एनटीपीसी NTPC
एक महारत्न कंपनी

एन टी पी सी लिमिटेड
(भारत सरकार का उद्यम)
NTPC Limited
(A Govt. of India Enterprise)
गाडरवारा/ GADARWARA

NTPC-Gadarwara-HYC-Apr19 –Sep19

Dated: 02/11/2019

The Additional Chief Conservator of forest
Ministry of Environment, forest & Climate Change
Regional Office, MoEF (Western Zone),
Kendriya Paryavaran Bhavan,
E-5Arera Colony Link Road No.3,
Ravishankar Nagar, Bhopal (M.P.) - 462 016

Sub: Half yearly Compliance report of NTPC-Gadarwara (2 x 800 MW) April'19 to Sep'19
Reference : Environment Clearance J-13012/ 125/ 2009- IA.II (T) dated 22/03/2013

Dear Sir,
Please find enclosed Half Yearly Compliance (HYC) report of NTPC-Gadarwara (2 x 800 MW) for the period April'19 to September'19 in line with the guidelines as stipulated by MoEF&CC for kind perusal please.

Thanking you,

(D. Shrikhande)

(AGM) Environment Group

GADARWARA SUPER THERMAL POWER PROJECT,
STAGE-I (2X800 MW)

Compliance status of Environmental Clearance Vide Letter No: J-13012/125/2009-IA,II(T) Dt:22/03/13
Period of Compliance Report – (01.04.2019 to 30.09.2019)

SL.NO.	MOEF STIPULATION	STATUS AS ON 30.09.2019
A. Specific Conditions:		
i	The project proponent shall set up the power project as a model plant demonstrating that ecology and development can co-exists in harmony and set examples for others to emulate similar practice.	NTPC Gadarwara is setting up power project as a model plant demonstrating that ecology and development can co-exists in harmony. The details are attached as **Annexure-I**
ii	Sulphur and ash contents in the coal to be use in the project shall not exceed 0.5 % and 34 % respectively at any given time. In case of variation of coal quality at any point of time fresh reference shall be made to the Ministry for suitable amendments to environmental clearance condition wherever necessary.	Noted After the supply of coal is established on regular basis from designated coal source, NTPC-Gadarwara shall approach MoEF & CC for any variation in coal quality . The results of the coal so far received, is attached as **Annex. II**
iii	Bi-flue stack of 275 m height with flue gas velocity not less than 22 m/s shall be installed and provided with continuous online monitoring equipment's for SOx, NOx and PM2.5 & PM10. Mercury emissions from stack may also be monitored on periodic basis.	A bi-flue stack of 275 meters height constructed and minimum flue gas velocity of 22 m/sec ensured . Continuous stack monitoring facility for online measurement of SO_2, NOx, Particulate Matter (PM) and Mercury level has been provided. The photographs of the Stack and Technical Details of stack are enclosed as **Annex.–III**.
iv	No mine void filling or filling up of low lying areas with fly ash shall be undertaken.	No mine void filling shall be done. If required in future at all, due permissions shall be taken from appropriate authority. No low lying area shall be filled, however, ash may be used for engineered fills leveling, backfilling or reclaiming of low lying area and also for raising plant plinth levels.
v	COC of 5.0 shall be adopted	Closed cycle cooling system has been designed with COC of 5.0 for optimisation of water requirement.
vi	Continuous monitoring of Narmada River water quality in its upstream and downstream of water tapping point shall be undertaken regularly and records maintained.	Continuous monitoring of Narmada River water quality in its upstream and downstream of water tapping point is being undertaken regularly during operation phase of the project.
vii	The project proponent shall explore possibility for storage of excess monsoon water for use during lean season. The same could be by construction of barrage at appropriate location which could be carried out in close consultation with the WRD, Govt. of Madhya Pradesh.	Gadarwara project has already constructed weir on Narmada River in consultation with WRD, Government of Madhya Pradesh.
viii	The ash pond design shall be such that no breach takes place even in the worst case of natural calamity. Since the geology of the area indicates sandy loam and loamy soil, the ash pond need to be appropriately lined with appropriate impermeable media.	All the engineering practices have been followed for the construction of Ash Dyke. It has been designed with adequate factor of Safety. The design of ash dyke also takes into consideration the seismic parameters. Regular monitoring and inspection of ash dykes will ensure no risks of failure. In addition ash pond lined with suitable impermeable material like Bentonite blended clay. Moreover, the Fly Ash Disposal System for the project envisages the use of High Concentration Slurry Disposal (HCSD) System, which leads to solidification of the layers of ash slurry within 1-2 days. The solidified layers of ash shall be self-supporting and there will be no risk of ash flowing in the surrounding areas. For disposal of bottom ash, a conventional slurry disposal system with ash water recirculation has been envisaged.

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ix	Ash pond for Stage-II (400 acres) can be considered only after the first ash pond is dispensed with by filling up of bottom ash and demonstration of 100% fly ash utilization established within four years of commissioning of the plant. The 2nd ash pond for Stage-II (400 acres) requirement should not arise and land earmarked can be converted for green belt and or water storage.	Noted and shall be complied. Noted
x	Long term study shall be carried to assess impact on the ecology of the river Narmada downstream of the present project site at a different location especially at tapping points for drinking water supply and irrigation. The study shall be carried out by an institute of repute like IIT, Roorkee preferably within six months and report submitted to the Ministry. Thereafter the study shall be repeated after commissioning of both units of 2x800 MW and report subsequently submitted to the Ministry.	Study on impact of water intake and of effluent discharge for the project on ecology of River Narmada has been awarded to Centre of Advanced Study in Marine Biology, Annamalai University, Chennai vide LOA dated 17.03.2015. The copy of the final report is enclosed as **Annexure-IV.**
xi	The project proponent shall explore setting up of R.O System to treat cooling tower blow down discharge of about 5 cusecs and the R.O system shall be so designed so as to take care of drinking water supply for the nearest few villages.	Cooling tower blow down water is being reused for ash handling system, fire water, service water etc. within the plant. However, drinking water ATMs has been provided in nearby villages.
xii	The village ponds / surface water bodies located within 5 kms radius of the project site shall be regenerated in the as part of its social welfare activities.	Under Various community CSR-CD works following initiatives were undertaken: Five ponds in project affected villages (PAVs) have been identified for deepening. Four (04) ponds deepening activity completed another One pond deepening work awarded for 01 Pond in Dongargaon village, (work not started yet due to Electric pole in between.)
xiii	An amount of Rs 45.60 Crores as one time investment shall be earmarked for activities to be taken up under CSR during construction phase of the Project. A detailed CSR Action Plan be furnished to the Ministry within 3 months. Recurring expenditure for CSR thereafter shall be Rs 9.2 Crores per annum till the life of the plant. Social Audit by a reputed University or an Institute shall be carried out annually and details to be submitted to MOEF besides putting it on Company's website.	A requisite fund of Rs 45.60 Crore has been earmarked for Community Development works for Gadarwara project and out of which expenditure of Rs 29.20 Crore has been already done regarding Community Development works in the neighboring villages. Detail and Status of CD-CSR work is enclosed as **Annexure-V.** Thereafter, an amount of Rs. 9.2 Crores per annum will be earmarked as recurring expenditure for R&R/CSR activities till the life of the plant and its expense details will be submitted to the Ministry. In addition the social audit will be carried out as per the stipulations and its report will be submitted to MOEF&CC besides putting it on Company's website
B. General Conditions		
(i)	Vision document specifying prospective plan for the site shall be formulated and submitted to the Regional Office of the Ministry within six months.	NTPC vide letter dated 08.04.2013 has already submitted the Project Vision Document to the Regional Office (Western Zone) of the Ministry of Environment and Forest & Climate Change (MOEF&CC), Bhopal. Copy of vision document is once again enclosed at Annexure-VI.
(ii)	Scheme for implementation for harnessing solar power within the premises of the plant particularly at available roof tops shall be formulated and status of implementation shall be submitted periodically to the Regional Office of the Ministry.	Installation and Commissioning of 1200KW of Rooftop Solar PV panels is envisaged. In the 1st phase process of installation of 700kW Rooftop Solar PV panels have already started.
(iii)	Provision for installation of FGD shall be provided for future use.	Installation of FGD work is in progress, Contract awarded to ISGEC Heavy Eng. Ltd. On 26/09/2018, scheduled completion date for Unit#1 is 17/06/2021 and for Unit#2 is 17/12/2021

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(iv)	Coal transportation to plant site shall be undertaken by rail and no road transportation shall be permitted.	The required amendment in Environment Clearance (MOEF&CC-letter-J-13012/125/2009-IA.II(T) Ministry of Environment & Forests and Climate Change (MOEF&CC) vide letter dated 22.10.2019 has accorded amendment in Environment Clearance (EC) regarding extension of permission for transportation of 10,000 TPD coal by road .
(v)	A long term study of radio activity and heavy metals contents on coal to be used shall be carried out through a reputed institute. Thereafter mechanism for an in-built continuous monitoring for Radio activity and heavy metals in coal and fly ash (including bottom ash) be put in place.	Consultancy Work for undertaking long term study of radio activity was awarded to 'BARC' for analyzing natural background radiation monitoring at Gadarwara project. The radio activity study awarded to BARC. 'BARC' has done all initial sampling and report is under preparation.
(vi)	Utilization of 100% Fly Ash generated shall be made from 4th year of operation. Status of implementation shall be reported to the Regional Office of the Ministry from time to time.	Process for auction of Flyash through MSTC Limited has been initiated for the quantity 3000 MT/day. Cement industries are at a distance of more than 250 kms from Gadarwara and have expressed their interest for transportation through rail route.
(vii)	High Efficiency Electrostatic Precipitators (ESPs) shall be installed to ensure that particulate emission does not exceed 50 mg/Nm3.	The High Efficiency Electrostatic Precipitators (ESP) are designed and installed for achieving guaranteed efficiency of 99.99 %. Details of ESP design parameters attached. Annexure-VII
(viii)	Adequate dust extraction system such as cyclones / bag filters and water spray system in dusty areas such as in coal handling and ash handling points, transfer areas and other vulnerable dusty areas shall be provided.	Dust extraction system at Coal crusher house and adequate no. of dust suppression systems are being provided in coal handling area including coal stock yard area, ash handling points, transfer points and other vulnerable dusty areas for control of fugitive dust Emissions. Dry fog dust suppression system has been provided at coal conveyor transfer Points. Water sprinklers installed at dust prone sites in order to attenuate fugitive dust emission.
(ix)	Fly ash shall be collected in dry form and storage facility (silos) shall be provided. Unutilized fly ash shall be disposed off in the ash pond in the form of slurry form. Mercury and other heavy metals (As,Hg,Cr,Pb etc.) shall be monitored in the bottom ash as also in the effluents emanating from the existing ash pond. No ash shall be disposed off in low lying area.	An ash management scheme shall be implemented consisting of dry ash extraction system (DAES) for dry collection of fly ash with storage facility (silos). Supply of ash to entrepreneurs for utilization and promoting ash utilization to maximum possible extent and safe disposal of unused ash in the ash pond area. The plant shall have two different systems for ash disposal– conventional wet slurry disposal with ash water re-circulation for bottom ash and High Concentration Slurry Disposal (HCSD) for disposal of unused fly ash. Periodic monitoring for mercury & heavy metals in the bottom ash and water emanating from ash pond shall be done during the operation phase of the project. No ash shall be disposed off in low lying area.
(x)	Ash pond shall be lined with HDPE/LDPE lining or any other suitable impermeable media such that no leachate takes place at any point of time. Adequate safety measures shall also be implemented to protect the ash dyke from getting breached. Ash pond water shall be re- circulated and utilized.	To avoid the ground water contamination from bottom ash slurry, one of the bottom ash lagoons is separated by a small temporary bund and the small area shall be lined with impervious liner of 300 MM thickness. Ash pond is lined with suitable impermeable material like Bentonite blended clay or HCSD layer. All the engineering practices have been followed for the construction of Ash Dyke. It has been designed with adequate factor of Safety. The design of ash dyke also takes into consideration the seismic parameters. Regular monitoring and inspection of ash dykes will

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		ensure no risks of failure. AWRS system has been also envisaged.
(xi)	Fugitive emissions shall be controlled to prevent impact on such that no agricultural/non-agricultural land. Impact to any land shall be mitigated and suitable compensation provided in consultation with the local Panchayat.	Adequate no. of dust suppression and extraction system shall be provided in coal handling area including coal stock yard area, ash handling points, transfer areas and other vulnerable dusty areas for control of fugitive dust Emissions. Extensive plantation shall be undertaken in all available areas, selectively with Air Pollution Tolerant Index (APTI) plant species.
(xii)	Hydrogeology of the area shall be reviewed annually from an institute / organization of repute to assess impact of surface water and ground regime (especially around ash dyke). In case any deterioration is observed specific mitigation measures shall be undertaken and reports / data of water quality monitored regularly and maintained shall be submitted to the Regional Office of the Ministry.	During operation phase of the project the Hydrogeology of the area shall be reviewed annually from an institute/ organization of repute to assess impact of surface water and ground regime (especially around ash dyke) and reports of water quality monitored shall be submitted to the Regional Office of the Ministry. Hydro-geological study for Gadarwara project has been carried out by National Institute of Hydrology (NIH) Roorkee. A copy of the report submitted to the Regional Office of the Ministry. **Annexure-VIII**
(xiii)	No ground water shall be extracted for use in operation of the power plant even in lean season.	As per the said stipulation, no ground water will be extracted for use during operation of the power plant.
(xiv)	No water bodies (including natural drainage system) in the area shall be disturbed due to activities associated with the setting up/operation of the power plant.	No water body including natural drainage system of the area has been disturbed due to activities associated with the setting up of the power plant. Moreover, the said stipulation will also be complied during the operation phase of the project.
(xv)	Regular monitoring of ground water level shall be carried out by establishing a network of existing wells and constructing new piezometers. Monitoring around the ash pond area shall be carried out particularly for heavy metals (Hg, Cr, As, Pb) and records maintained and submitted to the Regional Office of this Ministry. The data so obtained should be compared with the baseline data so as to ensure that the ground water quality is not adversely affected due to the project.	Adequate nos. of piezometers will be installed for regular monitoring of ground water level in and around ash pond area as per stipulation and report will be submitted to Regional Office (Western Zone) of MOEF&CC at Bhopal at regular interval during operation phase of the project.
(xvi)	Monitoring surface water quality in the area shall also be regularly conducted and records maintained. The monitored data shall be submitted to the Ministry regularly. Further, monitoring points shall be located between the plant and drainage in the direction of flow of ground water and records maintained. Monitoring for heavy metals in ground water shall be undertaken.	Monitoring of surface water quality shall be carried out regularly as per stipulations and reports shall be submitted to Regional Office of MOEF&CC (Western Zone) at Bhopal. Monitoring for heavy metals in ground water is being done and it's record maintained during operation phase of the project. Further details are enclosed as **Annexure-IX**
(xvii)	Minimum required environmental flow suggested by the Competent Authority of the state Govt. shall be maintained in the Channel/ Rivers (as applicable) even in lean season.	Noted.
(xviii)	The treated effluents conforming to the prescribed standards only shall be re- circulated and reused within the plant. Arrangements shall be made that effluents and storm water do not get mixed.	The project shall have an integrated scheme for treatment, re-cycle and re use of effluents. Provision is being kept to re-circulate cooling water and ash pond effluent. The cooling tower blow down is being used fully for ash handling, service water system, coal handling & firefighting etc. Provision is being kept for treatment, recirculation & reuse of entire quantity of coal handling plant effluents & service water effluents. The effluent treatment system comprising of neutralization pit for DM plant regeneration waste, oil separator/skimmers for oily waste, coal slurry settling pond for coal handling plant effluents,

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		lamella clarifier for service water effluents and cooling towers for hot water etc are being provided. The effluents shall be treated adequately conforming to the stipulated regulatory standards. An independent plant effluent drainage system is constructed to ensure that plant effluents do not mix with storm water drainage.
(xix)	Waste water generated from the plant shall be treated before discharge to comply limits prescribed by the SPCB/CPCB.	It is submitted that during normal course of project operation Zero Liquid Discharge (ZLD) system is adopted based on maximum recycle/reuse of waste water for various plant usage thereby reducing and optimizing the quantities of water requirement and effluent generation to the extent feasible. However, NTPC has already revised its water requirement in order to comply with the latest notification by MOEF&CC for TPP dated 07.12.2015.
(xx)	A sewage treatment plant shall be provided (as applicable) and the treated sewage shall be used for raising green belt/plantation.	All domestic sewage emanating from plant and township shall be treated in a sewage treatment plant. The treated sewage conforming to prescribed standards and shall be utilized for plantation & raising greenbelt to the extent possible.
(xxi)	The project proponent shall undertake rain water harvesting measures and shall develop water storage for use in operation of the plant. Rain water harvesting system shall be put in place which shall comprise of rain water collection from the built up and open area in the plant premises. Action plan for implementation shall be submitted to the Regional Office of the Ministry.	Rain water harvesting shall be practiced as per recommendation/stipulations of Central Groundwater Authority/Board. A study was conducted by NIH Roorkee for rain water harvesting at plant area and for township. Consultancy proposal for implementation plan has been awarded for approval from CGWB-Bhopal
(xxii)	Additional soil for leveling of the proposed site shall be generated within the sited (to the extent possible) so that natural drainage system of the area is protected and improved.	All additional soil leveling of the project site will be done from within the sites only with all necessary precautions will be taken to protect natural drainage system of the area.
(xxiii)	Common property resource falling in the vicinity of the project area shall be identified and if any common property resource (such as grazing land, pond etc.) is falling within the plant area and is developed and handed over to the community.	There is no common property resource falling within the plant area.
(xxiv)	Adequate safety measures shall be provided in the plant area to check/minimize spontaneous fires in coal yard, especially during summer season. Copy of these measures with full details along with location plant layout shall be submitted to the Ministry as well as to the Regional Office of the Ministry.	The entire fire system in NTPC Gadarwara plant is catered by - Hydrant pumps- 3 Motor driven + 1 Diesel driven Booster pumps in hydrant line- 1 Motor driven + 1 Diesel driven Spray pumps - 2 Motor driven + 1 Diesel driven Booster pumps in spray line- 1 Motor driven + 1 Diesel driven Following areas are covered by Hydrant and Spray Systems for fire protection 1) Hydrant system : Through piping network and valves covers entire main plant and offsite area 2) Hydrant Booster pumps : It is provided to supply adequate pressure in hydrant system of Boiler and elevated area like Bunker Transfer points 3) High Velocity Sprinkler system : It has been provided in areas where Oil is being used transformers, Turbine Driven BFPs, Boiler burner floors, Turbine lube oil system, Oil canal, Generator seal oil units

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		4) Medium Velocity Sprinkler system: Coal conveyors and Transfer points, LDO Tanks, DG Sets, Cable galleries at various levels at TG Building
xxv	Well-designed acoustic enclosures for the DG sets and noise emitting equipment's to achieve the desirable insertion loss viz. 25 dB (A) should be provided.	Well-designed acoustic enclosures meeting the latest statutory norms for DG sets are provided. The Noise Monitoring report is enclosed as **Annexure-X.**
xxvi	Storage facilities for auxiliary liquid fuel such as LDO/HFO/LSHS shall be made in the plant area in consultation with department of Explosives, Nagpur; Sulphur content in the liquid fuel shall not exceed0.5%. Disaster Management Plan shall be prepared to meet any eventuality in case of an accident taking place due to storage of oil.	Storage facilities for auxiliary liquid fuel LDO/HFO are designed conforming to the safety standards and where risk is minimal. A detailed Disaster Management Plan & Risk assessment including fire and explosion issues prepared and finalized in consultation with Department of Explosives, Nagpur and regular mock drills are being conducted as per plan in order to address any eventuality in case of an accident. Displayed on Gadarwara intranet.
xxvii	First Aid and sanitation arrangements shall be made for the drivers and other contract workers during construction phase.	All arrangements related to first aid, health & safety and sanitation for workers during construction phase of the project have been kept under the scope of EPC contractor. However, NTPC shall ensure effective compliance of the said stipulations. Various measures implemented during construction phase through contractor are: Adequate infrastructure facilities, such as sanitation, fuel, restroom, medical facilities, safety, and suitable water supply are being provided at various stages of project construction to the labor colonies housing the work force during construction phase of the project. The sanitary waste from these areas shall be accorded suitable treatment. Safety equipment such as earplugs and earmuffs, helmets, face shields, safety goggles etc. is being provided to workers engaged in high risk areas. A first aid center & ambulance have been established to provide immediate medical aid to the workers and their Family members. An ambulance service is available at site to transport injured workers to nearby hospitals.
xxviii	Noise levels emanating from turbines shall be limited to 85 dB (A) from source. For people working in the high noise area, requisite PPEs shall be provided. Workers engaged in noisy areas such as turbine area, air compressors etc. shall be periodically examined to maintain audiometric record and for treatment for any hearing loss including shifting to non-noisy/less noisy areas.	Design specification for the equipment's has been made to comply with the stipulation. Personal protective equipment has been arranged through contractors during construction phase. Periodic examination of workers during operation phase shall be done as stipulated. The workers of generator halls and other high noise area shall be provided with appropriate ear protection devices.
xxix	Regular monitoring of ambient air ground level concentration of SO2, NOx, PM2.5 & PM10 and Hg shall be carried out in the impact zone and record maintained. If at any stage these levels are found to exceed the prescribed limits, necessary control measures shall be provide immediately. The location of the monitoring stations and frequency of monitoring shall be decided in consultation with SPCB. Periodic reports shall be submitted to the Regional office of this Ministry. The data shall also be put on the website of the company.	Regular monitoring of AAQ shall be done during the operation of the plant. The four locations of AAQMS have been finalized in consultation with MPPCB. Four (4) no. of AAQMS equipment's have been installed at site and the infra-structure requirements for the stations are established. Linking with CPCB done for real-time data submission to the CPCB and SPCB. The data shall also be put up on the website of NTPC.

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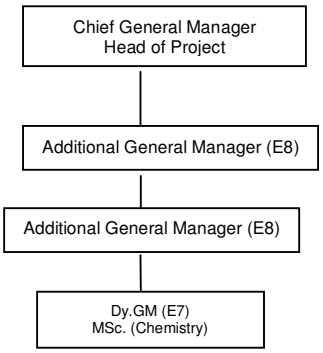
xxx	Green Belt consisting of 3 tiers of plantations of native species around plant not less than 100m width shall be raised (except in areas not feasible). The density of trees shall not less than 2500per ha with survival rate not less than 80%.	Green Belt around the Main Plant area except transmission corridor shall be planted. Around 100 acres of land has been envisaged for the green belt development. Extensive afforestation has been undertaken at all available spaces in and around project. Avenue Plantation along the Road is being done. The density of trees shall not less than 2500 per ha with all efforts to maintain the survival rate not less than 80%. 46,000 trees have been planted at project in 2018 under Green belt work, and road side plantation work. Details attached in **Annexure- XI**
xxxi	An Environmental Cell comprising of at-least one expert in environmental science / engineering, occupational health and a social scientist, shall be created preferably at the project site itself and shall be headed by an officer of appropriate superiority and qualification. It shall be ensured that the Head of the Cell shall directly report to the head of the organization who would be accountable for implementation of environmental regulations and social impact improvement / mitigation measures.	An Environment Management Group (EMG) has been set up at Gadarwara STPP.  The EMG will be responsible for implementing and monitoring the stipulations/ issues / statutory norms. EMG will have sufficient trained manpower and equipment for environmental monitoring and other environmental related activities to ensure compliance with statutory requirements. It shall interact regularly with the State Pollution Control Board.
xxxii	The project proponent shall also adequately contribute in the development of the neighbouring villages. Special package with implementation schedule for providing potable drinking water supply in the nearby villages and schools shall be undertaken in a time bound manner.	Expenditure of Rs. 29.20 Crore has been done regarding Community Development works in the neighboring villages. List of CD works executed in PAVs enclosed as **Annexure-V** Separate budget has been earmarked for implementing CSR-CD activities for the project and shall be utilized in accordance with the said stipulations.
xxxiii	CSR scheme shall be undertaken based on need based assessment in and around the villages within 5 km of the site and in constant consultation with the village Panchayat and the District Administration. As part of CSR employment of local youth after imparting relevant training as may be necessary shall be undertaken as committed.	Various CSR schemes have been implemented and will be continued based on need based survey in and around the villages within 5 km of the site and in consultation with the village Panchayat and the District Administration. Infrastructure works in Project Affected Villages (PAVs): • CC road constructed in Village Dongargaon. • Road side plantation was done in all PAVs. • CC road construction in Village Chorbarheta. **Drinking water:** • Hand pumps installed in all 7 PAVs. • Payment disbursed for supply of piped water to each household in PAVs.

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		Sanitation: • Ghat Pipariya is now open defecation free. • Payment disbursed for toilet construction in each house for Gangai & Umaria villages. • Toilets worth 29 lacs constructed in Village Chorbarheta. • Ghat Pipariya is now open defecation free. • Payment disbursed for toilet construction in each house for Gangai & Umaria villages. • Toilets worth 29 lacs constructed in Village Chorbarheta. **Education:** • Boundary wall of schools under construction in all PAVs. • Additional room made in School at Raipur Highrer Secondary and Gangai High School • Scholarship distributed to meritorious students o Government schools of class V, VIII & X. • School Bag and Note book distributed • Sweater distributed in primary school • Chair and Table distributed to all PAVs (07) school • Desk Top computer distributed to all PAVs (07) school • Ceiling Fans distributed to all PAVs (07) school **Health:** • 7 medical camps, one family planning and one cataract screening eye camp organized for PAVs. • Upgradation of District hospital was done. • Upgradation of Red Cross hospital was done. • Up gradation of Gadarwara Hospital completed and • Chichli PHC work in progress **Other welfare measures:** • Contribution made towards 2 camps for upliftment o weaker sections and one cultural program. • Rural Sports, Kabadi was organized at Gangai • Sewing Class for women empowerment was conducted in three villages • Computer class for PAVs Girls was organized in NTPC school • Career Counseling for Class 9 to 12 class students carried out in association of XIDAS, Jabalpur • Self defense for Girls training program conducted Infrastructure works in Vicinities: • Two CC road constructed in Narsinghpur. • Solar system installed in remotely located Village Badagaon. • Community Centers constructed in various villages Gadarwara & villages, Gadarwara & Narsinghpur. • Auditorium at Gadarwara completed • Auditorium work at Chichli and Gangai in progress Detail and Status of CD works is attached as **Annexure – V**
xxxiv	It shall be ensured that an in-built monitoring mechanism for the CSR schemes identified is in place and annual social audit shall be got done from the nearest government institute of repute in the region. The project proponent shall also submit the status of implementation of the scheme from time to time. The achievements should be put on company's website.	The said stipulation shall be complied during operation phase of the project. (Proposal for Social Audit initiated)

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xxv	Provision shall be made for the housing of construction labor (as applicable) within the site with all necessary infrastructures and facilities such as fuel for cooking, mobile toilets, mobile STP, safe drinking water, medical health care , crèche etc. The housing may be in the form of temporary structure to be removed after the completion of the project.	All construction agencies working at NTPC Gadarwara Project are providing temporary accommodation for their workers near to work site. The engaged contractors are responsible for providing facilities for housing of construction labor(as applicable) within the site with all necessary infrastructures and facilities such as fuel for cooking, mobile toilets, safe drinking water, medical health care etc.
xxxvi	The project proponent shall advertise in at least two local news papers widely circulated in the region around the project, one of which shall be in the vernacular language of the locality concerned within seven days from the date of this clearance letter, informing that the project has been accorded environmental clearance and copies of clearance letter are available with the State Pollution Control Board/Committee and may seen at Website of the Ministry of Environment and Forests at http://envfor.nic.in.	The information of Environmental Clearance was published in Two newspapers widely circulated in the region; Dainik Bhaskar on 27.03.2013 (Hindi) Nayi Duniya on 23.03.2013 (Hindi)
xxxvii	A copy of the clearance letter shall be sent by the proponent to concerned Panchayat, Zila parishad/ Municipal Corporation, urban local body and the Local NGO, if any, from whom suggestions/representations, if any, received while processing the proposal. The clearance letter shall also be put on the website of the Company by the proponent.	The copy Environmental Clearance has been submitted to the following concerned offices. (1) Collector, Narsinghpur. (2) General Manager, District Trade & Industries Centre, Narsinghpur. (3) CEO, Zila Panchayat (4) Secretary, Gram Panchayat Gangai. (5) Secretary, Gram Panchayat Kudari. (6) Secretary, Gram Panchayat Chor Barheta. The Environmental Clearance has also been uploaded on the NTPC website.
xxxviii	The proponent shall upload the status of compliance of the stipulated environmental clearance conditions, including results of monitored data on their website and shall update the same periodically. It shall simultaneously be sent to the Regional Office of MOEF, the respective Zonal Office of CPCB and the SPCB. The criteria pollutant levels namely; SPM,RSPM (PM2.5&PM10), SO2, NOx (ambient levels as well as stack emissions) shall be displayed at a convenient location near the main gate of the company in the public domain	The latest HYC report of EC conditions is regularly being submitted to the Regional Office (Western Zone) of MOEF&CC at Bhopal and at the same time it is also uploaded on the NTPC website which is periodically being replaced with updated HYC report. Online continuous Stack Emission Monitoring System (CSEMS) for the parameters like particulate matter (PM) NOX, SO2, Mercury are commissioned. Linking with CPCB done for real-time data submission to the CPCB and SPCB.
xxxix	The environment statement for each financial year ending 31st March in Form-V as is mandated to be submitted by the project proponent to the concerned State Pollution Control Board as prescribed under the Environment (protection) Rules, 1986, as amended subsequently, shall also be put on the website of the company along with the status of compliance of environmental clearance conditions and shall also be sent to the respective Regional Offices of the Ministry by e-mail.	The environment statement for each financial year ending 31st March in Form-V submitted to Madhya Pradesh Pollution Control Board (MPPCB).
xl	The project proponent shall submit six monthly reports on the status of the implementations of the stipulated environmental safeguards to the Ministry of Environment and Forests, its Regional Office, Central Pollution Control Board and State Pollution Control Board. The project proponent shall upload the status of compliance of the environment of the environmental clearance conditions on their website and update the same periodically and simultaneously send the same by email to Regional office, Ministry of Environment and Forests.	Latest Six monthly reports on the status of the implementations of the stipulated environmental safeguards is regularly being submitted to the MOEF&CC/MPPCB/Regional Office (Western Zone, Bhopal) and at the same time and it is also uploaded on the NTPC website which is periodically being replaced with updated HYC report.

SL.NO.	MOEF STIPULATION	STATUS AS ON 30.09.2019
xli	Regional office of the Environment & Forests shall monitor the implementation of the stipulated conditions. A complete set of documents including Environmental Impact Assessment Report and Environment Management plan along with the additional information submitted from time to time shall be forwarded to the Regional Office for their use during monitoring. Project proponent shall up-load the compliance status in their website and up-date the same from time to time at least six monthly basis. Criteria pollutants levels including NOx (from stack & ambient air) shall be displayed at the main gate of the power plant.	A complete set of documents including Environmental Impact Assessment (EIA) Report and Environment Management Plan (EMP) along with the additional information / clarifications were forwarded on 10.03.2014 to the Regional Office (Western Region) of MOEF&CC at Bhopal.
xlii	Separate funds shall be allocated for implementation of environmental protection measures along with item – wise break –up. These cost shall be included as part of the project cost. The funds earmarked for the environment protection measures shall not be diverted for other purpose and year-wise expenditure should be reported to the ministry.	The requisite funds for environmental mitigation measures have been included in the project cost. Financial provision stipulated towards environmental mitigate measures shall not be diverted for other purposes.
xliii	The project authorities shall inform the Regional Office as well as the Ministry regarding the date of financial closure and final approval of the project by the concerned authorities and the dates of start of land development work and commissioning of plant.	Shall be complied.
xliv	Full cooperation shall be extended to the Scientists/officers from the Ministry / Regional Office of the Ministry/ CPCB /SPCB who would be monitoring the compliance of environmental status.	Full cooperation shall be extended to the Scientists / officers from the Ministry / Regional Office of the Ministry at Bhopal (Western Region) / the CPCB / the MPPCB during monitoring of the project.
xlv	The Ministry of Environment and Forests reserves the right to revoke the clearance if conditions stipulated are not implemented to the satisfaction of the Ministry. The Ministry may also impose additional environmental conditions of modify the existing ones, if necessary.	Noted.
xlvi	The environmental clearance accorded shall be valid for a period of 5 years to start operations by the power plant	Noted.
xlvii	Concealing factual data or submission of false/fabricated data and failure to comply with any of the conditions mentioned above may result in withdrawal of this clearance and attract action under the provisions of Environment (Protection) Act, 1986.	Noted.
xlviii	In case of any deviation or alteration in the project proposed including coal transportation system from those submitted to this Ministry for clearance, a fresh reference should be made to the Ministry to assess the adequacy of the condition(s) imposed and to add additional environmental protection measures required, if any.	Noted.

A. <u>Specific Conditions:</u>
RO, MoEF&CC Stipulations:

I. The project proponent shall set up the power project as a model plant demonstrating that ecology and development can co-exists in harmony and set examples for others to emulate similar practice.

⇒ **NTPC Reply:**

In the present era of rapid urbanization, industrialization and modernization, the power industry has emerged as a masterworks that enable production of electrical energy which appeared as one of the basic & prime needs of life after water and food and also played a pivotal role in overall development. However, it is also known fact that the as every anthropogenic activity is associated with some externalities and therefore power generation through burning of fossil fuel is also having some consequences on environment which can be minimized/attenuated only through proper environmental management systems supported by state of art technologies so that balance between ecology and development can co-exists.

NTPC well accepts the facts of these externalities and likely impacts of power projects on environment. However, being a committed and socially responsible corporate citizen since its inception, sustainable power generation has always been the prime objectives of NTPC Limited since its inception. The proposed Gadarwara STPP, Stage-I (2x800 MW) has been planned as an example of the effort of NTPC towards achieving this objective for generating and providing reliable power at competitive prices in a sustainable manner by optimizing the use of multiple energy resource with innovative eco-friendly technologies thereby contributing to the economic development of the nation, social upliftment of the society and promoting a healthy environment.

In pursuance of above, NTPC Gadarwara Project is committed install the adequate mitigative measures for controlling the air emission/pollution from the project and maintain the ambient air quality in the surrounding area within latest NAAQ limit and also to comply with the latest emission standards for Thermal power plant dated 07.12.2015. Some mitigative measures proposed to be adopted for ensuring minimal degradation of the environment due to the operation of the proposed power project are as follows;

- ✓ The proposed project is designed with super-critical technology having higher efficiency compared to the conventional sub- critical technology based units. Adoption of higher cycle parameters will improve power plant efficiency and thereby reduce coal consumption per unit of electricity generation with consequent reduction in CO_2 emissions. The super critical technology is relatively new to the Indian Power sector; where till recently, plants were operating on sub-critical parameters. These super critical units have a cycle efficiency of around 4-5% more than conventional sub-critical technology and

consume 5% less fuel for the same amount of energy generated. This results in consequent reduction in CO_2 foot print.

- ✓ Installation of high efficiency electrostatic precipitators (ESPs) to limit the particulate emission to 30 mg/Nm^3.
- ✓ Twin flue stack of 275 m height for wider dispersal of remaining particulates and gaseous pollutants resulting in lower ground level concentrations.
- ✓ Installation of Flue Gas De-sulphurization (FGD) system for removal of excess sulphur dioxide (SO_2).
- ✓ Suitable technology for controlled emission of NO_x.
- ✓ The project will be designed with zero Liquid Discharge (ZLD) concept in order to reduce the quantity of effluents generated from the plant
- ✓ About 150 acres of land has been envisaged for the development of thick green belt (within all available spaces of the project area & township which will attenuate the impact of air pollution and also play a vital role in offsetting the carbon footprint.
- ✓ The ash disposal scheme for fly ash envisages collection of fly ash by DAES (dry ash extraction system) to the storage silos and residual fly ash transported through HCSD (High Concentration Slurry Disposal system), which uses thick – viscous – high concentration slurry of ash for disposal which gets solidified within 1-2 days, thereby minimizing the possibility of fugitive emission. Under the above disposal system there is no risk of Ash flying in the wind due to its being cemented
- ✓ Dust suppression and extraction system shall be installed at coal handling plant area and ash handling plant to control fugitive dust emission.
- ✓ Water spraying shall be done at all dust generation areas viz., the coal and ash handling areas.
- ✓ Regular monitoring of ambient air quality parameters through three nos. fixed Continuous Automatic Ambient Air Quality Monitoring Stations (AAQMS) as well as portable Ambient Air Quality Monitoring equipment.
- ✓ Continuous emission monitoring system in stack for all the flues.

Hence, it can be concluded that implementation of above practices/technology at proposed Gadarwara project will enhance the power Generation Efficiency in eco-friendly manner.

N0. NML/ANC/F-13

CSIR-NML

TEST REPORT

CSIR-National Metallurgical Laboratory

(Council of Scientific & Industrial Research)

JAMSHEDPUR-831007

TC-6499

Test Report No. :

Job Requisition Reference :	Js/Ts-NTPCG1	Page No. : 01
Sample Receiving Date:	14.09.2019	BDM Ref (for external)
Test Report Issue Date:	01.10.2019	NML/ANC/TS-NTPCG1
Sample Description :		Name & Address of the Customer
Coal sample		NTPC, Gadarwara

1. Analytical Results:

Sr. No.	Sample Name	Radicals	Result	Unit	Method of Analysis
1	NTPC-GwSTPP/RCF/05.08.2019/800 MW	**Eq. Moist**	7.0	%	IS 1350(Part I) 1984,Reaffirmed 2019
		Eq.Ash	40.1	%	IS 1350(Part I) 1984,Reaffirmed 2019
		Eq.VM	23.8	%	IS 1350(Part I) 1984,Reaffirmed 2019
		Fixed Carbon	29.1	%	By Calculation
		Eq.GCV	3700.5	cal/gm	ASTM D5865:2013
		Carbon	41.1	%	ASTM: D5373:16
		Hydrogen	3.24	%	ASTM: D5373:16
		Nitrogen	0.90	%	ASTM: D5373:16
		Sulphur	0.61	%	ASTM: D5373:16

2. Additional Information; if any:-

The test results pertains to the samples submitted by you. For copies of report kindly clause No. 5.10.6 of our quality manual.

Signature of analyst and date
(Rupa Das Biswas)

Signature of authorised Personnel with date and seal
(Dr. Sanchita Chakravarty)

N0. NML/ANC/F-13

CSIR-NML

TEST REPORT

CSIR-National Metallurgical Laboratory

(Council of Scientific & Industrial Research)

JAMSHEDPUR-831007

TC-6499

Test Report No. :

Job Requisition Reference :	Js/Ts-NTPCG1	Page No. : 02
Sample Receiving Date:	14.09.2019	BDM Ref (for external)
Test Report Issue Date:	01.10.2019	NML/ANC/TS-NTPCG1
Sample Description :		Name & Address of the Customer
Coal sample		NTPC, Gadarwara

1. Analytical Results:

Sr. No.	Sample Name	Radicals	Result	Unit	Method of Analysis
1	NTPC-GwSTPP/RCF/05.08.2019/800 MW	SiO_2	62.5	%	NML/AAC/ASH Analysis/ XRF
		Al_2O_3	27.8	%	NML/AAC/ASH Analysis/ XRF
		Fe_2O_3	4.1	%	NML/AAC/ASH Analysis/ XRF
		TiO_2	1.6	%	NML/AAC/ASH Analysis/ XRF
		K_2O	1.1	%	NML/AAC/ASH Analysis/ XRF
		CaO	1.0	%	NML/AAC/ASH Analysis/ XRF
		SO_3	0.7	%	NML/AAC/ASH Analysis/ XRF
		MgO	0.6	%	NML/AAC/ASH Analysis/ XRF
		P_2O_5	0.2	%	NML/AAC/ASH Analysis/ XRF
		Na_2O	0.1	%	NML/AAC/ASH Analysis/ XRF
		MnO	0.1	%	NML/AAC/ASH Analysis/ XRF
		BaO	0.1	%	NML/AAC/ASH Analysis/ XRF
		ZrO_2	0.0	%	NML/AAC/ASH Analysis/ XRF
		V_2O_5	0.0	%	NML/AAC/ASH Analysis/ XRF
		Cr_2O_3	0.0	%	NML/AAC/ASH Analysis/ XRF
		ZnO	0.0	%	NML/AAC/ASH Analysis/ XRF
		SrO	0.0	%	NML/AAC/ASH Analysis/ XRF
		NiO	0.0	%	NML/AAC/ASH Analysis/ XRF
		CuO	94.0	ppm	NML/AAC/ASH Analysis/ XRF
		Rb_2O	79.0	ppm	NML/AAC/ASH Analysis/ XRF
		Y_2O_3	72.0	ppm	NML/AAC/ASH Analysis/ XRF
		Ga_2O_3	52.0	ppm	NML/AAC/ASH Analysis/ XRF
		Nb_2O_5	45.00	ppm	NML/AAC/ASH Analysis/ XRF
		As_2O_3	29.00	ppm	NML/AAC/ASH Analysis/ XRF

2. Additional Information; if any:-

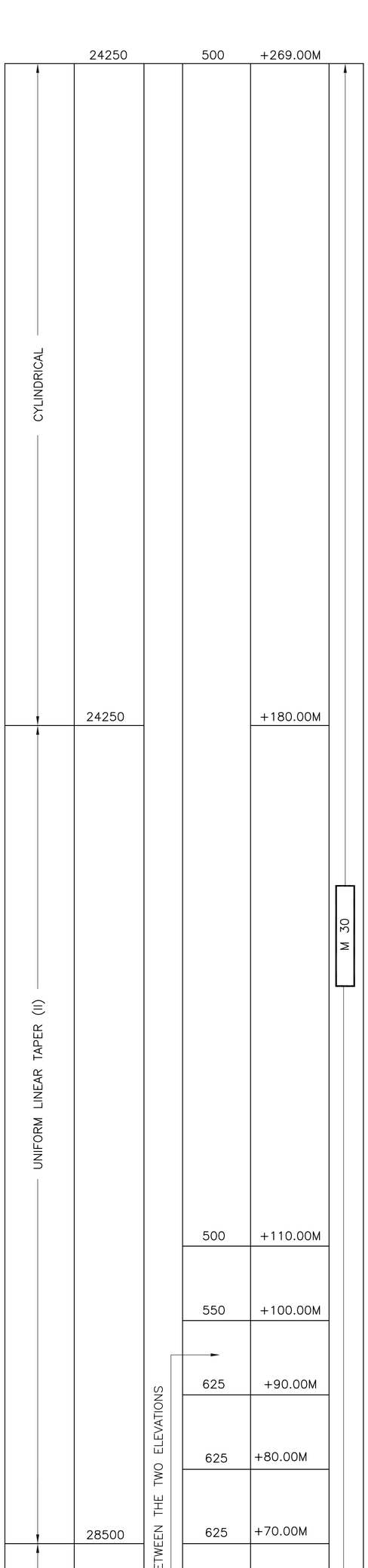
The test results pertains to the samples submitted by you. For copies of report kindly clause No. 5.10.6 of our quality manual.

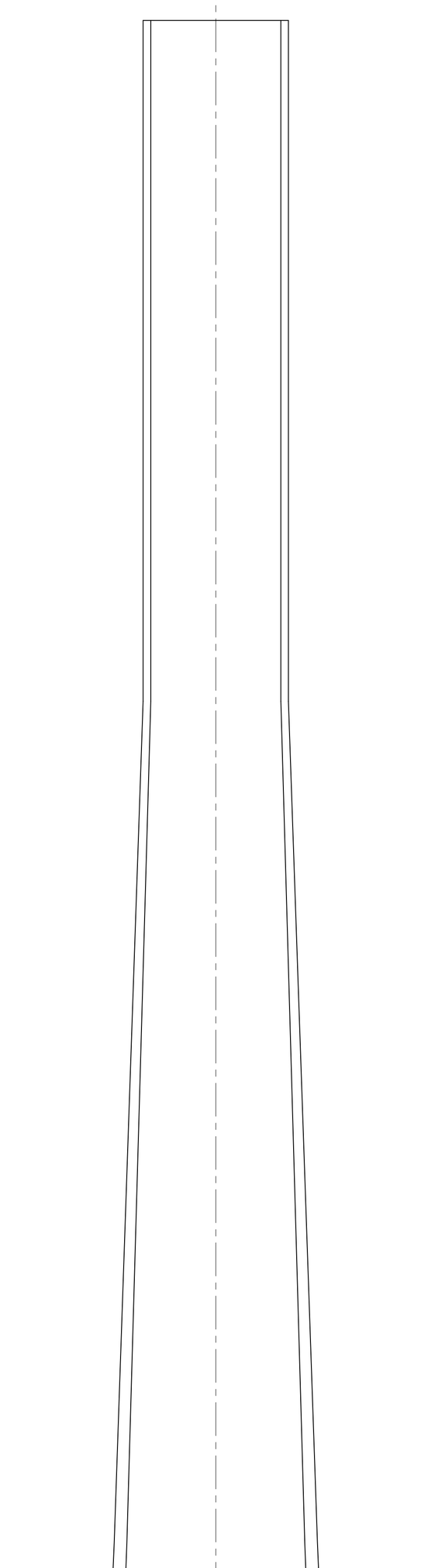
Signature of analyst and date
(Rupa Das Biswas)

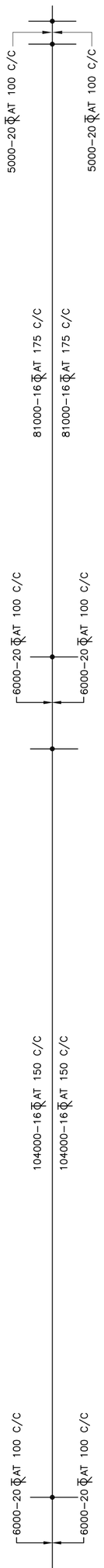
Signature of authorised Personnel with date and seal
(Dr. Sanchita Chakravarty)

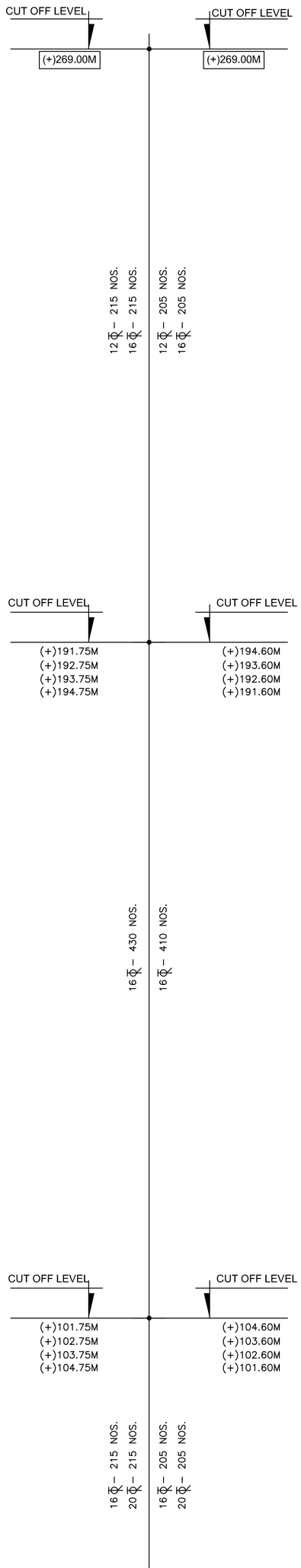
Annex. III

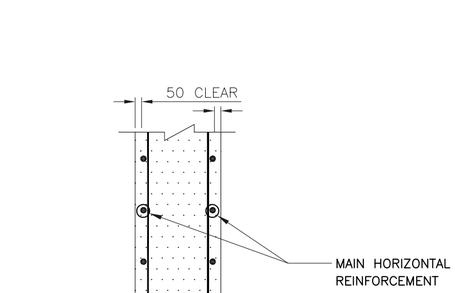
DRG. NO. 9572-315-POC-C-0554 REV. NO. 0











SHELL REINFORCING ARRANGEMENT

HORIZONTAL REINFORCEMENT

VERTICAL REINFORCEMENT

FOR DOWELS FROM FOUNDATION
REFER DRG. NO. 9572-315-POC-C-0552

NOTES:-

1. ALL DIMENSIONS ARE IN MILLIMETRES AND LEVELS ARE IN METRES.
2. EL (±) 0.00M CORRESPONDS TO RL (+)358.50M.
3. CONCRETE FOR CHIMNEY SHELL, SHALL BE OF GRADE M−30 CONFORMING TO IS:456 WITH MAXIMUM SIZE OF GRADED COARSE AGGREGATE NOT EXCEEDING 20 MM.
4. ALL REINFORCEMENT STEEL SHALL BE THERMO MECHANICALLY TREATED (TMT) HIGH YIELD STRENGTH BARS WITH MINIMUM PERCENTAGE ELONGATION 14.5% CONFORMING TO IS:1786.
5. LAP LENGTH IN REINFORCEMENT BARS (REBARS) SHALL NOT BE LESS THAN 42 TIMES THE DIAMETER OF BAR.
6. HORIZONTAL REBARS SHALL BE IN MANAGEABLE LENGTHS AND THE LAPS IN ANY BAR SHALL BE STAGGERED FROM THE LAPS OF BARS BELOW AND ABOVE IT.
7. THE REBAR CUT OFF LEVELS HAVE BEEN INDICATED TO SHOW THE LAP STAGGER IN THE VERTICAL REBARS. MINOR ADJUSTMENTS IN THESE LEVELS MAY BE MADE TO SUIT THE REBAR LENGTHS AVAILABLE AT SITE. MINOR LEVEL DIFFERENCES AMONGST THE BARS OF ANY STAGGER GROUP IS ALSO ACCEPTABLE.
8. MAIN REBARS SHALL BE SUITABLY CURTAILED AROUND SHELL OPENINGS AND RECESSES.
9. ALL MATERIAL, QUALITY, TESTING, STORAGE, FORM WORK, CONCRETE MIX DESIGN, REINFORCEMENT DETAILING, CONCRETE MIXING, PLACEMENT OF REINFORCEMENT AND CONCRETE, WORK−MANSHIP, SAFETY, ETC. SHALL CONFORM TO IS:456 AND THE TECHNICAL SPECIFICATIONS.

CONSTRUCTION REFERENCE DRAWINGS:-

1. REFER DRG. No. 9572−315−POC−C−0552 FOR DOWELS FROM FOUNDATION.
2. REFER DRG. No. 9572−315−POC−C−0555 THROUGH 0563 FOR EXTRA REINFORCEMENT AROUND OPENINGS AND RECESSES IN THE CHIMNEY SHELL.
3. REFER DRG. No. 9572−315−POC−C−0564 FOR DETAILS OF EXTERNAL PLATFORMS.
4. REFER DRG. No. 9572−315−POC−C−0565 FOR DETAILS OF EMBEDMENT SLEEVE NUT ASSEMBLY FOR INTERNAL GALLERY AT EL(+)43.50M.
5. REFER DRG. No. 9572−315−POC−C−0583 & 0584 FOR LAYOUT & DETAILS OF STAIRCASE EMBEDMENTS.
6. REFER DRG. No. 9572−315−POC−C−0589 FOR LAYOUT & DETAILS OF STRAKES/STRAKE EMBEDMENTS.

SPECIAL NOTE:−
STRAKE EMBEDMENTS AND STRAKES SHALL BE INSTALLED SIMULTANEOUSLY WITH THE CASTING OF THE CHIMNEY SHELL. ADEQUATE SUSPENSION ARRANGEMENTS SHALL BE MADE FROM THE SLIPFORM STRUCTURES TO INSTALL THE STRAKES AS THE CASTING PROGRESSES. FOR LAYOUT & DETAILS OF STRAKES & STRAKE EMBEDMENTS, REFER DRG. NO. 9572−315−POC−C−0589

एन टी पी सी NTPC
RELEASED FOR CONSTRUCTION
16.04.2014 DATE
Sd/−(AAT) SIGNATURE

REV.NO.	DESCRIPTION	DRAWN	DESIGN	CHKD.	M (L)	E	C	C&I	ARCH.	APPD	DATE
0	RELEASED FOR CONSTRUCTION	DEEP	AAT	SB	--	--	SU	--	--	SU	16.04.14
					CLEARED BY						

एन टी पी सी NTPC
एन टी पी सी लिमिटेड
NTPC Limited
(A GOVERNMENT OF INDIA ENTERPRISE)
ENGINEERING DIVISION

PROJECT: GADARWARA SUPER THERMAL POWER PROJECT
STAGE-I (2x800 MW)

TITLE: MAIN PLANT AND OFFSITE CIVIL WORKS PACKAGE
CHIMNEY-SHELL PROFILE AND DETAILS OF MAIN REINFORCEMENT

SIZE	SCALE	DRG. NO.	REV. NO.
A1	N.T.S.	9572-315-POC-C-0554	0

CAD FILE NAME : 9572−315−POC−C−0554

STUDY ON IMPACT OF WATER INTAKE FOR GADARWARA STPP ON ECOLOGY OF NARMADA RIVER (MADHYA PRADESH)

Submitted to:

NTPC Ltd.

Engineering Office Complex
Sector-24
Noida (Uttar Pradesh)
PIN- 201301

ANNAMALAI UNIVERSITY

CENTRE OF ADVANCE STUDY (CAS) IN MARINE BIOLOGY

PARANGIPETTAI- 608502 (TAMIL NADU)

August, 2017.

STUDY ON IMPACT OF WATER INTAKE FOR GADARWARA STPP ON ECOLOGY OF NARMADA RIVER (MADHYA PRADESH)

Submitted to:

NTPC Ltd.

Engineering Office Complex
Sector-24
Noida (Uttar Pradesh)
PIN- 201301

ANNAMALAI UNIVERSITY

CENTRE OF ADVANCE STUDY (CAS) IN MARINE BIOLOGY

PARANGIPETTAI- 608502 (TAMIL NADU)

EXECUTIVE SUMMARY

The present ecological survey was carried out to ascertain the feasibility of setting up of a power plant (1980 MW coal based plant namely Gadarwara Super Thermal Power Plant (STPP) based on supercritical technology) in Gadarwara, Madhya Pradesh. The power plant has planned to draw fresh water for condenser cooling from Narmada River. The sampling station were fixed taking into account the intake and outlet point of power plant besides the proximity of water in the above said two regions and also control point, which would be a referral point where the impact can be assessed. Out of 5 stations, four stations (A2, A3, A4 & A5) fall in Narmada River and one station (A1) at confluence point Sita River and Shakkkar River. In the proposed project area, the baseline information's was generated as per the norms stipulated by the by the Ministry of Environment and Forest and Climate Change (MOEF&CC), Govt. of India. To accomplish this task, a research team consisting of five Assistant Professors with their chosen field of interest and four Research Scholars from Centre of Advanced Study (CAS) in Marine Biology of Annamalai University carried two surveys during October, 2015 (post monsoon) and May, 2016 (pre monsoon). During survey water samples from 5 different stations were collected across two different depths (surface and subsurface), sediment and biological samples were also collected from all the stations.

The present ecological survey, which lasted for two surveys revealed the following facts: The physico-chemical parameters, did not exhibit wide variations. However, TSS and Turbidity showed an elevated range due to the dynamic nature of the environment. The surface water temperature varied from 24^0 to 29^0 C, which might due to the typical seasonal, geographical location and sampling time. The distribution of pH in surface waters remained alkaline invariably in all stations. Likewise, the observations made on the prime physical factors such as the turbidly also registered maximum with 30.6 NTU in station A4. This abnormality in this parameter is might be due to

constant dynamism in the water flow with turnover of nutrients from bottom to surface layer.

Further, the ecologically sensitive chemical parameters such as Dissolved Oxygen and water nutrients were also at the optimal concentration, which very well corresponding to the seasonal variation. The oxygen level in the water varied between 4.4 (A3) and 5.6 mg/l (A5). As observed in other parameters the water nutrients such as ammonia, nitrite, nitrate, inorganic phosphate and silicate were also found to be permissible range. Similarly, soil textural composition indicated that the sand and silt were higher in most of the stations which might be due to sediment transportation. Similarly, the metal concentrations recorded in the present study are comparatively less than the levels reported in rivers waters elsewhere.

Regarding plankton diversity, only a total 44 species phytoplankton belonging to three groups Chlorophyceae, fourteen to Bacillariophyc eae and ten to Cyanophyceae and 27 species of zooplankton belongings to the rotifers had 10 species, followed by Cledoceran with 07 species, and Copepod with 5 species and protozoan with 05 species in all the stations collected.

The potential environmental impacts due to project activities expected to be temporary and reversible. The proposed mitigation measures for the impacting activities are sufficient. All negative impacts during and post construction, including those deemed "significant" can be properly mitigated and no comprehensive or irreversible adverse impacts have been identified.

NTPC LIMITED

GADARWARA SUPER THERMAL POWER PROJECT

EXPENSES INCURED AS ON 30.04.2019

B	COMMUNITY DEVELOPMENT (CD)		Actual Approve (Rs.in Cr)	Broad Description	Activities	Approved RAP (In Lakhs)	Approved (in Lacs)	Disbursed (in Lacs)	Balance (in Lacs)	Blance RAP (In Lakhs)
B.1	**CD works in**			PAVs-Project Affected Villages						
B.1	B.1.1	Infrastructure works **	10.8075	Construction of cement concrete (CC) roads & drainage, community halls, Panchayat bhawan, weekly market places (02), passenger shelter, welcome gates, playgrounds, river bank ghat, public orchard, tree plantation, solar lights, etc	CC ROADS	1,080.75	928.69	883.25	45.44	152.06
	B.1.2	Drinking water	3.033	Overhead tanks & pipelines, hand-pumps, deepening of pond.	Hand pumps	303.30	156.83	156.06	0.77	146.47
	B.1.3	Sanitation	2.9435	Individual toilets in all households, common urinal, public garbage dumping place.	Toilets	294.35	214.14	214.14	-	80.21
	B.1.4	Education	3.67	Construction of Anganwadi, additional rooms in schools, kitchen sheds, study material, computers, books, sports item, etc	Merit scholarship to students	367.00	224.76	176.16	100.60	142.24
	B.1.5	Health	0.882	Providing Ambulance, medical camps, additional room in Govt dispensary	medical camps,	88.20	13.66	9.70	3.96	74.54
	B.1.6	Other Welfare measures	2.55	Providing water tanker, utensils, support to Indira Awas Scheme of Govt. for BPL's, Rural Sports, PAPs ID card, Cooperative societies formation, Empowerment, etc.	Water tanker	255.00	20.69	14.86	5.83	234.31
	SUM B.1		**TOTAL**	**B1.1 +B1.2+ B1.3+ B1.4+B1.5 +B1.6**		**2,388.60**	**1,558.77**	**1,454.17**	**156.60**	**829.83**
B	**COMMUNITY DEVELOPMENT (CD)**		**Actual Approve (Rs.in Cr)**	**Broad Description**	**Activities**	**Approved RAP (InN Lakhs)**	**Utilise(Amount in Lascs)**	**Actual Expenditure in Lakhs**	**Balance**	**Blance RAP (In Lakhs)**
B.2	**CD works in project vicinity**			CD in vicinity villages/Tehsil town/District						-
	B.2.1	Infrastructure works*	12.0434	Construction of CC roads & drainage, community halls, public orchard, facilities at railway station , solar lights, Indoor stadium with **Auditorium^** & swimming pool at Narsinghpur, Outdoor stadium with **Auditorium** at Gadarwara, etc	Vicinity	1,312.62	956.18	799.37	159.33	356.44
			1.0508	Amount can be utilized for **Auditoriums^/** activities to be taken up in future as per consensus in VDAC/ directed by GoI/ GoMP.	Auditorium					
			2.632	Cement Concrete road	Construction of 7 Km (Village Khadai-Sawari in tribal area, south of project site) (Special CD works)					
		Sanitation		Construction of Public toilets in various villages in Narsinghpur	BOD APPROVAL	260.00	260.00	260.00	-	-
	B.2.2	Drinking water	0.25	Drinking WaterWater	Hand-pumps	25.00	8.40	8.40	0.00	16.60
	B.2.3	Education	2.675	Construction of Anganwadi, additional rooms in schools, sheds, study material, computers, books, sports item, etc	School activities	267.50	194.71	183.28	11.42	72.79
	B.2.4	Health	3.0625	Ambulance, health center up-gradation, medical camps, awareness camps, etc.	Health Facilities	306.25	166.21	163.79	2.42	140.04
			TOTAL	**B2.1 +B2.2+ B2.3+ B2.4**		**2,171.37**	**1,585.50**	**1,414.84**	**173.18**	**585.87**
						4,559.97	**3,144.27**	**2,869.02**	**329.77**	**1,415.70**
				Initial Community Development	**ICD**	**50.00**	**50.00**	**50.00**	**-**	**-**
Toatal						**4,609.97**	**3,194.27**	**2,919.02**	**329.77**	**1,415.70**

Annexure – 1

Project Vision Document
Gadarwara STPP, Stage-I (2x800 MW)

The vision of Gadarwara STPP originates from the vision of the parent company, i.e. NTPC Limited,

"To be the world's largest and best power producer, powering India's growth."

In order to realize the above, the company has developed the following mission:

"Develop and provide reliable power, related products and services at competitive prices, integrating multiple energy sources with innovative and eco-friendly technologies and contribute to society."

Established in 1975, NTPC is India's largest power company today and establishment of Gadarwara STPP is another step towards achieving the mission of NTPC. NTPC ranked 317th in the 2009, Forbes Global 2000' ranking of the World's biggest companies. NTPC became a Maharatna company in May, 2010, one of the only four companies to be awarded this status.

The total installed capacity of the company is 41, 174 MW (including JVs) with 15 coal based and 7 gas based stations, located across the country. The company has set a target to have an installed power generating capacity of 1,28,000 MW by the year 2032, with a diversified fuel mix comprising 56% coal, 16% Gas, 11% Nuclear and 17% Renewable Energy Sources (RES) including hydro. By 2032, non-fossil fuel based generation capacity shall make up nearly 28% of NTPC's portfolio.

NTPC has been operating its plants at high efficiency levels. Although the company has 18.10% of the total national capacity, it contributes 28.60% of total power generation due to its focus on high efficiency.

Gadarwara STPP was conceived as a coal fired base load power project, Stage-I of the project comprising of 2x800 MW units is under the feasibility stage. The project will have an ultimate capacity of 4x800 MW with planning of Stage-II comprising of 2x800 MW.

Apart from generating cheap, reliable, quality power essential for the development of national economy, establishment of Gadarwara STPP shall also help in the growth of the region. The vision statements of Gadarwara STPP may be derived as:

	NTPC's Vision Statement	Gadarwara STPP's Vision Statement
1.	Develop and provide reliable power, related products and services at competitive prices, integrating multiple energy	Sustainable power generation maintaining high standards of efficiency and financial strength, over the design life (25 years) and extended life of the project through

	sources	suitable Renovation and Modernisation Programmes from Time to Time
2.	Implement innovative and eco-friendly technologies and	Use of super critical technology for power generation, compliance with environmental norms and conservation of natural resources like land, water, fuel. Large scale afforestation with local species in and around the project.
3.	Contribution to society	Community Development & Corporate Social Responsibility

At NTPC, People before Plant Load Factor is the mantra that guides all policies. The same is reflected through the three parts of the vision statements of NTPC (as a whole) as well as Gadarwara STPP – Economy, Environment for Everyone. The concept of Corporate Social Responsibility is deeply ingrained in NTPC's culture. Through its expansive CSR initiatives, NTPC strives to develop mutual trust with the communities that surround its power stations.

Gadarwara STPP is committed to supply quality power keeping in view of a cleaner and healthier environment around the project. The project will adopt the vision of conservation of pure drinking water sources, clean and calm surroundings, sustainable economic development and natural resource conservation. A continuous surveillance program on all important environmental parameters is being framed from the pre-feasibility stage with particular reference to the prevailing national standards.

In order to translate the visions of NTPC and Gadarwara STPP into reality, following specific programmes are envisaged:

	Gadarwara STPP's Vision Statement	**Gadarwara STPP's Specific Programmes**
1.	Sustainable power generation maintaining high standards of efficiency and financial strength, over the design life (25 years) and extended life of the project through suitable Renovation and Modernization Programmes from Time to Time	1. Timely commissioning of the project. 2. Operation at high PLF 3. Continual improvement in efficiency and PLF through efficient operation and maintenance and Renovation and Modernisation Programmes from Time to Time gaining extended life of the project 4. Certification of Project with ISO: 9001, OSHAS-16601, & 5S.
2.	Use of super critical technology for power generation, compliance with environmental norms and conservation of natural resources like land, water and fuel.	1. Commissioning of all pollution control systems (for air pollution control, water pollution control and noise pollution control) along with

		- the commissioning of plant. 2. Implementation of Ash Utilization Plan. 3. Compliance with Environmental Norms and Standards. 4. Certification of Project with ISO: 14001. 5. Surveillance of all important environmental parameters on a continuous basis and apply corrective measures. 6. Large scale afforestation in and around the project as an effective mitigatory mechanism.
3.	Community Development & Corporate Social Responsibility	1. Implementation of R&R Plan for PAPs as per details agreed with the State Govt. and other stakeholders. 2. Community Development Activities in the surrounding areas. 3. Activities under Corporate Social Responsibility for improving health care, employability, education etc. with special focus on women empowerment, physically challenged & economically weaker section of the Society. 4. Provision of electricity within 5 km. as per MOP circular. 5. Certification of Project with SA-6600.

NTPC Gadarwara

Sl No	ESP Design Parameters	Unit	ESP Guarantee Point	ESP Design Point
1.	Gas Flow	m3/s	1354	1465
2.	Gas Temperature	Deg C	127	145
3.	Inlet Dust Concentration	gm/Nm3	60.64	73.07
4.	No of fields out of operation	--	Nil	One
5.	Required outlet concentration	mg/Nm3	18	51
6.	ESP Collection Efficiency	%	99.97	99.93

HYDRO-GEOLOGICAL STUDY FOR GADARWARA SUPER THERMAL POWER PROJECT, MADHYA PRADESH

Submitted to

NTPC Ltd.

GADARWARA

By

NATIONAL INSTITUTE OF HYDROLOGY

(An ISO 9001:2008 Institute under MoWR, RD and GR, Govt. of India)

ROORKEE – 247667 (UTTARAKHAND)

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12 RAINWATER HARVESTING

12.1 RAINWATER HARVESTING

Rainwater harvesting, in its broadest sense, is a technology used for collecting and storing rainwater for human use from rooftops, land surfaces or rock catchments using simple techniques such as jars and pots as well as engineered techniques. In India, rainwater harvesting has been practiced for more than 4,000 years, owing to the temporal and spatial variability of rainfall. It is an important water source in many areas with significant rainfall but lacking any kind of conventional, centralized supply system. It is also a good option in areas where good quality fresh surface water or groundwater is lacking. The application of appropriate rainwater harvesting technology is important for the utilization of rainwater as a water resource.

Among the various alternative technologies to augment freshwater resources, rainwater harvesting and utilization is a decentralised, environmentally sound solution, which can avoid many environmental problems often caused in conventional large-scale projects using centralized approaches. Typically, once an industrial unit is constructed, the paved surface area increases and infiltration/ percolation area decreases. It has been reported that surface runoff can increase from 10% to 55% and infiltration volume can decrease from 50% to 15%. This causes two types of problems, e.g., (i) lowering of the groundwater table due to less recharges, and (ii) increase in localized flooding. If designed properly good rainwater harvesting system can address both the issues. It can prevent the lowering of the water table by artificial recharge of the aquifer and can prevent localized flooding by retaining or detaining surface runoff.

Rainwater harvesting has many advantages, such as:

- Improvement in the quality of ground water
- Rise in the water levels in wells and bore wells that are drying up

- Mitigation of the effects of drought and attainment of drought proofing
- An ideal solution to water problems in areas having inadequate water resources
- Reduction in the soil erosion as the surface runoff is reduced
- Decrease in the choking of storm water drains and flooding of roads
- Saving of energy, to lift ground water. (One-meter rise in water level saves 0.40-kilowatt hour of electricity).

Apart from these, there are other advantages of rainwater harvesting, which includes:

- Rainwater harvesting can co-exist with and provide a good supplement to other water sources and utility systems, thus relieving pressure on other water sources.
- Rainwater harvesting provides a water supply buffer for use in times of emergency or breakdown of the public water supply systems, particularly during natural disasters.
- Rainwater harvesting can reduce storm drainage load and flooding in city streets.
- Users of rainwater are usually the owners who operate and manage the catchment system, hence, they are more likely to exercise water conservation because they know how much water is in storage and they will try to prevent the storage tank from drying up.
- Rainwater harvesting technologies are flexible and can be built to meet almost any requirements. Construction, operation and maintenance are not labour intensive.

Typically, a rainwater harvesting system consists of three basic elements: the collection system, the conveyance system and the storage system. Collection systems can vary from simple types within a household to bigger systems where a large catchment area contributes to an impounding reservoir from which water is either gravitated or pumped to water treatment plants. The categorisation of rainwater harvesting systems depends on factors like the size and nature of the catchment areas and whether the systems are in urban or rural settings. Some of the systems are described below.

Simple roof water collection systems: While the collection of rainwater by a single household may not be significant, the impact of thousands or even millions of household rainwater storage tanks can potentially be enormous. The main components in a simple roof water collection system are the cistern itself, the piping that leads to the cistern and the appurtenances within the cistern. The materials and the degree of sophistication of the whole system largely depend on the initial capital investment. Some cost effective systems involve cisterns made with ferrocement, etc. In some cases, the harvested rainwater may be filtered. In other cases, the rainwater may be disinfected.

Larger systems for educational institutions, stadiums, airports, Industrial areas etc.: When the systems are larger, the overall system can become a bit more complicated, for example rainwater collection from the roofs and grounds of institutions, storage in underground reservoirs, treatment and then use for non-potable applications.

Land surface catchments: Rainwater harvesting using ground or land surface catchment areas can be a simple way of collecting rainwater. Compared to rooftop catchment techniques, ground catchment techniques provide more opportunity for collecting water from a larger surface area. By retaining the flows (including flood flows) of small creeks and streams in small storage reservoirs (on surface or underground) created by low cost (e.g., earthen) dams, this technology can meet water demands during dry periods. There is a possibility of

high rates of water loss due to infiltration into the ground, and because of the often marginal quality of the water collected, this technique is mainly suitable for storing water for agricultural purposes.

12.2 COMPONENTS OF RAINWATER HARVESTING

There are three main components of rainwater harvesting system, (i) Catchment, (ii) Conveyance system, and (iii) Storage tank.

Catchments: The catchment of a water harvesting system is the surface which directly receives the rainfall and provides water to the system. It can be a paved area like a terrace or courtyard of a building, or an unpaved area like a lawn or open ground. A roof made of reinforced cement concrete (RCC), galvanized iron or corrugated sheets can also be used for water harvesting. Runoff coefficient for different catmint surfaces are given in ***Table 37***.

Coarse mesh at the roof to prevent the passage of debris

Gutters: Channels all around the edge of a sloping roof to collect and transport rainwater to the storage tank. Gutters can be semi-circular or rectangular and could be made using locally available material such as plain galvanized iron sheet (20 to 22 gauges), folded to require shapes.

Semi-circular gutters of PVC material can be readily prepared by cutting those pipes into two equal semi-circular channels.

Bamboo or betel trunks cut vertically in half.

Table 37: Run-off Coefficients for Various Catchment Surfaces

Type of Catchments	Run-off Coefficients
Roof Catchments	
Tiles	0.8-0.9
Corrugated Metal sheets	0.7-0.9
Ground surface coverings	

Concrete	0.6-0.8
Brick pavements	0.5-0.6
Untreated Ground Catchments	
Soil on slopes less than 10%	0.0-0.3
Rocky natural catchments	0.2-0.5

The size of the gutter should be according to the flow during the highest intensity rain. It is advisable to make them 10 to 15 per cent oversize. Gutters need to be supported so they do not sag or fall off when loaded with water. The way in which gutters are fixed depends on the construction of the house; it is possible to fix iron or timber brackets into the walls, but for houses having wider eaves, some method of attachment to the rafters is necessary.

Conduits: Conduits are pipelines or drains that carry rainwater from the catchment or rooftop area to the harvesting system. Conduits can be of any material like polyvinyl chloride (PVC) or galvanized iron (GI), materials that are commonly available. Size of pipes for different rainfalls is given in ***Table 38***.

First-flushing: A first flush device is a valve that ensures that runoff from the first spell of rain is flushed out and does not enter the system. This needs to be done since the first spell of rain carries a relatively larger amount of pollutants from the air and catchment surface.

Filter: The filter is used to remove suspended pollutants from rainwater collected over roof. A filter unit is a chamber filled with filtering media such as fiber, coarse sand and gravel layers to remove debris and dirt from water before it enters the storage tank or recharges structure.

Storage Facility and Recharge Structures: Storage tanks may be constructed with respect to the shape, size and the material of construction. Rainwater may be charged into the groundwater aquifers through any suitable structures like dug wells, bore wells, recharge trenches and recharge pits.

Table 38: Size of pipes for different rainfall intensities

Diameter of Pipe (in mm)	Roof area					
	50	75	100	125	150	200
	Average Rate of Rainfall in mm/ hour					
50	13.4	8.9	6.6	5.3	4.4	3.3
65	24.1	16.0	12	9.6	8	6.0
75	40.8	27.0	20.4	16.3	13.6	10.2
100	85.4	57.0	42.7	34.2	28.5	21.3
125			80.5	64.3	53.5	40.0
150					83.6	62.7
Sizing of rainwater pipe for roof drainage (*Source: National Building Code)*						

12.3 DETAILED RAINWATER HARVESTING PLAN

Rooftop rainwater runoff

In urban areas, the roof top rainwater can be conserved and used for recharge of groundwater. This approach requires connecting the outlet pipe from rooftop to divert the water to either existing wells/ tube wells/bore wells or specially designed wells. The urban housing complexes or institutional buildings have large roof area which can be utilized for harvesting roof top rainwater to recharge aquifer in urban areas.

The industrial roofs are of RCC finished with cement, sand and mortar. Most of the water can be collected with roof drains hence 80-85% rainwater can be available. About 15% of water is lost in evaporation etc. The water is collected through rainwater drains from rooftop. The roof should be finished to avoid percolation and should be cleaned every year before rains in order to prevent possible contamination.

Surface Runoff rainwater

The rainfall runoff flowing from the roads, paved areas and open grounds is substantial during the monsoon. This water often creates the water logging and the drainage system is put under stress in the urban agglomerates. This ultimately flows out of the area unutilized. This water if conserved and utilized properly may bring much needed relief to the water scarce areas. This system will improve both quality and quantity of water.

The subsurface reservoirs are technically feasible alternative for storing surplus monsoon runoff. Wide spectrums of techniques are in vogue to recharge ground water reservoir. The artificial recharge techniques vary widely depending upon hydro-geological studies of the area. The maximum rate at which water can enter the soil at particular point depends upon infiltration capacity. The infiltration capacity depends upon soil type, moisture content, organic matter, vegetative cover, season, air entrapment, etc. The infiltration and percolation capacity are closely related. The infiltration takes place due to gravity but capillary force, divert gravity water. Runoff coefficient for rooftop area can be taken as 80%. Similarly, for cemented/paved area, run-off coefficient has been taken as 70% while for green belt area, it is generally varying between 10-30%.

12.4 RAINWATER HARVESTING SYSTEM FOR GADARWARA STPP

The water harvesting potential of storm water is the amount of water that can be efficiently harvested from the total amount of water that is received in the form of precipitation over an area. This is influenced by catchment type and climatic conditions such as rainfall, and its pattern.

Total ultimate land requirement for the 2x800 MW Super Thermal Power Plant is 1350 Acres as per details given in ***Table 39***:

Table 39: Land breakup for Gadarwara STPP

Area	Stage-I (2X800MW) Acres	Ultimate Capacity (4X800MW) Acres
Main Plant, CHP, Water System, Switchyard, Misc. BOP facilities	410	610
Water Reservoir	50	50
Green Belt	150	190
Ash Disposal Area	400	800
Township	100	100
Misc. Corridors	240	240
Total	1350	1990

Out of the total 1350 acres, rainwater harvesting can be implemented only in the Main Plant area (410 acres), Green Belt (150 acres) and Township Area (100 acres).

Main plant area will have total area 410 acres. Considering 25% of the this area (102.5 acres) area to be open space and rest 75% (307.5 acres) to be building and paved area, the rainwater harvesting potential of the Main Plant area has been computed.

Township shall be constructed in an area of 100 acres. Assuming green area to be 20%, i.e., 20 acres, open area to be 20%, i.e., 20 acres and building and paved area to be 60%, i.e., 60 acres of the total township area, the water harvesting potential has been estimated for township.

For green area having slope less than 10%, runoff coefficient is generally taken as 15%. For the open area, runoff coefficient is normally higher and has been considered as 20%. For the paved area and roof area, an average value of 75% has been considered. Runoff potential from various types of surface areas has been computed by the equation given below:

Runoff Potential (m^3/yr) = Av. Annual Rainfall (m/yr)*Catchment Area (m^2)*Runoff Coeff.

The estimated rainwater harvesting potential from main plant area, township area and green belt and afforestation area is given in ***Table 40***.

Table 40: Annual Rainwater harvesting potential from Main Plant of 2x800 MW Gadarwara STPP

Landuse	**Area**		**Average Rainfall**	**Runoff Coefficient**	**Runoff Potential**
	Acres	***m^2***	***(m)***		***(m^3/yr)***
Main Plant Area					
Roofed and Paved area (including roads)	307.5	12,44,408	1.295	0.75	12,08,632 ***(≈ $12.1*10^5$)***
Open / Barren including Others	102.5	4,14,803	1.295	0.20	1,07,434 ***(≈ $1.1*10^5$)***
Sub Total (A)					13,16,066 ***(≈ $13.2*10^5$)***
Township Area					
Roofed and Paved area (including roads)	60.0	2,42,812	1.295	0.75	2,35,831 ***($2.4*10^5$)***
Open / Barren including Others	20.0	80,937	1.295	0.20	20,963 ***(≈$2.1*10^4$)***
Green Belt	20.0	80,937	1.295	0.15	15,722 ***(≈$1.6*10^4$)***
Sub Total (B)					**2,72,516 (≈ $2.7*10^5$)**
Green Belt and Afforested area	190.0	7,68,903	1.295	0.15	1,49,359 ***(≈$1.5*10^5$)***
Sub Total (C)					1,49,359 ***(≈$1.5*10^5$)***
Total (A+B+C)					**17,37,941 ($1.74*10^6$)**

The suitable design for rooftop rainwater harvesting structure has to be prepared based on the basis of monsoon rainfall, roof size, type of roof, landuse and hydrogeology of the area. As per IMD records, the maximum probable precipitation (PMP) in a day for Gadarwara is 309 mm. It means that the average hourly rainfall intensity should be approximately 13 mm. Based on this intensity; water generated from the Main Plant area shall be about 13,084 m^3/hr, from green belt and afforestation area about 1,499 m^3/hr and from Township area about 2,736 m^3/hr. The water collected from the rainwater harvesting may be utilized in the Power Plant and the Township for various purposes, such as,

gardening, washing and cooling etc. The volume of water generated on hourly basis is given in ***Table 41***.

Table 41: Maximum hourly rainwater harvesting potential

Landuse	**Area**		**Average Rainfall**	**Runoff Coefficient**	**Runoff Potential**
	Acres	***m^2***	***(m)***		***(m^3/yr)***
Main Plant Area					
Roofed and Paved area (including roads)	307.5	12,44,408	0.13	0.75	1,21,330 ***(≈ 1.21*10^5)***
Open / Barren including Others	102.5	4,14,803	0.13	0.20	10,785 ***(≈ 1.1*10^4)***
Sub Total (A)					1,32,115 ***(≈ 1.32*10^5)***
Township Area					
Roofed and Paved area (including roads)	60.0	2,42,812	0.13	0.75	23,674 ***(2.3*10^4)***
Open / Barren including Others	20.0	80,937	0.13	0.20	2,104 ***(≈2.1*10^3)***
Green Belt	20.0	80,937	0.13	0.15	1,578 ***(≈1.6*10^3)***
Sub Total (B)					**27,357 (≈ 2.7*10^4)**
Green Belt and Afforested area	190.0	7,68,903	0.13	0.15	14,994 ***(≈1.5*10^4)***
Sub Total (C)					14,994 ***(≈1.5*10^4)***
Total (A+B+C)					**1,74,465 1.74*10^5**

The water collected from the rainwater harvesting may be utilised in the Power Plant and the Township for various purposes, such as, gardening, washing etc.

12.5 WATER HARVESTING STRUCTURES

Industrialization and urbanization is not only causing pollution hazards but also cutting down the scope of natural recharge of groundwater. Failure of monsoon and dependence on groundwater to meet the needs have resulted decline of

groundwater storage in many parts of the country. Rainwater harvesting and artificial recharge is the right solution to mitigate the problem.

To evaluate the possibility of groundwater recharge in the area the status of various conditions mentioned above has been examined. The main water bearing formation in the area alluvium. The project area falls under SAFE zone, as declared by Central Ground Water Board.

Still to manage the ground water resource properly, artificial recharge to ground may be taken up wherever groundwater table is deep (>8m).

As per the lithological analysis of the soils of the area. The top lithological unit is sandy in nature and is suitable for direct groundwater recharge through recharge pits.

Total rainwater harvesting potential from the Plant Area shall be 13.2 * 10^5 m^3/yr or 1.32 MCM/yr, from township area shall be 2.7 * 10^5 m^3/yr or 0.27 MCM/yr and from green belt area 1.5 * 10^5 m^3/yr or 0.15 MCM/yr. As discussed above more than 90% rainfall occurs during the months of June to October, the rainwater harvesting shall take place only during these months. Considering 5 fillings of the reservoir and an average depth of 5 meters, the size of the rainwater harvesting structures have been determined. ***Table 42***.

Table 42: Details of proposed water harvesting structures

S No.	Details	Plant area	Township area	Green belt
1	Surface area of individual water harvesting structures	9,500 m^2	4,860 m^2	5400 m^2
2	Depth of the structure	5	5	5
3	Total harvesting potential of structure considering average five fillings	0.264 MCM	0.135 MCM	0.15 MCM
4	No. of structures proposed	5	2	1
5	Total water harvesting	1.32 MCM	0.26 MCM	0.15 MCM
6	Recharge shaft proposed	10 recharge shafts	4 recharge Shafts	2 recharge shafts

In addition to the above rainwater harvesting structures, rainwater from the township area may be harvested by construction of checkdams across the stream passing through the township area.

13 SUMMARY

NTPC is setting up a Super Thermal Power Project, of capacity 1600 MW (2X800MW), in Gadarwara Tehsil in Narsinghpur district of Madhya Pradesh, for meeting the power demand of Western Region. It is one of the modernized super critical and environment friendly thermal power projects to be set up by NTPC Ltd. For this purpose NTPC has awarded a consultancy study to NIH on "*Hydro-geological Study for Gadarwara Super Thermal Power Project*" with the main objectives to (i) To study the source water availability from Omkeshwar Dam, (ii) To study the hydro-geology and groundwater characteristics, (iii) To assess the water quality of surface and groundwater, (iv) To study the quantitative and qualitative impact of construction and operation of power project on the hydrology of the study area, (v) To prepare a water harvesting plan for the project area and (vi) To develop a plan for monitoring of surface water systems and groundwater in the study area.

The geographical extent of the study area consists of an area within 10 km from the periphery of the project site. Under the present investigations, various maps such as location map, drainage map, DEM, etc. have been prepared. The drainage pattern in the study area is in general dendrite in nature. Narmada is the largest river flowing on the Northern side of the project. The smaller streams are ephemeral in nature and flow for few months in a year. The elevation in the study area is observed to range from 255 m to 402 m above mean sea level with a general slope from south east to North West direction.

The climate of Narsinghpur district is generally dry except for the South-West monsoon season. The year can be divided into four seasons. The district receives maximum rainfall during South-West monsoon period i.e. June to September. About 91.3% of the annual rainfall takes place during monsoon season. Only 8.7% of the annual rainfall takes place between October to May period. The Gadarwara town receives an average annual rainfall of 1295 mm. The normal maximum temperature during the month of May is 42.5 ^{0}C and minimum during

the month of January is 8.2 ^{0}C. The relative humidity generally exceeds 90% in the month of August while rest of year is drier. The wind velocity is highest in June at around 8.0 km/hr and is lowest at about 2.0 km/hr in November. Gridded (0.250 x 0.250) rainfall data for Gadarwara for the period of 2000 to 2013 indicates that the average minimum temperature ranged from 17.6 to 19.0 ^{0}C. The average maximum temperature ranged from 30.8 to 32.7 ^{0}C. The average mean temperature varied from 24.4 to 25.8 ^{0}C. Precipitation ranged from a low of 568.9 mm in 2006 to 1749.1 mm in 2013.

A number of field visits were undertaken to the field site and a number of field investigations have been carried out including reconnaissance survey, pre-monsoon and post monsoon water quality sampling, sampling for isotopic investigations, infiltration tests, determination of RL's of sampling location, measurement of ground water level data and its conversion to above mean sea level, drilling of pumping well and pumping test, etc.

There are numerous small/mid-size ponds/tanks, varying in size from 0.3 to 11.2 ha, spread over the entire 10 km buffer zone of the thermal power plant. Most of the ponds are manmade and are located around the villages and are degenerated. Thirty-four ponds are larger than 0.5 ha, out of which 03 ponds are degenerated and have growth of weeds. The weeds are caused by the inflow of nutrients into the ponds from the villages. If the nutrients, such as nitrogen, phosphorus and fertilisers are stopped from entering into these ponds, the health of these ponds can be improved.

The Gadarwara STPP requires water for meeting the various demands. The total water requirement for the Project is estimated to be 5,980 m^3/hr. Water requirement for the project will be sourced from Narmada River by a pipeline at a distance of 30 km (north) from the project site. A pick up weir is being constructed at Kakra Ghat (23.046480 ^{0}N latitude and 78.787798 ^{0}E longitude) to draw the make-up water for the Gadarwara STPP. The M.P. Government has committed a water supply of 125 cusecs for the ultimate stage of the project.

Dependable flow analysis has been carried out based on the observed daily data being monitored at Barman Ghat. It is observed that sufficient amount of the water flows through the stream throughout the year. The 95% and 99% dependable flows have been computed as 45.52 m^3/s and 18.68 m^3/s respectively. Therefore, 18.68 m^3/s of water is always available at Narmada River at the Barman gauging site. Therefore, it shall be possible to divert the assured supply of 3.54 m^3/s from the Weir being constructed at Kakra Ghat for meeting the requirements of NTPC Project, which is at present limited only to 1.66 m^3/s. Therefore, diversion of 3.54 m^3/s of water from the river will not have any considerable impacts of the streamflow in the river system downstream of the intake point. Thus, the source of water for the power plant and the allocated amount of water is sustainable. However, as the intake structure is to be constructed on the bank of the river, it may cause erosion of the bank. Therefore, for protection of the bank from erosion after construction of the in-take structure, bank protection works should be taken up to retain the present configuration of the bank on the left bank of the river Narmada.

Hydrogeologically, District Narsinghpur is covered by the Narmada alluvium, the thickness of which varies depending on the sub-surface configuration of the basin of deposition. Silicate rock and slate were have been reported at depths of 261.81 and 292.5 meters respectively at Gadarwara. Water occurs in this alluvium both under water table and confined conditions. According to the CGWB report (2013), the transmissivity of the alluvial aquifers tapped by dug wells ranges from 57 to 400 m^2/day while the hard rock aquifers have very low transmissivity of the order of 19 m^2/day. The Transmissivity of the confined to semi-confined aquifers ranges from 23 to 2400 m^2/day. Storativity values (storage coefficient) ranges from 2.01 x 10^{-6} to 1.15 x10^{-3} indicating confined to semi confined nature of deep aquifers.

Dynamic ground water resources of the district have been estimated for the base year -2008/09 on block-wise basis. The net ground water availability in the district is 1,22,600 ham and Ground Water Draft for all uses is 94,590 ham,

making stage of ground water development 77 % (63 % in 2003/04) as a whole for district. About 93% of the geographical area of the district is ground water recharge worthy area. Chanwarpatha, Chichli, Gotegaon and Kareli (safe in 2003/04) blocks of the district are categorized as semi critical and Narsinghpur (safe in 2003/04) as Critical. The highest stage of ground water development is computed as 94% in Narsinghpur block.

Long term variation in some selected wells of the districts which are located within the same tehsil and within (or very near to the boundary of) the study area, has been analyzed. Water levels of ground water sources have been monitored and analyses of groundwater level variation has been carried out.

For the two open wells at monitored at Kaudiya and Manakwada, the ground water is very near to surface during the post monsoon period (November, 2015) and shows a significant decline during the pre-monsoon season (May, 2016). The variations were as high as almost 12 m, which is much higher than the rest of the locations. This probably indicates perched condition of aquifer for these two sources not having connectivity to the aquifers of the other sites. In the other handpumps and tube wells monitored during the study, the water level was observed to vary from 13.87 m to 31.7 m during November 2015, 14.87 m to 34.46 m during March, 2016 and 16.04 to 38.65 m during May, 2016. In general, it has been observed that ground water level was higher in areas near to the rivers Shakkar, Seta Rewa and after their confluence, obviously because of the recharging effect. In general, at sites located near the rivers the variation was observed to be less than 4 meters while for those away from the recharge sources/rivers the fall in water level during the pre-monsoon period (May, 2016) was much higher (6 m to 7.85 m). Further, it has been observed that the water levels observed during the post monsoon and pre-monsoon period were higher during the study period when compared to the available data of the past years.

Ground water level contour maps have been prepared to determine the flow direction of ground water. The general direction of flow of water in the study area

follows the same pattern as the surface water flow. It flows from South-East to the North West direction following the general topography of the area.

Pump test has been conducted within the ash pond area for which pumping well and observations wells were drilled. Transmissivity of the aquifer has been determined using Theis method. The average Transmissivity of the aquifer is 447 m^2/d. The storage coefficient could not be ascertained due to no-drawdown in the observation wells.

Infiltration characteristics of the study area have been studied in details at 9 locations and the results of the tests have been provided. The sandy soil at Chichli showed the highest infiltration capacity of 16.89 mm/hr clay soil at Sihora showed lowest rate of 0.69 mm/hr.

Water quality has been studied for about 30 locations for ground water and surface water including hand pumps, tube wells, lakes, pond, open well etc. and baseline data have been generated including data on trace metals. Variation in water quality has been analyzed and discussed. Various physico-chemical parameters, anions and cations and trace metals have been analysed both for pre and post monsoon. No toxic metal contamination has been observed in the study area. To assess the accuracy of water quality parameter determination, ionic balance was calculated. The overall error of ionic balance during both pre and post monsoon was found to be below 5%.

The water quality pf the source water has also been monitored at Kakra ghat and historical water quality data for the source water has been provided. No significant change in water quality of the source water has been observed.

Based on the water quality characteristics of the study area, a water quality monitoring plan has been suggested for the study area. For the monitoring of surface water bodies, it is proposed that water quality of surface water bodies be monitored at 10 locations, 5 locations on the streams (SW-1 to SW-5) and 5 locations on ponds (SW-6-SW-10) that are used for domestic purposes. Water

quality of groundwater is good in the buffer zone of Gadarwara STPP. The Flow direction of groundwater in the area is from South-East to North-West. Therefore, it is proposed to monitor the groundwater quality more in the in the northern side of the thermal plant area. The suggested sampling frequency is once in three months.

Isotopic characteristics of the water from different surface and ground water sources have been studied and its significance has been discussed.

A rainwater harvesting plan for the plant area has been developed and provided. Total rainwater harvesting potential from the Plant Area shall be $13.2*10^5$ m^3/yr or 1.32 MCM/yr, from township area shall be $2.7*10^5$ m^3/yr or 0.27 MCM/yr and from green belt area $1.5*10^5$ m^3/yr or 0.15 MCM/yr. More than 90% rainfall occurs during the months of June to September. Therefore, the rainwater harvesting shall take place only during these months. Considering 5 fillings of the reservoir and an average depth of 5 meters, the size of the rainwater harvesting structures have been determined. Eight rainwater-harvesting structures, 5 in main plant area, two in township area and one in green belt area have been suggested.

In addition, the rainwater may be harvested from the stream passing through the township area by constructing checkdams across the stream.

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Engineers, Consultants, Environmental Monitoring Laboratory & Contractors

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Water Sample Analysis Report

Report No.: ME-NG17292-191031-SA-NTPC-NARSINGHPUR			**Date:** 31.10.2019
Name and Address of Customer	**NTPC LIMITED GADARWARA STPP** Tehsil- Gadarwara, Village-Dongargaon, P.O. Gangai, Dist.- Narsinghpur, Madhya Pradesh – 487770, India.		**Order Reference:** PO.No.5500033605-057-1049 Dtd.20.07.2019 (version: 0)
Sample Description/Type	Surface Water	**Sample Collected by**	Laboratory
Sampling Location	Narmada River	**Sample Quantity/Packing**	5 L X 1 No. PVC Can 100 mL X 1 No. PVC Can 500mLX1No.Sterile Glass Bottle
Date of Sampling	16.10.2019	**Date of Receipt of Sample**	21.10.2019
Sampling Procedure	IS:3025(Part I): 1987 RA2003, APHA 23rd Ed. 2017, 1060-B, 1-40; 9060 A,9-36		
Date of Start of Analysis	21.10.2019	**Date of Completion of Analysis**	31.10.2019

Sr. No.	Parameter	Unit	Result	Method Reference
1.	Temperature	°C	30	APHA 23rd Ed. 2017, 2550-B, 2-74
2.	pH	-	7.9	APHA 23rd Ed. 2017, 4500-H^+-B, 4-95
3.	Electrical Conductivity	µS/cm	427	APHA 23rd Ed. 2017, 2510- B, 2-58
4.	Total Dissolved Solids	mg/L	252	IS 3025 (Part 16):1984 Reaffirmed 2006, Ed.2.1(1999-12)
5.	Total Suspended Solids	mg/L	<5	APHA 23rd Ed. 2017, 2540-D, 2-70
6.	Ca-Hardness (as $CaCO_3$)	mg/L	100	APHA 23rd Ed. 2017, 3500-Ca-B, 3-69
7.	Mg-Hardness (as $CaCO_3$)	mg/L	80	APHA 23rd Ed. 2017, 3500-Mg- B, 3-86
8.	Biochemical Oxygen Demand (3 days 27rdC)	mg/L	4.8	IS 3025 (Part 44): 1993, Reaffirmed 2009
9.	Chemical Oxygen Demand	mg/L	16	APHA 23rd Ed. 2017, 5220-B, 5-18
10.	Fluoride (as F)	mg/L	0.414	APHA 23rd Ed. 2017, 4500-F, D, 4-90
11.	Boron (as B)	mg/L	<0.1	APHA 23rd Ed. 2017, 4500-B B, 4-27

ULR- TC748719000017292F

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Phone: 2582 0658/ 3139/ 1663/ 3154 Fax: 91-22-25823543 thane@mahabal.com

Report No.17292 Cont…

Sr. No.	Parameter	Unit	Result	Method Reference
Microbiological Analysis				
22.	Total Colliforms	MPN/ 100mL	<1.1	APHA 23rd Ed. 2017, 9221–B & C, 9-69, 9-72
23.	E-Coli	MPN/ 100mL	Absent	APHA 23rd Ed. 2017, 9221–B, C & G, 9-69, 9-72 & 9-80
Remark: N.D.: Not Detected. Values with '<' symbol indicate results below method detection limit				

----------END----------

FOR MAHABAL ENVIRO ENGINEERS PVT. LTD.

Harish Mendhi
TECHNICAL MANAGER
(Chemical Testing)

Pranali Kurve
TECHNICAL MANAGER
(Biological Testing)

Note:
1. The result listed refers only to the tested sample(s) and applicable parameter(s).
2. This report is not to be reproduced except in full, without written approval of the laboratory.

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Noise Level Monitoring Report

Report No.: ME-NG17293-191025-SA-NTPC-NARSINGHPUR		**Date:** 25.10.2019
Name and Address of Customer	**NTPC LIMITED GADARWARA STPP** Tehsil- Gadarwara, Village- Dongargaon, P.O. Gangai, Dist.- Narsinghpur, Madhya Pradesh – 487770, India.	**Order Reference:** PO.No.5500033605-057-1049 Dtd.20.07.2019 (version: 0)
Sample Description/Type	Noise Level Monitoring	
Date of Sampling	14.10.2019	
Sampling Procedure	IS 9876:1981 & manufacturer Manual	

Discipline : Chemical Testing; Product Group: Atmospheric Pollution (Ambient Air)

Location	Time (h)	Unit	Result	Limit (For Industrial Zone)	
				Day Time	Night Time
CCR Area Unit-1	16:15	dB(A)	62.4	75	70
Gate No.2	13:15	dB(A)	49.2		
Gate No.1 (Material Gate)	09:30	dB(A)	48.4		

----------END----------

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Harish Mendhi
TECHNICAL MANAGER

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Sample Description/Type	Noise Level Monitoring	
Date of Sampling	14.10.2019	
Sampling Procedure	IS 9876:1981 & manufacturer Manual	

Discipline : Chemical Testing; Product Group: Atmospheric Pollution (Ambient Air)

Location	Time (h)	Unit	Result	Limit (For Residential Zone)	
				Day Time	Night Time
Township Area	10:15	dB(A)	43.2	55	45
Meharkheda Village	11:05	dB(A)	40.3		

----------END----------

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Annexure-XI Annex. Annex. ANNEX.X

Tree Plantation Status:-

	Tree Plantation Scheme	**Plantation area**	**No. of Trees**	**Status**
1	Under Accelerated afforestation drive with the State Forest Departments of Madhya Pradesh, Bihar, Assam, Karnataka, Andhra Pradesh, Telengana and Maharashtra to plant 10 million trees..	In seven district of M.P. – 2016-17 (One time program)	Total 1 crore tree planted in all across India, Out of which 50 Lakhs tree plantation in MP. (Rest in other states)	Completed
2	Under the scheme Intended Nationally Determined Contribution (INDC-2030) creating additional Carbon Sink (10 years program)	MOU for 50 thousand tree plantation per year, through MPRVVNL in Seoni District -2016 and 2017 target completed	1 lakh tree planted	1 Lakh tree plantation for 2018 & 2019 Proposed at Near Village Chichli
3	Green Belt Development	Near Project	20000 trees	Completed through MPRVVN
		Inside Project	10500 trees	
		Road side plantation	14000 trees	
		Distribution to PAV's	2500 tree	Thr CSR