Executive Summary

1.0 Introduction

M/s MAHAGENCO proposed to setup 1×250 MW thermal power plant at Paras by replacing the existing two units of 1×30 MW and 1×62.5 MW respectively. The present capacity of the existing power plant is 500 MW (2×250 MW) which with the addition of 1×250 MW unit will become 750 MW. The land requirement for the proposed unit is estimated as 110.92 ha which MAHAGENCO has already acquired. The water requirement of 6.5 million m^3 per annum will be met from the Mun barrage constructed on the river Mun. The coal requirement for the proposed plant would be 1.3 MTPA and will be met from the Mahanadi coal block. The ash bund area (30 ha) of the existing unit will be used for the proposed unit also. Besides an additional land of 60 ha area is earmarked for the proposed plant. It is also proposed to provide one RCC chimney of 220 m height as per the prevailing regulatory norms so that suspended particular matter and SO_2 emission remain well within the permissible limit.

The existing power plant is located near the village Paras in Balapur tehsil of Akola district in Maharashtra at Latitude: $20^{O}43'40"$N and Longitude: $76^{O}48'50"$E. The site is almost equidistant (2 km) from Paras village and Paras railway station and is connected by all weather tar road to National Highway No. 6, which is about 6kms from the power plant site. The land available with the existing power plant is 110.92 ha. The site of proposed plant is located at 22^{0} 44 '53.56" N Latitude and 76^{0} 48' 04.30" E Longitude.

Infrastructure facilities viz. roads, railway siding, communication system, administrative blocks, security office, time office, canteen already available for the existing power plant would be used for proposed expansion and as such MAHAGENCO would not need to acquire any additional land. In view of the availability of these infrastructure facilities at the existing power station, installation of the proposed unit is considered to be techno-economically viable and the project would be taken up for execution soon after necessary clearances/approvals.

The Airports Authority of India (AAI) has also issued No Objection Certificate (NOC) for construction of a 220 meter high stack for the power plant.

The site for the proposed 1×250 MW power plant satisfies the requirements of site selection criteria of the Ministry of Environmental and Forests (MoEF), Govt. of India as detailed below:

1. The site is more than 500 m away from the NH-6
2. The site is not located very close to metropolitan cities, national park, wildlife

sanctuary, biophere reserves and ecologically sensitive areas

3. The site is located at far off distance from the defence installation
4. The site is not located near the places of archeological site of National importance

2.0 Baseline Environmental Status

Baseline environmental quality data was collected for various environmental components, viz. air, noise, water, land, biological and socioeconomic environment within the impact zone of 10 km radial distance from the proposed project during post-monsoon season (October-November) of the year 2012. The data formed the basis for predicting and evaluating the potential impacts of the project and evolving an effective EMP for minimizing the adverse impacts.

2.1 Air Environment

SPM, PM_{10}, $PM_{2.5}$, SO_2 & NO_X were monitored for 24 hour duration. The windrose diagram for post monsoon season indicates that the predominant wind direction during post-monsoon are NE, E, NW and N directions. The calm conditions prevailed 16.67% with predominant wind speed being 1-5 kmph.

The ambient air quality was monitored in the study area. A total of 14 sampling locations were selected for monitoring. Micrometeorological data was also collected simultaneously in terms of wind speed, wind direction, temperature, relative humidity etc.

Particulate Matter

The minimum and maximum 24 hourly SPM values of 24 varied between 74 and 150 µg/m^3 with a variation in average values as 108-130 µg/m^3.The minimum and maximum 24 hourly PM_{10} values varied between 33-70 µg/m^3 with average variation in the range of 53-66 µg/m^3 respectively. The minimum and maximum 24 hourly average $PM_{2.5}$ concentrations varied in the range of 17-40 µg/m^3 whereas and average 24 hourly concentration ranged from 21-30 µg/m^3 respectively.

Gaseous Pollutants

The minimum and maximum concentrations of SO_2 and NO_X were observed in the range of 21-49 µg/m^3 and 20-50 µg/m^3 respectively with corresponding average concentration ranging from 31 to 37 µg/m^3 and 30 to 38 µg/m^3 respectively. The observed minimum and maximum concentration of ammonia at all locations ranged between 15 and 38 µg/m^3 while

average concentration ranged from 24-30 µg/m^3 respectively. The observed minimum and maximum concentration of *Ozone* at all the locations ranged from 12-30 µg/m^3 whereas average concentration ranged between 22 and 27 µg/m^3 respectively. All the values were below the stipulated standards. Carbon Monoxide concentration at all the locations varied between 0.56 and 0.69 mg/m^3.

Particulate Associated Toxic Pollutants

Various toxic pollutant were monitored and concentrations as recorded at all the locations were: Lead (Pb): 0.10-0.16 µg/m^3 ; Arsenic (As): BDL ; Nickel (Ni) :7.8-12.3 ng/m^3; and Benzo(a)pyrene (BaP): 0.28-0.34 ng/m^3. The concentrations of total Hydrocarbons ranged from 1.47-1.74 µg/m^3.

Predictions for Ground Level Concentrations (GLCs) of SO_2, NO_X and PM_{10} were made in the impact zone (10 km radial distance) for post-monsoon season. The maximum GLCs of SO_2, NO_X and PM_{10} for the existing scenario were 27.0 µg/m^3, 13.8 µg/m^3 and 1.7 µg/m^3 respectively at 2.1 km distance in the SW direction. Predictions for GLCs of SO_2, NO_X and PM_{10} on 24 hourly averages values basis for the proposed unit (1x250 MW) were also made which revealed maximum concentrations of SO_2, NO_X and PM_{10} as 5.8 µg/m^3 for SO_2, 2.2 µg/m^3 for NO_X and 0.2 µg/m^3 for PM_{10} at a distance of 3.5 km in SW direction.

The predictions of cumulative GLCs of SO_2, NO_X and PM_{10} on 24 hourly average values basis for the existing and proposed power plant unit were done which showed the predicted maximum concentrations for SO_2, NO_X and PM_{10} as 31.3 µg/m^3, 15.4 µg/m^3 and 1.8 µg/m^3 respectively at a distance of 2.1 km from the plant in SW direction.

2.2 Noise Environment

Noise levels were monitored at 14 locations in the study area covering commercial, residential, industrial and silence zones (schools, hospitals etc.) The noise levels were recorded as 39.2-54.0 dBA in residential areas, 61.2-65.2 dBA in industrial areas, 60.8-66.4 in commercial area and 36.1-39.5 dBA in silence zone respectively. These levels are within the regulatory permissible levels.

Day and night equivalent noise levels measured in the residential, commercial, industrial and silence zones were observed to be well within the standards prescribed by CPCB.

The impact of noise generated due to various machineries to be installed in the proposed 250 MW power plant would be insignificant on the human settlements within the

study area. From occupational exposure point of view, the impact on the workers during 8 hours working shift would also be insignificant. On the basis of estimated noise level by using standard attenuation model, it was found that the noise levels inside the power plant premises as also in the surrounding villages would be well within the prescribed standard limits.

As regards impacts of vibrations generated due to proposed unit, these will be negligible on nearby human settlements and the effects would be relatively low in nature. As new equipment and machinery to be installed will be based on modern technologies, they are expected to produce minimum noise and vibrations.

2.3 Water Environment

Physico-chemical Parameters

Surface Water

The surface water samples collected from river Mun during post monsoon season 2012 were analyzed for physicochemical characteristics. The water quality was observed to be good in terms of turbidity: <1 to 1 NTU and total suspended solids: 6-8 mg/l. Buffering capacity in terms of alkalinity was found to be in the range of 155-208 mg/l, whereas pH was in the range of 8.1-8.5. Nutrient load in terms of Nitrates as N was in the range of 0.89-1.05 mg/l, whereas total phosphates were 0.03-0.07 mg/l. DO and COD were observed to be in the range of 4.8 mg/l and 4.4-4.8 mg/l respectively, where as oil and grease was found to be in the range of 1.0-2.0 mg/l. Heavy metals like nickel, cadmium, chromium, copper, lead, iron, manganese, zinc and cobalt were observed in the range of ND-0.01, ND, ND-0.01, ND, ND, 0.30-2.26, ND-0.02, ND-0.02 and ND-0.03 mg/l respectively.

Groundwater

Ground water samples were collected from 14 groundwater sources and analyzed. Turbidity was found to be in the range of <1 to 4 NTU while corresponding total suspended solids varied from 3-14 mg/l. The total alkalinity as $CaCO_3$, was found in the range of 216-678 mg/l whereas pH showed a variation from 7.3-8.7. DO and COD were found to be in the range of 3.0-4.4 and <3 - 8 mg/l respectively. Heavy metals viz. nickel, cadmium, chromium, copper, lead, iron, manganese, zinc and cobalt were found in the range of ND-0.02, ND-0.02, ND-0.03, ND-0.02, ND-0.01, 0.10-3.36, ND-0.03, ND-1.36 and ND-0.04 mg/l respectively.

Bacteriological Characteristics

Surface and ground water samples were collected in sterilized bottles in post monsoon season and preserved. The samples were analyzed for total and faecal coliforms by

membrane filtration technique.

The results of bacteriological analysis of samples collected from river Mun showed total coliform counts varying from 220-260 CFU/100 ml and corresponding faecal coliform counts as 40-45 CFU/100ml. The groundwater samples indicated presence of total coliform as ND-35 CFU/ 100 ml and faecal coliforms as ND-6 CFU/ 100 ml. The presence of faecal coliforms in both surface water and groundwater warrant the need for chlorination before consumption.

Biological Characteristics

Phytoplankton

Total phytoplankton count represents approximate measure of quantity of plankton in the water sample. Surface water of river Mun showed total phytoplankton count in the range of 480-528 Nos./ml with the corresponding Shannon Weiner Diversity Index (SWDI) as 3.10-3.28.

In groundwater, dug well samples showed presence of phytoplanktons; whereas bore well and hand pump water samples showed absence of phytoplankton population indicating that the groundwater quality is good. Dug well samples showed total phytoplankton count in the range of 72-144 Nos./ml and corresponding SWDI ranged from between 1.58 and 2.24.

Zooplankton

The surface water of river Mun showed total zooplankton count in the range of 1000-1538 Nos/m^3 with corresponding SWDI varying from 2.26-2.50 during study period. Rotifera was the dominant group followed by Copepoda.

Zooplankton population in dug well samples was observed in the range 158 to 539 no/m^3. The Shanon Weiner Diversity Index (SWDI) for zooplankton in dug well samples varied from 1.00-1.37. with Cladocera as dominant species.

Though no guideline values have been set for presence of free living organisms in drinking water, it is desirable that these free living organisms should be absent in drinking water. The potability of water may be aesthetically affected due to presence of these organisms leading to alteration in its colour, odour, taste, turbidity etc.

Water Requirement and Wastewater Generation

The proposed power plant of 1×250 MW would require 32876 m^3/d water and the water requirement for 2×250 MW plant would be 65752 m^3/d which will be met from river Mun. The total waste water generation by power plant will be of the order of 15480 m^3/d.

The sources of wastewater generation from the proposed TP unit would be boiler blow down, cooling tower bleed off, condenser cooling, DM plant, ash slurry and sanitary sewage from the colony and plant.

MAHAGENCO proposes to attain zero discharge. For achieving this, adequate treatment would be provided to individual wastewater streams with a view to satisfy the requirements of Maharashtra Pollution Control Board (MPCB) and most of the wastewaters after treatment would be reused within the power plant. For minimizing impacts of wastewater on the river water quality and surrounding groundwater, MAHAGENCO has proposed to adopt High Concentration Slurry Disposal (HCSD) system.

With the implementation of management plans viz. sewage treatment facilities for domestic and sanitary wastes, HCSD system for fly ash disposal and reuse of treated wastewaters within the power plant, the adverse impacts on water environment are anticipated to be insignificant.

2.4 Land Environment

For assessment of land environment soil samples from 15 locations were collected in the study area and analysed for relevant parameters. It was observed that the texture of soils in the region varies from clay to clay loam. The bulk density of soils varies from 1.11-1.33 gm/cm^3. The porosity and water holding capacity of soils were observed to be in the range of 40.96-47.83% and 52.61-65.70% respectively.

Exchangeable sodium percentage (ESP) in the soils varies from 5.0 to 6.1 indicating that the soils are free from sodicity. Organic carbon, available nitrogen, phosphorus and phosphorus were observed to be in the range of 0.50-1.19%, 179.38-321.13 Kg/ha, 10.95-15.95 Kg/ha and 108.55-156.53 Kg/ha respectively. This shows that the soils have moderate to high inorganic carbon content whereas nitrogen, phosphorous and potassium contents in soils are low indicating poor to medium fertility level.

A land use pattern study was undertaken in the study area employing Remote Sensing Technique and using IRS 1 C LISS III data. The land use / land cover status of the region indicates that 14.78% area is covered with water body, 32.49 covered with fallow land, 19.75% covered with agricultural land, 23.06% are waste land whereas 9.92% is built up land.

The proposed power plant will generate bottom ash and fly ash. For disposal of bottom ash , MAHAGENCO plans to adopt intermittent operation of one and a half hour per shift using one pump set and necessary pipeline. A scheme for bottom ash disposal will be designed by which slurry in the concentrated form would be disposed off separately.

MAHAGENCO, for fly ash disposal, has proposed to adopt high concentration slurry disposal system with ash to water ratio of 70:30 by weight. The high concentration slurry would be transported to dump yard in the form of paste under high pressure through seamless pipeline by piston diaphragm pumps. Due to high concentration of ash slurry, seepage and dusting problems would be minimized to a great extent and the system would lead to conservation of water and land resources. The high concentration slurry disposal would have minimal impacts on surface and groundwater, also the impacts due to dusting problem would be minimized.

Deposition of fly ash and coal dust on the vegetation and subsequent fall out on the soil during rainy days will be supportive to the plants as the trace metals present in the ash will help for the growth of the plants through control recycling of trace metals. Similarly greenbelt development in and around the ash disposal area will help in arresting the particulate matter emanating from the ash disposal site.

2.5 Biological Environment

2.5.1 Aquatic

Water samples were collected from Mun River as also from groundwater sources and were analyzed for phytoplankton and zooplankton, which are good indicators of environmental stress. Based the data on phytoplankton count, Shannon Wiener Diversity Index was estimated for river water samples and the values ranged from 3.10 to 3.28 indicating moderate to good productivity. Groundwater samples did not exhibit presence of phytoplankton species since phytoplankton cannot survive in underground environment for long time.

Presence of zooplankton was observed in river water samples with the counts in the range of 1000-1538 No./m^3 and value of diversity index ranged from 2.26 to 2.50 indicating moderate productivity. The zooplankton count was absent in groundwater samples due to the fact that they cannot survive in underground environment for longer period.

Due to adoption of zero discharge of wastewaters for the proposed unit, the aquatic biology parameters will not have significant adverse impacts.

2.5.2 Terrestrial Aspects

The study area comes under dry deciduous forest type. There is no dense forest existing in the vicinity and only scrub land exists to the extent of 24 percent. The forest in the study area is in degraded state due to biotic pressure of local people for grazing, illicit lopping and felling of trees for fuel wood, fodder and timber. Good diversity of flora was observed in NE sector of the power plant site.

During studies on Avifauna, a total number of 45 species of birds were encountered in the area. Maximum numbers of 22 species of birds were observed in Paras. House sparrow were the most dominant bird observed followed by house crow.

Studies on fauna (wildlife) revealed that the fauna of the area comprises of 17 mammals, 45 birds and 11 reptiles. Out of these, 2 mammals and one species of bird attract provision of wild life (Protection Act), 1972 for which total protection is required to be provided for their conservation. No wildlife sanctuary, biosphere reserves or national park is located within 10 km radius surrounding the power plant site. Freshwater fishing is practiced in the study area but no sensitive species of fish have been recorded.

Since the proposed power plant unit will be located within the land available in the existing power station area, no adverse impact due to cutting of trees and deforestation is anticipated. Similarly, the impact of SPM in the form of fly ash would be insignificant on the vegetation and trees due of installation of high efficiency ESPs,. The impact of power plant operation on fauna would also be insignificant.

2.6 Socio-economic Environment

The total population of the study area is 57535 of which 29660 are males and 27875 are females. The sex ratio (number of female per thousand male) in the region is 939 this shows that male population is higher in the region as compared with the female population. The study area spreads in 25373 ha and corresponding population density is 44 person per sq/km. The literacy rate is 66.38% and more than 57.25% of the main workers are engaged in agricultural activities.

Most of the villages are having basic infrastructural facilities like drinking water supply, medical, power supply, P & T and communication.

Socio-economic survey was conducted in randomly selected 14 villages within 10 km radial distance and data was collected for the indicators of quality of life. The average cumulative Quality of Life Index (QoL) of the study area was estimated to be 0.55 indicating unsatisfactory level prior to commissioning of power plant. With the implementation of welfare measures including provision of basic facilities / amenities QoL index is expected to increase from 0.55 to 0.57. Overall, there would be positive impact on socio-economic environment due to commissioning of power plant.

3.0 Environment Management Plan

Based on the baseline data collected during post-monsoon season for various environmental components viz. air, noise, water, land, biological and socio-economic as well as

prediction and evaluation of impacts, strategies and control measures have been formulated for minimizing the potential adverse impacts due to installation and commissioning of proposed power plant. The component wise EMP measures are delineated as follows:

3.1 Air Environment

- At present, the provision of FGD has not been envisaged, However, provision of adequate space needs to be made in the layout for installation of FGD for future
- Attempts should be made to achieve/maintain the Plant Load Factor (PLF) of at least 80%. This will certainly help in minimizing environmental damage. It is anticipated that a reasonably well maintained system can operate over 80% PLF
- It should be ensured that the efficiency of ESP is always equal to or more than its designed efficiency of 99.89%. This will help in minimizing SPM emission from the stack and consequently the impacts due to SPM can be mitigated
- For fine dust emission control at coal crusher and bunkers, bag filters should be installed. Similarly bag filters need be installed at transfer points for collection of coal dust, coal handling system should be provided with closed conveyor system
- For minimizing fly ash nuisance, use of beneficiated coal need to be adopted. The beneficiated coal will have higher calorific value and would minimize the cost of electricity generation
- Low NO_X burners be installed for reduction in NO_X emissions
- The combustion units shall be maintained properly for obtaining optimum efficiency which will also ensure that the emission rates of air pollutants do not exceed the design levels
- Personal protective devices such as masks er plugs etc. should be provided to the workers
- A scientifically designed greenbelt need be developed in and around the power plant for attenuation of fugitive dust emissions.

3.2 Noise Environment

- Manufacturers and suppliers of major equipments and machineries be asked to provide enclosures / mufflers for low noise generation.
- The operator's cabin should be acoustically insulated and provided with special doors and observation windows.

- The operators working in high noise area should be provided with protective devices such as ear muffs/ear plugs and they should be trained to use these devices.
- Personnel working near vibration generating machines should be provided with well designed vibration resistant hand gloves/foot wares.

3.3 Water Environment

- Adequate treatment to individual wastewater streams such as DM plant effluent, boiler blow down, coal yard drainage, cooling tower bleed off and fly ash slurry should be provided
- Tertiary treatment for additional treatment to the earlier treated wastewaters need be provided and as planned, the treated wastewater should be recycled and reused within the plant premises for achieving zero discharge
- The sanitary wastes from power plant buildings as also from the township should be treated separately in a well designed and operated sewage treatment plant and the treated sewage should be used for green belt development to the maximum possible extent
- Performance Evaluation of wastewater treatment plant be evaluated on regular basis to take corrective actions well in time

3.4 Land Environment

- After the construction of power plant is over, the land clearance activities need be taken up and the area be developed aesthetically
- The stack emissions from the proposed power plant should be controlled properly and brought within the stipulated limits so as to minimize adverse impacts on crops and vegetation
- For fly ash disposal, high concentration slurry disposal system should be adopted and the disposal area should be provided with impermeable lining at the bottom and sides to minimize impacts due to leachates and migration of pollutants
- As far as possible, utilization of fly ash and bottom ash should be encouraged and the local farmers / brick manufacturers may be provided ash even free of cost

- The domestic solid wastes from township should be disposed of by sanitary landfill/composting
- The waste oil/spent oil likely to be generated from the proposed expansion unit needs to be stored in an environment friendly manner and sold to the units registered with MoEF for its further processing and reuse

3.5 Biological Environment

- Rich and diverse vegetation in the study area should be protected and maintained by adopting appropriate measures
- Destruction of natural habitats of animals should be avoided
- Scientifically designed greenbelt with identified plant species should be developed within and around the power plant premises. This will help in arresting air pollutants and would help in attenuation of noise also.

3.6 Socio-economic Environment

- Regular environmental awareness programmes should organized to educate the local population about the beneficial impacts of the project as also about the measures being undertaken for improving Quality of Life
- For social welfare activities, collaboration should be sought from local Gram Panchayat, Block Development Office etc.
- Mobile medical dispensaries be provided for health check-up and for providing medicines to the local population
- To minimize strain on existing infrastructure, adequate provision of basic amenities, viz. education, health, transport etc. be made considering the needs of workforce and migrating population
- Educational facilities in the region need to be strengthened
- Social forestry should be developed by promoting tree plantation in the study area.

General

- Adequate provisional should be made by MAHAGENCO to undertake measures outlined in EMP such as pollution control, greenbelt development, social welfare measure etc.

- Post-project environmental quality monitoring should be undertaken on regular basis by MAHAGENCO. This will help taking corrective measures in time, in case of non-compliance MPCB regulations.

4.0 Risk Assessment & Management

- A workable Disaster Management Plan (DMP) should be formulated based on the guidelines described (Manual on Emergency Preparedness for Chemical Hazards MoEF, 1992) for various hazardous scenarios presented in chapter 13 for the proposed power plants. Workers / employees should be made aware of all such hazards arising within the facility. Mock drills should be carried out from time to time. Reports of individual mock drill and action on them performed will go a long way in strengthening DMP for the power station
- Fire and toxic gas release are major hazards that may take place from the power plant, hence their prevention be taken as one of the major areas for immediate action. The power plant should be equipped with all fire fighting and safety equipments.
- An offsite emergency preparedness plan involving Government Departments like public health, fire services, police, civil defense and other voluntary organizations should be drawn in order to mitigate serious risks to the people, livestock and property in the area. Risk mitigation measures have been recommended to avoid any unforeseen event. Proper communication system like sign boards as well as emergency contact nos. and no smoking sign should be displayed/installed at all the appropriate locations. A proper upkeep of all protective and safety equipment be ensured.