

Effects of Coal Based Thermal Power Plant in India

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Abstract - This paper analysed the impact of air pollution and plant effluents due to the operation of coal based power plant in the surrounding area. Thermal power plant is the huge emitter of carbon dioxide (CO₂), sulphur-dioxide (SO₂) and considerable amounts of nitrogen oxides. All are related with climate as well as health impacts. The thermal power plant has genuine impacts on arrive, soil, air and different social impacts the thermal power plant are too said to transmit expansive sum of mercury and produce expansive amount of fly fiery debris which crushes the surrounding environment. These plants moreover expend a expansive sum of water. Due to these issues they require a appropriate Natural affect appraisal some time recently graduation of the extend which isn't done wisely in our nation. This study mainly focuses on Pollution aspects due to the plant, particularly air pollution, noise and vibration. Air quality monitored at three different locations around the plant radius of 1 km found that their values are well below National Ambient Air Quality Standards (NAAQS). Noise and Vibration in the study area is assed to be minor due to plant operation and does not impact on local faunal species. Concentration of heavy metals in the waste water analysis found below the acceptable limit except suspended solids.

Keywords: Coal-fired power plant, environmental impact, Fly ash, Effluents, Air pollution

I. INTRODUCTION

Coal is a major contributor to world electricity production. According to the Central Electricity Authority, Coal-fired plants generated 72% of India's electricity in 2018-19. India's coal utilization in the power sector is the second largest in the world after China. More prominent association to the power network for the rustic populace, mechanical development, and the government's gigantic framework program have contributed to higher coal development within the past two a long time in 2017 and 2018[2]. India has committed to cutting its outflows escalated -- the sum of greenhouse gasses discharged for each unit of financial development -- by almost a third from 2005 levels by 2030, beneath the Paris Understanding. As portion of India's objective to diminish emanations and address intense issues of discuss contamination, especially in urban regions, and relieve the utilize of coal-fired control, the government set a target for

renewables other than huge hydroelectric plants to extend to 175 GW of capacity by 2022 from around 87 GW in early 2020[4]. Concurring to BP Factual Audit of World Vitality 2018 report, the overall coal control era capacity of the world was 9,723TWh in 2017.

Overall, the world's electricity production stood at 25,551TWh [1]. Table 1 show that the Country wise coal-fired power generating capacities where India stands at third spot with an electricity production of 1,141.4TWh in 2017. Coal-fired power stations generate electricity through conversion of thermal energy. The thermal energy is generated by the combustion of coal. During combustion, air pollutants are also generated. Major sources of air pollutants are SO₂, NO_x, and particulate matter, carbon monoxide (CO), volatile organic compounds (VOCs), and various trace metals like mercury, into the air through stacks that can disperse this pollution over large areas. Huge outflows of Sulfur oxides (SO_x) [5-6] not as it were lead to corrosive testimony, but too advance the arrangement of auxiliary airborne and cause cloudiness contamination. Hence, SO_x may be a key discuss toxin for the in general change of surrounding discuss quality [7-9]

Table 1: Country wise coal-fired power generating capacities

Sl.NO	Country	Production
1	china	4,360.9 TWh
2	US	1,314 TWh
3	India	1,141.4 TWh
4.	Japan	342.5 TWh
5	South Korea	264.4TWh

With expanding within the demand of the coal as fuel in thermal power plants, combustion items foot fiery remains and fly cinder gotten to be a genuine natural issue due to their filtering characteristics [11]. The tracing elements present in coal ash migrate to ground water, surface water and soil over a period of time [13]. Another study observed that fast increment in request of coal for the thermal Power Plants causes tremendous amounts of coal-ash. An inorganic fibre generation innovation may be developed and coal-ash has been liquefied in a combining heater and prepared into strands [12]. Power plant effluents



significantly affect the sea-going biological system wherein living organism being like microorganisms, fish, creepy crawlies, spineless creatures and plants associated with the encompassing [14]. Emissions from coal-fired control plants have drawn critical concern due to their long-range transport, hurtful impacts on human wellbeing, climatic visibility, vegetation, and social legacy [10]. Europe and the US are two of the major vitality buyer regions of the world. To lighten natural contamination, coal-fired control plants will be staged out over Europe to attain the vitality preservation and emanation lessening targets set as portion of the Paris Understanding, marked

on April 22, 2016. In specific, the German government guaranteed on January 26, 2019 that all their coal-fired control plants will be closed down by 2038 [3]. To improve the accuracy of inventories, different studies have been put together for air pollutant emanation databases from coal-fired control plants based on accessible field estimations and the utilize of a ceaseless outflow observing framework [16]. As the emanation benchmarks for coal-fired control plants have been fixed in worldwide in later a long time, few efforts have been made to examine the discuss poison emanation slant using field measurements.

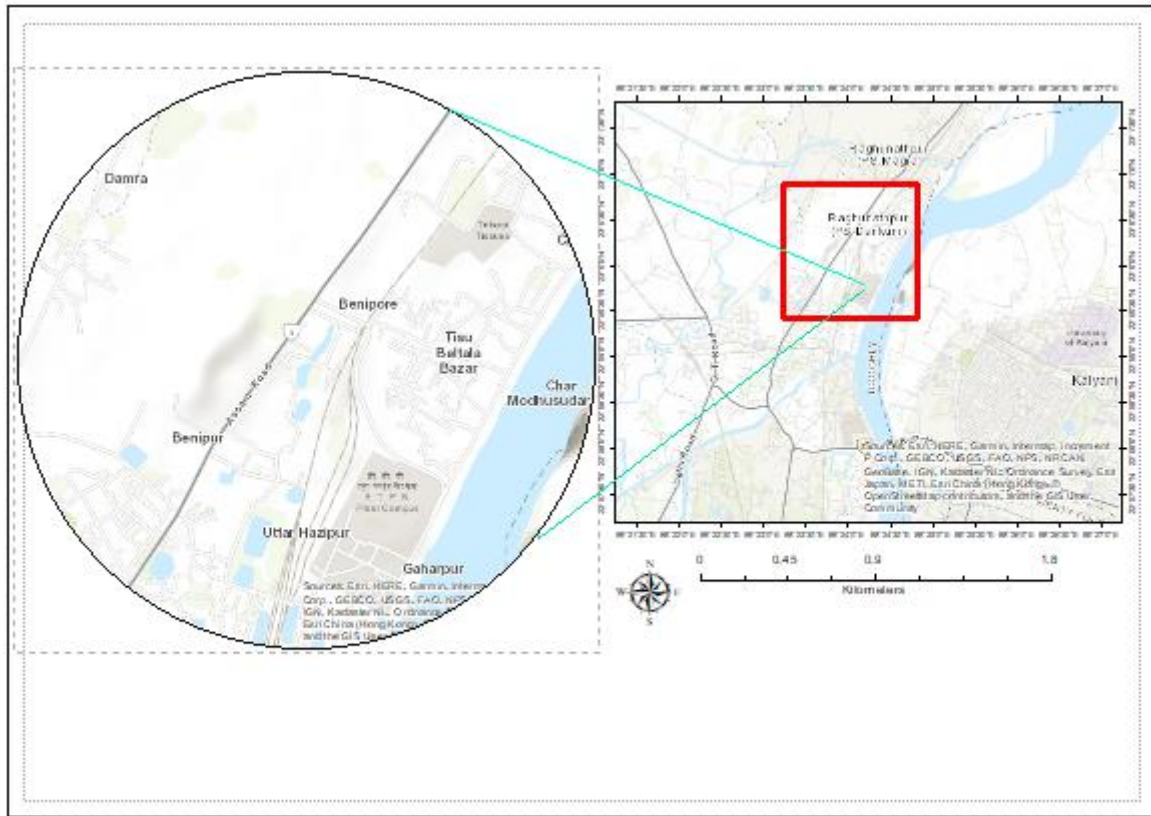


Figure 1: Study location

II. STUDY AREA:

The power plan is located near Tribeni town in the district of Hugli in West Bengal and is about 50 km from Kolkata. The power plant is another nearby town which is the nearest major railway station on the main Howrah -Delhi railway line of Eastern Railway. Its latitude and longitudinal extents are 22°54' N and 88°24' E, respectively. The location of the study area shown in Fig.1. The plant is situated on the western bank of river Hugli (also called Ganga), about 1 km away from Assam road. It is connected to National Highway 2 by Assam Road and then Delhi Road. The water source required for the plant is located on the Hooghly River.

III. MATERIALS AND METHODS

The study area was selected in West Bengal with installed capacities 4 units of 80 MW and 1 unit of 120 MW. Presently first 4 units have been derated to 60 MW each from 80 mw each. The chimney connected to the boiler of unit 1 to 4 is 60 m high and the chimney on unit 5 has a height of 120 m. The study was conducted mainly on the basis of data from documents published by government and non-government organizations, collecting data by personal visit, engagement with academics, activists involved in environmental activities [18]. However, there were many challenges in collecting the data. The majority of the results are based on available research.

In a coal fired power plant thermal energy is generated by the combustion of coal in a boiler. When heat is added in the boiler, it converts water into steam. High temperature

steam then enters the turbine which rotates the turbine blades. Then, the turbine rotor turns the electric generator, which produces electricity. Air pollutants are moreover produced amid coal combustion. They are expelled by control gadgets such as denitrification, clean evacuation, and desulfurization units, and are at last radiated from the stack.

With a few varieties the temperature remains tall all through the year. Three seasons can be distinguished in which winter season starts from November to February, Summer Season from March to June, rainstorm Season from mid-June to mid-September expanding now and then to October. A post-monsoon season is additionally in some cases considered between October to November. On the complete the climate bears the highlights of a tropical region. The closest meteorological station of Kolkata of India Meteorological Department (IMD) is at Alipore. In this study, we examine the air pollution emission from coal fired power plant based on data collected from power plant. All the emission data collected from the plant were measured from April 2017 to March 2018.

III. RESULTS AND DISCUSSION

This power plant utilizes pulverized coal as a fuel for its operation. Typical pulverized coal combustion electricity generation system is illustrated in Fig. 2. In this method, heat created by combustion is exchanged into steam and utilize a steam turbine to produce electric power. NOx, SOx produced in combustion of pulverized coal expelled with a De-NOx unit, an electrostatic precipitator(ESP) and a desulfurization unit found downstream, and a clean vent gas is discharged from a stack. A major source of pollutant emission released from boiler stack for any coal-fired thermal power plant. The details of ambient air pollution concentration for all five stacks are shown in Fig.3. The parameters studied were Particulate Matter, Nitrogen Oxides (NOx), Sulphur dioxide (SO₂) and mercury (Hg). SO₂ is the highest

pollutant concentration and Hg is lowest among all. The highest value of SO₂ concentration found 724 mg/Nm³ in stack III . The quantity of pollution discharged on per day basis shown in Fig 4. SO₂ is the highest discharged pollutant with a value of 15600 kg/day in stack V.

Ambient air quality monitoring was carried out at three different location namely location 1, location 2 and location 3 around the plant radius of 1 km for 24 hours average shown in table 2. Parameters studied were Particulate Matter (PM10), Particulate Matter (PM10), Sulphur Dioxide (SO₂), Nitrogen Dioxide (NO₂), Ozone (O₃), Ammonia (NH₃), Lead (Pb), Benzene, Arsenic , Benzo(a)Pyrene, Nickel, Carbon Monoxide etc. The major pollutants PM₁₀, PM_{2.5}, SO₂, NO₂, O₃, NH₃, CO varied from 68.69- 72.46 µg/m³, 37.13-43.01 µg/m³, 6.28-6.60 µg/m³, 39.25-40.16 µg/m³, 36.61-37.56 µg/m³, 24.69-27.14 µg/m³ respectively. The other pollutants found vey nominal. The main source of air pollution in the plant and around is leakage or other irregular gasses called fugitive emission from different sources such as wagon tippler, coal crusher, coal transfer point coal mill etc. The parameters observed were Respirable Suspended Particulate Matter (SPM), SO₂, NO₂ etc. as shown in tale 3. RPM, SPM, SO₂ and NO₂ varied from 199-352 µg/m³, 454-1090 µg/m³, 5.10-7.40 µg/m³, 39.7-47.90 µg/m³ respectively.

The operation of a thermal control creates diverse sorts of wastes. These are liquid wastes, vaporous wastes and strong wastes from diverse units related to generation of control and from diverse utilities operation. The major sources of liquid effluents are Neutralisation Pit, Cooling water (CW) Outlet, Ash pond Over flow and Sewage Treatment Plant (STP) as shown in table 4. The parameters observed were pH, Suspended Solids, Oil & grease, Phosphate, Copper, Chromium, Zinc, Iron and Residual Chlorine. pH was found to be neutral in a range of 7.25-7.69. Suspended Solids varied from 18-62.92 mg/lit. Other parameters found to be nominal. Noise level was monitored at 4 different locations as shown table 5.

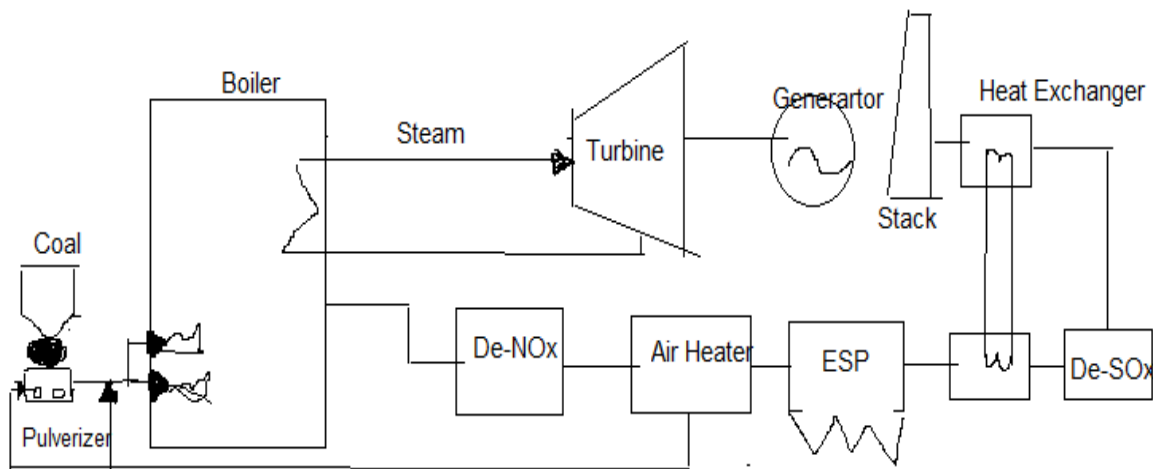


Figure2: Typical Pulverized coal power generation system.

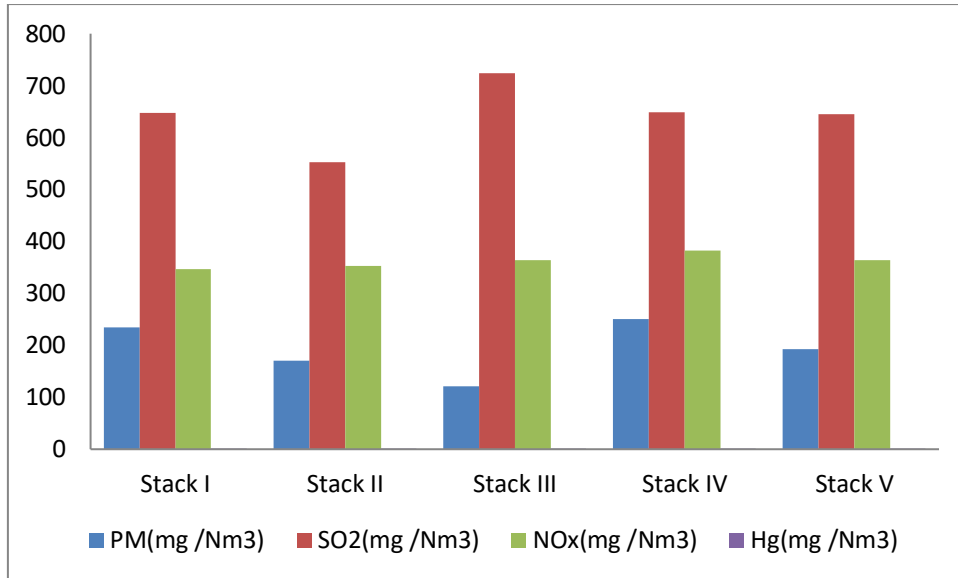


Figure: 3 Pollution Concentration from stack I-V

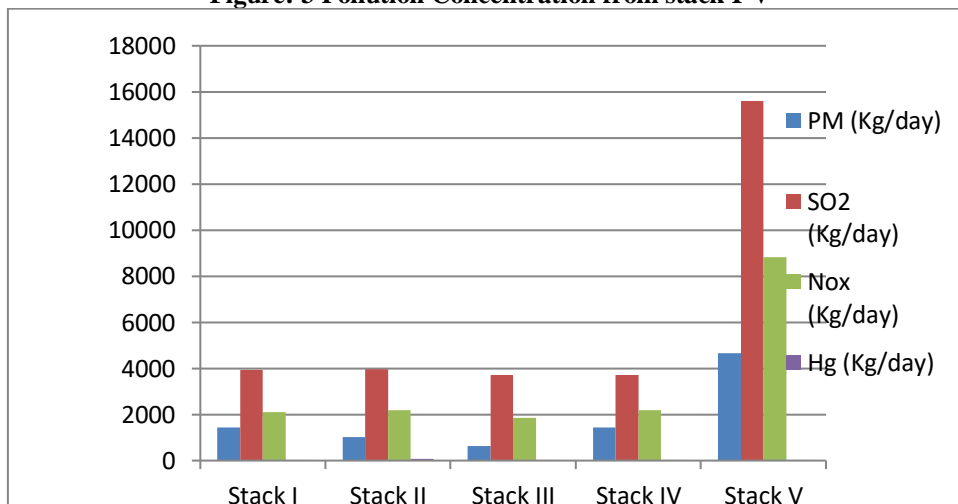


Figure: 4 Quantity of Pollution Discharged from stack I-V

Table 2. Results of Ambient Air Monitoring

Parameters	Unit	Location-1(Fuel Office near Plant gate no-3 , Radius about 1 km, 24hrs. avg.)	Location-2 (Plant gate near CHP, Radius about 1 km, 24 hrs. avg.)	Location3 (Township Hospital, Radius about 1 km, 24hrs. avg.)
Particulate Matter (PM ₁₀)	µg/m ³	72.46	78.15	68.69
Particulate Matter (PM _{2.5})	µg/m ³	40.43	43.01	37.13
Sulphur Dioxide (SO ₂)	µg/m ³	6.60	6.38	6.28
Nitrogen Dioxide (NO ₂)	µg/m ³	40.16	39.28	39.25
Ozone (O ₃)	µg/m ³	37.51	37.56	36.61
Ammonia (NH ₃)	µg/m ³	27.14	26.68	24.69
Lead (Pb)	µg/m ³	0.07	0.07	0.08
Benzene (C ₆ H ₆)	µg/m ³	1.47	1.36	1.45
Arsenic	ng/m ³	1.52	1.52	1.52
Benzo(a)Pyrene [B(a)P]	ng/m ³	0.45	0.49	0.43
Nickel (Ni)	ng/m ³	8.91	9.12	8.89
Carbon Monoxide (CO)	mg/m ³	1.13	1.16	1.07

Table 3. Results of Fugitive Air Monitoring

Parameters	wagon tippler	Coal Crusher	Coal Transfer Point(TP8A)	Coal mill 5 th Unit
Respirable Particulate Matter ($\mu\text{g}/\text{m}^3$)	352	329.1	199	299
Suspended Particulate Matter ($\mu\text{g}/\text{m}^3$)	1090	936	454	937
SO ₂ ($\mu\text{g}/\text{m}^3$)	6.10	5.80	5.10	7.40
NO ₂ ($\mu\text{g}/\text{m}^3$)	45.4	40.5	39.7	47.90

Table 4. Average concentration of different effluents

AVERAGE WASTE WATER ANALYSIS RESULTS						
SL NO.	Parameters	Unit	Concentration of Pollutants			
			Neutralisation Pit	CW Outlet	Ash Pond Over flow	STP Outlet
1	pH	-	7.25	7.69	7.69	7.27
2	Suspended Solids	(mg/lit.)	23.91	62.92	41.58	18.00
3	Oil & grease	(mg/lit.)	<5.0	<5.0	<5.0	<5.0
4	Phosphate	(mg/lit.)	0.18	0.05	0.18	0.42
5	Copper	(mg/lit.)	<5.0	<5.0	<5.0	<5.0
6	Chromium	(mg/lit.)	<5.0	<5.0	<5.0	<5.0
7	Zinc	(mg/lit.)	0.13	0.03	0.12	0.03
8	Iron	(mg/lit.)	1.09	1.62	0.56	0.53
9	Residual Chlorine	(mg/lit.)	<0.1	<0.1	<0.1	<0.1

Table 5: .Noise Level Survey

Sl.No	Location	Noise Level in dB(A)		
		Day 1	Day 2	Day 3
1	Township near Recreation Club	56.3	54.3	54.8
2	CHP Area (near crusher House)	75.0	70.3	73.1
3	Power House (Ground Floor)	88.0	81.6	85.5
4	Power House (Turbine Floor)	84.5	80.7	82.1

Table 6: Waste Water (Effluent) Generated on Per Day Basis

Sl.No	Nature	Source	Qty.m ³ /day	Place of Discharge
1	CW Outlet (Once thru)	Plant	1055349	River Hooghly
2	Ash Pond Overflow	Plant	8436	River Hooghly & Irrigation land
3	Township sewage	Township	980	River Hooghly & Irrigation land
4	Neutralization Pit	Plant	95	River Hooghly & Irrigation land
5	Drinking Water	Plant	400	River Hooghly & Irrigation land

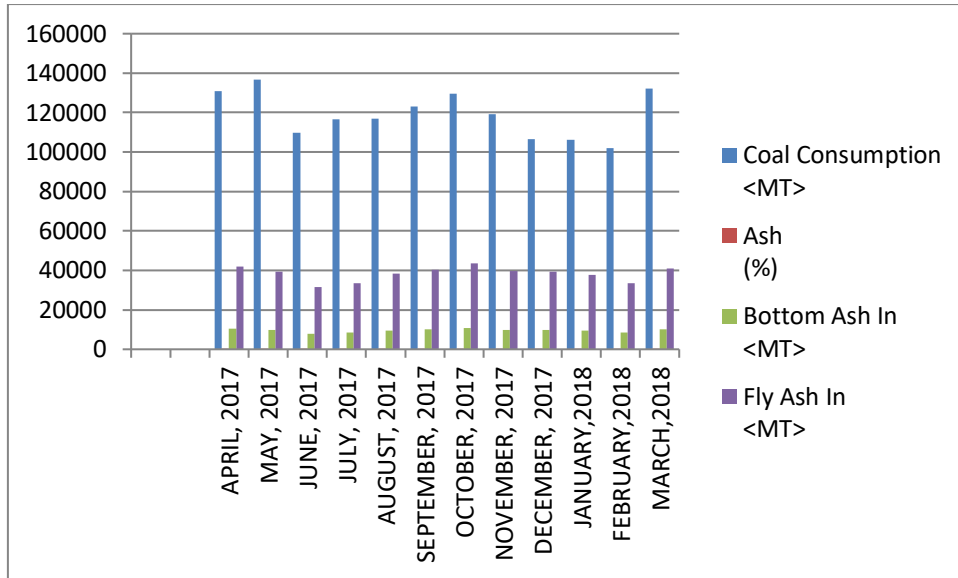


Figure 5: Average Coal Consumption and Ash Generation

Discharge of untreated sewage or effluent from various sources is a major concern for any thermal power plant. Natures of sources are Cooling Water (CW) outlet, Ash Pond Overflow, Township sewage, Neutralization Pit, Drinking Water. The quantity of waste water generated on per day basis shown in table 6. The major solid waste from coal-fired power plants is coal-burning ash.

Coal has 25-40% ash and the production of ash depends on that. Ashes occur in two forms. Approximately 20% of the coarse ash is in the bottom of the boiler, known as bottom ash. The rest of the ash runs off as fine particles with the smog. These particulates are collected in economisers, superheaters and generally in ESP at the conclusion. This is often called fly ash. The average coal use and ash production are illustrated in Fig. 5. Total Coal consumption and total fly ash production during the period of April, 2017 to March, 2018 was observed 1429210 MT and 574154 MT respectively.

On the basis of present study and field measurement, it has been observed that the major pollutant from the operation of coal based thermal power plant is SO₂. SO₂ can respond with other compounds within the air to make little particles. These particles contribute to particulate matter (PM) contamination. Little particles may enter profoundly into the lungs and in adequate amount can contribute to wellbeing issue. Dust control advances can decrease filterable PM emanations from coal-fired control plants; in any case, they have constrained impacts on condensable PM shaped by vaporization–condensation within the flue gas when molecule distances across are littler than 1 μm. Any changes in air quality generally affect on earthly biology and changes in water quality of stream affect on oceanic environment. The control plant utilizes water from Hooghly stream and water withdrawal may have potential affect on downstream side of stream influencing sea-going environment. The release of water from the plant may have affect on waterway water quality which may lead to affect

on sea-going environment. The Hooghly Waterway is an imperative living space for angles and other aquatic fauna. Any changes within the water body parameters in surface water reflect in species composition and subsequently, within the aquatic environment.

The suspended solids concentrations within the emanating streams are regularly higher than the allowable limit. Typically since that the effluent streams are blended with distinctive unidentified and untreated wastewater from the plant. In case of ash water streams, a local deplete falls into it and because it the stream goes through an open channel by the side of a open street, there's small observation on it. There will be course of action for collection of the isolated oil. Isolated oil should be further gravity isolated from the water coming with it. This oil can be sold as used oil as done for dangerous squander or can be burnt in evaporator as supplementary fuel.

The power station is being planned to meet the pertinent rules for environmental noise. Where suitable, debilitates and discuss impalpable will be equipped with silencers to decrease noise levels at the source. The expanded level of commotion and vibration in and around proposed venture location may cause unsettling influence to nearby faunal species but study found that there is no major impact from plant operational noise.

Redesign and modernization of coal/lignite based Thermal Power Stations require to include the mechanical headway required to guarantee improvement of dry fly ash collection, capacity and transfer facilities so that fly fiery remains in dry frame may well be made available to its users.

V. CONCLUSION

The study was carried out to distinguish, evaluate, and assess the potential impacts of a proposed undertaking on the environment. Frequently, those matters are utilized to help the decision makers in adjusting the objectives of the

proponent with those of the venture partners. As a result, it gives an responsible and traceable approach that coordinating financial advancement with environmental administration activities. Release of untreated sewage or effluents due to plant operation, onto the land or surface water body may contaminate the ground and surface water. This will in turn have auxiliary affect on the greenery, fauna and biodiversity of that area. All pollutants released from the power plant such as stack emanation, ash pond effluent, primary plant emanating and residential effluent should have checked at the stipulated recurrence at the source itself and at the focuses of release. In arrange to motivate business people to come forward with ash usage plans, thermal power stations must ensure the use of ash and ash-based products such as bricks and cement to improve infrastructure like development of buildings & streets, recovery of low lying ranges, the raising of ash dyke etc. Amid operational stage prepare effluents created from the plant are treated through RO plant and ETP (Effluent Treatment Plant) before recently being released into the Stream. Standard and long-term perceptions of discuss and water quality are critical, and careful monitoring should be carried out to understand the consider region's long-term impact on biodiversity and environmental conditions.

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