R1 Factor Calculation

according to Annex II of Directive 2008/98/EC

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-	WSC HMB	50131962	0.1	09.06.21
-	Combustion Diagram [CB-000]	50125757	0.0	05.03.21
-	Burner fuel consumption [CSP-139]	-	0.0	28.04.21

Remarks

The fuel considered for the burner is fuel oil.
No heat export foreseen for the calculation

INPUT DATA

Plant Capacity		Unit	LPN
Nominal throughput of 1 boiler		t/h	28.125
Design LHV		GJ/t	9.60
Nominal waste thermal input of one boiler		MW	75.0
Number of boilers		u	2
Plant availability		h	8000
Nominal annual plant throughput		t/y	450'000
Description of Performance Guarantees		**Unit**	
Net power output			
Gross Power produced for export at point LPN = Maximum Thermal Loading, Fouled Boiler		MWe	48.93
Net Power produced for export at point LPN = Maximum Thermal Loading, Fouled Boiler		MWe	44.49
Plant electrical consumption at nominal throughput (incl. transformer losses, civil)		MWe	4.44
CHP power output			
Heat Export at point LPN		MWth	0.00
Additives and Consumables			
Auxiliary fuel LHV		MJ/kg	42.7
Maximum fuel consumption for one cold start-up of one boiler		kg	21'500
Maximum fuel consumption for one normal stop of one boiler		kg	17'500

R1 CALCULATION

According to the Guidelines on the interpretation of the R1 Energy efficiency formula for Incineration facilities dedicated for the processing of municipal solid waste according to Annex II of Directive 2008/98/EC on waste

The plant is designed to meet an expected efficiency performance value of approximately 0.822 in Electricity only mode

[Ep - (Ef + Ei)] / [0,97 * (Ew + Ef)] > 0.65

The definition and expected values for the different parameters are provided below and are calculated on an annual

Parameter	Definition	Equivalence Factor	Unit	Expected Value Electricity Only
1)Ep	**Ep** means annual energy produced as heat or electricity. It is calculated with energy in the form of electricity being multiplied by 2.6 and heat produced for commercial use multiplied by 1.1 **Ep** = (Epe + Eph) with:		GJ/year	**3'480'386**
Epe	**Epe** = total **generated** electricity = power output at generator outlet **at nominal load** after 8'000 hours [of operation MW] x 8000 [h/y] x 0.95 x 3.6 [GJ/MWh] 0.95 is a correction factor that accounts for boiler continuous blow-down and soot-blowers, and for potential turbine lower efficiency with load variations, ambient Temperature variations, fouling of the ACC	**x 2.6**	GJ/year	**3'480'386**
Eph	**Eph** = total exported heat **Transport losses, inefficient use by third parties and transformation of heat into electricity by third parties** Nota: Ep is the energy produced by the incineration facility. The fact that energy is used inefficiently by third parties shall not be taken into account and shall have no effect on the R1 energy efficiency formula. The same applies in the case of energy losses due to transport of heat energy. **Backflows and return flows of generated energies** Backflows from external sources shall be deducted from Ep as they directly lower the rate of energy recovery from waste.	**x 1.1**	GJ/year	-
2)Ef	**Ef** means annual energy input to the system from fuels contributing to the production of steam **Ef** = 50% of heat input used in start-up/auxiliary burners = 50% x LHV oil/gas x number of boilers x (4.5 x guaranteed oil/gas usage for cold start-up per boiler + 6 x guaranteed oil/gas usage for shutdown per boiler) [GJ/y] Nota: 50% is an accepted ratio for the part of the heat usage through the burners that produces steam 4.5 accounts for 3 cold start-ups and 3 warm start-ups per year, assuming oil/gas consumption for warm start-up being half of a cold start-up LHV of gas oil of 42.65 MJ/kg is assumed No equivalence factor applies for fuels (fuel-oil, gas …), i.e. the actor is 1	**x 1.0**	GJ/year	**8'615**
3)Ew	**Ew** means annual energy contained in the treated waste calculated using the lower net calorific value of the waste **Ew** = **Nominal** plant throughput [t/y] x design LHV [GJ/t]		GJ/year	**4'320'000**
4)Ei	**Ei** means annual energy imported excluding Ew and Ef **Ei** = Eie + Eih with:		GJ/year	**18'405**
Eie	**Eie** = Electricity import = (Guaranteed Plant electrical consumption [MW] x 150 h/annum + 0.5 MW x 760 h/annum) x 3.6 [GJ/MWh] 150 h/annum accounts for electricity import during unplanned turbine shutdown + the annual time required for start-ups Nota: 500 kW x 760 h/annum accounts for electricity import for maintenance during total plant shutdown and when no incineration takes place	**x 2.6**	GJ/year	**9'791**
Eih	**Eih =** External heat consumed for process purposes (SCR…) + 50% x total oil/gas usage start-ups and shutdwons Nota: The consumption at the burner during start-up and shut down periods is roughly 50%without steam being produced (Ei) and 50 % with steam production (Ef)	**x 1.1** **x 1.0**	GJ/year	**8'615**
0.97	**0.97** is a factor accounting for energy losses due to bottom ash and radiation.			**0.97**
R1 - Efficiency Performance	**[Ep - (Ef + Ei)] / [0,97 * (Ew + Ef)]**			**0.822**