Chimney Height Optimisation in Thermal Power Plants

K.K.Pandian , Tamil Nadu , Chennai, India, +919966529456

ABSTRACT: This proposal is based on my Experience on height optimization of chimney in thermal power plants without deviating from the stringent environmental norms laid out. It is the outcome of my exposure to projects, thermal power plants present status & analysis of reports. Outcome of above said confirms that chimney height reductions/ optimization is a viable option and directly proportionate to chimney cost as well.

———————————— ◆ ————————————

1.0.0 INTRODUCTION

This proposal based on our Engineering experience in Thermal power plant. It was realized during 1980's to 1990's to meet pollution control norms and Limitations, chimney heights were rapidly increased to 220meters and 275 meters (500 MW and above) with ESP Outlet Dust Burden as 150mg/Nm3. The main purpose being pollution to be discharged at a considerable height such that dispersion take place over a wide area , their concentration on reaching the ground would satisfy the strict stipulations of pollution regulatory standards . Execution of work at considerable heights not only posed techno economic problems to the contractors but also require modern sophisticated design tools and construction techniques (slipform). The present study is made to reduce chimney height considering all the pollution levels and reduced the construction cost and construction time . With the latest modern technology, pollution control equipment " Electrostatic Precipitator (with high Efficiency 99.9% " has been developed to maintain outlet flue gas dust levels less than 50mg/Nm3 /hr. In most of the countries ESP have been designed and operational to maintain outlet dust burden less than 50 mg/Nm3 apart from this Flue gas de suphurization equipment also be installed to control SOx levels .

2.00.00 CHIMNEY HEIGHT CALCULATION

Height of the chimney	
Formula for Height of Chimney	**(A*Q*F*K/CP)^0.5 x (N/VOL /Δ T)^1/6**

Parameter	Unit	Value	Remarks
A	Constant	200	
Q	mg/sec	29.25	dust leaving chimney (500 MW) 585 x 50/1000=29.25
F	Constant	2	if ESP eff > 90 %
K	Constant	0.9	Exit velocity 22-25m/sec
CP	GLC	0.05	Ground level concentration
N	No's	1	no of chimney
Vol	m3/sec	889.286	Volume of Flue Gases (500 MW) @ worst coal firing
	Nm3/sec	575.000	Volume of Flue Gases (500 MW) @ worst coal firing
Δ T		92	(gas temp-ambient temp) (142-50)
ODB	mg/Nm3	50	Outlet Dust Burden
Calculated Height	mts	69.651	
Flue gas Inlet Duct Height	mts	18	
Boiler height	mts	80	
Total Height of Chimney	mts	207.65	(69.65+18+80*1.5=207.65) @ ODB 50mg/Nm3
Total Height of Chimney	mts	259	@ODB 150mg/Nm3

It can be observed from the above calculations that same volume of flue gases and exit velocity with different ODB .The Height of Chimney for ODB = 150mg/Nm3/hr is 259mts with GLC = 0.05 as guided /per standard practice and there is a considerable reduction in Chimney Height with ODB = 50mg/Nm3 is 207.65mts by maintaining same GLC of .05. The ODB can be achieved with high efficiency Electrostatic Precipitator (99.9%) which are in functional in various power plants and proven technology to maintain ODB less than 50mg/Nm3/hr. Hence Chimney height can be reduced 275m to 207.65mts by maintaining the ODB and GLC .

Based on the stringent Pollution norms, It will also be remarkable to note that in most of the countries ESP manufacturers have designed ESP with high Efficiency (99.9 %) to maintain ODB less than 50mg/Nm3.

ESP Efficiency :

ESP Efficiency

Volume of Flue gasses in Nm3/sec	IDB in gm/Nm3	ODB in mg/Nm3	ESP Efficiency
585	70.88	50	99.928
585	70.88	100	99.857
585	70.88	150	99.785

It can be observed from above table ESP Efficiency that for a given volume of flue gases and Ash Content and IDB, by increasing the efficiency of ESP ,ODB can be maintained as per the required pollution norms. Presently such ESP's are in operational with high efficiency at various power plants with stated efficiencies.

Chimney Draft :

Chimney Draft			
Height of Chimney	Draft	Losses	Net Draft at Chimney Inlet
275	52.5	40.2	12.31
207	37.5	37.2	0.3

Civil Structure, RCC reduction :

The reduction in Civil quantities due to change in CHIMNEY Height is approximately 24.5% which will in turn reduce the Civil Quantities and leads to cascading effect on Construction Cost, time and Generation Cost.

CONCLUSIONS AND RECOMMENDATIONS :

Meeting the stringent Pollution norms of 50mg/Nm3 and GLC (0.05). The chimney height can be reduced by 68 from 275mts to 207mts. Thus reduction in Chimney Height is saving in terms of Construction time material and Cost of Thermal Power Plant.

Reference :

1. Chimney sizing conditions limitation and concept is referred from S.N.Monohar " Tall chimney construction-Design "