ATTACHMENT 3

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Bell Bay Pulp Mill Project
Tasmania

In the matter of the Bell Bay Pulp Mill Project: A project of State Significance Resource Planning and Development Commission inquiry

Proponent: Gunns Limited

GASEOUS EMISSIONS CALCULATIONS
Attachment 3

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INTRODUCTION

1.1 Emission rates in the Draft IIS

The Bell Bay Pulp Mill gaseous emission rates from the main stack are presented in Annex VI of Pöyry report 16B0104- E0035, which is located at Volume 7 of the Draft IIS.

The operating conditions for the environmental analysis assume a very high mill load in combination with equipment operating at non optimal conditions[1]. An example of such non-optimal conditions include situations where there are low black liquor dry solids for the recovery boiler, plugged lime mud filter for the lime kiln, or wet fuel for the power boiler. This combination of events occurring simultaneously is very rare, as process disturbances typically reduce the rate of pulp production. Nonetheless, it is on this basis that environmental impact modelling has been carried out.

The same annex also presents emissions during normal operation[2]. This rate is most relevant to calculate maximum yearly releases of various substances. In addition, the same annex presents emissions during short time upsets[3] (max 1 hr). This rate represents those times during a year where process failures result in abnormal operation before the situation can be controlled (typically totalling about 15 to 30 minutes, although here assumed to be 1 hr, occurring two to three times per year).

This document records the procedure used to calculate the emission figures in the DIIS.

1.2 Methodology for calculating emissions

Gaseous emission rates from the main stack are calculated by adding the gaseous emissions from each source. Gaseous emissions from each source are the product of the following:

- Volumetric flow rates for each source expressed as m^3n/s; and
- Estimated volumetric concentration of the substance being emitted in the gas for that source.

The volumetric flow is established by calculating the heat and mass balances of the equipment producing the emission. The volumetric flow has been calculated by Pöyry.

The estimated volumetric concentration is arrived at in a number of ways, depending upon the substance concerned. These include reference to:

- Publicly available data accumulated from operating pulp mills. The sources of this information include:
- Swedish forest industry statistics from Naturvårdsverket
- Environmental report statistics from Finnish Forest Industries Federation
- Data from pulp and paper company web pages;

[1] DIIS, Volume 7, Annex VI, table at Page 1 of 4, B MAXIMUM CONTINUOUS EMISSIONS FROM THE MAIN STACK
[2] DIIS, Volume 7, Annex VI, table at Page 1 of 4, A AVERAGE EMISSIONS FROM THE MAIN STACK
[3] DIIS, Volume 7, Annex VI, table at Page 1 of 4, C SHORT-TERM MXIMUM EMISSIONS FROM THE MAIN STACK

- Literature in professional journals and conferences and related research etc, such as those listed as an attachment to my witness statement;
- The professional judgement of the design engineers; and
- An assumption that operating the Bell Bay Pulp Mill in violation of the Emission Limit Guidelines[4] would, with the exception of NOx emissions[5], lead to a shutdown of the mill until the problem had been rectified.

Pöyry was first engaged to prepare a mill design concept in January 2005. This process of developing a design concept is iterative. As the design concept evolved and as more information became available, the possibilities for improving the efficiency, cost and environmental performance emerged.

As part of the development of the design concept, a set of emission figures were derived to conduct environmental impact assessment modelling. As the modelling was ongoing, further design refinements in the mill concept improved the reliability of the emission estimates originally used for the modelling.

The Draft IIS contains the emissions figures calculated by Pöyry, which reflected the state of design concept at the time of its publication.

The calculations contained in this document include various elements of conservatism.

It should also be noted that the figures for emission estimates relied upon in the environmental impact assessments included in the Draft IIS are derived from earlier iterations of the design concept and, with the exception of TRS, are more conservative than those emission rates established by Pöyry in July 2006.

[4] Table 3 in Volume 2 of *Development of new environmental emission limit guidelines for any new bleached eucalypt kraft pulp mill in Tasmania* (2004)

[5] See the paper on in-stack NOx emissions at Annex XV in Volume 7 of the draft IIS and the discussion of this issue in my witness statement

2 NOX

The DIIS includes a figure for maximum continuous emissions from the main stack of 5835 kg/day for NOx[6], equating to 67.5 g/s as NO_2[7]. This figure represents the accumulation of NOx in the stack derived from the sum of the NOx emissions derived from the following sources:

- recovery boiler 41.7 g/s ;
- lime kiln 13.2 g/s;
- NCG incinerators 1.0 g/s; and
- power boiler 11.7 g/s.

The emission rate for each part of the total NOx has been calculated as follows:

2.1 NOx Recovery Boiler

The above figure for NOx generated by the recovery boiler was arrived at by assuming the following values:

The product of:

- 189 m^3n (dry)/s being the product of the following variables divided by the number of seconds in a day to arrive at the volumetric flow:
  - Specific flue gas flow: 3.68 m^3n (dry)/kg dry solids
  - Dry solids flow: 1.27 t dry solids/ADt
  - Pulp production: 3492 ADt/d

- 220 mg/m^3n (dry), being the estimated gas concentration for high nitrogen containing wood such as Eucalyptus[8].

The NOx emission rate of 41.7 g/s as NO_2 for the recovery boiler includes a level of conservatism because it assumes:

- While the estimate of gas concentration of 220 mg/m^3n (dry) is an appropriate figure to use for maximum daily emissions, with proper operation this figure could be reduced to less than 200 mg/m^3n (dry). Assuming this concentration at maximum continuous production the emission rate would be 38.2 g/s;
- The pulp production rate used in the calculation (i.e. the maximum continuous rate of 3492 ADt/d) is 10 % higher than the average daily rate (i.e. 3143 ADt/d); and
- Assuming the combined effect of a reduction in estimated gas concentration and the use of the average daily production (as opposed to the maximum continuous), the emission rate would be 33.6 g/s. This figure has been used in calculating the average emission.

The short term maximum NOx emission rate of 47.2 g/s as NO_2 for the recovery boiler was arrived at by assuming the following values:

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[6] DIIS, Volume 7, Annex VI, table at Page 1 of 4, B MAXIMUM CONTINUOUS EMISSIONS FROM THE MAIN STACK

[7] To convert emissions from ppm to mg/m^3n, one has to assume some compound with which to do conversions. Measurements are typically done in ppm. It is customary for NOx conversions to use the mole weight of NO_2 as this is the final end product in air. NOx emissions from pulp mills are mostly NO.

[8] Aho, 1994 ; Kjörk et al., 2000 ; Vakkilainen 2005

– 250 mg/m^{3}n (dry) being the estimated gas concentration; and
– The pulp production rate of 3492 ADt/d.

2.2 NOx Lime Kiln

The above figure for NOx generated by the lime kiln was arrived at by assuming the following values:

The product of:

– 24 m^{3}n (dry)/s being the product of the following variables divided by the number of seconds in a day to arrive at the volumetric flow:
  – Specific flue gas flow: 2.3 m^{3}n (dry)/kg lime
  – Lime flow: 258 kg lime/ADt
  – Pulp production: 3492 ADt/d, and

– 550 mg/m^{3}n (dry) being the estimated gas concentration[9]

The NOx emission rate of 13.2 g/s as NO_2 for the lime kiln includes a level of conservatism because it assumes:

– The lime kiln is running on natural gas[10] which results in higher NOx emissions than for oil;
– While the estimate of gas concentration of 550 mg/m^{3}n (dry) is an appropriate figure to use for maximum daily emissions, with proper operation this figure could be reduced to less than 500 mg/m^{3}n (dry). Assuming this concentration at maximum continuous production, the emission rate would be 12 g/s;
– The pulp production rate used in the calculation (i.e. the maximum continuous rate of 3492 ADt/d) is 10% higher than the average daily rate (i.e. 3143 ADt/d); and
– Assuming the combined effect of a reduction in estimated gas concentration and the use of the average daily production (as opposed to the maximum continuous), the emission rate would be 10.8 g/s. This figure has been used in calculating the average emission.

The short term maximum NOx emission rate of 15.6 g/s as NO_2 for the lime kiln was arrived at by assuming the following values:

– 650 mg/m^{3}n (dry) being the estimated gas concentration; and
– The pulp production rate of 3492 ADt/d.

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[9] European Commission; Reference Document on Best Available Techniques in the Pulp and Paper Industry p. 43

[10]
1. There is a choice for the fuel used for the lime kiln:
   a. fuel oil; or
   b. natural gas
2. Fuel Oil has the following disadvantages
   a. it is costly
   b. burning fuel oil results in a higher SOx emission than natural gas
   c. burning fuel oil results in increased greenhouse gas emissions
   d. burning fuel oil results in TRS gas emissions
   e. oil requires road transportation resulting in increased road traffic
3. It is environmentally preferable to use natural gas
4. If natural gas is used in the lime kiln, then in combination with the emissions from other parts of the process the emission guidelines will be exceeded in the stack for NOx, however the ground level concentration guidelines of NOx will be met.

2.3 NOx NCG Incinerator

The above figure for NOx generated by the incinerator was arrived at by assuming the following values:

The product of:

- 1.84 m^3n (dry)/s being the product of the following variables divided by the number of seconds in a day to arrive at the volumetric flow:
  - Specific flue gas flow: 4.56 m^3n (dry)/kg NCG fuel
  - NCG fuel flow: 10 kg NCG/ADt
  - Pulp production: 3492 ADt/d, and

- 550 mg/m^3n (dry) being the estimated gas concentration[11]

The NOx emission rate of 1.0 g/s as NO_2 for the NCG incinerators includes a level of conservatism because it assumes:

- The pulp production rate used in the calculation (i.e. the maximum continuous rate of 3492 ADt/d) is 10% higher than the average daily rate (i.e. 3143 ADt/d);
- Assuming the use of the average daily production (as opposed to the maximum continuous), the emission rate would be 0.9 g/s. This figure has been used in calculating the average emission; and
- Additionally, the NCG Incinerator should operate at full load only much less than 4 % of the time (less than 2 weeks per year). In both calculations, it has been assumed to be operating 100 % of time.

The short term maximum NOx emission rate of 1.1 g/s as NO_2 for the NCG incinerator was arrived at by assuming the following values:

- 600 mg/m^3n (dry) being the estimated gas concentration; and
- The pulp production rate of 3492 ADt/d.

2.4 NOx Power Boiler

The above figure for NOx generated by the power boiler was arrived at by assuming the following values:

The product of:

- 53.3 m^3n (dry)/s being the product of the following variables divided by the number of seconds in a day to arrive at the volumetric flow:
  - Specific flue gas flow: 2.842 m^3n (dry)/AD kg Power Boiler fuel
  - Power boiler fuel flow: 464 AD kg Power Boiler fuel/ADt
  - Pulp production: 3492 ADt/d, and

- 220 mg/m^3n (dry) at 3 % O_2 being the estimated gas concentration [12] [13]

[11] Data from modern mills checked against vendors' proposals received by Gunns

[12] European Commission; Reference Document on Best Available Techniques for Large Combustion Plants, p. 45 ; RPDC Emission Limit Guidelines, p. 17

[13] The RPDC Emission Limit Guidelines specify 80 mg NO_2/MJ fuel input and approximately 240 mg/m^3n (dry) at 3 % O_2

The NOx emission rate of 11.8 g/s as NO_2 for the power boiler includes a level of conservatism because it assumes:

- While the estimate of gas concentration of 220 mg/m^{3}n (dry) is an appropriate figure to use for maximum daily emissions, with proper operation this figure could be reduced to less than 200 mg/m^{3}n (dry). Assuming this concentration at maximum continuous production, the emission rate would be 10.6 g/s;
- The pulp production rate used in the calculation (i.e. the maximum continuous rate of 3492 ADt/d) is 10% higher than the average daily rate (i.e. 3143 ADt/d); and
- Assuming the combined effect of a reduction in estimated gas concentration and the use of the average daily production (as opposed to the maximum continuous), the emission rate would be 9.6 g/s. This figure has been used in calculating the average emission.

The short term maximum NOx emission rate of 17.0 g/s as NO_2 for the power boiler was arrived at by assuming the following values:

- 320 mg/m^{3}n (dry) being the estimated gas concentration; and
- The pulp production rate of 3492 ADt/d.

2.5 Impact Assessment Figure

In the DIIS the figure used for the impact assessment for NOx was 67.7 g/s[14] [15].

[14] DIIS does not contain a value used for impact assessment however based on information received a total value of 67.73 g/s NOx was used. The breakdown is as follows:

Recovery Boiler	46.36 g/s
Lime kiln	8.59 g/s
NCG Boiler	0.76 g/s
Power Boiler	12.02 g/s
Total	67.73 g/s

[15] Volume 9, Appendices, Section 6.1, page 18. GHD have noted (page 18) that the data that they have based their emission rates on is based on data presented by Pöyry in June 2005 and that they understand that the data has undergone several iterations.

3 N_2O

In response to submissions regarding the level of N_2O, a figure for maximum continuous emissions from the main stack of 190 kg/day for N_2O equating to 2.2 g/s has been calculated. This figure represents the accumulation of N_2O in the stack derived from the sum of the N_2O emissions derived from the following sources:

- recovery boiler ~0 g/s ;
- lime kiln ~0 g/s;
- NCG incinerators ~0 g/s; and
- power boiler 2.2 g/s.

The emission rates for equipment other than the power boiler are insignificant[16]. N_2O is only formed where special combustion conditions exist. In fluidized bed boilers, there is a combination of temperatures less than 900 ^oC and the presence of suitable precursors (HCN).

The emission rate for the power boiler N_2O has been calculated as follows:

3.1 N_2O Power Boiler

The N_2O generated by the power boiler was arrived at by assuming the following values:

The product of:

- 53.3 m^3n (dry)/s being the product of the following variables divided by the number of seconds in a day to arrive at the volumetric flow:
  - Specific flue gas flow: 2.842 m^3n (dry)/AD kg Power Boiler fuel
  - Power boiler fuel flow: 464 AD kg Power Boiler fuel/ADt
  - Pulp production: 3492 ADt/d, and

- 40 mg/m^3n (dry) at 3% O_2 being the estimated gas concentration [17]

The N_2O emission rate of 2.2 g/s for the power boiler includes a level of conservatism because it assumes:

- While the estimate of gas concentration of 40 mg/m^3n (dry) is an appropriate figure to use for maximum daily emissions, with proper operation this figure could be reduced to less than 20 mg/m^3n (dry). Assuming this concentration at maximum continuous production, the emission rate would be 1.1 g/s
- The pulp production rate used in the calculation (i.e. the maximum continuous rate of 3492 ADt/d) is 10% higher than the average daily rate (i.e. 3143 ADt/d); and
- Assuming the combined effect of a reduction in estimated gas concentration and the use of the average daily production (as opposed to the maximum continuous), the emission rate would be 1.0 g/s. This figure can be used in calculating the average emission.

The short term maximum N_2O emission rate of 3.3 g/s for the power boiler was arrived at by assuming the following values:

[16] Zevenhoven and Kilpinen, 2001 p. 4-3
[17] Zevenhoven and Kilpinen, 2001, p. 4-39

- 60 mg/m^3n (dry) being the estimated gas concentration; and
- The pulp production rate of 3492 ADt/d.

4 SO_X

The DIIS includes a figure for maximum continuous emissions from the main stack of 1976 kg/day for SOx[18], equating to 22.9 g/s as SO_2. This figure represents the accumulation of SOx in the stack derived from the sum of the SOx emissions derived from the following sources:

- recovery boiler 9.5 g/s ;
- lime kiln 2.4 g/s;
- NCG incinerators 0.4 g/s; and
- power boiler 10.6 g/s.

The emission rate for each part of the total SOx has been calculated as follows:

4.1 SOx Recovery Boiler

The above figure for SOx generated by the recovery boiler was arrived at by assuming the following values:

The product of:

- 189 m^3n (dry)/s being the product of the following variables divided by the number of seconds in a day to arrive at the volumetric flow:
  - specific flue gas flow: 3.68 m^3n (dry)/kg dry solids
  - dry solids flow: 1.27 t dry solids/ADt
  - pulp production: 3492 ADt/d, and
- 50 mg/m^3n (dry) being the estimated gas concentration[19]

The SOx emission rate of 9.5 g/s as SO_2 for the recovery boiler includes a level of conservatism because it assumes:

- While the estimate of gas concentration of 50 mg/m^3n (dry) is an appropriate figure to use for maximum daily emissions, with proper operation this figure could be reduced to from 0 to 12 mg/m^3n (dry) with sufficient air mixing, hot lower furnace and high enough air ratio. Assuming a concentration of 12 mg/m^3n (dry) at maximum continuous production, the emission rate would be 2.3 g/s;
- The pulp production rate used in the calculation (i.e. the maximum continuous rate of 3492 ADt/d) is 10% higher than the average daily rate (i.e. 3143 ADt/d); and
- Assuming the combined effect of a reduction in estimated gas concentration and the use of the average daily production (as opposed to the maximum continuous), the emission rate would be 2.1 g/s. This figure has been used in calculating the average emission.

The short term maximum SOx emission rate of 18.9 g/s as SO_2 for the recovery boiler was arrived at by assuming the following values:

- 100 mg/m^3n (dry) being the estimated gas concentration; and
- The pulp production rate of 3492 ADt/d.

[18] DIIS, Volume 7, Annex VI, table at Page 1 of 4, B MAXIMUM CONTINUOUS EMISSIONS FROM THE MAIN STACK

[19] Wallen et al., 2004 ; McKeough and Janka 2001 ; Vakkilainen 2005, p. 11-10

4.2 SOx Lime Kiln

The above figure for SOx generated by the lime kiln was arrived at by assuming the following values:

The product of:

- 24 m^3n (dry)/s being the product of the following variables divided by the number of seconds in a day to arrive at the volumetric flow:
  - Specific flue gas flow: 2.3 m^3n (dry)/kg lime
  - Lime flow: 258 kg lime/ADt
  - Pulp production: 3492 ADt/d, and

- 100 mg/m^3n (dry) being the estimated gas concentration[20]

The SOx emission rate of 2.4 g/s as SO_2 for the lime kiln includes a level of conservatism because it assumes:

- While the estimate of gas concentration of 100 mg/m^3n (dry) is an appropriate figure to use for maximum daily emissions, with proper operation this figure could be reduced to less than 50 mg/m^3n (dry). Assuming this concentration at maximum continuous production, the emission rate would be 1.2 g/s;
- The pulp production rate used in the calculation (i.e. the maximum continuous rate of 3492 ADt/d) is 10% higher than the average daily rate (i.e. 3143 ADt/d); and
- Assuming the combined effect of a reduction in estimated gas concentration and the use of the average daily production (as opposed to the maximum continuous), the emission rate would be 1.1 g/s. This figure has been used in calculating the average emission.

The short term maximum SOx emission rate of 4.8 g/s as SO_2 for the lime kiln was arrived at by assuming the following values:

- 200 mg/m^3n (dry) being the estimated gas concentration; and
- The pulp production rate of 3492 ADt/d.

4.3 SOx NCG Incinerator

The above figure for SOx generated by the NCG incinerator was arrived at by assuming the following values:

The product of:

- 1.84 m^3n (dry)/s being the product of the following variables divided by the number of seconds in a day to arrive at the volumetric flow:
  - Specific flue gas flow: 4.56 m^3n (dry)/kg NCG fuel
  - NCG fuel flow: 10 kg NCG/ADt
  - Pulp production: 3492 ADt/d, and

- 200 mg/m^3n (dry) being the estimated gas concentration with efficient scrubber[21]

The SOx emission rate of 0.4 g/s as SO_2 for the NCG incinerator includes a level of conservatism because it assumes:

[20] European Commission; Reference Document on Best Available Techniques in the Pulp and Paper Industry, p. 44
[21] Data from modern mills checked against vendors' proposals received by Gunns

- the pulp production rate used in the calculation (ie the maximum continuous rate of 3492 ADt/d) is 10% higher than the average daily rate (ie 3143 ADt/d);
- assuming the use of the average daily production (as opposed to the maximum continuous), the emission rate would be 0.33 g/s. This figure has been used in calculating the average emission; and
- additionally, the NCG Incinerator should operate at full load only much less than 4 % of the time (less than 2 weeks per year). In both calculations, it has been assumed to be operating 100 % of time.

The short term maximum SOx emission rate of 0.6 g/s as SO_2 for the NCG incinerator was arrived at by assuming the following values:

- 300 mg/m^{3}n (dry) being the estimated gas concentration; and
- The pulp production rate of 3492 ADt/d.

4.4 SOx Power Boiler

The above figure for SOx generated by the power boiler was arrived at by assuming the following values:

The product of:

- 53.3 m^{3}n (dry)/s being the product of the following variables divided by the number of seconds in a day to arrive at the volumetric flow:
  - Specific flue gas flow: 2.842 m^{3}n (dry)/AD kg Power Boiler fuel
  - Power boiler fuel flow: 464 AD kg Power Boiler fuel/ADt
  - Pulp production: 3492 ADt/d, and
- 200 mg/m^{3}n (dry) at 3% O_2 being the estimated gas concentration[22]

The SOx emission rate of 10.6 g/s for the power boiler includes a level of conservatism because it assumes:

- While the estimate of gas concentration of 200 mg/m^{3}n (dry) is an appropriate figure to use for maximum daily emissions, with proper operation this figure could be reduced to less than 146 mg/m^{3}n (dry). Assuming this concentration at maximum continuous production, the emission rate would be 7.8 g/s;
- The pulp production rate used in the calculation (i.e. the maximum continuous rate of 3492 ADt/d) is 10% higher than the average daily rate (i.e. 3143 ADt/d); and
- Assuming the combined effect of a reduction in estimated gas concentration and the use of the average daily production (as opposed to the maximum continuous), the emission rate would be 7.0 g/s. This figure has been used in calculating the average emission.

The short term maximum SOx emission rate of 13.3 g/s as SO_2 for the power boiler was arrived at by assuming the following values:

- 250 mg/m^{3}n (dry) being the estimated gas concentration; and
- The pulp production rate of 3492 ADt/d.

[22] European Commission; Reference Document on Best Available Techniques for Large Combustion Plants, p. 45; RPDC Emission Limit Guidelines, p. 17

4.5 Impact Assessment Figure

The SOx emission figure used in the impact assessment in the Draft IIS was 25.5 g/s[23] [24].

[23] DIIS does not contain a value used for impact assessment however based on information received a total value of 25.5 g/s for SOx was used. The breakdown is as follows:

Recovery Boiler	11.59 g/s
Lime kiln	2.86 g/s
NCG Boiler	0.37 g/s
Power Boiler	10.68 g/s
Total	25.5 g/s

[24] Volume 9, Appendices, Section 6.1, page 18. GHD have noted (page 18) that the data that they have based their emission rates on is based on data presented by Pöyry in June 2005 and that they understand that the data has undergone several iterations.

5 TOTAL REDUCED SULPHUR (TRS)

The DIIS includes a figure for maximum continuous emissions from the main stack of 100 kg/day for TRS, equating to 1.15 g/s as H_2S for TRS[25]. This figure represents the accumulation of TRS in the stack derived from the sum of the TSR emissions derived from the following sources:

- recovery boiler 0.69 g/s;
- lime kiln 0.36 g/s;
- NCG incinerators 0.01 g/s; and
- power boiler 0.10 g/s.

The emission rate for each part of the total TRS has been calculated as follows:

5.1 TRS Recovery Boiler

The above figure for TRS generated by the recovery boiler was arrived at by assuming the following values:

The product of:

- 189 m^3n(dry)/s being the product of the following variables divided by the number of seconds in a day to arrive at the volumetric flow:
  - Specific Flue gas flow: 3.68 m^3n (dry)/kg dry solids
  - Dry solids flow: 1.27 t dry solids/ADt
  - Pulp production: 3492 ADt/d, and
- 3.5 mg/m^3n (dry) being the estimated gas concentration derived for the recovery boiler operation[26]

The TRS emission rate of 0.66 g/s as H_2S for the recovery boiler includes a level of conservatism because it assumes:

- while the estimate of gas concentration of 3.5 mg/m^3n (dry) is an appropriate figure to use for maximum daily emissions, with proper operation this figure could be reduced to from 0 to 2 mg/m^3n (dry) with sufficient air mixing, hot lower furnace and high enough air ratio. Assuming a concentration of 2 mg/m^3n (dry) at maximum continuous production, the emission rate would be 0.38 g/s;
- the pulp production rate used in the calculation (i.e. the maximum continuous rate of 3492 ADt/d) is 10% higher than the average daily rate (i.e. 3143 ADt/d); and
- assuming the combined effect of a reduction in estimated gas concentration and the use of the average daily production (as opposed to the maximum continuous), the emission rate would be 0.35 g/s. This figure has been used in calculating the average emission.

The short term maximum TRS emission rate of 1.2 g/s as H_2S for the recovery boiler was arrived at by assuming the following values:

- 6 mg/m^3n (dry) being the estimated gas concentration; and
- The pulp production rate of 3492 ADt/d.

[25] DIIS, Volume 7, Annex VI, table at Page 1 of 4, B MAXIMUM CONTINUOUS EMISSIONS FROM THE MAIN STACK

[26] Vakkilainen 2005, p. 11-2

5.2 TRS Lime Kiln

The above figure for TRS generated by the lime kiln was arrived at by assuming the following values:

The product of:

- 24 m^3n (dry)/s being the product of the following variables divided by the number of seconds in a day to arrive at the volumetric flow:
  - specific flue gas flow: 2.3 m^3n (dry)/kg lime
  - lime flow: 258 kg lime/ADt
  - pulp production: 3492 ADt/d, and

- 15 mg/m^3n (dry) being the estimated gas concentration derived from[27] [28]

The TRS emission rate of 0.36 g/s as H_2S for the lime kiln includes a level of conservatism because it assumes:

- While the estimate of the gas concentration of 15 mg/m^3n (dry) is the appropriate figure to use for maximum daily emissions, with proper operation and clean water/condensate used to efficiently wash the lime mud this figure could be reduced to less than 5 mg/m^3n (dry). Assuming this concentration at maximum continuous production, the emission rate would be 0.11 g/s;
- The pulp production rate used in the calculation (i.e. the maximum continuous rate of 3492 ADt/d) is 10% higher than the average daily rate (i.e. 3143 ADt/d); and
- Assuming the combined effect of a reduction in estimated gas concentration and the use of the average daily production (as opposed to the maximum continuous), the emission rate would be 0.10 g/s. This figure has been used in calculating the average emission.

The short term maximum TRS emission rate of 0.4 g/s as H_2S for the lime kiln was arrived at by assuming the following values:

- 16 mg/m^3n (dry) being the estimated gas concentration; and
- The pulp production rate of 3492 ADt/d.

5.3 TRS NCG Incinerator

The above figure for TRS generated by the incinerator was arrived at by assuming the following values:

The product of:

- 1.84 m^3n (dry)/s being the product of the following variables divided by the number of seconds in a day to arrive at the volumetric flow:
  - Specific flue gas flow: 4.56 m^3n (dry)/kg NCG fuel
  - NCG fuel flow: 10 kg NCG/ADt
  - Pulp production: 3492 ADt/d, and

[27] European Commission, Reference Document on Best Available Techniques in the Pulp and Paper Industry, p. 43

[28] The RPDC limit value (16 mg/m^3n) was erroneously used in the DIIS report instead of the expected maximum continuous value of 12 mg/m^3n. This meant that the lime kiln portion of the TRS indicated in the DIIS was 0.1 g/s higher than it should have been.

- 7 mg/m^{3}n (dry) being the estimated gas concentration with efficient scrubber operation[29]

The TRS emission rate of 0.01 g/s as H_2S for the NCG incinerator includes a level of conservatism because it assumes:

- The pulp production rate used in the calculation (i.e. the maximum continuous rate of 3492 ADt/d) is 10% higher than the average daily rate (i.e. 3143 ADt/d);
- Assuming the combined effect of a reduction in estimated gas concentration and the use of the average daily production (as opposed to the maximum continuous), the emission rate would be 0.0012 g/s. This figure has been used in calculating the average emission; and
- Additionally, the NCG Incinerator should operate at full load only much less than 4 % of the time (less than 2 weeks per year). In both calculations it has been assumed to be operating 100 % of time.

The short term maximum TRS emission rate of 0.03 g/s as H_2S for the NCG incinerator was arrived at by assuming the following values:

- 20 mg/m^{3}n (dry) being the estimated gas concentration; and
- The pulp production rate of 3492 ADt/d.

5.4 TRS Power Boiler

The above figure for TRS generated by the power boiler was arrived at by assuming the following values:

The product of:

- 53.3 m^{3}n (dry)/s being the product of the following variables divided by the number of seconds in a day to arrive at the volumetric flow:
  - Specific flue gas flow: 2.842 m^{3}n (dry)/AD kg Power Boiler fuel
  - Power boiler fuel flow: 464 AD kg Power Boiler fuel/ADt
  - Pulp production: 3492 ADt/d, and

- 2 mg/m^{3}n (dry) at 3% O_2 being the estimated gas concentration[30]

The TRS emission rate of 0.10 g/s for the power boiler includes a level of conservatism because it assumes:

- While the estimate of gas concentration of 2 mg/m^{3}n (dry) is an appropriate figure to use for maximum daily emissions, with proper operation this figure could be reduced to less than 1 mg/m^{3}n (dry). Assuming this concentration at maximum continuous production, the emission rate would be 0.05 g/s;
- The pulp production rate used in the calculation (i.e. the maximum continuous rate of 3492 ADt/d) is 10% higher than the average daily rate (i.e. 3143 ADt/d); and
- Assuming the combined effect of a reduction in estimated gas concentration and the use of the average daily production (as opposed to the maximum continuous), the emission rate would be 0.04 g/s. This figure has been used in calculating the average emission.

[29] Data from modern mills checked against vendors' proposals received by Gunns

[30] European Commission; Reference Document on Best Available Techniques for Large Combustion Plants, p. 45 ; RPDC Emission Limit Guidelines, p. 17

The short term maximum TRS emission rate of 0.4 g/s as H_2S for the power boiler was arrived at by assuming the following values:

- 8 mg/m^3n (dry) being the estimated gas concentration; and
- The pulp production rate of 3492 ADt/d.

5.5 TRS Effluent Treatment Plant

The DIIS includes a figure for fugitive TRS emissions generated from the effluent treatment plant. This figure was arrived at by assuming the following values:

The sum of the following maximum continuous fugitive emissions:

- Primary clarifiers
- Equalization basin
- Spill basin
- Aeration basin
- Secondary clarifiers

The fugitive emission rates from these equipment areas have been calculated based on the product of:

- Surface area, in m^2, of the equipment; and
- TRS gas dispersion rate, in mg TRS/m^2/d, from the equipment

The TRS emission rate of 0.050 g/s as H_2S for the effluent treatment plant includes a level of conservatism because it assumes:

- The spill pond is full and emitting fugitive emissions;
- The pulp production rate used in the calculation (i.e. the maximum continuous rate of 3492 ADt/d) is 10% higher than the average daily rate (i.e. 3143 ADt/d); and
- Assuming the combined effect of a reduction in estimated gas concentration and the use of the average daily production (as opposed to the maximum continuous), the emission rate would be 0.014 g/s. This figure has been used in calculating the average emission.

5.6 Impact Assessment Figure

The emission figure for TRS used in the impact assessment in the Draft IIS was based on a 3 tier TRS emission rate varying through the year according to the % occurrence and duration given above and allowing for random placing of the 3 day and 1 hour peaks. It uses the 3 figures issued by Pöyry for the main stack for the following conditions:

	Main Stack	**Effluent Treatment Plant**
Average	0.448 g/s	0.0137 g/s
Maximum continuous	1.03 g/s	0.0502 g/s
Maximum short term	1.94 g/s	

In arriving at these values on a g/s basis, the annual emission rate has been divided by 365 days/annum.

The Pöyry data presented in Volume 6 and in this document has divided the annual discharges by 350 days/annum, which corresponds to the number of operating days. The results give slightly different results on a g/s basis – higher for Pöyry.

The maximum continuous emissions have been described above. The "average" emission supplied by Pöyry for the main stack is 14 tonnes/annum. 14 tonnes/annum over 365 days is 0.448 g/s, which is the value used in the impact assessment for the "average".

The "maximum short term" emission supplied by Pöyry for the main stack was 7 kg/h. 7 kg/h is 1.94 g/s, which is the value used in the impact assessment for the "maximum short term"[31].

The impact assessment in the Draft IIS assumes a figure of 0.34 kg S/ADt total sulphur emission[32] [33]. The S values were calculated as part of the impact assessment as the sum of the S content in the SO_2 emissions, TRS emissions from the main stack, and TRS emissions from the effluent treatment plant. Pöyry did not provide a figure for the sulphur modelling at that time.

For the purposes of this document, Pöyry has calculated a figure based on the maximum continuous values provided for the main stack and effluent treatment plant of 0.28 kg S(asS)/ADt.

The value of 0.28 kg S/ADt is derived as the sum of the following sources:

- Main stack SO_2, 1974 kg/d. When expressed as Sulphur with maximum continuous production of 3492 ADt/d, the total S in the main stack from SO_2 is 0.28 kg S/ADt;
- Main stack TRS, 100 kg/d. When expressed as Sulphur with maximum continuous production of 3492 ADt/d, the total S in the main stack from the TRS is 0.027 kg S/ADt; and
- Effluent treatment plant fugitive emissions, 0.050 g/s. When expressed as Sulphur with maximum continuous production of 3492 ADt/d, the total S from the TRS in effluent treatment fugitive emissions is 0.001 kg S/ADt.

[31] Volume 9, Appendices, Section 6.1, page 18. GHD have noted (page 18) that the data that they have based their emission rates on is based on data presented by Pöyry in June 2005 and that they understand that the data has undergone several iterations.
[32] Volume 9, Appendices, Section 6.1, Table 6.2, page 18.
[33] Volume 9, Appendices, Section 6.1, page 18. GHD have noted (page 18) that the data that they have based their emission rates on is based on data presented by Pöyry in June 2005 and that they understand that the data has undergone several iterations.

6 TOTAL SUSPENDED PARTICULATES (TSP)

The DIIS includes a figure for maximum continuous emissions from the main stack of 1062 kg/day for TSP[34] equating to 12.3 g/s. This figure represents the accumulation of TSP in the stack derived from the sum of the TSP emissions derived from the following sources:

- recovery boiler 9.5 g/s;
- lime kiln 1.2 g/s;
- NCG incinerators 0.1 g/s; and
- power boiler 1.6 g/s.

In response to submissions regarding the level of fine particles, a figure for the ratio of fine particles has been estimated. I agree with the statement of Ohlström where he stated:

> "The problems with PM2.5 standards, however, are the difficulties in measuring and thus controlling the concentrations of fine particles. There are many sampling and analysis systems and numerous different measuring instruments available. The results of different measuring methods are not yet very comparable with each other."[35]

Accordingly, I have presented ranges of estimated PM10 and PM2.5 emissions from the pulp mill.

The emission rate for each part of the total TSP has been calculated as follows:

6.1 TSP Recovery Boiler

The above figure for particulates generated by the recovery boiler was arrived at by assuming the following values:

The product of:

- 189 m^3n(dry)/s being the product of the following variables divided by the number of seconds in a day to arrive at the volumetric flow:
  - Specific Flue gas flow: 3.68 m^3n (dry)/kg dry solids;
  - Dry solids flow: 1.27 t dry solids/ADt;
  - Pulp production: 3492 ADt/d; and
- 50 mg/m^3n (dry) being the estimated gas concentration derived from[36];

The TSP emission rate of 9.5 g/s for the recovery boiler includes a level of conservatism because it assumes:

- While the estimate of gas concentration of 50 mg/m^3n (dry) is an appropriate figure to use for maximum daily emissions, with proper operation this figure could be reduced to less than 40 mg/m^3n (dry). Assuming this concentration at maximum continuous production the emission rate would be 7.5 g/s;

[34] DIIS, Volume 7, Annex VI, table at Page 1 of 4, B MAXIMUM CONTINUOUS EMISSIONS FROM THE MAIN STACK
[35] Ohlström et al., 2000
[36] Vakkilainen 2005, p. 11-8, It has been assumed that RPDC guidelines can not be exceeded.

- The pulp production rate used in the calculation (ie the maximum continuous rate of 3492 ADt/d) is 10% higher than the average daily rate (ie 3143 ADt/d); and
- Assuming the combined effect of a reduction in estimated gas concentration and the use of the average daily production (as opposed to the maximum continuous), the emission rate would be 6.8 g/s. This figure has been used in calculating the average emission.

The short term maximum TSP emission rate of 15.2 g/s for the recovery boiler was arrived at by assuming the following values:

- 80 mg/m^{3}n (dry) being the estimated gas concentration; and
- The pulp production rate of 3492 ADt/d.

A large portion of particles in recovery boiler emissions are fine particle emissions[37]. The ESP outlet particle distribution is similar to the inlet distribution[38].

Based on the typical distribution of particle sizes, the size distribution for recovery boiler dust is (lower values Ohlström et al. 2000 – higher values Mikkanen et. al. 1995):

– Total dust emission	100 %	9.5 g/s
– Emission dust smaller than 10 μm (PM10)	60 - 90 %	5.7 - 8.5 g/s
– Emission dust smaller than 2.5 μm (PM2.5)	50 - 80 %	4.7 - 7.7 g/s

6.2 TSP Lime Kiln

The above figure for particulates generated by the lime kiln was arrived at by assuming the following values:

The product of:

- 24 m^{3}n (dry)/s being the product of the following variables divided by the number of seconds in a day to arrive at the volumetric flow:
  - Specific flue gas flow: 2.3 m^{3}n (dry)/kg lime
  - Lime flow: 258 kg lime/ADt
  - Pulp production: 3492 ADt/d, and

- 50 mg/m^{3}n (dry) being the estimated gas concentration[39]

The TSP emission rate of 1.2 g/s for the lime kiln includes a level of conservatism because it assumes:

- While the estimate of gas concentration of 50 mg/m^{3}n (dry) is an appropriate figure to use for maximum daily emissions, with proper operation this figure could be reduced to less than 40 mg/m^{3}n (dry). Assuming this concentration at maximum continuous production the emission rate would be 1.0 g/s;
- The pulp production rate used in the calculation (i.e. the maximum continuous rate of 3492 ADt/d) is 10% higher than the average daily rate (i.e. 3143 ADt/d); and
- Assuming the combined effect of a reduction in estimated gas concentration and the use of the average daily production (as opposed to the maximum continuous),

[37] Jokiniemi et al, 2004 ; Mikkanen, 2000
[38] Mikkanen et al. 1995.
[39] European Commission Reference Document on Best Available Techniques in the Pulp and Paper Industry, p. 43

the emission rate would be 0.9 g/s. This figure has been used in calculating the average emission.

The short term maximum TSP emission rate of 1.8 g/s for the lime kiln was arrived at by assuming the following values:

- 75 mg/m^{3}n (dry) being the estimated gas concentration; and
- The pulp production rate of 3492 ADt/d.

A typical particle distribution for the lime kiln ESP dust shows that a large portion of emission is fine particle emission[40].

Based on the typical distribution of particle sizes, the size distribution for lime kiln dust is (lower values personal experience– higher values Environmental Protection Agency, 1995):

– Total dust emission	100 %	1.2 g/s
– Emission dust smaller than 10 μm (PM10)	70 - 90 %	0.8 - 1.1 g/s
– Emission dust smaller than 2.5 μm (PM2.5)	60 - 80 %	0.7 - 1.0 g/s

6.3 TSP NCG Incinerator

The above figure for particulates generated by the incinerator was arrived at by assuming the following values:

The product of:

- 1.84 m^{3}n (dry)/s being the product of the following variables divided by the number of seconds in a day to arrive at the volumetric flow:
  - Specific Flue gas flow: 4.56 m^{3}n (dry)/kg NCG fuel
  - NCG fuel flow: 10 kg NCG/ADt
  - Pulp production: 3492 ADt/d, and

- 30 mg/m^{3}n (dry) being the estimated gas concentration[41]

The TSP emission rate of 0.1 g/s for the NCG incinerators includes a level of conservatism because it assumes:

- While the estimate of gas concentration of 30 mg/m^{3}n (dry) is an appropriate figure to use for maximum daily emissions, with proper operation this figure could be reduced to less than 25 mg/m^{3}n (dry). Assuming this concentration at maximum continuous production, the emission rate would be 0.06 g/s;
- The pulp production rate used in the calculation (i.e. the maximum continuous rate of 3492 ADt/d) is 10% higher than the average daily rate (i.e. 3143 ADt/d);
- Assuming the combined effect of a reduction in estimated gas concentration and the use of the average daily production (as opposed to the maximum continuous) the emission rate would be 0.05 g/s. This figure has been used in calculating the average emission; and

[40] Environmental Protection Agency, 1995
[41] Data from modern mills checked against vendors' proposals received by Gunns

– Additionally, the NCG Incinerator should operate at full load only much less than 4 % of the time (less than 2 weeks per year). In both calculations it has been assumed to be operating 100 % of time.

The short term maximum TSP emission rate of 0.1 g/s for the NCG incinerator was arrived at by assuming the following values:

– 50 mg/m^{3}n (dry) being the estimated gas concentration; and
– The pulp production rate of 3492 ADt/d.

Typical particle distribution mean is between 1 and 10 μm[42].

Based on the typical distribution of particle sizes the size distribution for NCG incinerator dust is:

– Total dust emission	100 %	0.1 g/s
– Emission dust smaller than 10 μm (PM10)	50 - 80 %	0.05 – 0.08 g/s
– Emission dust smaller than 2.5 μm (PM2.5)	30 - 50 %	0.03 – 0.05 g/s

6.4 TSP Power Boiler

The above figure for particulates generated by the power boiler was arrived at by assuming the following values:

The product of:

– 53.3 m^{3}n (dry)/s being the product of the following variables divided by the number of seconds in a day to arrive at the volumetric flow:
  – Specific flue gas flow: 2.842 m^{3}n (dry)/AD kg Power Boiler fuel
  – Power boiler fuel flow: 464 AD kg Power Boiler fuel/ADt
  – Pulp production: 3492 ADt/d, and
– 30 mg/m^{3}n (dry) at 3 % O_2 being the estimated gas concentration[43]

The TSP emission rate of 1.6 g/s for the power boiler includes a level of conservatism because it assumes:

– While the estimate of gas concentration of 30 mg/m^{3}n (dry) is an appropriate figure to use for maximum daily emissions, with proper operation this figure could be reduced to less than 25 mg/m^{3}n (dry). Assuming this concentration at maximum continuous production, the emission rate would be 1.3 g/s;
– The pulp production rate used in the calculation (i.e. the maximum continuous rate of 3492 ADt/d) is 10% higher than the average daily rate (i.e. 3143 ADt/d); and
– Assuming the use of the average daily production (as opposed to the maximum continuous), the emission rate would be 1.2 g/s. This figure has been used in calculating the average emission.

The short term maximum TSP emission rate of 3.2 g/s for the power boiler was arrived at by assuming the following values:

– 60 mg/m^{3}n (dry) being the estimated gas concentration; and
– The pulp production rate of 3492 ADt/d.

[42] Distribution can be assumed based on gas fired boilers
[43] European Commission; Reference Document on Best Available Techniques for Large Combustion Plants, p. 45 ; RPDC Emission Limit Guidelines, p. 17

A typical particle distribution for BFB power boiler fine particle emission at the ESP outlet shows that a large portion of emission is fine particle emission[44][45].

Based on the typical distribution of particle sizes, the size distribution for power boiler dust is (lower values Linna 2005 – higher values Jokiniemi et al. 2004):

– Total dust emission	100 %	1.6 g/s
– Emission dust smaller than 10 μm (PM10)	50 - 70 %	0.8 - 1.1 g/s
– Emission dust smaller than 2.5 μm (PM2.5)	35 - 50 %	0.5 - 0.8 g/s

6.5 Impact Assessment Figures

The figure for TSP used in the impact assessment was 14.68 g/s particulate matter[46] [47].

I understand that GHD assumed a PM10:PM2.5 ratio of 2:1.

[44] Linna, 2005

[45] Jokiniemi et al. 2004

[46] DIIS does not contain a value used for impact assessment, however based on information received a total value of 14.68 g/s for particulate matter was used. The breakdown is as follows:

Recovery Boiler	11.59 g/s
Lime kiln	1.43 g/s
NCG Boiler	0.06 g/s
Power Boiler	1.6 g/s
Total	14.68 g/s

[47] Volume 9, Appendices, Section 6.1, page 18. GHD have noted (page 18) that the data that they have based their emission rates on is based on data presented by Pöyry in June 2005 and that they understand that the data has undergone several iterations.

7 CO

The DIIS includes a figure for maximum continuous emissions from the main stack of 5364 kg/day for CO,[48] equating to 62 g/s of CO. This figure represents the accumulation of CO in the stack derived from the sum of the CO emissions derived from the following sources:

- recovery boiler 42 g/s;
- lime kiln 5 g/s;
- NCG incinerators 1 g/s; and
- power boiler 15 g/s.

It should be noted that controlling CO emissions by adjusting excess air ratio is very easy. The mill should be able to run at given CO emissions. Lowering CO from presented levels means that estimated NO emissions subsequently increase. Similarly lowering CO means higher flue gas losses i.e. low energy efficiency. Typically boilers are running at 50 – 250 mg/m^{3}n CO[49].

The emission rate for each part of the total CO emissions has been calculated as follows:

7.1 CO Recovery Boiler

The above figure for CO generated by the recovery boiler was arrived at by assuming the following values:

The product of:

- 189 m^{3}n (dry)/s being the product of the following variables divided by the number of seconds in a day to arrive at the volumetric flow:
  - specific flue gas flow: 3.68 m^{3}n (dry)/kg dry solids
  - dry solids flow: 1.27 t dry solids/ADt
  - pulp production: 3492 ADt/d, and

- 220 mg/m^{3}n (dry) being the estimated gas concentration derived[50]

The CO emission rate of 42 g/s as CO for the recovery boiler includes a level of conservatism because it assumes:

- While the estimate of gas concentration of 220 mg/m^{3}n (dry) is an appropriate figure to use, with proper operation this figure could be reduced but is not to achieve minimum NO emission;
- The pulp production rate used in the calculation (i.e. the maximum continuous rate of 3492 ADt/d) is 10% higher than the average daily rate (i.e. 3143 ADt/d); and
- Assuming the combined effect of a reduction in estimated gas concentration and the use of the average daily production (as opposed to the maximum continuous), the emission rate would be 38 g/s. This figure has been used in calculating the average emission.

[48] DIIS, Volume 7, Annex VI, table at Page 1 of 4, B MAXIMUM CONTINUOUS EMISSIONS FROM THE MAIN STACK
[49] European Commission; Reference Document on Best Available Techniques for Large Combustion Plants, p. 340
[50] Vakkilainen, 2005, p. 11-2

The short term maximum CO emission rate of 76 g/s as CO for the recovery boiler was arrived at by assuming the following values:

- 400 mg/m^{3}n (dry) being the estimated gas concentration; and
- The pulp production rate of 3492 ADt/d.

7.2 CO Lime Kiln

The above figure for CO generated by the lime kiln was arrived at by assuming the following values:

The product of:

- 24 m^{3}n (dry)/s being the product of the following variables divided by the number of seconds in a day to arrive at the volumetric flow:
  - Specific flue gas flow: 2.3 m^{3}n (dry)/kg lime
  - Lime flow: 258 kg lime/ADt
  - Pulp production: 3492 ADt/d, and

- 200 mg/m^{3}n (dry) being the estimated gas concentration[51]

The CO emission rate of 5 g/s as CO for the lime kiln includes a level of conservatism because it assumes:

- Which the estimate of gas concentration of 200 mg/m^{3}n (dry) is an appropriate figure to use for maximum daily emissions, with proper operation this figure could be reduced but is not to achieve maximum energy efficiency;
- The pulp production rate used in the calculation (i.e. the maximum continuous rate of 3492 ADt/d) is 10% higher than the average daily rate (i.e. 3143 ADt/d); and
- Assuming the combined effect of a reduction in estimated gas concentration and the use of the average daily production (as opposed to the maximum continuous), the emission rate would be 4 g/s. This figure has been used in calculating the average emission.

The short term maximum CO emission rate of 10 g/s as CO for the lime kiln was arrived at by assuming the following values:

- 400 mg/m^{3}n (dry) being the estimated gas concentration; and
- The pulp production rate of 3492 ADt/d.

7.3 CO NCG Incinerator

The above figure for CO generated by the incinerator was arrived at by assuming the following values:

The product of:

- 1.84 m^{3}n (dry)/s being the product of the following variables divided by the number of seconds in a day to arrive at the volumetric flow:
  - Specific flue gas flow: 4.56 m^{3}n (dry)/kg NCG fuel
  - NCG fuel flow: 10 kg NCG/ADt
  - Pulp production: 3492 ADt/d, and

[51] Data from modern mills checked against vendors' proposals received by Gunns

– 500 mg/m^{3}n (dry) being the estimated gas concentration [52]

The CO emission rate of 1 g/s as CO for the NCG incinerators includes a level of conservatism because it assumes:

– the pulp production rate used in the calculation (ie the maximum continuous rate of 3492 ADt/d) is 10% higher than the average daily rate (ie 3143 ADt/d);
– assuming the use of the average daily production (as opposed to the maximum continuous), the emission rate would be 1 g/s. This figure has been used in calculating the average emission; and
– additionally, the NCG Incinerator should operate at full load only much less than 4 % of the time (less than 2 weeks per year). In both calculations, it has been assumed to be operating 100 % of time.

The short term maximum CO emission rate of 1.3 g/s as CO for the NCG incinerator was arrived at by assuming the following values:

– 700 mg/m^{3}n (dry) being the estimated gas concentration; and
– The pulp production rate of 3492 ADt/d.

7.4 CO Power Boiler

The above figure for CO generated by the power boiler was arrived at by assuming the following values:

The product of:

– 53.3 m^{3}n (dry)/s being the product of the following variables divided by the number of seconds in a day to arrive at the volumetric flow:
  – Specific flue gas flow: 2.842 m^{3}n (dry)/AD kg Power Boiler fuel
  – Power boiler fuel flow: 464 AD kg Power Boiler fuel/ADt
  – Pulp production: 3492 ADt/d, and

– 280 mg/m^{3}n (dry) at 3% O_2 being the estimated gas concentration[53]

The CO emission rate of 15 g/s for the power boiler includes a level of conservatism because it assumes:

– While the estimate of gas concentration of 280 mg/m^{3}n (dry) is an appropriate figure to use for maximum daily emissions, with proper operation this figure could be reduced but is not to achieve maximum energy efficiency;
– The pulp production rate used in the calculation (i.e. the maximum continuous rate of 3492 ADt/d) is 10% higher than the average daily rate (i.e. 3143 ADt/d); and
– Assuming the combined effect of a reduction in estimated gas concentration and the use of the average daily production (as opposed to the maximum continuous), the emission rate would be 13 g/s. This figure has been used in calculating the average emission.

The short term maximum CO emission rate of 32 g/s as CO for the power boiler was arrived at by assuming the following values:

[52] Data from modern mills checked against vendors' proposals received by Gunns
[53] European Commission; Reference Document on Best Available Techniques for Large Combustion Plants, p. 340 ; RPDC Emission Limit Guidelines, p. 17

- 600 mg/m^3n (dry) being the estimated gas concentration; and
- The pulp production rate of 3492 ADt/d.

8 TOC/VOC

The DIIS includes a figure for maximum continuous emissions from the main stack of 5364 kg/day for TOC/VOC[54] equating to 3.4/1.8 g/s of C. This figure represents the accumulation of TOC/VOC in the stack derived from the sum of the TOC/VOC emissions derived from the following sources:

- recovery boiler 2.7/1.3 g/s ;
- lime kiln 0.4/0.4 g/s;
- NCG incinerators 0.1/0.1 g/s; and
- power boiler 0.4/0.1 g/s.

The emission rate for each part of the total TOC/VOC emissions has been calculated as follows:

8.1 TOC/VOC Recovery Boiler

The above figure for TOC/VOC generated by the recovery boiler was arrived at by assuming the following values:

The product of:

- 189 m^3n (dry)/s being the product of the following variables divided by the number of seconds in a day to arrive at the volumetric flow:
  - specific flue gas flow: 3.68 m^3n (dry)/kg dry solids
  - dry solids flow: 1.27 t dry solids/ADt
  - pulp production: 3492 ADt/d, and
- 14/7 mg/m^3n (dry) being the estimated gas concentration derived[55]

The TOC/VOC emission rate of 2.7/1.3 g/s as C for the recovery boiler includes a level of conservatism because it assumes:

- The pulp production rate used in the calculation (i.e. the maximum continuous rate of 3492 ADt/d) is 10% higher than the average daily rate (i.e. 3143 ADt/d); and
- Assuming the effect of the use of the average daily production (as opposed to the maximum continuous), the emission rate would be 2.4/1.2 g/s. This figure has been used in calculating the average emission.

The short term maximum TOC/VOC emission rate of 2.8/1.4 g/s as C for the recovery boiler was arrived at by assuming the following values:

- 15/8 mg/m^3n (dry) being the estimated gas concentration; and
- The pulp production rate of 3492 ADt/d.

8.2 TOC/VOC Lime Kiln

The above figure for TOC/VOC generated by the lime kiln was arrived at by assuming the following values:

The product of:

[54] DIIS, Volume 7, Annex VI, table at Page 1 of 4, B MAXIMUM CONTINUOUS EMISSIONS FROM THE MAIN STACK

[55] Vakkilainen 2005, p. 11-8

- 24 m^3n (dry)/s being the product of the following variables divided by the number of seconds in a day to arrive at the volumetric flow:
  - Specific flue gas flow: 2.3 m^3n (dry)/kg lime
  - Lime flow: 258 kg lime/ADt
  - Pulp production: 3492 ADt/d, and
- 15/15 mg/m^3n (dry) being the estimated gas concentration[56]

The TOC/VOC emission rate of 0.4/0.4 g/s as C for the lime kiln includes a level of conservatism because it assumes:

- The pulp production rate used in the calculation (i.e. the maximum continuous rate of 3492 ADt/d) is 10% higher than the average daily rate (i.e. 3143 ADt/d); and
- Assuming the effect of the use of the average daily production (as opposed to the maximum continuous), the emission rate would be 0.3/0.3 g/s. This figure has been used in calculating the average emission.

The short term maximum TOC/VOC emission rate of 0.5/0.5 g/s as C for the lime kiln was arrived at by assuming the following values:

- 20/20 mg/m^3n (dry) being the estimated gas concentration; and
- The pulp production rate of 3492 ADt/d.

8.3 TOC/VOC NCG Incinerator

The above figure for TOC/VOC generated by the incinerator was arrived at by assuming the following values:

The product of:

- 1.84 m^3n (dry)/s being the product of the following variables divided by the number of seconds in a day to arrive at the volumetric flow:
  - Specific flue gas flow: 4.56 m^3n (dry)/kg NCG fuel
  - NCG fuel flow: 10 kg NCG/ADt
  - Pulp production: 3492 ADt/d, and
- 30/30 mg/m^3n (dry) being the estimated gas concentration [57]

The TOC/VOC emission rate of 0.1/0.1 g/s as C for the NCG incinerators includes a level of conservatism because it assumes:

- the pulp production rate used in the calculation (ie the maximum continuous rate of 3492 ADt/d) is 10% higher than the average daily rate (ie 3143 ADt/d);
- assuming the use of the average daily production (as opposed to the maximum continuous), the emission rate would be 0.1/0.1 g/s. This figure has been used in calculating the average emission; and
- additionally, the NCG Incinerator should operate at full load only much less than 4 % of the time (less than 2 weeks per year). In both calculations, it has been assumed to be operating 100 % of time.

The short term maximum TOC/VOC emission rate of 0.1/0.1 g/s as C for the NCG incinerator was arrived at by assuming the following values:

- 40/40 mg/m^3n (dry) being the estimated gas concentration; and

[56] Data from modern mills checked against vendors' proposals received by Gunns
[57] Data from modern mills checked against vendors' proposals received by Gunns

– The pulp production rate of 3492 ADt/d.

8.4 TOC/VOC Power Boiler

The above figure for TOC/VOC generated by the power boiler was arrived at by assuming the following values:

The product of:

– 53.3 m^3n (dry)/s being the product of the following variables divided by the number of seconds in a day to arrive at the volumetric flow:
  – Specific flue gas flow: 2.842 m^3n (dry)/AD kg Power Boiler fuel
  – Power boiler fuel flow: 464 AD kg Power Boiler fuel/ADt
  – Pulp production: 3492 ADt/d, and
– 8/2 mg/m^3n (dry) at 3% O_2 being the estimated gas concentration[58]

The TOC/VOC emission rate of 0.4/0.1 g/s for the power boiler includes a level of conservatism because it assumes:

– The pulp production rate used in the calculation (i.e. the maximum continuous rate of 3492 ADt/d) is 10% higher than the average daily rate (i.e. 3143 ADt/d); and
– Assuming the effect of the use of the average daily production (as opposed to the maximum continuous), the emission rate would be 0.4/0.1 g/s. This figure has been used in calculating the average emission.

The short term maximum TOC/VOC emission rate of 1.6/0.3 g/s as C for the power boiler was arrived at by assuming the following values:

– 30/6 mg/m^3n (dry) being the estimated gas concentration; and
– The pulp production rate of 3492 ADt/d.

[58]Data from modern mills checked against vendors' proposals received by Gunns ; RPDC Emission Limit Guidelines, p. 17

9 HCL

The DIIS includes a figure for maximum continuous emissions from the main stack of 72 kg/day for HCl[59]. This figure represents the accumulation of HCl in the stack derived from the sum of the HCl emissions derived from the following sources:

- recovery boiler 3 kg/d;
- power boiler 69 kg/d;
- lime kiln ~0 g/s; and
- NCG incinerators ~0 g/s.

The emission rate for each part of the total HCl emissions has been calculated as follows:

9.1 HCl Recovery Boiler

The above figure for HCl generated by the recovery boiler was arrived at by assuming the following values:

The product of:

- 189 m^3n (dry)/s being the product of the following variables divided by the number of seconds in a day to arrive at the volumetric flow:
  - Specific flue gas flow: 3.68 m^3n (dry)/kg dry solids
  - Dry solids flow: 1.27 t dry solids/ADt
  - Pulp production: 3492 ADt/d, and

- 0.2 mg/m^3n (dry) being the estimated gas concentration derived[60]

The HCl emission rate of 3 kg/d for the recovery boiler includes a level of conservatism because it assumes:

- The pulp production rate used in the calculation (i.e. the maximum continuous rate of 3492 ADt/d) is 10 % higher than the average daily rate (i.e. 3143 ADt/d); and
- Assuming the combined effect of a reduction in estimated gas concentration and the use of the average daily production (as opposed to the maximum continuous), the emission rate would be 1.5 kg/d.

The short term maximum HCl emission rate of 5 kg/d for the recovery boiler was arrived at by assuming the following values:

- 0.3 mg/m^3n (dry) being the estimated gas concentration; and
- The pulp production rate of 3492 ADt/d.

9.2 HCl Power Boiler

The above figure for HCl generated by the power boiler was arrived at by assuming the following values:

[59] DIIS, Volume 7, Annex VI, table at Page 1 of 4, B MAXIMUM CONTINUOUS EMISSIONS FROM THE MAIN STACK

[60] Someshwar and Jain, 1995 ; Boonsongsup et al., 1994, Vakkilainen, 2005 p. 11-12

The product of:

- 53.3 m^3n (dry)/s being the product of the following variables divided by the number of seconds in a day to arrive at the volumetric flow:
  - Specific flue gas flow: 2.842 m^3n (dry)/AD kg Power Boiler fuel
  - Power boiler fuel flow: 464 AD kg Power Boiler fuel/ADt
  - Pulp production: 3492 ADt/d, and

- 15 mg/m^3n (dry) at 3% O_2 being the estimated gas concentration[61]

The HCl emission rate of 69 kg/d for the power boiler includes a level of conservatism because it assumes:

- The pulp production rate used in the calculation (ie the maximum continuous rate of 3492 ADt/d) is 10% higher than the average daily rate (ie 3143 ADt/d); and
- Assuming the use of the average daily production (as opposed to the maximum continuous), the emission rate would be 64 kg/d.

The short term maximum HCl emission rate of 92 kg/d for the power boiler was arrived at by assuming the following values:

- 20 mg/m^3n (dry) being the estimated gas concentration; and
- The pulp production rate of 3492 ADt/d.

9.3 Chemical plant

The figure for HCl from chemical plant in the impact assessment was 0.0013 g/s. I understand Mr Ed Bechberger has been asked by Gunns to prepare an expert witness statement on Gunns' integrated chemical plant technology, and that one of the things he has been asked to do is comment on HCl emissions.

[61] European Commission; Reference Document on Best Available Techniques for Large Combustion Plants, p. 337, RPDC Emission Limit Guidelines, p. 17

10 DIOXINS AND FURANS

In response to requests for emissions figures for dioxins and furans, a figure for maximum continuous emissions from the main stack was calculated at 0.037 g/year as TEQ. This figure represents the accumulation of dioxins and furans in the stack derived from the sum of the dioxin and furan emissions from the following sources:

- recovery boiler 0.024 g/a;
- lime kiln 0.003 g/a; and
- power boiler 0.010 g/a.

The emission rate for each part of the total dioxins and furans has been calculated as follows:

10.1 Dioxins and Furans Recovery Boiler

The above figure for dioxins and furans generated by the recovery boiler was arrived at by assuming the following values:

The product of:

- 15.55 ng/ton BLDS being the TEQ-Emission Factor of recovery boiler [62]; and
- 1535490 BLDSt/a being the estimated yearly recovery boiler fuel utilization.

The 15.55 ng/ton BLDS TEQ-Emission Factor of recovery boiler corresponds to 4.2 pg I-TEQ/m^3n using:

- Specific flue gas flow: 3.68 m^3n (dry)/kg dry solids

The dioxin and furan emission rate of 0.024 g/a for the recovery boiler includes a level of conservatism because while the estimate of TEQ-Emission Factors of 15.55 ng/ton BLDS is an appropriate figure to use for maximum daily emissions, with proper operation this figure could be reduced to less than 10 ng/ton BLDS. Assuming this concentration at maximum continuous production, the emission rate would be 0.015 g/a, which corresponds to 4.2 pg TEQ/m^3n.

The value of 4.2 pg TEQ/m^3n is below the Recommended environmental emission limit guidelines[63] which specify 100 pg TEQ/m^3n as the limit.

The value of 4.2 pg TEQ/m^3n is below German values for waste incineration[64] and EU values of waste incineration[65]

10.2 Dioxins and Furans Lime Kiln

The above figure for dioxins and furans generated by the lime kiln was arrived at by assuming the following values:

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[62] Uloth and van Heek, 2002

[63] RPDC Emission Limit Guidelines p. 16

[64] The German 17.BImSchV (Seventeenth Ordinance on the Implementation of the Federal Emission Control Act) sets a limit value of 0.1 ng I-TEQ/m^3 for dioxin emissions from waste incinerators

[65] European Waste Incineration Directive (2000/76/EC) sets a limit value of 0.1 ng TEQ/ Nm^3 for dioxin emissions from waste incinerators

The product of:

- 9 ng/ton burnt lime being the TEQ-Emission Factor of lime kiln [66] ; and
- 286000 tons of burnt lime/a being the estimated yearly lime kiln production.

The 9 ng/ton burnt lime TEQ-Emission Factor of recovery boiler corresponds to 4 pg I-TEQ/m^3n using:

- Specific flue gas flow: 2.3 m^3n (dry)/kg lime

The dioxin and furan emission rate of 0.003 g/a for the lime kiln includes a level of conservatism because:

- While the estimate of TEQ-Emission Factors of 9 ng/ton burnt lime is an appropriate figure to use for maximum daily emissions, with proper operation this figure could be reduced to less than 7 ng/ton of burnt lime.

Assuming this concentration at maximum continuous production, the emission rate would be 0.002 g/a, which corresponds to 3.9 pg TEQ/m^3n.

The value of 3.9 pg TEQ/m^3n is below the Recommended environmental emission limit guidelines[67] which specify 100 pg TEQ/m^3n as limit.

The estimate of 3.9 pg I-TEQ/m^3n is below German values for waste incineration[68] and EU values of waste incineration[69]

10.3 Dioxins and Furans Power Boiler

The above figure for dioxins and furans generated by the power boiler was arrived at by assuming the following values:

The product of:

- 40 ng/BDt hog fuel being the TEQ-Emission Factor of power boiler [70]
- 255000 BDt/a being the estimated yearly power boiler fuel utilization

The 40 ng/BDt hog fuel TEQ-Emission Factor of recovery boiler corresponds to 14 pg I-TEQ/m^3n using:

- Specific flue gas flow: 2.842 m^3n (dry)/AD kg Power Boiler fuel

The dioxin and furan emission rate of 0.010 g/a for the power boiler includes a level of conservatism because:

- While the estimate of TEQ-Emission Factors of 40 ng/BDt hog fuel is an appropriate figure to use for maximum daily emissions, with proper operation this figure could be reduced to less than 30 ng/BDt hog fuel.

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[66] Uloth and van Heek, 2002
[67] RPDC Emission Limit Guidelines, p. 16
[68] The German 17.BImSchV (Seventeenth Ordinance on the Implementation of the Federal Emission Control Act) sets a limit value of 0.1 ng I-TEQ/m^3 for dioxin emissions from waste incinerators
[69] European Waste Incineration Directive (2000/76/EC) sets a limit value of 0.1 ng TEQ/ Nm^3 for dioxin emissions from waste incinerators
[70] Uloth and van Heek

Assuming this concentration at maximum continuous production, the emission rate would be 0.008 g/a, which corresponds to 14 pg TEQ/m^3n.

The value of 14 pg TEQ/m^3n is below Recommended environmental emission limit guidelines[71] which specify about 140 pg TEQ/m^3n as limit.

The estimate of 14 pg I-TEQ/m^3n is below German values for waste incineration[72] and EU values of waste incineration[73]

[71] RPDC Emission Limit Guidelines p. 17 specify a limit of 100 pg TEQ/m^3n at 8 % O_2 concentration

[72] The German 17.BImSchV (Seventeenth Ordinance on the Implementation of the Federal Emission Control Act) sets a limit value of 0.1 ng I-TEQ/m^3 for dioxin emissions from waste incinerators

[73] European Waste Incineration Directive (2000/76/EC) sets a limit value of 0.1 ng TEQ/ Nm^3 for dioxin emissions from waste incinerators

11 HEAVY METALS

For the purposes of this document heavy metals is defined as the sum of all components. Heavy metals thus include antimony (Sb), arsenic (As), barium (Ba), beryllium (Be), cadmium (Cd), chromium (Cr), cobalt (Co), copper (Cu), gold (Au), iron (Fe), lead (Pb), manganese (Mn), mercury (Hg), niobium (Nb), nickel (Ni), selenium (Se), silver (Ag), tellurium (Te), thallium (Th), zinc (Zn), vanadium (V) and other even more minor elements.

The DIIS includes a preliminary figure for maximum continuous emissions from the main stack of 615 kg/year for heavy metals from recovery boiler, and 120 kg/year for heavy metals from power boiler[74]. These figures were assumed based upon Finnish emission factors. The figures used in the DIIS are conservative. The correct figure is 75.8 kg/year equating to 2.5 mg/s heavy metals. This figure represents the accumulation of heavy metals in the stack derived from the sum of the heavy metals emissions derived from the following sources:

- recovery boiler 2.0 mg/s ;
- lime kiln 0.1 mg/s;
- NCG incinerators ~0 g/s; and
- power boiler 0.4 mg/s.

NCG incinerators are not heavy metal emitters as the fuel and the scrubbing media do not contain heavy metals. The emission rate for each part of the total heavy metals has been calculated as follows:

11.1 Heavy Metals Recovery Boiler

The above figure for heavy metals generated by the recovery boiler was arrived at by assuming the following values:

The product of:

- 189 m^3n (dry)/s being the product of the following variables divided by the number of seconds in a day to arrive at the volumetric flow:
  - specific flue gas flow: 3.68 m^3n (dry)/kg dry solids
  - dry solids flow: 1.27 t dry solids/ADt
  - pulp production: 3492 ADt/d, and

- 11 µg/m^3n (dry) being the estimated gas concentration derived[75]

The heavy metals emission rate of 2.0 mg/s for the recovery boiler includes a level of conservatism because it assumes:

- While the estimate of gas concentration of 11 µg/m^3n (dry) is an appropriate figure to use, the heavy metal emissions are associated with dust particles. Thus, they reduce with same ratio as dust emissions to 9 µg/m^3n; and
- The pulp production rate used in the calculation (i.e. the maximum continuous rate of 3492 ADt/d) is 10% higher than the average daily rate (i.e. 3143 ADt/d); and

[74] DIIS, Volume 7, Annex VI, table at Page 1 of 4, B MAXIMUM CONTINUOUS EMISSIONS FROM THE MAIN STACK

[75] Vakkilainen, 2005 p. 11-14

– Assuming the combined effect of a reduction in estimated gas concentration and the use of the average daily production (as opposed to the maximum continuous) the emission rate would be 1.6 mg/s. This figure has been used in calculating the average emission.

The short term maximum heavy metals emission rate of 3 mg/s for the recovery boiler was arrived at by assuming the following values:

– 17 μg/m^3n (dry) being the estimated gas concentration; and
– The pulp production rate of 3492 ADt/d.

11.2 Heavy Metals Lime Kiln

The above figure for heavy metals generated by the lime kiln was arrived at by assuming the following values:

The product of:

– 24 m^3n (dry)/s being the product of the following variables divided by the number of seconds in a day to arrive at the volumetric flow:
  – Specific flue gas flow: 2.3 m^3n (dry)/kg lime
  – Lime flow: 258 kg lime/ADt
  – Pulp production: 3492 ADt/d, and

– 3 μ g/m^3n (dry) being the estimated gas concentration[76]

The heavy metals emission rate of 0.1 mg/s for the lime kiln includes a level of conservatism because it assumes:

– While the estimate of gas concentration of 3 μg/m^3n (dry) is an appropriate figure to use, the heavy metal emissions are associated with dust particles. Thus, they reduce with same ratio as dust emissions to 2 μg/m^3n;
– The pulp production rate used in the calculation (i.e. the maximum continuous rate of 3492 ADt/d) is 10% higher than the average daily rate (i.e. 3143 ADt/d); and
– Assuming the combined effect of a reduction in estimated gas concentration and the use of the average daily production (as opposed to the maximum continuous) the emission rate would be 0.1 mg/s. This figure has been used in calculating the average emission.

The short term maximum heavy metals emission rate of 0.1 mg/s for the lime kiln was arrived at by assuming the following values:

– 5 μg/m^3n (dry) being the estimated gas concentration; and
– The pulp production rate of 3492 ADt/d.

11.3 Heavy Metals Power Boiler

The above figure for heavy metals generated by the power boiler was arrived at by assuming the following values:

The product of:

– 53.3 m^3n (dry)/s being the product of the following variables divided by the number of seconds in a day to arrive at the volumetric flow:

[76] Data from modern mills checked against vendors' proposals received by Gunns.

- Specific flue gas flow: 2.842 m^3n (dry)/AD kg Power Boiler fuel
- Power boiler fuel flow: 464 AD kg Power Boiler fuel/ADt
- Pulp production: 3492 ADt/d, and

- 8 μ g/m^3n (dry) at 3% O_2 being the estimated gas concentration[77]

The heavy metals emission rate of 0.4 mg/s for the power boiler includes a level of conservatism because it assumes:

- While the estimate of gas concentration of 8 μ g/m^3n (dry) is an appropriate figure to use for maximum daily emissions, the heavy metal emissions are associated with dust particles, thus they reduce with same ratio as dust emissions to 6 μg/m^3n;
- The pulp production rate used in the calculation (i.e. the maximum continuous rate of 3492 ADt/d) is 10% higher than the average daily rate (i.e. 3143 ADt/d); and
- Assuming the combined effect of a reduction in estimated gas concentration and the use of the average daily production (as opposed to the maximum continuous), the emission rate would be 0.3 mg/s. This figure has been used in calculating the average emission.

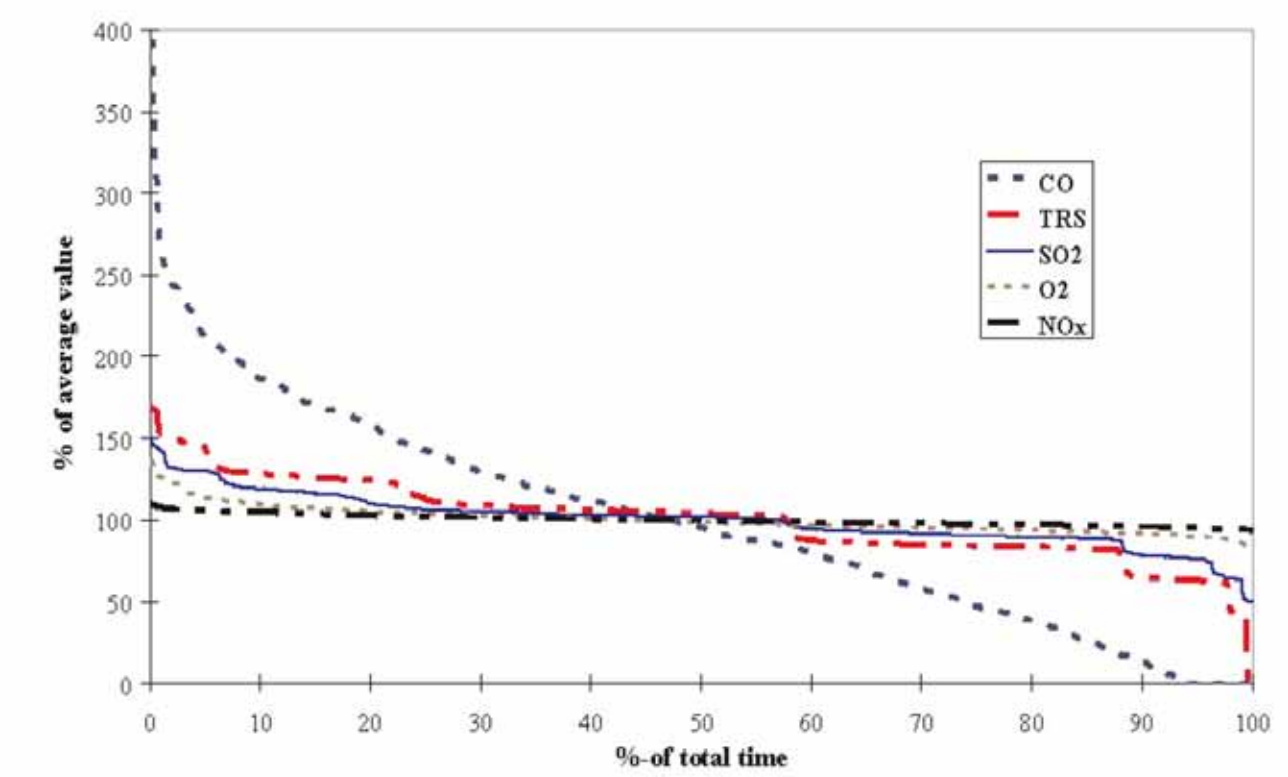
The short term maximum heavy metals emission rate of 0.9 mg/s for the power boiler was arrived at by assuming the following values:

- 15 μg/m^3n (dry) being the estimated gas concentration; and
- The pulp production rate of 3492 ADt/d.

[77] European Commission; Reference Document on Best Available Techniques for Large Combustion Plants, p. 336

12 TYPICAL VARIABILITY OF AIR EMISSIONS

The DIIS includes estimations of variability for emissions. The variability of estimation for the recovery boiler has been estimated using the following figure that represents the typical variability during operation[78].



When looking at the above figure, one should note that CO emissions typically vary much more than other emissions. It peaks up and down in 2 – 5 min intervals, and does not form a stable value. If CO is controlled, then the control is based on predictive hourly average.

[78] Vakkilainen, 2005

Summary of Emissions to Air

The dust emissions divided to size ranges for Maximum Continuous Emissions are

		Total	PM10	PM2.5
Recovery boiler	mg/m^{3}n	50	30-45	25-40
	kg/ADt p	0.23	0.14-0.21	0.12-0.19
Lime kiln	mg/m^{3}n	50	35-45	30-40
	kg/ADt p	0.03	0.02-0.03	~0.02
NCG boiler	mg/m^{3}n	30	15-25	10-15
	kg/ADt p	0.001	~0.001	~0.001
Power boiler	mg/m^{3}n	30	15-20	5-10
	kg/ADt p	0.04	~0.02	~0.01
Mill total	kg/ADt p	0.30	0.18-0.26	0.14-0.22

The average monthly emissions compared to RPDC's *Recommended environmental emission limit guidelines for any new bleached eucalypt kraft pulp mill in Tasmania* (2004) are as follows.

Recovery boiler	Plantation mg/m^{3}n	Native mg/m^{3}n	Pine mg/m^{3}n	RPDC mg/m^{3}n
CO	200	200	200	
TRS	2	2	2	7
SO_2	12	12	12	
NO_x	200	200	180	
TSP	40	40	40	50
TOC	14	14	14	
VOC	7	7	7	
HCl	0.1	0.1	0.1	
NH3	0.2	0.2	0.2	
Dioxins and furans	<0.1 ng/m^{3}n	<0.1 ng/m^{3}n	<0.1 ng/m^{3}n	0.1 ng/m^{3}n

Lime kiln	mg/m^{3}n	mg/m^{3}n	mg/m^{3}n	RPDC mg/m^{3}n
CO	200	200	200	
TRS	5	5	5	16
SO_2	50	50	50	
NO_x	300	300	300	
TSP	40	40	40	40
VOC	15	15	15	
Dioxins and furans	<0.1 ng/m^{3}n	<0.1 ng/m^{3}n	<0.1 ng/m^{3}n	0.1 ng/m^{3}n

NCG boiler	mg/m^{3}n	mg/m^{3}n	mg/m^{3}n	RPDC mg/m^{3}n
CO	500	500	500	
H_2S	7	7	7	7
SO_2	200	200	200	
NO_x	411	411	411	
TSP	25	25	25	
VOC	30	30	30	

Power Boiler	Plantation mg/m^{3}n	Native mg/m^{3}n	Pine mg/m^{3}n	RPDC kg/ADt
CO	349	349	349	
HCl	15.4	15.4	15.4	
SO_2	146	146	146	
NO_x	240	240	240	~240
TSP	25	25	25	~42
TOC	5	5	5	
VOC	1	1	1	
Dioxins and furans	<0.1 ng/m^{3}n	<0.1 ng/m^{3}n	<0.1 ng/m^{3}n	~0.14 ng/m^{3}n

The average yearly emissions compared to RPDC's *Recommended environmental emission limit guidelines for any new bleached eucalypt kraft pulp mill in Tasmania* (2004) for pulping of the three types of wood raw material are as follows.

Pulping no Power Boiler	Plantation	Native	Pine	RPDC
	kg/ADt	kg/ADt	kg/ADt	kg/ADt
CO	1.2	1.5	1.7	
TRS	0.01	0.02	0.02	
SO_2	0.09	0.14	0.13	
S_{tot}	0.1	0.1	0.1	0.4
NO_x	1.26	1.56	1.64	1.3
TSP	0.21	0.26	0.30	

Corresponding average emissions from stack for pulping of the three types of wood raw material are as follows.

Pulping with Power Boiler	Plantation	Native	Pine
	g/s	g/s	g/s
CO	56.0	52.8	52.8
TRS	0.5	0.5	0.5
SO_2	10.5	10.1	10.2
NO_x	55.3	51.8	48.5
TSP	8.9	8.4	8.3

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