Appendix 3.3 Detailed Calculations of Emissions from STF

Oa:	Oxygen concentration of flue gas, dry gas
Os:	Standard oxygen concentration, dry gas
Ca, dry, Oa:	Actual flue gas concentration, dry gas, Oa
Ca, dry, Os:	Actual flue gas concentration, dry gas, Os
Ca, wet, Oa:	Actual flue gas concentration, wet gas, Oa
Cs:	Flue gas concentration at standard conditions
Va, dry:	Volume of flue gas at emission point, dry gas
Va, wet:	Volume of flue gas at emission point, wet gas
Vs:	Volume of flue gas under standard condition, dry gas
M:	Mass of pollutant in flue gas
%H2O:	% of moisture in flue gas
Pa:	Pressure of flue gas at emission point
Ps:	Standard pressure
Ta:	Temperature of flue gas at emission point
Ts:	Standard temperature

In accordance with Annex VI of EU Directive 200/76/EC,

Ca, dry, Oa	= Ca, dry, Os x (20.9 - Oa) / (20.9 - Os)	(eqn. 1)
Ca, dry, Oa	= M / Va, dry	(eqn. 2)
	= M / [Va, wet x (1 - %H2O)]	(eqn. 3)
Ca, wet, Oa	= M / Va, wet	
	= Ca, dry, Oa x (1 - %H2O)	(from eqn. 3)
	= Ca, dry, Os x (1 - %H2O) x (20.9 – Oa) / (20.9 – Os)	(from eqn. 1) (eqn. 4)
Cs	= M / Vs	(eqn. 5)

By standard gas law,

Pa x Va, dry / Ta = Ps x Vs / Ts

Since Pa = Ps,
Therefore, Va, dry / Ta = Vs / Ts

From eqn. 2 and eqn. 5,
(M / Ca, dry, Oa) / Ta = (M / Cs) / Ts

Therefore,
Ca, dry, Oa = Cs x Ts / Ta

From eqn. 4,
Ca, wet, Oa = Cs x (Ts / Ta) x (1 - %H2O) x (20.9 – Oa) / (20.9 – Os)

For STF, for any pollutant,

Oa= 11%
Os= 11%
%H2O= 39.76%
Ta= 463K
Ts= 273K

Therefore,

Ca, wet, Oa= Cs x (273K / 463K) x (1 – 0.3976) x (20.9 – 11) / (20.9 – 11)
= 0.355 Cs

The actual flow rate= 432,411 m3/hr,

Air Pollutant	BPM Emission Limits (mg m-3)		Emission Rate (g/s)	
	Half-Hourly	Daily or as specified	Hourly	Daily or as specified
Particulates	30	10	1.28	0.43
SO2	200	50	8.53	2.13
NOx	400	200	17.06	8.53
Carbon Monoxide (CO)	100	50	4.26	2.13
Gaseous or vaporous organic	20	10	0.85	0.43
Hydrogen Chloride (HCl)	60	10	2.56	0.43
Hydrogen Fluoride (HF)	4	1	0.17	0.04
Total of 9 Heavy Metals	-	0.5	0.021	0.021
Mercury	-	0.05	2.13E-03	2.13E-03
Total Cadmium & Thallium	-	0.05	2.13E-03	2.13E-03
Dioxins & Furans	-	1.00E-07	4.26E-09	4.26E-09