

Table 1: Comments on Sasol emissions scenarios evaluated in the AIR (Annexure T) and the subsequent health impact study (Annexure U)

Scenario	Scenario, as described in Annexure U to the appeal	Stack	AIR <sup>1</sup> modelled SO <sub>2</sub> emission Rates, g/s	Calculated emission rates, <sup>2</sup> t/d	Comments (Emissions and emission rates refer to SO <sub>2</sub> )
A	<b>Baseline (95<sup>th</sup> Percentile SO<sub>2</sub>):</b> This baseline assessment is based on the 95 <sup>th</sup> percentile mass emission rate, during the defined time period, of current operation for SO <sub>2</sub> , to represent the expected higher emission load during normal operations.	B1	3197	276	The 95 <sup>th</sup> percentile value is not an acceptable estimator of maximum expected value as it implies that this value would be exceeded about 18 times per year. <b>The 99<sup>th</sup> percentile value, with expected 4 exceedances per year, would better approximate the AIR regulatory requirement to use the maximum expected emission rate.<sup>3</sup></b>
		B2	2895	250	
		<b>Total:</b>		<b>526</b>	
B	<b>Baseline (Average):</b> The baseline assessment for mass emission rates, has been based on the average normal plant operation for NO <sub>x</sub> and PM. The time was based on a period during which the plant had stable operations	B1	2766	239	The baseline average emission rates appear to be consistent with the Annual Emission Report <sup>4</sup> data, Figures 3 and 4.
		B2	2547	220	
		<b>Total:</b>		<b>459</b>	
C	<b>Scenario 1: 95<sup>th</sup> Percentile SO<sub>2</sub> with 4% emission load reduction:</b> Interim (2025 – 2030) load scenario – This scenario is based on the 95 <sup>th</sup> percentile SO <sub>2</sub> baseline including a 4 per cent emission load reduction.	B1	3211	277	See comment in scenario A above.
		B2	2621	226	
		<b>Total:</b>		<b>504</b>	
D	<b>Scenario 2: Compliance with the 2020 new plants standard for steam plant:</b> This is modelled for NO <sub>x</sub> , SO <sub>2</sub> and PM to represent current emission load aligned with the prescribed 2020 Minimum emission standards (MES) for new plant concentrations. This reflects a hypothetical scenario where SO <sub>2</sub> emissions conform to the standard of 1 000 mg/Nm <sup>3</sup> and to continuously operate at the standard. This scenario will be representative of the maximum emission load for SO <sub>2</sub> that will ensure compliance to MES standard with a 15 per cent emission load reduction from SO <sub>2</sub> baseline 95 <sup>th</sup> percentile.	B1	2421	209	<b>These emission rates are incorrect because they result in stack concentrations 50% in excess of the MES limit.</b> An MES-compliant plant <i>operating at current loads</i> would have maximum and average emission rates of <b>292 t/d and 229 t/d</b> respectively. Refer to Table 2 below for the relevant calculations. At 15% lower loads, the maximum and average emission MES-compliant rates would be 15% lower, <b>248 t/d and 195 t/d</b> respectively.
		B2	2771	239	
		<b>Total:</b>		<b>449</b>	

<sup>1</sup> Stack emission rates (g/s) as per Table 5-7 of the AIR, Annexure T

<sup>2</sup> Calculated as (g/s)x(seconds per day)x1000000.

<sup>3</sup> The Regulations prescribing the format of the Atmospheric Impact Report, 2013, require evaluation based on "Point Source Maximum Emission Rates during Normal Operating Conditions". The AIR (Appendix B to Annexure T to the appeal) avers "There is no information available regarding the maximum rates, because these are not measured, and are impractical to measure; therefore, only emissions rates during normal operating conditions are available". However, the highest value in a set of data is clearly available. The top 1% (the 99<sup>th</sup> percentile) of values is clearly a better estimate of the maximum value. The 95<sup>th</sup> percentile value is an underestimate.

<sup>4</sup> Annexure 2 of Annexure V.

<b>E</b>	<b>Scenario 3: Load-based compliance with 30% boiler load emission reduction 2030:</b> Load base compliance scenario is based on a 30% load reduction, with an ambient impact similar Scenario 2. The intent of this scenario is to reflect the impact on ambient air quality should the load-based equivalent emission limit be equal to the promulgated emission standard of 1 000 mg/Nm <sup>3</sup> .	B1	2164	187	The stack gas flow rate (the load), Scenario 3 was reduced by <b>25%</b> , not 30%. At 25% lower loads, the maximum and average emission MES-compliant rates would be 25% lower, <b>219 t/d and 173 t/d</b> respectively.
		B2	2053	177	
		<b>Total:</b>		<b>364</b>	

Table 2: Calculation<sup>5</sup> of stack SO<sub>2</sub> concentrations for Sasol AIR scenarios

Sasol AIR scenarios	Stack	Temperature (°C)	Stack tip diameter, m	Exit velocity, m/s	Volumetric flow rate, Am <sup>3</sup> /s	Volumetric flow rate, Nm <sup>3</sup> /s	SO <sub>2</sub> emissions (g/s)	SO <sub>2</sub> emissions, t/d	Stack concentrations, mg/Nm <sup>3</sup>	SO <sub>2</sub> emissions relative to Baseline- average
<b>Baseline-95th percentile</b>	B1 (MSW)	168	13,6	20,9	3036	1550	3197	276	2063	
	B2 (MSE)	176	14,4	22,3	3632	1821	2895	250	1590	
	<b>TOTALS--&gt;</b>						<b>3370</b>	<b>6092</b>	<b>526</b>	<b>1808</b>
Baseline-average	B1 (MSW)	168	13,6	20,9	3036	1550	2766	239	1785	
	B2 (MSE)	176	14,4	22,3	3632	1821	2547	220	1399	
	<b>TOTALS--&gt;</b>						<b>3370</b>	<b>5313</b>	<b>459</b>	<b>1576</b>
Scenario 1: Interim load, 4% reduced load, 95th percentile	B1 (MSW)	168	13,6	20,9	3036	1550	3211	277	2072	
	B2 (MSE)	176	14,4	22,3	3632	1821	2621	226	1440	
	<b>TOTALS--&gt;</b>						<b>3370</b>	<b>5832</b>	<b>504</b>	<b>1731</b>
Scenario 2: "Compliance with MES, at 1000 mg/Nm <sup>3</sup> , 15% reduced"	B1 (MSW)	168	13,6	20,9	3036	1550	2421	209	1562	
	B2 (MSE)	176	14,4	22,3	3632	1821	2771	239	1522	
	<b>TOTALS--&gt;</b>						<b>3370</b>	<b>5192</b>	<b>449</b>	<b>1541</b>
Scenario 3: Load based, 30% load reduction	B1 (MSW)	162	13,6	14,6	2121	1097	2164	187	1972	
	B2 (MSE)	170	14,4	17,4	2834	1440	2053	177	1426	
	<b>TOTALS--&gt;</b>						<b>2537</b>	<b>4218</b>	<b>364</b>	<b>1662</b>

(Site barometric pressure: 83,5 kPa.a)

<sup>5</sup> Actual volumetric flow rate (Am<sup>3</sup>/s) = (stack area x exit velocity); normalised volumetric flow rate (Nm<sup>3</sup>/s) = (Am<sup>3</sup>/s)x(273,15/(273,15+exit temperature, °C)x(101,3/barometric pressure). Stack concentrations = emission rate (g/s)/(Nm<sup>3</sup>/s)

Table 3: Calculation of stack SO<sub>2</sub> concentrations for AEL and MES- compliant scenarios

<b>AEL compliant scenario</b>	Stack	Temperature (°C)	Stack tip diameter, m	Exit velocity, m/s	Volumetric flow rate, Am <sup>3</sup> /s	Volumetric flow rate, Nm <sup>3</sup> /s	SO <sub>2</sub> emissions (g/s)	SO <sub>2</sub> emissions, t/d	<b>Stack concentration, mg/Nm<sup>3</sup></b>	SO <sub>2</sub> emissions relative to Baseline- average
At AEL limit of 2000 mg/Nm <sup>3</sup> , current load	B1 (MSW)	168	13,6	20,9	3036	1550	3099	268	2000	
	2000 B2 (MSE)	176	14,4	22,3	3632	1821	3641	315	2000	
	<b>TOTALS--&gt;</b>						<b>3370</b>	<b>6740</b>	<b>582</b>	<b>2000</b>
<b>MES compliant scenarios</b>	Stack	Temperature (°C)	Stack tip diameter, m	Exit velocity, m/s	Volumetric flow rate, Am <sup>3</sup> /s	Volumetric flow rate, Nm <sup>3</sup> /s	SO <sub>2</sub> emissions (g/s)	SO <sub>2</sub> emissions, t/d	<b>Stack concentration, mg/Nm<sup>3</sup></b>	SO <sub>2</sub> emissions relative to Baseline- average
MES, 1000 mg/Nm <sup>3</sup> limit, current load	B1 (MSW)	168	13,6	20,9	3036	1550	1550	134	1000	56%
	1000 B2 (MSE)	176	14,4	22,3	3632	1821	1821	157	1000	71%
	<b>TOTALS--&gt;</b>						<b>3370</b>	<b>3370</b>	<b>291</b>	<b>1000</b>
MES compliant, average concentrations, current load	B1 (MSW)	168	13,6	20,9	3036	1550	1218	105	786	44%
	1000 B2 (MSE)	176	14,4	22,3	3632	1821	1431	124	786	56%
	<b>TOTALS--&gt;</b>						<b>3370</b>	<b>2649</b>	<b>229</b>	<b>786</b>
MES compliant @1000 mg/Nm <sup>3</sup> limit, 75% load, average emissions	B1 (MSW)	162	13,6	14,6	2121	1097	863	75	786	31%
	1000 B2 (MSE)	170	14,4	17,4	2834	1440	1132	98	786	44%
	<b>TOTALS--&gt;</b>						<b>2537</b>	<b>1994</b>	<b>172</b>	<b>786</b>