management solutions.
- **Condensation**: This option was considered in order to recover the VOCs. In order to treat the CO_2 stream containing dilute VOC components with condensation, sub-zero temperatures are required, which requires additional energy inputs to the process. This would increase electricity demand for the site, which is counter to Sasol's energy efficiency objectives and is therefore seen as a less preferable solution.
- **Removal of the CO_2 currently going to the saturation columns**: This option is considered since removal of the CO_2 would potentially avoid the entrainment of VOCs, which results in increased VOC emissions. In order to establish viability of this option, a test run is planned to remove the CO_2 from the CO_2 Saturation Columns. Should the test run be successful and not compromise the extraction of phenols downstream in the plant, the amount of VOCs released will be reduced.
- **Regenerative Thermal Oxidation (RTO)** (the same technology described for the Tar Value Chain Phase 1 project): this could be effected through the installation of an RTO unit dedicated to Phenosolvan off-gas, or the use of spare capacity - if available - at the RTOs to be constructed at the Gas Liquor Separation plant as part of the Tar Value Chain Phase 1 project.

Investigations are still ongoing, but interim conclusions are that the solutions ordered by preference, are: the removal of CO_2 currently going to the saturation columns (if feasible), followed by the use of spare RTO capacity at the Gas Liquor Separation plant (if feasible); followed by the construction of a dedicated RTO for the Phenosolvan plant.

8.4 Project schedule

Regarding the Sasol project development and governance process outlined above, Sasol is currently in the prefeasibility stage, with feasibility, engineering, construction and commissioning to follow subject to successful completion of each sequential project stage.

The project plan to reduce VOC emissions from the Phenosolvan plant involves the following actions, in order to identify feasible compliance solutions:

- Test run to remove CO_2 to the saturation column to verify whether the VOCs emitted can be significantly reduced by removing CO_2 to the saturation column.
- Should the test run not reduce VOCs to the limits specified in the MES, or should it have negative impacts on production, a prefeasibility package will be developed, to try and make use of potentially available VOC destruction capacity at an RTO.
- If neither of the above options (or any other identified feasible solutions) should prove successful, then a dedicated RTO could be required for Phenosolvan. In this scenario, it may not be possible for Synfuels to comply with the MES by 1 April 2020, and a further postponement could be required.

At this early stage of the project, an initial five years of postponement is requested, to complete the studies, identify a feasible compliance solution, and proceed with the project governance processes.

8.5 Postponement request

Sasol, on behalf of Sasol Synfuels, applies for a five-year year postponement of compliance timeframes for existing plant standards for the VOC emission limits for Category 3.6 for the Phenosolvan plant. While existing plant standards will not be achieved by 1 April 2015, if the preferred options are established to be feasible, the new plant standards could be reached by 1 April 2020.

The postponement on the existing plant standard is required to conduct the necessary investigations to confirm viability of the preferred options. If neither of the two most preferable options are feasible,

a further postponement on the existing plant standards (and, at that point, the new plant standards as well) may be required, but this would be confirmed closer to 2020.

In the interim, the VOC emissions from the Phenosolvan plant will be managed as part of the site fugitive emission monitoring plan.

9 Sulphur Recovery and Rectisol Plant (Sasol Synfuels)

9.1 Applicable standards

MES Category 3.6 prescribes emission limits applicable to Sasol Synfuels' sulphur recovery and Rectisol plants.

Table 12: Category 3: Carbonization and Coal Gasification, Subcategory 3.6: Synthetic Gas Production and Clean-up

Description:	The production and clean-up of a gaseous stream derived from coal gasification and includes gasification, separation and clean-up of a raw gas stream through a process that involves sulphur removal and Rectisol as well as the stripping of a liquid tar stream derived from the gasification process.		
Application:	All installations		
Substance or mixture of substances		**Plant status**	**mg/Nm^3 under normal conditions of 273 Kelvin and 101.3 kPa**
Common name	**Chemical symbol**		
Hydrogen Sulphide	H_2S	New	3,500
		Existing	4,200
Total Volatile Organic Compounds	N/A	New	130
		Existing	250
Sulphur dioxide	SO_2	New	500
		Existing	3,500

This postponement application pertains to the existing plant standard for SO_2 emissions of 3 500 mg/Nm^3.

9.2 Description of the plant

The first step in the CTL process involves a series of chemical reactions, collectively known as "gasification", which converts solid coal, water (in the form of steam) and oxygen into a raw (or unpurified) synthesis gas (syngas), comprising mainly carbon monoxide (CO) and hydrogen (H_2). The syngas is then transformed into various hydrocarbon streams in the patented Sasol Advanced Synthol™ (SAS) technology, which is based on the Fischer-Tropsch process. The hydrocarbon chains are precursors for a wide array of liquid fuel and chemical product components.

Iron oxide catalysts assist the chemical conversions that take place in the SAS™ reactors, and these catalysts only work effectively in the presence of a highly purified syngas stream. Contaminants in the gas stream such as sulphur (in the form of hydrogen sulphide, H_2S) serve to 'poison' the catalyst and thereby reduce the efficacy of the chemical transformation. A sulphur removal process is therefore essential to purify the syngas stream prior to the SAS™ reactors, to remove both sulphur and other reaction contaminants. The necessity to exclude all sulphur from the gas stream prior to the SAS™ reactors means that Sasol Synfuels produces ultra low-sulphur fuels.

Three key process units are involved in the sulphur removal process, as described in detail in the Sasol Synfuels additional postponement motivation report. For the purposes of this report, only the sulphur recovery plant is described.

9.2.1 The Sulphur Recovery Plant

When Sasol's facilities in Sasolburg and Secunda were first constructed, there was no proven technology to extract any of the compounds from the "off-gas" that was separated from the raw syngas. As a result the off-gas was routed directly to the stack and emitted directly to atmosphere. The effect of this was to create odour episodes as far afield as Johannesburg and Pretoria because H_2S has a "rotten eggs" smell.

For more than a decade, Sasol scientists collaborated with international technology suppliers to find a way of removing sulphur from the off-gas stream. After extensive research and development, the Sulfolin process was developed, and sulphur recovery plants based on that process were built on the Sasol Synfuels East and West factories. The sulphur recovery plants now remove some 75% of the H_2S that was previously emitted to atmosphere. As importantly, the recovered sulphur is turned into a high purity (up to 99%), saleable product through a filtering and granulation process. The remaining H_2S in the off-gas stream is emitted from one of two main stacks in combination with higher temperature off-gases from the steam plant boilers. The heat from the steam plant boilers enhances the lift of all emissions, especially the cooler H_2S, resulting in improved dispersion in the atmosphere.

There is a possibility that some of the H_2S emitted from the sulphur recovery process naturally converts into SO_2, which would be emitted via the main stacks.

9.3 Technology options for compliance with new plant standard

Prior to the promulgation of the amended MES in November 2013, no SO_2 emission limit had been contemplated for this listed activity.

For this reason the potential conversion of H_2S emitted from the sulphur recovery process into SO_2 emissions has not been measured, with all SO_2 emissions measured in the main stacks being attributed to the Steam plants' boilers.

Accordingly, compliance with the MES needs to be confirmed, and if required, technical investigations be initiated to explore potential solutions for compliance.

9.4 Postponement request

Sasol, on behalf of Sasol Synfuels, applies for a five-year year postponement of compliance timeframes for existing plant standards for SO_2 emissions relating to Category 3.6.

The postponement on the existing plant standards is required to establish a comprehensive emission baseline inventory under all normal operating conditions, to ascertain whether the process is compliant with the MES or not, and if not, to initiate a project to identify an appropriate solution. Pending the outcome of such studies, a further postponement may be applied for, prior to April 2020.

10 Storage Tanks (Sasol Solvents)

10.1 Applicable standards

Category 6 prescribes special arrangements that apply for control of VOCs from storage of raw materials, intermediate and final products with a vapour pressure above 14 kPa at operating temperature. The special arrangement stipulates that alternative control measures that can achieve the same or better results as the prescribed abatement technologies may be used.

Table 13: Category 6 – Organic Chemicals Industry, special arrangement (6)(b)(i)

Storage vessels for liquids shall be of the following type:

Application	All permanent immobile storage facilities at a single site with a combined storage capacity greater than 100 cubic metres
True vapour pressure of contents at product storage temperature	**Type of tank or vessel**
Type 1: Up to 14 kPa	Fixed roof tank vented to atmosphere, or as per Type 2 and 3
Type 2: Above 14 kPa and up to 91 kPa with a throughput of less than 50 000 m^3 per annum	Fixed-roof tanks with Pressure Vacuum Vents fitted as a minimum, to prevent “breathing losses”, or as per Type 3
Type 3: Above 14 kPa and up to 91 kPa with a throughput greater than 50 000 m^3 per annum	a) External floating-roof tank with primary rim seal and secondary rim seal for tank with a diameter greater than 20m, or b) fixed-roof tank with internal floating deck/roof fitted with primary seal, or c) Fixed roof tank with vapour recovery system
Type 4: Above 91 kPa	Pressure vessel

Sasol Solvents intends to comply with this special arrangement, but requires additional time to implement the necessary measures to do so, and hence applies for postponement of compliance timeframes.

10.2 Description of the plant

The Sasol complex in Secunda has various process units producing a range of different fuel and chemical intermediate and final products. The products from these units are stored in tanks at the tank farm area (in the case of Sasol Synfuels and Sasol Oil, as described above) or adjacent to a manufacturing process, in the case of Sasol Solvents. The intermediate and final products stored here are either sent to downstream production units for further processing or dispatched to the customer after quality control.

Tanks falling under Type 1, Type 2 and Type 4 classifications comply with the MES. This postponement application pertains to certain Type 3 tanks.

10.3 Technology options for compliance with new plant standard

Most storage tanks at the Sasol Secunda complex are fixed-roof tanks, and all those tanks with vapour pressure between 14 kPa and 91 kPa have pressure vacuum vents installed as a measure to abate VOC emissions.

Tanks which may fall into MES Category 6's "Type 3" classification have been identified. This was established by initial studies conducted by independent parties to identify the number of tanks exceeding the 14 kPa vapour pressure limit. The results are presently being verified through further measurement campaigns on VOCs, as well as vapour pressure simulations.

As indicated in Category 6 of the MES, "Type 3" tanks must be external floating roof tanks, or tanks retrofitted with internal floating roofs or vapour recovery units, or tanks retrofitted with alternative control measures that can achieve the same or better results.

Sasol Solvents is working together with Sasol Synfuels to implement a pilot study to test the effectiveness of abatement equipment (in the form of floating devices which are placed on the surface of the tanks' contents) as an alternative to the stipulated internal floating roof technology. The reason for the selection of floating devices over the installation of floating roofs, are the following significant advantages:

- **Comparable emission reduction:** The floating devices are expected to achieve similar abatement results to internal floating roofs, with other significant operational advantages outlined below. Internal floating roofs are estimated to achieve reductions of 90-98% on tanks designed and constructed according to the needed specifications, but efficiency losses are experienced on older tanks retrofitted with internal floating roofs, due to out of roundness and wall roughness factors. Supplier claims of floating devices indicate reduction of VOC emissions by 86-92%. Initial pilot test work conducted suggests that the results are promising, and piloting is nearing completion to assess the emission reduction potential of these floating discs under different operating conditions, in order to confirm the suitability for different applications of the technology
- **Reduction of storage capacity:** An estimated period of 16 weeks is required to install a single floating roof. To meet production schedule during the time of retrofit, additional storage capacity is required. In addition to this, internal floating roofs reduce the working capacity of a tank by 10-25%. Therefore, additional tanks would be required to be installed to replace the unavailable storage capacity. The installation of floating devices or similar technology for emission abatement will not require any additional tanks to be installed, since it does not have material impacts on the working capacity of the current tanks. This is beneficial to Sasol from a total project cost and plot space requirement perspective.
- **Costs:** The very rough order of magnitude total cost to install floating devices is estimated to be 10-15% of the costs to install internal floating roofs, This is due to savings in the technology itself, avoidance of building additional storage tanks to make up for lost working capacity, and the avoidance of associated additional utilities that would be required for new tanks.
- **Plot space requirements:** The installation of new tanks will be required to replace unavailable working capacity of existing tanks, if internal floating roofs are installed. These additional tanks would require significant plot space. The positioning of additional tanks must take existing equipment and tanks into consideration to ensure compliance with safety regulations and guidelines, such as explosion safety areas extending beyond the perimeters of the Sasol facility. The installation of internal floating roofs has a significant impact on already constrained plot space, while the installation of floating devices does not require any additional plot space.

Sasol Solvents therefore seeks postponement in order to finalise its studies to confirm technology effectiveness, thereafter to obtain the competent authority's approval on the use of the alternative technology, and, subject to its approval, implement the solution on the applicable tanks. Subject to their approval and installation, the efficiency of the floating devices would be monitored as part of the Sasol Solvents fugitive emissions monitoring program to ensure that the floating devices remain effective over time.

10.4 Project schedule

Regarding the Sasol project governance process outlined above, Sasol is currently in the prefeasibility stage, with feasibility, engineering, construction and commissioning to follow subject to successful completion of each sequential project stage, including the required approval of the National Air Quality Officer.

The particular schedule constraints for the project schedule relate to the construction phase, due to the shutdown schedule and the statutory inspection for the storage tanks.

As for the rest of the Sasol Secunda facility, which operates for 365 days of the year, tanks are taken out of service according to a carefully planned GO schedule to avoid disruptions to production.

Retrofitting of a compliance solution requires the tanks to be decommissioned in accordance to this schedule, since the installation of any abatement equipment requires the tanks to be clean and free of vapour for safety and occupational health reasons. Current indications from the GO schedule are that the construction phase would require approximately a decade to complete. Thus, a total of more than five years extension on the compliance timeframe for the special arrangement would be required. Successive postponement applications would therefore be required to accommodate the compliance project schedule.

10.5 Postponement request

Sasol, on behalf of Sasol Solvents, applies for an initial five-year postponement of compliance timeframes from special arrangement (6)(b)(i) of Category 6.

In light of the project schedule, a second postponement will be sought closer to 2020. In the interim, the VOC emissions from these units will be managed as part of the site fugitive emission monitoring plan.

Should the results of the pilot study on the floating disc technology not prove successful, or should the technology not be approved by the National Air Quality Officer as a suitable alternative control measure, Sasol Solvents will use the postponement period to evaluate the compliance implications of the prescribed technologies.

11 Sewage Solids Incinerator (Sasol Synfuels)

11.1 Applicable standards

MES Category 8.1 prescribes emission limits applicable to Sasol Synfuels' Sewage Solids Incinerator.

Table 14: Category 8 – Thermal Treatment of General and Hazardous Waste, Subcategory 8.1 – Thermal Treatment of General and Hazardous 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 273 Kelvin and 101.3 kPa**
Common name	**Chemical symbol**		
Particulate Matter	N/A	New	10
		Existing	25
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 + Tl	New	0.05
		Existing	0.05
Total organic compounds	TOC	New	10
		Existing	10
Ammonia	NH_3	New	10
		Existing	10
		Ng I-TEQ/Nm^3 under normal conditions of 10% O2, 273 Kelvin and 101.3 kPa	
Dioxins and furans	PCDD/PCDF	New	0.1
		Existing	0.1

11.2 Description of the plant

Sasol Synfuels owns and operates a sewage treatment plant that treats sewage from the office buildings of the Sasol complex in Secunda as well as sewage from the town of Secunda on behalf of the Govan Mbeki municipality. On entering the treatment facility, the sewage is screened and the screenings are incinerated by the sewage solids incinerator. Once screened, the sewage proceeds to the sewage plant for treatment.

Category 8 of the repealed 2010 MES included a listed activity threshold throughput size of 10 kg/hour. This meant that thermal treatment activities below this threshold size were not required to comply with the MES as listed activities, since they were deemed to be small processes not likely to contribute significantly to ambient air quality. In November 2013, when the new MES were promulgated, the threshold size for this category was reduced from 10 kg/hour to 10 kg/ day, so that facilities one twentieth of the original threshold size are also included as listed activities which need to comply.

The small sewage solids incinerator was not a listed activity prior to the recent re-promulgation of the Regulations in November 2013.

While emissions have been managed in accordance with licencing requirements, the amendments impose new measurement and emission limits compliance obligations on the incinerator. As a result of the recent regulatory changes, an emission baseline from this incinerator is currently in the process of being established.

11.3 Technology options for compliance

The sewage solids incinerator was not a listed activity prior to the promulgation of the MES in November 2013, as the throughput of the incinerator was below the threshold published in the 2010 MES.

For this reason the emissions from the incinerator have not been fully characterised and an extensive monitoring campaign will be required. No technical investigations have been undertaken into potential solutions for compliance with the MES to date, given the recent changes to this listed activity category. A compliance project investigation would therefore need to be kicked off, commencing from the idea generation phase of the Sasol project development and governance model.

11.4 Postponement request

Sasol, on behalf of Sasol Synfuels, applies for a five-year year postponement of compliance timeframes for existing plant standards for the sewage solids incinerator specified in Category 8.1.

The postponement on the existing plant standards is required to conduct establish a comprehensive emission baseline inventory under all normal operating conditions, to ascertain what emissions will require abatement to comply with the MES.

The postponement will further be required to identify possible technology solutions for compliance, and establish whether any are feasible for this small point source. Pending the outcome of investigations, a further postponement may be applied for, prior to April 2020.