Stack Height Calculation

Flue Gases

Flow		150,850	Nm³/h		
Temperature	T_d	134	℃		
Moisture	% v/v	16.4%			
Oxygen	% v/v dry	4.9%			
Reference Flow	Dry, 11% O_2	135,234	Nm³/h		
	V	224,894	Actual m³/h	62.470 m³/s	$Q = \frac{V\left(1-\frac{283}{T_d}\right)}{2.9}(MW)$
Heat release	Q	6.563	MW		
Exit Velocity	Required	20.0	m/s		
Stack Diameter	Required Max	1.994	m		
	Actual	1.950	m		
Exit Velocity	Actual	20.9	m/s		

Pollution Index Calculation

Pollutant	Emission Concentration	Discharge Rate	Guideline Concentration	Background Concentration	Pollution Index
	At Reference Conditions	D	G_d	B_c	P_i
	mg/m³	g/s	mg/m³	mg/m³	m³/s
HCl	30	1.127	0.800	*0.003*	1,415
SO_2	100	3.757	0.266	0.015	14,942
Total Acid gases					16,357
CO	375	14.087	10	0.548	1,490
Particulate	30	1.127	0.050	0.043	165,728
NO_2	300	11.270	0.200	0.049	74,435
				Pollution Index P_i	**165,728**

$$P_i = \frac{D}{(G_d - B_c)} \times 1000$$

Gd values are taken from National Air Quality Strategy for short term quality standards. See reference Library>ADMS section> AQSO or from D1 where no EQS exists

P_i for calculation purposes is maximum value in table above

Buoyancy Calculation

Q>1MW

$$a = -0.84 - 0.1\exp(Q^{0.31})$$
$$b = 0.46 + 0.011\exp(Q^{0.31})$$

Q=<1MW

$$a = -1.11 - 0.19 \times \log Q$$
$$b = 0.49 + 0.005 \times \log Q$$

	a	-1.4401		
	b	0.5283		
Uncorrected Stack Height	U_b	20.76		
Minimum	$U_b$min	3.06	<Ub	$U_b = 10^a \times P_i^b$

$$U_b \min = 1.7 + 0.25 \times Q^{0.9}$$

Momentum Calculation

Velocity	w	20.9	m/s	$M = \frac{283}{T_d} \times V \times w$
Stack Diameter	d	1.95	m	
Momentum	M	909		
	x	-1.046		$x = -3.7 + (\log_{10} M)^{0.9}$
	y	4.054		$y = 5.9 - 0.624 \log_{10} M$
	z	-13.403		$z = 4.24 - 9.7 \log_{10} M + 1.47(\log_{10} M)^2 - 0.07(\log_{10} M)^3$
	Log(U_m)	1.739		
	U_m	54.86		
	$U_m$min	7.25	<Um	$U_m \min = 0.82 \times M^{0.32}$

$$\log_{10} U_m = x + \sqrt{y \log_{10} P_i + z}$$

Buildings

Affected radius	$5U_m$	274.3	m	
Uncorrected height	**U**	**20.76**	Ub	(lesser of U_m and U_b)
	A	2.64	U_m/U_b	

$$C = H + 0.6\left\{U + (2.5H - U)\left(1 - A^{-U/H}\right)\right\}$$

Buildings and Structures within 5Um

	Straw Barn 1	Straw Barn 2	Wood Storage	Turbine Hall	Boiler House
Distance from stack	78.50	21.00	77.50	40.70	17.80
Height	18.00	18.00	14.10	12.00	32.00
Width (perpendicular to line of stack)	73.79	73.79	14.74	43.24	33.24
K (lesser of H or B)	18.00	18.00	14.10	12.00	32.00
T = (H+1.5K)	45.00	45.00	35.25	30.00	80.00
	Do not Ignore	Do not Ignore	Do not Ignore	Do not Ignore	Do not Ignore
Number of Buildings	5	5	5	5	5

Height	H_m	32.00	
	T_m	80.00	H+1.5K
	C	61.1	
	C*	61.1	
Multiple Buildings?	YES	Use C*	
Is U>2.5H?	NO	Use C*	
Is U>T with multiple buildings?	NO	Use C*	
	C	61.1	

$$C^* = H_m + \left(1 - H_m/T_m\right) \times \left[U + (T_m - U) \times \left(1 - A^{-U/H_m}\right)\right]$$

CORRECTED STACK HEIGHT = 62 m
Rounded up to nearest metre