



# DB POWER (MADHYA PRADESH) LIMITED

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Ref. DB Power/MP/05

Date: 23<sup>rd</sup> May 2019

The Director  
Ministry of Environment & Forest  
Regional Office, Western Region  
Kendriya Paryavaran Bhavan  
Link Road No.3, E-5, Ravi Shankar Nagar  
Bhopal, Madhya Pradesh-462016 *Email: rowz.bpl-mef@nic.in*

Subject: Six Monthly Compliance Report for the period October 2018- March 2019

Ref: 1. EC granted vide MoEF letter no. J-13012/156/2008-IA.II (T) dated 9<sup>th</sup> September 2010 and 4<sup>th</sup> March 2016 & 30<sup>th</sup> May 2018 for 1X 660MW Thermal Power Plant  
2. Your office Letter – File No. 4-23/2010(ENV) 955 Dated 20.12.2018

Dear Sir,

We are pleased to enclose herewith six monthly Compliance Status Report for the conditions stipulated in the subject EC granted to our Thermal power plant located at Village Gorgi, Taluk-Deosar, District-Singrauli, Madhya Pradesh of M/S DB Power (Madhya Pradesh) Limited with necessary supporting documents.

Project is still under construction, major work of the project is remaining because of unforeseen circumstances which are beyond the control of the company.

With reference to your letter #4-23/2010(ENV) 955 Dated 20.12.2018, find details as required in the compliance of this letter.

Thanking you

Sincerely Yours,  
For M/s. DB Power (MP) Limited

  
Manoj Kumar Panda  
Head - Environment

*Email - manojkumar.panda@dbpower.in*

Registered Office:

Office Block 1A, 5TH Floor, Corporate Block, DB City Park, DB City Arera Mills, Opposite M. P. Nagar Zone – I, Bhopal – 462016 (M. P.)

Six Monthly Compliance Status of conditions stipulated in EC granted vide MOEF letter no: J-13012/156/2008-IA.II (T) dated: 9<sup>th</sup> September 2010 and dated 4<sup>th</sup> March 2016 & 30<sup>th</sup> May 2018 to M/s DB Power (MP) Limited for its 1x660 MW project located at Village Gorgi, Tehsil- Deosar, Dist- Singrauli, Madhya Pradesh for the period October 2018 to March 2019

**A) Specific Conditions**

Item No.	Condition	Compliance Status
1	Environmental clearance shall be applicable for 1x660 MW. However, at a later stage when firm coal linkage for second unit of 660 MW is also available, the project proponent may request the Ministry for inclusion of second unit of 660MW, which the Ministry shall consider appropriately.	Agreed.
2	Vision document specifying prospective plan for the site shall be formulated and submitted to the Ministry within six months.	Complied. Vision document submitted to MoEF Regional office at Bhopal vide our letter dated 15 <sup>th</sup> April 2011. Annexure # 1
3	Sulphur and ash contents in the coal to be used in the project shall not exceed 0.5% and 34% respectively at any given time. In case of variation of coal quality at any given time fresh reference shall be made to MOEF for suitable amendments to environmental clearance condition wherever necessary.	Plant is still under construction stage.
4	A bi-flue stack of 275 m height shall be provided with continuous online monitoring equipments for SO <sub>x</sub> , NO <sub>x</sub> and Particulate Matter. Exit velocity of flue gases shall not be less than 22 m/sec. Mercury emissions from stack may also monitored on periodic basis.	Noted and will be complied
5	Water requirement shall be restricted to 40 MCM/annum for two units of 660 MW. No ground water shall be extracted for use in operation of the power plant even in lean season.	Agreed. Presently no water withdrawal for the project. Water requirement shall be restricted to 40 MCM/annum for two units of 660 MW and shall be complied specific water consumption >3.5 m <sup>3</sup> /MW as per MOEF & CC Notification dated 7 <sup>th</sup> Dec. 2015.
6	Source sustainability study of water requirement shall be carried out by an institute of repute. The study shall also specify the source of water for meeting the requirement during lean season. The report shall be submitted to the Regional Office of the Ministry within six months.	Complied. Source sustainability study of water requirement had been completed. It was submitted to MOEF Regional office at Bhopal vide our letter dated 27.04.2011.

Item No.	Condition	Compliance Status
7	Hydro geological study of the area shall be reviewed annually and report submitted to the Ministry. 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 ground water extraction for the project is envisaged.
8	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.	Agreed
9	COC of 5.0 shall be adopted.	Agreed.
10	Local employable youth shall be trained in skills relevant to the project for eventual employment in the project itself. The action taken report and details thereof to this effect shall be submitted to the Regional Office of the Ministry and the State Govt. Department concerned from time to time.	DB Power had adopted two Industrial Training Institutes in Singrauli district for skill development of the local people. One is Construction Skill Training Centre (CSTC),ITI, Waidhan, Singrauli. 330 people had been given employment from among the locals. Economically poor meritorious students are awarded scholarship for higher studies under Urjaanchal Scheme. The people from Project affected population are given preference for the employment. Other CSR activities are also being undertaken by DB Power Ltd in the area. Annexure # 2
11	Additional soil for the leveling of the proposed site shall be generated within the sites (to the extent possible) so that natural drainage system of the area is protected and improved.	Agreed.
12	Provision for installation of FGD shall be provided for future use. High efficiency Electrostatic Precipitators (ESPs) shall be installed to insure the particulate emission does not exceed 50 mg/Nm <sup>3</sup> .	Space provision for FGD has been made in the plot plan. ESP is being designed such that particulate emission does not exceed 50 mg/Nm <sup>3</sup> .
13	Adequate dust extraction system such as cyclones/ bag filters and water spray system in the dusty areas such as in coal handling and ash handling points, transfer areas and other vulnerable dusty areas shall be provided.	Agreed.
14	Utilization of 100% Fly ash generated shall be made from 4 <sup>th</sup> year of operation of the plant. Status of implementation shall be reported to the Regional Office of the Ministry from time to time.	Plant is still under construction, the Fly ash utilization plan will be implemented as per the MoEF notifications 2009 and amendments thereon. We will submit plan for utilization of fly ash before commencement of operation.
15	Fly ash shall be collected in dry form and storage facility (silos) shall be provided. Unutilized fly ash shall be	Agreed.

Item No.	Condition	Compliance Status
	disposed off in the ash pond in the slurry form. Mercury and other heavy metals (As, Hg, Cr, Pb, etc.) will be monitored in the bottom ash as also in the effluents coming from the existing ash pond. No ash shall be disposed off in low lying area.	
16	Ash pond shall be lined with HDPE/LDPE lining or other suitable impermeable media such that no leach ate takes place at any point of time. Adequate safety measures shall also be implemented to protect the ash dyke from getting breached.	HDPE/LDPE lining besides adequate safety measures are being incorporated in construction of design of Ash pond.
17	For disposal of Bottom Ash in abandoned mines (If proposed to be undertaken) it shall be ensured that the bottom and sides of the mined out areas are adequately lined with clay before bottom Ash is filled up. The project proponent shall inform the State Pollution Control Board well in advance before undertaking the activity.	Will be complied as specified, in support with mining authorities.
18	Green belt consisting of 3 tiers of plantations of native species around plant and at least 100 m width shall be raised. Wherever 100 m width is not feasible a 50 m width shall be raised and adequate justification shall be submitted to the Ministry. Tree density shall not less than 2500 per ha with survival rate not less than 75%.	The green belt development has already begun with the construction phase. We have planted >34, 900 no of saplings in 35 acres of land. Annexure # 3
19	Two nearest village shall be adopted and basic like development of roads, drinking water supply, primary health centre, primary school etc. shall be developed in co-ordination with the district administration.	The two nearest villages namely Papal and Niwas had been adopted as required. Drinking water supply and other basic support to primary health centre and school have been extended. The villages are being developed in co-ordination with the district administration.
20	For the tribal families (if any) affected directly or indirectly by the proposed project, specific schemes for upliftment of their sustainable livelihood shall be prepared with time bound implementation and inbuilt monitoring programme. The status of implementation shall be submitted to the Regional Office of the Ministry from time to time.	Not applicable as there is no tribal family affected by proposed project.

Item No.	Condition	Compliance Status
21	The project proponent shall also adequately contribute in the development of the neighboring villages. Special package with implementation schedule for free portable drinking water supply in the nearby villages and schools shall be undertaken in a time bound manner.	DBMPL is contributing in the development of the neighboring villages by supplying free potable water etc in nearby Papal, Niwas and Mahuagaon villages.
22	Action plan for R&R (as applicable) with package for the project affected persons be submitted and implemented as per prevalent R&R policy within 3 months from the date of issue of this letter.	Complied. Action plan already submitted to MoEF vide our letter dated 25 <sup>th</sup> January 2011. The agreement has been done with the Collector, Singrauli by M/S DB Power (MP) Ltd for R&R and an amount of Rs.5,78,76,848.00 has been deposited with the Collectorate. The implementation is being done as per the policy of government of India and the government of Madhya Pradesh. Annexure # 4
23	An amount of Rs 25.0 Crores shall be earmarked as one time capital cost for CSR programme. Subsequently a recurring expenditure of Rs 5.0 Crores per annum shall be earmarked as recurring expenditure for CSR activities. Details of the activities to be undertaken shall be submitted within one month along with road map for implementation.	Complied. Detail of CSR activities being undertaken has been submitted to MoEF vide our letter dated 9th October 2010. Annexure # 2
24	While identifying CSR programme the company shall conduct need based assessment for the nearby villages to study economics measures with action plan which can help in upliftment of poor section of society. Income generating projects consistent with the traditional skills of the people besides development of the fodder farm, fruit bearing orchards, vocational training etc. can form a part of such programme. Company shall provide separate budget for community development activities and income generating programmers. This will be in addition to vocational training for individuals imparted to take up self-employment and jobs.	The CSR program has been designed on the basis of need based assessment and submitted to MoEF vide letter dated 9 <sup>th</sup> October 2010. The various CSR activities are in progress accordingly. The local youths have been trained in income generating traditional skills such as Plumbing (40 youths), Tailoring (62) and other income generating activities (66)as Masonry, Hand pump repair etc by company.  Initiatives have also been taken in developing skills as fodder farm and fruit bearing orchards.

Item No.	Condition	Compliance Status
25	It shall be ensured that in-built monitoring mechanism for the 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.	Being complied. For 2018-19 report under preparation & will be submitted later on.

**B) General Conditions:**

Item No.	Condition	Compliance Status
1	The treated effluents conforming to the prescribed standards only shall be re-circulated and reused within the plant. There shall be no discharge outside the plant boundary except during monsoon. Arrangements shall be made that effluents and storm water do not get mixed.	The plant is designed based on zero discharge concepts. The layout of plant has been designed such that effluents and the storm water do not mix.
2	A sewage treatment plant shall be provided (as applicable) and the treated sewage shall be used for raising greenbelt/plantation.	Agreed
3	Rainwater harvesting should be adopted. Central Groundwater Authority/ Board shall be consulted for finalization of appropriate rainwater harvesting technology within a period of three months from the date of issue of clearance and details shall be furnished to the Regional Office of the Ministry.	The report had been submitted on 17 <sup>th</sup> March 2011. Hydro geological investigation & rain water harvesting system scheme is attached as Annexure # 5.
4	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.	Will be complied as applicable. Risk assessment and safety measure in mentioned in EIA report as Annexure # 6.
5	Storage facilities for auxiliary liquid fuel such as LDO and/HFO/LSHS shall be made in the plant area in consultation with Department of Explosives, Nagpur. Sulphur content in the liquid fuel will not exceed 0.5%. Disaster Management Plan shall be prepared to meet any eventually in case of an accident taking place due to storage of oil.	Shall be complied as required.
6	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	Will be Complied as required.

Item No.	Condition	Compliance Status
	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.	
7	Monitoring surface water quality and quantity 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.	Regular Monitoring of Surface and ground water is under progress. The results of analysis are attached Annexure #7.
8	First aid and sanitation arrangements shall be made for the drivers and other contract workers during construction phase.	First Aid facility is made available to workers at site. Separate sanitation facilities for Female and male worker have been provided at the construction site.
9	Noise levels emanating from turbines shall be so controlled such that the noise in the work zone shall be limited to 75 dB. For people working in the high noise area, requisite personal protective equipment like earplugs/ ear muffs etc. 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.	Shall be complied as required. The results of Periodical monitoring of Ambient noise Quality is enclosed as Annexure # 7.
10	Regular monitoring of ground level concentration of SO <sub>x</sub> , NO <sub>x</sub> , PM <sub>2.5</sub> & PM <sub>10</sub> and Hg shall be carried out in the impact zone and records maintained. If at any stage these levels are found to exceed the prescribed limits, necessary control measures shall be provided 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 the Ministry. The data shall also be put on the website of the company.	The results of periodical monitoring of Ambient Air Quality is enclosed as Annexure # 7.
11	Provision shall be made for the housing of construction labor (as applicable) within the site with all necessary infrastructure and facilities such as fuel for cooking, mobile toilets, mobile STP, safe drinking water,	The necessary facilities are being provided by the Proponent for construction workers.

Item No.	Condition	Compliance Status
	medical health care, crèche etc. The housing may be in the form of temporary structures to be removed after the completion of the project.	
12	The project proponent shall advertise in at least two local newspapers 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 also be seen at website of the Ministry of Environment and Forests at <a href="http://envfor.nic.in">http://envfor.nic.in</a> .	Complied.
13	A copy of the clearance letter shall be sent by the proponent to concerned Panchayat, ZilaParisad/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.	Complied.
14	An Environment cell shall be created at the project site itself and shall be headed by an officer of appropriate seniority and qualification. It shall be ensured that the head of the Cell directly report to the head of the organization.	A separate EMC has been established. It is headed by a Senior officer. Same is suitably staffed. He reports directly to Station head.
15	The proponent shall upload the status of compliance of the stipulated EC 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 (PM <sub>2.5</sub> & PM <sub>10</sub> ), SO <sub>2</sub> , NO <sub>x</sub> (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.	Being Complied. <a href="https://diligentpower.com/html/safety.html">https://diligentpower.com/html/safety.html</a>
16	The environment statement for each financial year ending 31 <sup>st</sup> 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	Will be complied as applicable.

Item No.	Condition	Compliance Status
	environmental clearance conditions and shall also be sent to the respective Regional Offices of the Ministry by e-mail.	
17	The project proponent shall submit six monthly reports on the status of the implementation 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 environmental clearance conditions on their website and update the same periodically and simultaneously send the same by e-mail to the Regional Office, Ministry of Environment and forests.	Complied.
18	Regional Office of the Ministry of Environment & Forests will 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 will 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 NO <sub>x</sub> (from stack & ambient air) shall be displayed at the main gate of the power plant.	Complied.
19	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.	Being complied.
20	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.	<ul style="list-style-type: none"> <li>• Date of financial Closure- 20.04.2012</li> <li>• Land development work started from October 2010.</li> </ul>
21	Full cooperation shall be extended to the scientists/officers from the Ministry/ Regional Office of the Ministry at Bangalore/CPCB/SPCB who would be monitoring the compliance of environmental status.	Full cooperation is extended to the Scientists / Officers from the Ministry / Regional Office of the Ministry at Bhopal / CPCB / SPCB as and when required.

**VISION DOCUMENT**

**FOR PROPOSED 2X660 MW COAL BASED  
THERMAL POWER PROJECT  
AT VILLAGE - GORGI, TEHSIL-DEOSAR,  
DISTRICT - SINGRAULI  
MADHYA PRADESH**

**By**



**M/s D.B. Power (Madhya Pradesh) Limited**

**MARCH - 2011**



**VISION DOCUMENT FOR PLANT SITE**  
2X660MW Coal-Based Thermal Power Plant  
District: Singrauli, Madhya Pradesh

**TABLE OF CONTENT**

- 1. Introduction**
  - The Vision Document
  - The Project Proponent
  - Project Background
  - Location of Site
  - Status of Phase I
- 2. Environment Conditions**
  - Land
  - Area Drainage
  - Rainwater Harvesting
  - Air
  - Ash Management
  - Green Belt Development
  - Organization for Ash Management
- 3. Social Conditions**
  - R&R Activities
  - CSR Activities
  - CSR Unit



# VISION DOCUMENT FOR PLANT SITE

## 2X660MW Coal-Based Thermal Power Plant

District: Singrauli, Madhya Pradesh

## 1. INTRODUCTION

### THE VISION DOCUMENT

The Vision Document has been prepared as per the requirement of the EC conditions laid down by Expert Appraisal Committee, MoEF. The site identified for the project will have an ultimate capacity of 2640MW with four units of super-critical 660MW. The document describes the environment and socio-economic impact the project will have on the site and its adjoining areas for the ultimate capacity of 2640MW. The management of the site with minimum impact on the environment will also be described. This document has been prepared based on the assumption that the 2640MW power plant will operate for a period of 25-30 years.

### BACKGROUND OF THE PROPONENT

DB Power (Madhya Pradesh) Ltd is a company under the Bhaskar Group of Companies. Bhaskar Group is a multifaceted industry major with a turnover of Rs.2000 crores. Founded half-a-century ago, the group's initial foray was into the newspaper publication business. Since the mid-80's, the group has diversified into sectors such as textiles, solvent extraction, oil refinery, export of polished semi-precious stones, electronic media and information technology, real estates and theme/ amusement parks, and FMCG. The activities of the Group are spread across 14 states and employ more than 12,000 employees.

The company is planning to set up a coal-based power plant project of 2640 MW in the state of Madhya Pradesh for which company has applied for long-term coal linkage. Another power plant of capacity 2520MW has been proposed in Janjgir Champa District of Chhattisgarh. Over a period of next 3-5 years, company is committed to set up facilities to generate more than 6000 MW of power, largely coal-based.

### BACKGROUND OF THE PROJECT

D B Power (Madhya Pradesh) Ltd. is setting up 2640MW (4x660MW) Coal-based Thermal Power Project at Gorgi, Tehsil Deosar, District Singrauli, Madhya Pradesh in 2 phases. The Environment Clearance of Phase I (2x660MW) has already been received from EAC, MOEF in September 2010 and construction is in progress. The Consent to Establish has been also given by Madhya Pradesh Pollution Control Board, Bhopal in March 2011. The TOR for Phase II (2x660MW) has been also presented to MoEF in March 2011.

Coal for the project would be indigenous and will be sourced from Northern Coal Fields on long term basis. The company is also in the process of applying for allotment of coal blocks in the surroundings. Water requirement of the proposed plant will be met from Gopad River. The plant water requirement is estimated to be 80 MCM per annum for ultimate capacity. The water has been already allocated by Water Resource Department, Govt. of Madhya Pradesh.

### LOCATION OF SITE

The project site is located in Gorgi village of district Singrauli, Madhya Pradesh. Due care has been taken while identifying the project site to avoid habitations, forest lands and vicinity of wildlife sanctuaries, National Parks and other sensitive areas. The total land requirement for the ultimate capacity of this project activity is 995 acres.

The location is well connected from Niwas Road Railway Station on Katni-Singrauli-Chopan main-line. Water for the project will be drawn from Gopad River at a distance of 1.5 kms from the project site.

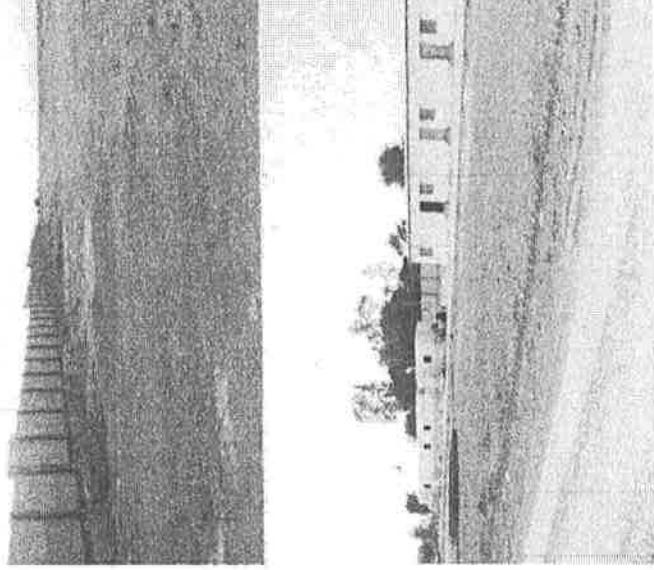


**VISION DOCUMENT FOR PLANT SITE**  
**2X660MW Coal-Based Thermal Power Plant**  
**District: Singrauli, Madhya Pradesh**

**STATUS OF PHASE I**

As mentioned earlier, the construction work for Phase I of the plant has been started since October 2010. The progress of work till date is given below:

- Land is already in possession of D B Power (Madhya Pradesh) Ltd.
- Order for Main Plant Equipment (BTG) and Balance of Plant (BOP) already placed
- The engineering consultant is M/S Desein.
- Construction of boundary wall has already been completed.
- Soil Investigation and geo-technical study completed
- Civil construction work for entire plant has already started with the target for commissioning of Unit I by July 2014.
- As per compliance to Environment clearance DBP(MP)L has already submitted CSR activities , R&R action Plan, Rainwater Harvesting Technology to MoEF , New Delhi and their Regional Office in time.



**VISION DOCUMENT FOR PLANT SITE**  
**2X660MW Coal-Based Thermal Power Plant**  
**District: Singrauli, Madhya Pradesh**

## **2. ENVIRONMENT**

### **LAND**

As already mentioned the land required for the project is 995 acres (735 acres for Phase I and 260 acres for Phase II). All the land for the Phase I has been acquired. There is no forest land involved in the project. Acquisition of balance revenue land for Phase II is in progress. The land acquired for the project is mainly single-crop agricultural land and barren land.

The 995 acres of land required for ultimate capacity will be mainly divided into plant area, ash dyke, green belt, water reservoir and township area. The area designated for the plant site is 330 acres, which will include all plant facilities. Due to the new notification for ash utilization, where there will be 100% utilization by 4<sup>th</sup> year of plant operation, the area finally used will be lesser. The dyke area for Phase II has been reduced drastically with the assumption that the area of Phase I will be re-used for Phase II. Thus the land wasted for the dyke will be minimal. Similarly the land used for green belt and reservoir will be 409 acres and will help in CO<sub>2</sub> reduction in the area. Efforts have been made in the designing that areas where the plant facility is not coming, to maintain the natural topography so that the drainage is not much affected. As the plant site does not have much vegetation, development off the green belt will help in greening the area.

### **DRAINAGE AND WATER INTAKE**

A suitable reservoir will be made on River Gopad to cater the water requirement during lean period. The water will be transported through a dedicated pipeline with pump house at the source and adequate number of pumping stations.

Sidhi and Singrauli district are mainly drained by three rivers, Son, Gopad and Banas, which are all perennial in nature. However the study area is drained by Gopad River flowing from south to north and located at a distance of 3.5 km from the project area. Gopad River serves as the principle water sources for irrigations purposes in the study area. A second order stream is passing from the area and meeting Karaundia nala flowing in the northern part of the study area and located at a distance of 3 km from the project site. The Karaundia nala merges to Kandas Nadi at a distance of 7 km from the project site flowing in the eastern part of the study area and ultimately meets to the Gopad River.

The total requirement of water for the power plant is 80 MCM as suggested by the project authorities. A detailed hydrological and water availability study have been conducted by WAPCOS to ascertain the availability of water and the propose suitable structures for storage of the water. This availability of water is stimulated by computing the rainfall and run-off data of River Gopad for 1979-80 to 2007-08 years. Two small dams will be constructed to cater to the water requirement of the plant. From the data available, the requirement of 55 MCM water for Phase-I can be fulfilled by constructing a dam.

The location of intake for drawing desired quantity of water has to satisfy certain conditions. The location is planned in such a way that:

- Required quantity of water is available
- Ambient sediment concentration is least.
- Adequate depth is available for ensuring water supply at different elevations.
- The distance from the proposed end, use location is minimum
- Site is accessible during all seasons
- Adequate space for down loading
- Erections of machinery required for construction is available.



## **VISION DOCUMENT FOR PLANT SITE** **2X660MW Coal-Based Thermal Power Plant** **District: Singrauli, Madhya Pradesh**

It was found that the site is feasible from geological, geo-technical, social and environmental consideration.

During flood, water level in the reservoir rises temporarily above FRL. Maximum water level will correspond to temporary water level up to which water in reservoir will rise when design inflow hydrograph is routed through reservoir (with initial reservoir level at FRL) and discharge is passing over dam with all gates open. Sufficient dam capacity shall be provided in the dam(s) so that rise in reservoir level is limited to 1m to avoid excessive submergence. Thus maximum water level may be taken as FRL plus 1 m.

It has been also calculated that the life of the reservoirs will be more than that of the plant (it has been taken as 25-30 years). So there will be no requirement of alternate sources for water during the plant operations.

### **RAINWATER HARVESTING**

A study on Rainwater Harvesting was conducted by consultant In-Situ Enviro-care, Bhopal. The objective was to study hydro-geological environment for rainwater harvesting system at proposed premises.

Ground water is the part of precipitation that seeps (infiltrates) deep into the ground. It flows downward by gravity until it reaches a hard layer of rock i.e. impermeable to water. Just above this impermeable rock layer is saturation zone, where all water that has soaked deep underground is stored. Most of the rocks contain numerous open spaces, called interstices, in which water may be stored and can move. The pore spaces (tiny spaces or fractures between pieces of rock or soil) in this zone are completely filled with water.

**Geology of Project Site:** The area is mainly represented by rocks of Gondwana Super Groups and recent alluvial fills. At surface the sandstones are of weathered nature. The thickness of weathering extends up to 5 m below ground level. The rocks are medium to coarse grained in nature. The nature of compactness increases with the depths. Along the nala sections recent alluviums are exposed. Ground water is mainly occurs in the weathered and fractured sandstone. Only a small part of the area is covered by the intrusive rocks of dolerite dykes.

**Depth to water level:** Based on the well inventoried and measurement of water level at the time of field investigation, reported groundwater level in summer season (pre monsoon) and actual ground water level measurement in winter (post monsoon) the following conclusion were drawn.

**Post monsoon depth to water level:** Based on field data and well inventoried, depth to water level map of post monsoon period of the investigated area has been prepared. The water level in the post monsoon seasons varies in the range of 3.00 m to 12.0 m bgl. In general average water level ranges between 8 to 10 m bgl. Variation in general ground water level is due to only due to the ground surface slope.

**Pre monsoon depth to water level:** The field information was collected by the enquiry with the local people and farmer and it is inferred that ground water level during pre-monsoon ranges from 15 to 20 m bgl.

**Seasonal fluctuation:** It is a fact that in and around area the fluctuation in groundwater level is mainly due to withdrawal, recharge and movement of groundwater. A seasonal ground water level fluctuation has been observed on the basis of field data and inventoried wells.

On the basis of the hydro-geological survey and geo-physical investigations it is inferred that three aquifer systems exist in study area. On the basis of aquifer allocation following ground water recharge and groundwater monitoring structures are recommended.

**Storm Water Drainage Structures:** To collect the storm water, suitable numbers of recharge pits with the dimension of 1.0 m x 1.0 m x 1.0 m filled with filter material is recommended at distance of 100 m along the sloping ground as per the availability of open land. The bottom of the



**VISION DOCUMENT FOR PLANT SITE**  
**2X660MW Coal-Based Thermal Power Plant**  
**District: Singrauli, Madhya Pradesh**

recharge pit will be open. The rainwater collected in form of storm water will be collected in the pit and it will recharge phreatic aquifer system.

**Roof Top Rainwater Harvesting:** To collect the rooftop rainwater 3 recharge pits in power plant area and 2 recharge pits in staff colony and administrative building with the suitable dimension filled with filter material is recommended. Rainwater from the rooftop area will be collected from roof through 5" diameter PVC pipe and it will lead to the recharge pit. Through this recharge, the phreatic aquifer system will be recharged. The major part of the proposed roof area is identified for recharging. A 30 m deep and 6" diameter bore well is recommended to drill inside each recharge pit to enhance the ground water recharge.

**Recharge through Stop Dam:** A stop dam site is recommended for recharging the phreatic aquifer system. The rainwater will be collected in the stop dam and it will recharge the weathered phreatic aquifer system in the area. Construction of stop dam will also add to the activities of Corporate Social Responsibility.

### **AIR**

Coal based thermal power plants emit fly ash as the major pollutant besides varying degrees of other pollutants namely: coal dust, sulphur dioxide and oxides of nitrogen etc. A detailed modeling for air dispersion due to the plant has been conducted and it has been found that the air quality outside plant will be within the standards prescribed by CPCB. Therefore it is recommended to monitor the concentration of particulate matters, SO<sub>2</sub> and NO<sub>x</sub> in the ambient air at regular intervals at predetermined locations.

The control measures to combat air pollution due to proposed power plant have been formulated under two categories, i.e. for individual units as well as for the whole power plant in general. These are delineated hereunder:

- **Coal Handling System:** Dust emission is mostly of fugitive type and necessities installation of close conveyor system along with suitable dust trapping/control facility at various transfer points. At coal yard, to prevent dust emission due to wind erosion, frequent spraying of water is recommended. This also prevents spot fires.
- **Coal Crusher and Bunkers:** For the fine dust control, bag filters have been successfully tried in such operations. Better efficiency dry collection system shall prove to be long term cost effective because of possibility of coal recovery in the process.
- **Flue Gas:** For high efficiency collection of fly ash in flue gas from the boiler, a high efficiency ESP is proposed to be installed in this plant and that would be designed to limit the emission of the particulate matter for permissible level. Sprinkling of water will be applied at the dust generating areas.

As far as gaseous pollutants namely NO<sub>x</sub> and SO<sub>2</sub> are concerned, control measures will be taken by provision of 275m stack as per regulations in the EPA, 1986.

**General Measures:** The following air pollution control measures have been recommended for implementation at the proposed power plant:

- Furnaces and boilers should be operated with minimum excess air so that fuel consumption is reduced and NO<sub>x</sub> emissions are minimized. Low NO<sub>x</sub> burners should be installed for further reduction in NO<sub>x</sub> emission.
- The stack should have sufficient capacity to take care of emergency release conditions, for additional load of flue gas under boiler start up and shutdown periods.
- All the internal roads shall be asphalted to reduce dust emission due to vehicular movement.
- The combustion units shall be maintained properly for obtaining optimum efficiency and to ensure that the emission rates remain within estimated levels.



## VISION DOCUMENT FOR PLANT SITE 2X660MW Coal-Based Thermal Power Plant District: Singrauli, Madhya Pradesh

- Green belt developed along the plant boundary will help in reducing emission

The fugitive emissions of coal dust from storage facilities, from crushers and at coal transfer points should be reduced by adopting appropriate measures like cyclones/ bag filters/ water sprinklers/ fog system.

### ASH MANAGEMENT

As per the new Ash Notification, 100% ash utilization has to be done within 4 years. Proper lining will be provided in the ash dyke to avoid any leaching to the ground. Ash (both fly and bottom) will be used for cement manufacturing, brick and tiles making and road making/paving. The utilization plan of ash is described below.

**Cement:** M/s Asstech India Pvt., Mumbai, Welcon-techno and Citi-transport Limited have agreed for MOU for lifting full quantity fly ash. Negotiation with them is at the final stage and they will be lifting ash from the first day of production.

**Bricks, blocks, tiles, etc:** There are about 20 potential fly ash brick manufacturing units in the region. Besides, there are more than 100 clay brick manufacturing units in the region who can use at-least 15% fly ash (by weight of soil) in clay brick making, which is also mandatory as per MoEF notification. It is expected that at least 0.36 MMTPA fly ash would be consumed by the brick industry.

D B Power (Madhya Pradesh) Limited is also planning to develop an Industrial Estate to enable local entrepreneurs to set up units to make ash-based products. This will help both in ash utilization and also developing livelihood for local people.

**Road and Embankment:** The target of Ministry of Rural Development (GOI) is to construct a minimum of 100 km rural road in each district of the country, under Pradhan Mantri Gramin Sadak Yojna (PMGSY) annually. Considering the projects under PMGSY in Singrauli and Sidhi Districts, about 200 km length road (8m wide, 1m high and 1:2 slopes) will be constructed under the scheme every year. If fly ash/ bottom ash is used upto 70% as a substitute of soil, the quantity of fly ash to be used will be approximately 1.4 MTPA of fly ash/ bottom ash (considering the bulk density of fly ash to be  $1g/cm^3$ ). This is in line with the notifications issued by MoEF. Necessary action plan would be drawn-up in consultation with the concerned agencies for the availability and application of ash.

It is envisaged that by the end of 10 years of plant operations with full capacity all ashes in the dyke will be utilized and the land area will be reclaimed. The area can be treated and used for social forestry through joint management of DB Power (Madhya Pradesh) Limited and Gram Panchayats.

### GREEN BELT DEVELOPMENT

With a view to attenuate air pollutants, to absorb noise and to care of uptake of water pollutants, it is recommended to develop a greenbelt on 291 acres of the total acquired area, all around the boundary and at several locations within the power plant premises.

A concept of three tier green belt development viz. rows of permanent trees in say 20 m width, followed by avenue trees with medium canopy in a width of approximately 10 m may be planted along the periphery of the plant, thereby developing approximately 50 m wide green belt all along the plant boundary. The various services / utility areas within the plant would be suitably graded to different elevations. Natural features of the plant site would be retained as far as possible to integrate with the buildings to form a harmonious / pleasant environment. Areas in front of various buildings and the entrance of power plant would be landscaped with ground cover, plants, trees based on factors like climate, adaptability etc. The green belt would consist of native perennial green and fast growing trees. Trees would also be planted around the coal stock pile area and ash disposal area to minimize the dust pollution.



## **VISION DOCUMENT FOR PLANT SITE** **2X660MW Coal-Based Thermal Power Plant** **District: Singrauli, Madhya Pradesh**

The plant species that may be useful for development of thick green cover keeping in view the nature of pollutants expected from power plant and pollution attenuation coefficient of plants, the following plants species are short listed for plantation.

The design and implementation of greenbelt within and around the complex of proposed power project shall follow the guidelines published by CPCB. The species identified for greenbelt development would be planted using pitting technique. The filling of soil should be completed at least 5-10 days before actual plantation. Healthy saplings of identified species should be planted in each pit.

### **ORGANIZATION FOR ENVIRONMENT MANAGEMENT**

#### **Environment Management Cell: Structure and Responsibilities**

A separate Environment Management Cell comprising of a team of experienced and qualified personnel reporting to a very senior level executive preferably an environmental engineer has been set up. Staff will be trained for environment control measures like air, water quality monitoring, solid waste management, noise abatement etc. Staff would also be trained to operate ESP and other pollution control equipment at optimum efficiency. The Environment Management Cell will be responsible for managing the following activities related to environment function of proposed Power Plant:

- Coordinate and manage the EMP implementation during pre-construction, construction and operation phase
- Appoint dedicated environment staff to manage environmental monitoring responsibilities
- Manage and coordinate environmental monitoring and control
- Coordination with other sections of the plant and government agencies in relation to environmental management activities
- Implement and monitor greenbelt protection and plantation activities
- Safety specialist will ensure safe working practices in all the sections of the plant

#### **Implementation of Environment Management System (ISO 14000)**

A structured and certified environment management system is suggested at the industry level for ensuring that all the activities, products and services conform to International environmental and social requirement. These shall include latest international technologies and practices. Certification of Environmental Management System to ISO 14001, assess how an organization handles environmental risks. ISO14001 is the international standard for Environmental Management Systems. This generic standard is applicable to any organization in any industry. For the proposed thermal power plant, the Environmental and Social Management System and its set up, role and responsibilities will be based on the requirement of ISO 14000 certification.

It has been calculated that D B Power (Madhya Pradesh) Limited will incur a one-time cost of approximately INR 450 crores for installing pollution control equipments, development of green belt and setting up of laboratory for sample testing. Other than the above the annual recurring cost for monitoring and green belt maintenance will be about Rs. 590 lacs excluding manpower cost.



**VISION DOCUMENT FOR PLANT SITE**  
**2X660MW Coal-Based Thermal Power Plant**  
**District: Singrauli, Madhya Pradesh**

### 3. SOCIAL DEVELOPMENT

#### R&R ACTIVITIES

As already mentioned, there will be no displacement due to the project. As a result the entire project affected people will benefit both from the R&R Compensation as well as the development activities to be carried out by DBPMPL under their CSR programme. The total compensation package has been developed as per the MP R&R Policy and has been sanctioned by the District Authorities.

#### CSR ACTIVITIES

As part of the Corporate Social Responsibility, D B Power has plans to undertake socio-economic and infrastructure development in the villages adjacent to the plant site. The company being a socially aware and responsible organization believes in integrated development. It is understood by the company that the power plant alone cannot bring about socio-economic development in the area. There has to be overall change in the socio-cultural, economic and infrastructural status in the target area. It is envisaged that upon implementation of community development programmes/welfare measures, as will be decided, would lead to increase in subjective Quality of Life Index QoL(s), which ultimately will result in increase of cumulative quality of life QoC (C) in the project area.

Various activities of social development and CSR already carried out by the group are being channelized in an organized manner in order to generate better results. Two villages, viz Papal and Niwas has been selected for initiation if CSR activities and this will slowly spread out to other villages over a period of five years. It is planned that about 6 villages will be adopted for intensive development, while other neighbouring villages will be provided with infrastructure facilities and livelihood programmes.

The focus areas for development activities are as follows:

- Healthcare and Sanitation
- Education
- Infrastructure development
- Skill Development

The schemes and programmes planned to be implemented is given below. Most of these programmes has been already initiated and are being implemented in Papal and Niwas villages.

#### HEALTH

- Setting up of dispensary/health center with hospitalization facility and necessary equipments for tests/treatment/ operation
- Providing hearse services.
- Awareness programmes & health camps.
- Immunization camps
- Nutrition programmes for pregnant ladies and children.



**VISION DOCUMENT FOR PLANT SITE**  
**2X660MW Coal-Based Thermal Power Plant**  
**District: Singrauli, Madhya Pradesh**

**INFRASTRUCTURE**

- Water facilities including restoration of ponds, digging bore wells, hand-pumps, constructing water tanks etc.
- Water Treatment plant to provide drinking water to villagers.
- Rural roads and pavements from fly-ash, parks, sports facilities
- Creating common facilities like community centre, restoration of religious facilities, Panchayat Bhawans, etc.
- Water Harvesting facilities
- Street illumination in the villages.



**EDUCATION**

- Construction and restoration of schools.
- Counseling for admission to school and higher education
- Providing computers/ equipment/ furniture to schools
- Support to deserving/meritorious BPL students by providing free books.
- Appropriate jobs to locals at plant facilities.
- Placement support to skilled youth with better employers.



**SKILL DEVELOPMENT & LIVELIHOOD GENERATION**

- Creating skill training centers with infrastructure, equipment, material etc
- Strengthen infrastructure and equipment and academics in nearby ITIs and skill development centre
- Providing training to local youth and prepare them, so that they can be absorbed during operation of plant. It has been considered that 60% of manpower during operation will be locally recruited.
- Create cottage industry clusters of SHGs in various products.
- Capacity building of farmers through training, technical support and better marketing avenues

DBPMPL foresees an overall development of the area within a span of 5 years. Introduction of educational institutions, training centres, up-gradation of school education, etc will help in improving the quality and capability of the manpower in the area. This will increase their capacity to get employment in the already industrialized area. Development of health and physical infrastructure will act as a catalyst to improve the physical quality of life of the villagers.

It has been decided that about INR 25 crores as part of the Phase I CSR activity. It will be spent over a period of 5 years. The future expenditure and planning will be done after monitoring the effectiveness of the programmes after 5 years.



**VISION DOCUMENT FOR PLANT SITE**  
**2X660MW Coal-Based Thermal Power Plant**  
**District: Singrauli, Madhya Pradesh**

**BUDGET (CAPITAL EXPENDITURE)**

Particular	Adopted Village	Project Influence Villages	Rs in Lacs	
			TOTAL	TOTAL
Health*	585	240	825	
Infrastructure	215	300	515	
Education	80	180	260	
Skill Development*	210	162	372	
Misc.	221	307	528	
<b>Total</b>	<b>1311</b>	<b>1189</b>	<b>2500</b>	

**ORGANIZATION FOR IMPLEMENTATION OF SOCIAL DEVELOPMENT ACTIVITIES**

The CSR activities of DBPMPPL will be undertaken through Bhaskar Foundation, which is a nonprofit charitable trust promoted by Dainik Bhaskar Group. Bhaskar Foundation provides expert advice, operational support and monitors CSR activities of DB Power Ltd. The aim is to run the CSR activities as per best practices and as per the best professional standards. A team of qualified and dedicated workers have been already employed at site to look after the implementation of CSR activities and programmes.



## CSR Activities

### Coverage Area

Villages identified for intervention

- Niwas
- Papal
- Mahuagaon
- Chhamrach are the affected villages.

# Establishment of Tailoring Centre



## Inauguration of tailoring centre by Ex MLA Tilak Raj Singh & Certificate distribution programme

1. A tailoring training centre started with 20 candidates at Niwas.
2. A number of 62 females have been trained from this centre.
3. Trained candidates are given certificates after successful completion of the course.

# Women Empowerment Activities



1. A total of 23 women SHG's in Papal, Chhamrach, Niwas and in Mahuagaon villages were formed.
2. They have been trained on mixture making, Jam & Jelly making, and poultry etc
3. Well received by villagers

# Establishment of Plumbing Centre



Sri Sanjay Ganjoo, Head CSR, with the student of Plumbing Centre

1. A plumbing training centre has been established at Niwas..
2. A total of 40 candidates trained from this centre.
3. Getting good business in adjoining urban areas

Left - Smt. Radha Singh, President Zila Panchayat, Singrauli addressing the audience during inauguration of Plumbing Centre at Niwas

# Orientation Programme



1. DBPLMP organized a session where Zila Udyog Kendra(zuk) and LIC officials explained to villagers purpose of 2 organizations. > 100 participants from SHG's and PAP's participated.
2. ZUK explained villagers purpose of Kendra as LIC officials explained how they should invest to multiply the money.

# Facts & Figures

Sl. No.	Activities	Village	No of Beneficiaries
1	Establishment of Tailoring Centre	Niwas	26+36 Candidate
2	SHG Formation (23 SHG Formed)	Katai, Hardi, Papal Mahuagaon , Niwas and in Hardi	271 Members
3	Certificate Distribution Programme	Niwas	26 Candidate
4	Establishment of Plumbing Centre	Niwas	20+20
5	Training on income generating activities	Niwas, Chhamrach	50+ 16
6	Orientation programme	Niwas & Papal	More than 100 PAP's, SHG Members & other land losers
7	Employment		370 Employees

# Education & Capacity Building Programme



1. In Balika Prathamik Vidyalaya, Niwas DBPLMP has provided computer table and chairs to start computers lying ideal in the school.
2. 12 educated PAP's were engaged as assistant teacher in primary schools of Chhamrach, Niwas, Papal and Mahuagaon villages.
3. Primary schools students were provided school bags.



# Adult Education (Inaugural Function)



1. On recommendation of the Panchayat, DBPL awarded scholarship to meritorious by DBPLMP.
2. Adult education centre has been started at Niwas by DBPL.

# Facts & Figures

Sl. No.	Activities	Village	No of Beneficiaries
1	Support of Computer table and chair in Balika Prathmik Sala,	Niwas	94 Students
2	Provided additional teachers in schools (No. of Teachers-9)	Niwas, Papal, Chhamrach	1561 Students
3	School Bag Distribution in the primary schools of adopted villages	Niwas, Chhamrach, Papal & in Mahuagaon	1500 Bags
4	Establishment of Adult Education	Niwas	20+35=55
5	Scholarship Distribution	Niwas & Papal	12 Students

# Health & Family Welfare Programme



1. For 30 Beded hospital Bhumipujan has been done by Govind Mishra (MP, Sidhi).
2. A First Aid Centre has been established at Papal village.
3. Rural Medical camps are organized in all the project affected villages by DBPLMP.
4. An Ambulance has been procured for providing referral services to the area.
5. Fogging done in the area to control malaria.



# Facts & Figures

Sl. No.	Activities	Village	No of Beneficiaries
1	Shilanyas & Bhoomipujan of 30 Beded Hospital	Papal	Construction awaited
2	Malaria Control Programme	All nearby villages of the project (15 Villages covered)	In 2808 (HH Spray Work) Treatment of 284 waterlogged places
3	Referral Services	For all nearby villages of the project	232 Cases
4	Establishment of First Aid Centre	Papal (For all nearby villages of the project)	1162

# Infrastructure Development



1. Family Health Centre has been renovated at papal.
2. Bore wells have been dug at Niwas and Papal
3. Ponds have been cleaned and deepened at Papal & Niwas.
4. Bathrooms have been constructed in Papal and Niwas villages.
5. Leveling of play ground at papal have also been done.



# Facts & Figures

Sl. No.	Activities	Village	No of Beneficiaries
1	Digging of 6 Bore wells	Niwas Papal	Community
2	2 Pond Repairing	Papal & Niwas	Community
3	3 Bathroom Construction	Niwas & Papal	Community
4	Leveling of Play Ground	Papal	214
5	Renovation of FWC	Papal	Community

# Social activities



# Facts & Figures

Sl. No.	Activities	Village	No of Beneficiaries
1	Organized Ramleela & Ganesh Pooja	Niwas	Community
2	Cricket Tournament	Niwas	8 Teams of Local villages
3	Establishment of Pyaoo	Niwas, Hardi, Mahuagaon, Chhamrach & Papal	Community
4	Hand pump Repairing	Niwas, Papal & Mahuagaon	11 Hand pumps
5	Digging of 6 Bore wells	Niwas & Papal	Community
6	Blanket Distribution	Niwas, Papal, Chhamrach & Mahuagaon	200 Poor people
8	Drinking Water Facility	In all nearby villages of the project	53 Tankers Supplied
9	Celebration of World Environment Day	DB Power office	
10	Celebration of National Festival	DB Power office	
11	Formation of VDC	Niwas	Community

## Expenditure Sheet of CSR

Year	Rs.
2010-11	523, 028
2011-12	19810715
2012-13	39,064,554
2013-14	6,173,066
2014-15	5167688
2015-16	5128000
2016-17	5125000
2017-18	5120843
2018-19	5120945

# Green belt

Annexure # 3

The green belt development has already begun with the start of construction phase. More than 22 acres of land has already been covered under green belt.

Area covered - 35 acres

Saplings planted - 34900 Nos.

Survival Rate - >80%

Name of Species - Native sp. as Shishum, Siris, Alstonia etc, avenue sp. like Peltaphorum Kachnar, Karanj and Guava orchard

Expenditure - Rs. 20,93, 040

Peltophorum sp.



Gulmohar sp.



Alstonia Sp.



Karanj(Millettia pinnata)



# Shishum (*Dalbergia sissoo*)



कार्यालय अपर कलेक्टर एवं मू-अर्जन अधिकारी, जिला-सिंगरौली (म.प्र.)  
क्रमांक / १५ / मू-अर्जन / 2011 दिनांक- 02.11.2011  
प्रति.

प्रोजेक्ट हेड,  
डी.बी. पावर (मध्यप्रदेश) लिमिटेड  
ग्राम-गोरगी तह0 देवसर  
जिला-सिंगरौली (म0प्र0)

विषय :- ग्राम गोरगी की निजी भूमि रकवा 56.57 है0 की अन्तर की राशि  
जमा करने बावत् ।

विषयांतर्गत डी.बी.पावर (मध्यप्रदेश) लिमिटेड के पावर प्रोजेक्ट की  
स्थापना हेतु अर्जित ग्राम- गोरगी की निजी भूमि रकवा 56.57 है0 एवं उन पर स्थित  
परिसंपत्तियों का एवार्ड दिनांक- 02.11.2011 को पारित एवं घोषित किया जा चुका है ।

आपके द्वारा दिनांक 02.11.2011 को किये गये संशोधित करारनामे के  
अनुसार उक्त भूमि के अन्तर की राशि 5,78,76,848.00 रू0 (शब्दों में पाँच करोड  
अठहत्तर लाख छिहत्तर हजार आठ सौ अड़तालीस रू0 मात्र) अपर कलेक्टर एवं सहायक  
पुनर्वास अधिकारी के खाता कं0 397502010119833 यूनियन बैंक आफ इंडिया शाखा  
निवास में जमा करने का कष्ट करें।

  
अपर कलेक्टर, सिंगरौली (म.प्र.)  
एवं मू-अर्जन अधिकारी  
जिला-सिंगरौली (म.प्र.)

UNION BANK OF INDIA  
 NAGRI NIWAS  
 AT AND POST NAGRI NIWAS  
 BEHIND HIGH SCHOOL NIWAS, DISTT SIDHI  
 PHONE: 07805-200400

DATE: 04-11-2011 ✓

MR RRR A/C - D B POWER (MP) LTD  
 ADDL D N & RRR D B POWER LTD  
 ADDL D N & RRR D B POWER LTD  
 NAGRI NIWAS-486667  
 MADHYA PRADESH, INDIA

CUST ID : 216377271

STATEMENT OF ACCOUNT FOR THE PERIOD FROM 02-11-2011 to 04-11-2011 SDGEN-A/C NO: 397503010119833 SB GENERAL (SB GENERAL) INR

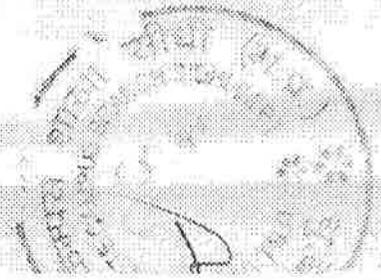
DATE	PARTICULARS	CHQ. NO.	WITHDRAWALS	DEPOSITS	BALANCE
02-11-2011	017				0
	SIDHI, COLLECTORATE CAMPUS				
11-11-2011	By DD POWER MP			5,78,76,848.00	5,78,76,848.00
	SIDHI, COLLECTORATE CAMPUS				
Cumulative Totals:			0	5,78,76,848.00	5,78,76,848.00

The Min. Balance Requirement in (Rural Br.) for SB Account is Rs 100 (without Cheque book) and Rs 200/- (with Cheque book)

Unless constituent notifies the bank immediately of any discrepancy found by him in his statements of Account, it will be taken that he has found the account correct.

FASTEST MODE OF FUNDS REMITTANCE RTGS (UNION BULLET).  
 IFSC code for NAGRI NIWAS is UBIN0539759

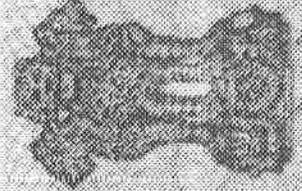
Contact all India toll Free no. 1800 22 22 for your account related queries / services



भारतीय नैऋत्यिक

एक सौ रुपये

Rs. 100



ONE

₹. 100

HUNDRED RUPEES

संकेत संख्या

S. N. No. 689011  
DATE 17/04/2007  
PLACE Bhopal

भारत INDIA



मध्य प्रदेश MADHYA PRADESH

P 235795

इकरारनामा

नरेश जी०बी० शर्मा (मध्यप्रदेश) लिमिटेड द्वारा अधिपूत शं० राजीव कुमार सिंह तथा श्री विरिधर गोपाल सिंह निवासी ६ प्रेस कॉम्पलेक्स एन०बी० नगर, भोपाल (म०प्र०) प्रथम एवं

द्वय

मध्यप्रदेश शासन राजस्व विभाग द्वारा कलेक्टर (म०प्र०) जिला-भिवारीली द्वितीय वडा

अधिकृत हस्ताक्षरी एवं एटाबी जी०बी० शर्मा (मध्यप्रदेश) लिमिटेड एवं कलेक्टर जिला-भिवारीली के नव्य दिनांक 11-07-2011 को मू.अर्थन अधिनियम की धारा 41 की तहत बन कर किया गया जिसके अनुसार विस्थापितों का पुनर्वास हेतु नव्य प्रदेश की आदेश पुनर्वास नीति 2002 तथा भारत सरकार की पुनर्वास नीति 2007 का पालन किया जायेगा और भूय प्रदेश शासन पुनर्वास विभाग बंगालय का पत्र क्रमांक 443/76/03/28 भोपाल, दिनांक 08.07.06 के अनुसार विस्थापितों को मध्यप्रदेश की अपर पुनर्वास नीति 2002 के अधिनियम सुविचार देते हेतु प्रथम एवं श्री चरमोति से कलेक्टर भिवारीली को अधिपूत किया

Notary/ गवाह  
Stamp Rs. 10,00/-

D B POWER (Madhya Pradesh) Ltd.

Dr. Raju Kumar  
Advocate

Handwritten signature

कलेक्टर एवं निवासी राजीव कुमार सिंह  
भोपाल-भिवारीली (म०प्र०)

Stamp from Shri  
Advocate Shri  
Madhya P. State



N. R. No. 6099/11  
 DATE 14/7/14  
 PLACE Noida (UP)

4. निःशुल्क परिवहन व्यवस्था एवं परिवहन व्यय :-

प्रायोजक निर्यापित परिवार को अपना घरेलू सामान ले जाने हेतु परिवहन व्यय रुपये 1,000/- देय होगा। इस्को अतिरिक्त 25 लिट्रीस की दूरी तक सामान ले जाने हेतु परिवहन की निःशुल्क सुविधा प्रदान की जायेगी।

5. बृद्धावस्था / पीड़ितों हेतु पेन्शन :-

निर्यापित पुरुष एवं महिला जिनकी उम्र वर्तमान में 60 वर्ष पूर्ण कर चुके हैं या उसके अतिरिक्त 8 को रुपये 1000/- प्रतिमा बृद्धावस्था पेनशन दी जायेगी। यह पेनशन सरकार द्वारा प्रदत्त पेनशन के अतिरिक्त होगी। अर्थात् व्यक्ति जैसे अल्प, मरीच, शिखा, अधिव्यक्ति एवं छोटी गर्द बच्चे (विधवा) (विधवा) या 80 वर्ष की उम्र पूरे करने वाली व्यक्ति जिन्हें कुछ गरीबी भिन्न है या किसी किसी दूसरी रोजी का सहारा नहीं है अथवा जो किसी परिवार का हिस्सा नहीं है, उन्हें परिवहन पदोन्नति द्वारा अपनी लगत पर रुपये 500/- प्रतिमा जो सरकार द्वारा प्रदान किया है देय होगा।



**शिक्षा एवं शिखा वृत्ति :-** निर्यापित परिवारों के बच्चों को पूर्णतया गान में कक्षा 10 तक शिक्षा व्यवस्था की जायेगी। गणना में पढ़ने वाले निर्यापित परिवार के बच्चों का जो शिक्षा लेने उन्हें निःशुल्क विद्यालय/स्कूल फ़ीस एवं प्रत्येक माह में शिक्षावृत्ति देय होगा। यदि निर्यापितों के बच्चों/पत्नी को पढ़ने हेतु आवश्यक है प्रवेश फ़ीस जायेगा एवं उनके मासिक शिक्षावृत्ति शुल्क दिया जायेगा।

कक्षा	लड़कों को दी जाने वाली शिक्षावृत्ति	लड़कियों को दी जाने वाली शिक्षावृत्ति
1 से 5	150 /-	200 /-
6 से 9	200 /-	250 /-
9 से 10	250 /-	300 /-

इस विद्यालय का संचालन सीपीओ एचए (स्कूल-देवर) लिमिटेड अथवा किसी और शोधित संस्थान द्वारा किया जायेगा। विद्यार्थ्य में अच्छे स्तर की शिक्षा एवं पर्याप्त बालक एवं आंगणवाड़ी केन्द्र, पुस्तकालय, दिव्य कक्ष, कार्टून, गणना, रसोईघर आदि का प्रबंधन होगा। यह विद्यालय आवश्यक कर्मचारियों से सुसज्जित होगा।

7. निःशुल्क शिक्षा सुविधा :-

पुनर्पत्र काली में शिक्षा निमित्त, सामुदायिक स्वास्थ्य केन्द्र के स्तर का होगा जिसमें प्रसूति गृह, फैमिली लेब, आपत्कालीन शिक्षा कक्षा, बच्चेकी शिक्षा कक्षा, नर्सिंग कक्षा, अध्यात्म मंत्र, अभिलेखागार, कान्फ़र एंड प्रोड्यूसर, क्विज एंड प्रमाण आदि का प्रबंधन होगा। बच्चों एवं महिलाओं की शिक्षा का विशेष ध्यान रखा जायेगा। यह

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D. B. POWER (Managing Director) Ltd.  
 Adv. Dr. Ranju KUMARI  
 (Dr. Ranju KUMARI)  
 Director  
 20, Ghosepalli, Noida, Uttar Pradesh  
 201301 (U.S.)

अधिष्ठाता एवं शिक्षा प्रदाता संस्थान  
 (D.B. Power) (U.S.)

Sl. No. 6098/12  
DATE 11-7-14  
PLACE Madhya Pradesh

विश्विद्या सुविधा केवल परियोजना प्रभारिता परिवार के सदस्यों को पहचान-पत्र प्रस्तुत करने पर ही दी जायेगी।

6. पुनर्वास कालोनी में निम्नलिखित सुविधाएं प्रस्तावित हैं :-

- क. शाहराजाला लक्ष्मी 10 ताल
- ख. पंचायत / सामुदायिक भवन
- ग. प्राथमिक स्वास्थ्य केंद्र
- घ. बाजार
- ङ. खेल का मैदान
- च. रेकमल की सुविधा
- ज. नमिलक स्थल का प्रबंधन
- झ. सड़कों व स्ट्रीट लाइट
- ञ. अगमन धार
- ट. कुआं-तालाब व पानी की टकी।

9. क. रोजगार - प्रत्येक विलंबित (पुनः) परिवार को ब्यान्डर की पुनर्वास नीति 2002 के अनुसार कम से कम एक सदस्य को परियोजना में योग्यतापूर्ण रोजगार, मौकसी उपलब्ध कराई जायेगी। गुणवत्ता विश्वसनीयता को निर्माण कार्य में अनुसूचित वर्गिक को रूप में प्रथमिकता दी जायेगी। विश्वपित अधिक अपना नाम परियोजना प्रतिनिधियों के पास दले परामर्श करवा सुनिश्चित करें।

इस कार्य में संबंधित ग्राम पंचायत के सदस्य भी सहयोग करेंगे। परियोजना पर्यवेक्षणियों द्वारा पुरुष एवं महिलाओं के नियोजन के संदर्भ में परियोजना निर्माण के दौरान आभेक्षण एवं मेंटेनेंस एक का विस्तृत किताबयन लेखना प्रस्तुत की जायेगी।

परियोजना पर्यवेक्षणियों द्वारा यह सुनिश्चित करने का प्रयास किया जायेगा कि प्रत्येक परियोजना प्रभारिता परिवार को किसी न किसी रूप में जीवनमन का समाधान दीर्घकालीन अवधि के लिये उपलब्ध हो सके। यह रोजगार संसाधन संरक्षण से नियमित करके, मन समितियों के सदस्यों के रूप में या परियोजना राज्यसीय/विलंबितों के पुनर्वास कालोनी में पुनर्वास आदि करने उपलब्ध कराया जायेगा।

कम्पनी द्वारा सीधे रूप की गई भूमियों के लिये भी यह अपूर्ण प्रभावशील होगा जिसके लिये उपयुक्त पहलवा देती है।

यदि परियोजना पर्यवेक्षणियों में अर्थात् अवार्ड की प्रमाण की लिये से 3 वर्ष की अवधि तक किसी न किसी रूप में रोजी की समस्या गती की जाती है ऐसी दशा में विलंबित प्रमाण से निवारण ऐसी अव हुन परिवार को निवृत्त (मृत) अथवा अन्य कुछ सहायता की व्यवस्था की जायेगी।

O S POWER (Madhya Pradesh) Ltd.

  
(Dr. RAJU KUMAR)  
Authorized Signatory



  
Authorizing Signatory  
Power-Transfer (2014)

क. श्रमकारी ठेका समितियों का गठन - इसमें श्रम प्रविष्ट विस्थापित परिवारों के सदस्य होंगे। परियोजना द्वारा निर्माण अथवा अन्य कार्यों में इन समितियों के सदस्यों को प्राथमिकता दी जायेगी। ऐसी परियोजना समितियों एवं समूहों के गठन में परियोजना द्वारा सहयोग प्रदान किया जायेगा। इन समितियों का परीक्षण जिला श्रम कार्यालय द्वारा किया जायेगा। परियोजना से सम्बन्धित अनुसूच्य वर्गों इन समितियों के माध्यम से करना जायेगा। जिला प्रशासन, कर्मचारी और श्रम पंजीकृत समिति के बीच एक त्रिपक्षीय समझौता किया जायेगा। जिससे ऐसी समिति को परियोजना में कार्य दिया जा सके।

ग. परियोजना की कलोमी एवं पुनर्वासि घाग में दुकानों का आवंटन - विस्थापित परिवारों हेतु दुकान आवंटन के लिए 90 प्रतिशत अराजण का प्रावधान है। दुकान आवंटन की प्राथमिकताई निम्नलिखित होगी :-

- > महिलाओं द्वारा स्थापित एवं सहायक समूह।
- > अंग व्यक्तित्व।
- > अनुसूचित जात/ती व्यक्तित्व।
- > अनुसूचित जाति के व्यक्तित्व।
- > अन्य निम्न वर्ग के व्यक्तित्व।
- > न्यु विस्थापित परिवार।
- > उपायक वर्ग के व्यक्तित्व।

उक्त अराजण मुल्य रूप से एच.ई.ड.एल.ई.एल.टी.एल.टी. आदि दुकानों के आवंटन पर लागू होगा एवं पुनर्वासि कारोमी को श्रम प्रविष्ट दुकानों विस्थापित परिवारों को उच्च दिने एवं प्राथमिकताओं के क्रम के आधार पर आवंटन किया जायेगा।

नोट :- (विस्थापित परिवार उपरोक्त में से किसी एक संजगार के लिदे ही पात्र होगा)

10. नौकरी हेतु कुशल विकास कार्यक्रम :-

अ. नि.सु.क. औद्योगिक प्रशिक्षण :- प्रत्येक विस्थापित परिवार को एक सरल सरसक को योग्यतानुसार नि.सु.क. औद्योगिक प्रशिक्षण (आइ.आई.एम.आई. / सी.आई.टी.सी.सी.) दिया जायेगा। इसके लिदे प्रत्येक मास से (शैक्षणिक योग्यता) उपलब्धता के आधार पर युवक/युवती की चुनौती पैगार कर समय-समय पर इशिक्षण के लिदे भेजा जायेगा। परियोजना पटराधिकारिनी द्वारा ऐसे युवक/युवतियों का उद्योग में संजगार सुनिश्चित करण हेतु हर समत प्रयास किया जायेगा।

D. B. POWER (Madhya Pradesh) Ltd.

  
DR. RAJNI KUMARI  
Authorised Signatory



  
Rajni Kumari  
Authorised Signatory  
संस्था एवं विकास सु-संगत अधिकारी  
(Geno-Madhyah (M.P.))

M. No. 6996/4  
 DATE 11-7-14  
 PLACE Lucknow

ब. स्वयं का रोजगार - इससे शिथे आरक्षण अधिका के खाखा आई जाईगी।  
 स्वयं का आरक्षण सभी उम्र के लोगों को खाखाम स्थानित करने के इच्छुक विद्यार्थियों को  
 जितना प्रस्तावना बैंक से प्राप्त की भी खाखाम करेगा।

11. युवाक व पंजीयक शुल्क से छुट - मध्यप्रदेश पुनर्वास नीति 2002 के धारा 20(3) के  
 अन्तर्गत विस्थापित परिवारों के कृषि भूमि खरीदने के लिये उत्सहित करने हेतु मुद्रक एवं  
 पंजीयन शुल्क में छुट (अधिकृत देखल एक जय ही गई भूमि पर) दी जायेगी। एकी  
 परिवारजन प्रभावित व्यक्तियों द्वारा प्राप्त पुनर्वास के तहत उपयोज्य किया जा सक और  
 जनसमूह के लिये कृषि रोजगार के बढ़ावा मिल सके।

12. स्थिरता भत्ता :- अनेक प्रदेशों में निस्थापित हुए लोगों के अनुभव को देखते हुये  
 बिन्हे कानूनी देदखली के उपरान्त लोगों को रोजगार सम्बन्धी से जुड़ना पडता है। उससे  
 शिथे परिशोधना से प्रभावित प्रत्येक परिवार जो भूमि अधिग्रहण के दौरान विस्थापित किया जा  
 रहा है। उन्हें निर्वाह भत्ता के रूप में नए में 25 दिन की न्यूनतम कृषि कार्य में दी जाने वाली  
 भूजपूरी विस्थापन की विधि से एक वर्ष तक देय होगी।

**अनुसूचक सूचना :-**

1. लिल्ट प्रशासन, मात्र डिप्लोमा के विद्यमान कार्य भी जारी करेगा। ये सभी युविकाएं  
 डिप्लोमाहियों को विस्थापन कार्य दिखाने के उपरान्त ही प्रदान की जायेगी।
2. निस्थापित परिवार, जिसकी भू-उर्जन अधिनियम जो प्राय 9 के अन्तर्गत पुनर्वासो की  
 जा चुकी है उसे ही उदात्त पुनर्वास सुविधाएं प्राप्त करने की पात्रता होगी।
3. अनुदान प्राप्त करने के पूर्व विस्थापित परिवार को अपनी भूमि/भजन रिखा करने संबंधी  
 प्रमाण पत्र अधिस्त अधिकारों/सर्वाधिकारी से प्राप्त करना होगा।
4. उदात्त प्रमाण पत्र प्रस्तुत करने के पश्चात्, पुनर्वास अनुदान एवं अन्य सुविधाएं प्राप्त हो  
 सकेंगी।
5. पुनर्वास कारोबारी में आवंटित भू-खण्ड/भजन का उदात्त प्रमाण पत्र प्रस्तुत करने पर  
 उदात्त दिया जायेगा।
6. उदात्त सभी सुविधाएं राज्य सरकार द्वारा दी जाने वाली सुविधाओं के अनुरिक हैं।

यां कक्षागत आज दिनांक 11-07-2014 को शीकीकार (मध्यप्रदेश) सिद्धि  
 की तलक से डॉ० रजनी कुमार सिंह और मांय प्रदेश सरकार राजल विभाग की तलक से  
 कलेक्टर एवं जिला पुनर्वास अधिकारी जित-सिंघोबी मध्यप्रदेश द्वारा हस्ताक्षर किया गया।

DB POWER (Madhya Pradesh) Ltd.

*(Signature)*

अधीक्षक (विद्युत, कानूनी)  
 शीकीकार मध्य प्रदेश (मध्यप्रदेश) लिमिटेड  
 राय - भोज, 480-0407

जित - सिंघोबी



*(Signature)*

अधीक्षक (विद्युत, कानूनी)  
 जिला-सिंघोबी (मध्यप्रदेश)  
 कानूनी एवं विद्युत विभाग (राय-भोज)

*(Signature)*

*(Signature)*  
 अधीक्षक (विद्युत, कानूनी)  
 जिला-सिंघोबी (मध्यप्रदेश)

**REPORT ON RAIN WATER HARVESTING  
&  
HYDRO-GEOLOGICAL INVESTIGATION  
FOR PROPOSED 2X660 MW COAL BASED  
THERMAL POWER PROJECT  
AT  
VILLAGE - GORGI, TEHSIL DEOSAR,  
DIST. – SINGRAULI (MADHYA PRADESH)**

**DEVELOPED BY:**



**M/s D.B. Power (M.P.) Limited**

**February – 2011**

**Prepared by:**



**A REPORT ON HYDROGEOLOGICAL INVESTIGATIONS & RAIN WATER HARVESTING  
SYSTEM IN M/S D. B. THERMAL POWER PROJECT AT VILLAGE GORGI,  
TEHSIL DEOSAR, DISTRICT SINGRAULI (M. P.)**

**CONTENTS**

**1.0 INTRODUCTION**

- 1.01 Location and extent of the area
- 1.02 Objectives
- 1.03 Scope of work

**2.0 HYDROMETEOROLOGY**

- 2.01 Rainfall
- 2.02 Temperature
- 2.03 Humidity

**3.0 PHYSIOGRAPHY & DRAINAGE**

- 3.01 Geomorphology
- 3.02 Soil
- 3.03 Drainage

**4.0 REGIONAL GEOLOGY**

**5.0 HYDROGEOLOGY**

- 5.01 Evaluation of Aquifer Parameter

**6.0 GEOPHYSICAL INVESTIGATIONS**

- 6.01 Electrical Resistivity Methods
- 6.02 Basic Principles of Resistivity Survey
- 6.03 Surface Resistivity Sounding



**A REPORT ON HYDROGEOLOGICAL INVESTIGATIONS & RAIN WATER HARVESTING  
SYSTEM IN M/S D. B. THERMAL POWER PROJECT AT VILLAGE GORGI,  
TEHSIL DEOSAR, DISTRICT SINGRAULI (M. P.)**

6.04 Equipments

6.05 Data Acquisition

6.06 Data Analysis and Interpretation

**7.0 SURFACE AND GROUND WATER RESOURCES POTENTIAL**

7.01 Surface Water Resources Potential

7.02 Ground Water Resources Potential

7.03 Ground Water Resources Potential of Project Area

**8.0 RAINWATER HARVESTING**

8.01 Recharge Test and Scope of Rainwater Harvesting in Area

8.02 Methodology

8.03 Assessment of factor for Harvesting Surplus Monsoon Runoff

8.04 Rainwater harvesting in the project area

**9.0 CONCLUSIONS/SUBMISSIONS**

9.01 Conclusions

9.02 Submissions

**10.0 RECOMMENDATION FOR RAINWATER HARVESTING**

**10.1 Ground Water Recharge Structures in Plant Area**

A Storm water drainage Structures

B Rooftop Rainwater Harvesting

C Recharge through stop dam

D Construction of Piezometers

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## CHAPTER – I

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### **1.0 INTRODUCTION**

Madhya Pradesh State has high potential for coal based generation of electricity. The State Government is making all efforts to convert the state in to power hub in the country. To meet the huge growth in power demand, large capacity projects need to be added to the system. The state has high potential for coal based thermal power generation of electricity.

D B Power Project, a company of the Dainik Bhaskar Group proposes to establish a 1320 (2x660 MW) coal fired thermal power plant around the Gorgi, Pepal, Mahuagaon and Chhamruch villages of Deosar Block in Singrauli district of Madhya Pradesh State. The proposed power station is suitable in respect of techno commercial aspect including adequacy of space, proximity to rail/road connection, space for power evacuation system and water for running all the units. Besides, the present site is also environmentally compatible as compared to other Greenfield locations considered in this region.

D B Power thermal project will meet its all water requirements from the Gopad River. Water for the project will be drawn from the Gopad River which is flowing at a distance of 3.5 km from the project site. The plant water requirement is estimated to be 55 MCM/annum. A suitable reservoir will be made on river Gopad to cater the requirement during the lean period. The water will be transported through a dedicated pipe line. The source of intake well is at 3.5 km from the site and water will be conveyed through pipe line. A water reservoir for 30 day's storage is proposed at the site to meet the water requirement of the plant. The entire water requirement will be met through only surface water sources. Ground water will not be utilized in any way by the project. No ground water shall be used in operation for the power plant even in lean period. The water allocation has all ready been obtained from Water Resources Department, Government of Madhya Pradesh.

The D B Power has engaged M/s Insitu Environ Care, Bhopal to study hydrogeological environment for rainwater harvesting system at proposed premises. The field work was carried out during the December 2010.

**A REPORT ON HYDROGEOLOGICAL INVESTIGATIONS & RAIN WATER HARVESTING SYSTEM IN M/S D. B. THERMAL POWER PROJECT AT VILLAGE GORGI, TEHSIL DEOSAR, DISTRICT SINGRAULI (M. P.)**

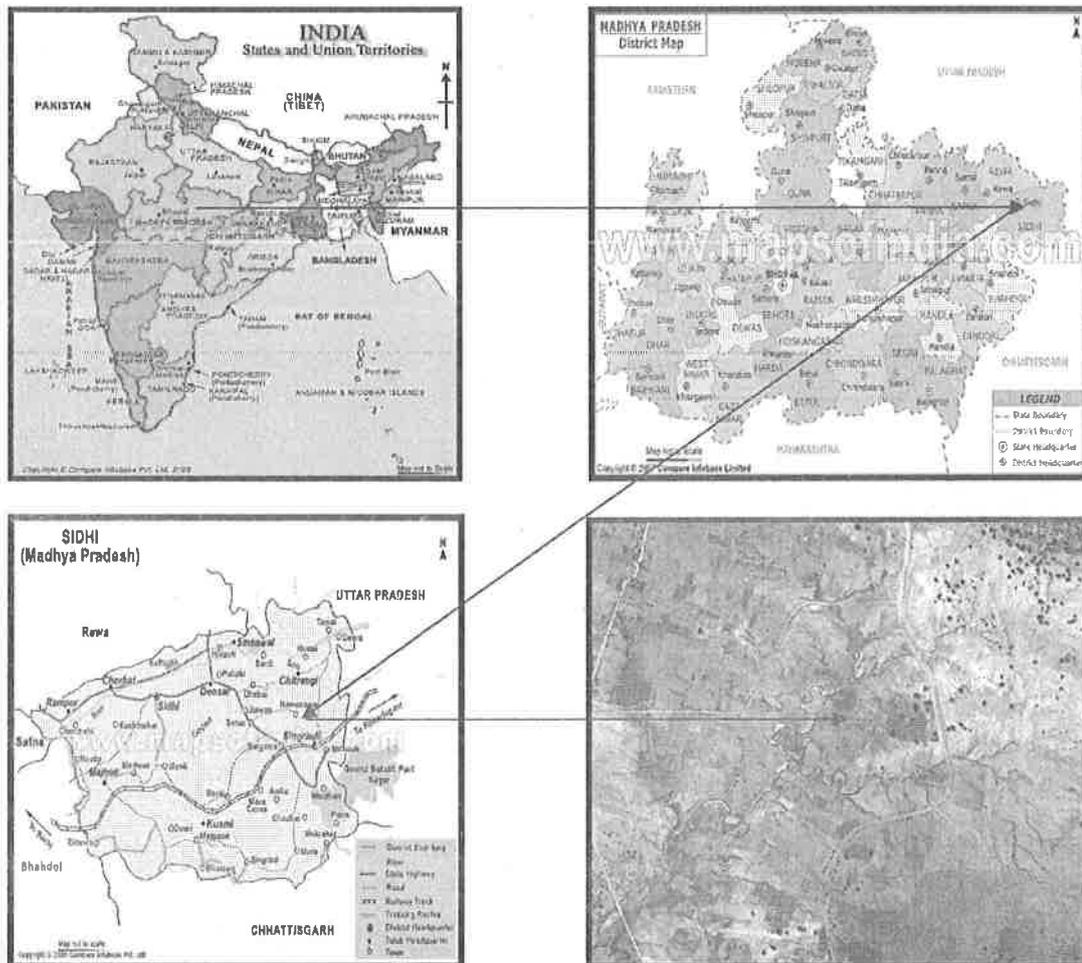
**1.01 Location and extent of the area**

D B Power thermal plant project is located at a distance of about 35 Km from Sidhi, and 14 km from Singrauli district head quarter. The nearest broad gauge railhead is Niwas railway station of Katni-Singrauli rail line, which is about 6 km from the project site. The project area is spread in 735 acres of land.

The investigated area falls under the Survey of India Topo sheet No. 63 H/16 between the latitude  $24^{\circ} 06' 49.6''$  N and  $24^{\circ} 07' 25.2''$  N and longitude  $81^{\circ} 55' 13.6''$  E and  $81^{\circ} 56' 41.1''$  E. The location map of the study area is shown in figure 1.1. The nearest airport is Varanasi, which is about 170 Km from project site. The site plan of proposed D B thermal power plant is shown in figure 1.2.

**Figure 1.1:**

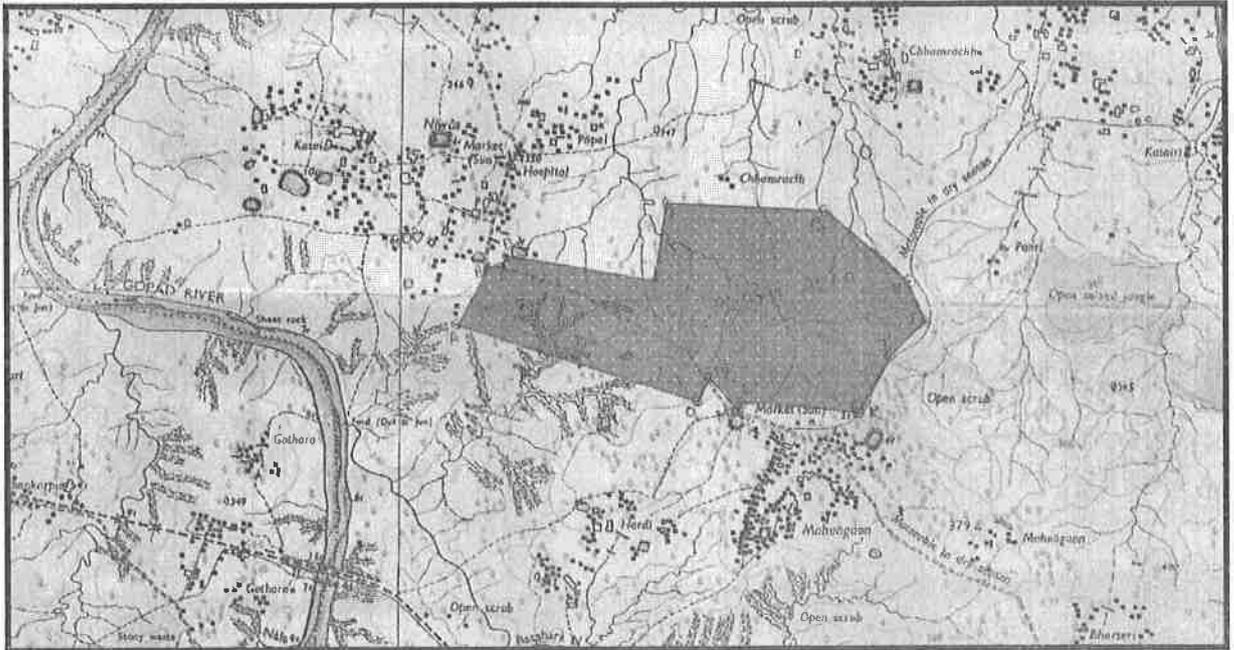
**The location of D B Thermal Power Project, at village Gorgi, District Singrauli.**



**A REPORT ON HYDROGEOLOGICAL INVESTIGATIONS & RAIN WATER HARVESTING  
SYSTEM IN M/S D. B. THERMAL POWER PROJECT AT VILLAGE GORGI,  
TEHSIL DEOSAR, DISTRICT SINGRAULI (M. P.)**

**Figure 1.2:**

**Site location of D B Thermal Power Project, at village Gorgi, District Singrauli**



### **1.02 Objectives**

Rainwater harvesting is the collection and storage of rain water runoff that goes as wastage from catchment areas like roofs, paved areas, roads and bare grounds as well as green belts. Rainwater is the purest form of water available on the earth at all places, though the quantity of availability varies from place to place. Collection of rainwater may be in the form of surface storage in RCC tanks, underground sumps or small syntax tanks to meet the domestic requirements immediately within a short period. The second option available is to collect the rainwater to utilize the same for recharging the ground water aquifer system (depleted aquifers) through appropriate recharge structures constructed as per the site hydrological and hydrogeological parameters. Rainwater harvesting is a simple, economical and eco-friendly technique of preserving every drop of water falling on the earth. The problems of large variations in water availability associated with growing demand leads to the need for rainwater harvesting. Catchment areas for collection of rainwater include rooftops, compounds, roads, parks, bare grounds or any other natural or artificial surface.

## CHAPTER – II

### 2.0 HYDROMETEOROLOGY

#### 2. 01 Rainfall

The nearest I.M.D. observatory and raingauge station is located at Sidhi. The study area receives rainfall from Southwest monsoon, which breaks in June and continues till September. The annual rainfall data of Sidhi, IMD raingauge station for a period of 28 years (1976-2005) have been collected and analyzed. These data are given in **Table-2.1**, and have been graphically represented in the **Figure-2.1**. The normal annual rainfall for the last 50 years is 1076.4 mm. It can be noticed from the annual rainfall data that the pattern of rainfall is erratic. During rainy season, about 91% of annual rainfall is received. Maximum rainfall of 1751.6 mm was recorded during 1997 and a minimum of 756.2 mm. in the year 1996, which are shown in **Figure-2.1**.

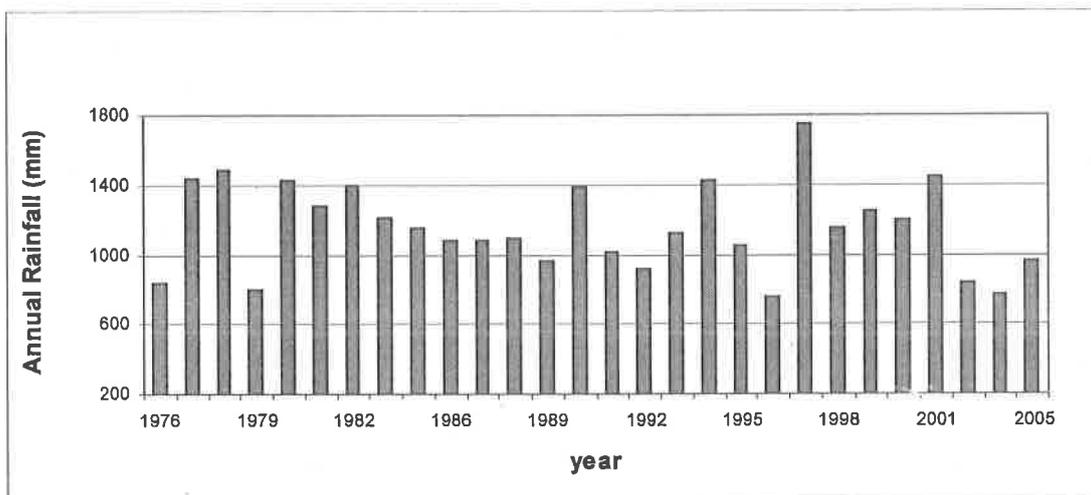
**Table-2.1: Monthly rainfall data of Sidhi raingauge station**

Year	Jan	Feb	March	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
1976	10.3	8.0	0.0	10.2	7.8	45.7	367.1	208.4	183.1	0.0	0.0	0.0	840.6
1977	35.8	4.2	4.8	2.8	6.1	256.2	396.2	326.8	299.2	68.2	28.6	10.4	1439.3
1978	33.4	80.6	40.4	54.0	0.0	313.6	261.4	154.4	490.1	26.8	0.0	30.8	1485.5
1979	53.8	43.6	0.4	0.0	0.0	162.4	231.6	170.2	96.8	0.0	41.4	0.0	800.2
1980	13.7	3.2	9.6	2.8	1.8	206.8	541.6	392.4	222.2	8.2	0.0	20.8	1423.1
1981	65.8	3.0	26.4	0.0	3.6	122.8	577.8	177.8	296.3	0.0	2.8	3.6	1279.9
1982	93.2	10.8	36.2	0.0	0.0	194.6	290.3	630.1	116.2	24.8	1.2	0.0	1397.4
1983	9.2	37.8	0.0	47.8	20.4	83.0	368.6	220.6	368.4	55.8	0.0	0.0	1211.6
1985	43.6	0.0	0.0	23.6	0.0	86.4	414.8	356.2	195.0	36.3	0.0	0.0	1155.9
1986	10.4	70.2	32.6	0.0	10.0	107.4	333.4	288.6	156.0	56.0	0.0	14.0	1078.6
1987	26.2	19.2	6.8	0.0	5.2	29.2	67.8	237.0	635.0	51.0	8.0	1.4	1086.8
1988	20.0	8.2	8.4	13.6	1.0	284.8	385.0	251.8	104.6	3.3	0.0	16.2	1096.9
1989	0.0	0.0	25.4	0.0	2.4	163.6	319.0	272.8	164.8	0.0	2.8	14.8	965.6
1990	0.0	69.2	42.6	0.0	55.6	200.8	407.9	274.9	281.7	53.0	0.0	0.0	1385.7
1991	5.4	15.2	9.4	9.8	17.6	177.6	169.0	416.2	187.2	3.6	0.0	1.3	1012.3
1992	0.0	4.0	0.0	0.0	26.6	28.2	163.4	395.4	284.8	16.8	0.0	0.0	919.2
1993	0.0	7.0	2.4	0.0	29.6	28.2	239.8	256.1	555.6	0.0	0.0	0.0	1118.7
1994	9.7	22.9	0.0	2.1	0.0	294.9	216.2	528.2	304.5	44.4	0.0	0.0	1422.9
1995	20.4	27.8	23.6	3.2	0.0	36.4	317.2	218.7	348.3	0.0	37.6	22.4	1055.6
1996	0.0	64.0	0.0	0.0	2.8	34.8	206.6	368.6	73.6	5.8	0.0	0.0	756.2
1997	4.0	0.0	0.0	18.6	5.4	136.1	522.3	515.3	402.3	55.6	39.4	52.6	1751.6
1998	-	-	-	-	-	-	-	-	-	-	-	-	1151.7
1999	2.6	7.6	0.0	0.0	13.0	105.2	366.1	250.6	298.8	202.4	0.0	0.0	1246.3
2000	0.0	0.0	7.0	0.0	9.6	184.5	584.8	147.4	271.6	0.0	0.0	0.0	1204.9
2001	12.4	0.0	14.0	18.2	24.0	295.8	664.0	199.1	95.6	121.2	0.0	0.0	1444.3
2002	0.0	84.8	5.6	0.0	6.2	32.4	90.6	409.8	186.8	19.0	0.0	0.0	835.2
2004	15.8	0.1	0.0	4.8	198.4	138.6	301.0	110.0	0.0	0.0	0.0	0.0	768.7
2005	46.2	0.0	16.0	0.0	22.6	92.4	407.4	198.2	159.5	24.0	0.0	0.0	966.3

**A REPORT ON HYDROGEOLOGICAL INVESTIGATIONS & RAIN WATER HARVESTING  
SYSTEM IN M/S D. B. THERMAL POWER PROJECT AT VILLAGE GORGI,  
TEHSIL DEOSAR, DISTRICT SINGRAULI (M. P.)**

**Figure-2.1:**

**Distribution of Annual Rainfall**



The annual departures from the normal rainfall have been computed in **Table-2.2** and are shown in **Figure-2.2**. The yearly departure from the average annual rainfall depicts the picture that the annual rainfall has never gone below 10% of the average but in the case for the upper part of the average line, which is six time 50% of the average annual rainfall. The annual rainfall recorded ranges from 25% less or 25% more of the average that is tolerable. As and when the annual rainfall goes up by more than 25%, it creates flood and less rainfall from the average amounting to 25% to 50% less, creates semi-drought conditions. Such flood conditions have been found in 1977, 1978, 1980, 1982, 1994, 1997 and 2001 which is shown in **Figure-2.2**

**Table-2.2:**

**Departure from normal rainfall data of Sidhi raingauge station**

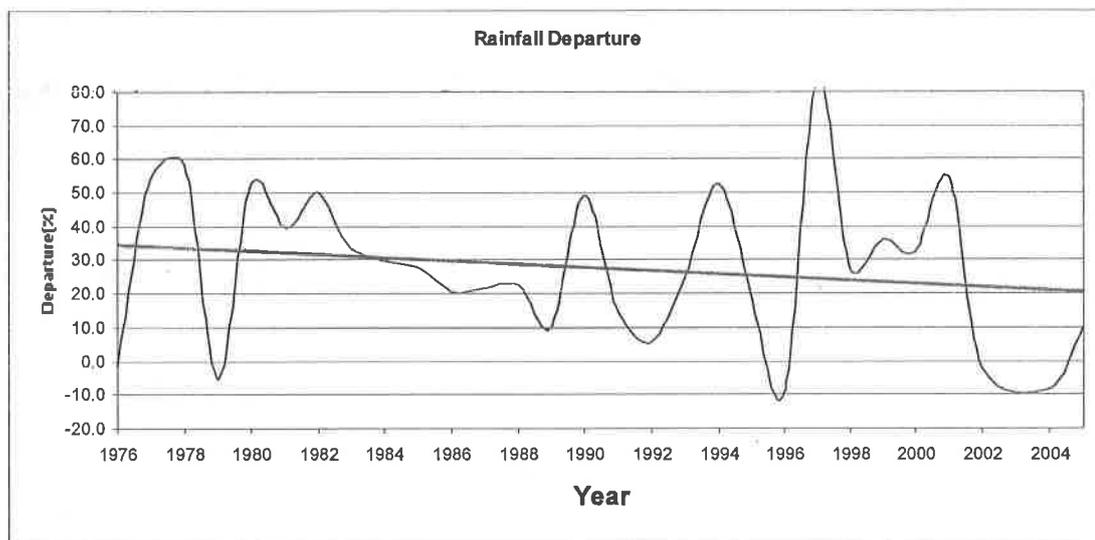
S. No.	Year	Annual rainfall (mm)	Departure from normal (mm)	Departure from normal (%)
1	1976	840.6	-235.4	-1.5
2	1977	1439.3	582.3	54.1
3	1978	1485.5	628.5	58.4
4	1979	800.2	-56.8	-5.3
5	1980	1423.1	566.1	52.6
6	1981	1279.9	422.9	39.3
7	1982	1397.4	540.4	50.2
8	1983	1211.6	354.6	33.0
9	1985	1155.9	298.9	27.8
10	1986	1078.6	221.6	20.6
11	1987	1086.8	229.8	21.4
12	1988	1096.9	239.9	22.3

**A REPORT ON HYDROGEOLOGICAL INVESTIGATIONS & RAIN WATER HARVESTING  
SYSTEM IN M/S D. B. THERMAL POWER PROJECT AT VILLAGE GORGI,  
TEHSIL DEOSAR, DISTRICT SINGRAULI (M. P.)**

13	1989	965.6	108.6	10.1
14	1990	1385.7	528.7	49.1
15	1991	1012.3	155.3	14.4
16	1992	919.2	62.2	5.8
17	1993	1118.7	261.7	24.3
18	1994	1422.9	565.9	52.6
19	1995	1055.6	198.6	18.5
20	1996	756.2	-100.8	-9.4
21	1997	1751.6	894.6	83.1
22	1998	1151.7	294.7	27.4
23	1999	1246.3	389.3	36.2
24	2000	1204.9	347.9	32.3
25	2001	1444.3	587.3	54.6
26	2002	835.2	-21.8	-2.0
27	2004	768.7	-88.3	-8.2
28	2005	966.3	109.3	10.2

**Figure-2.2:**

**Distribution of departure from normal rainfall data Monthly Rainfall**



The monthly distribution of rainfall in a year is 91% of the total precipitation falls in the rainy season i.e. during the month of June, July, August and September. The remaining 9% of rainfall occurs in rest of eight months. The monthly normal rainfall and rainy days are given in **Table-2.3** and pictorial presentation is shown in **Figure-2.3** and **2.4**. July and August months receive the maximum rainfall 320.9 mm and 351.9 mm respectively while April is the month which receives minimum rainfall that is 1.9 mm. There are 54 rainy days in a year on an average, out of these 46 rainy days belong to the monsoon period, while rest 8 days are distributed throughout the year.

**A REPORT ON HYDROGEOLOGICAL INVESTIGATIONS & RAIN WATER HARVESTING SYSTEM IN M/S D. B. THERMAL POWER PROJECT AT VILLAGE GORGI, TEHSIL DEOSAR, DISTRICT SINGRAULI (M. P.)**

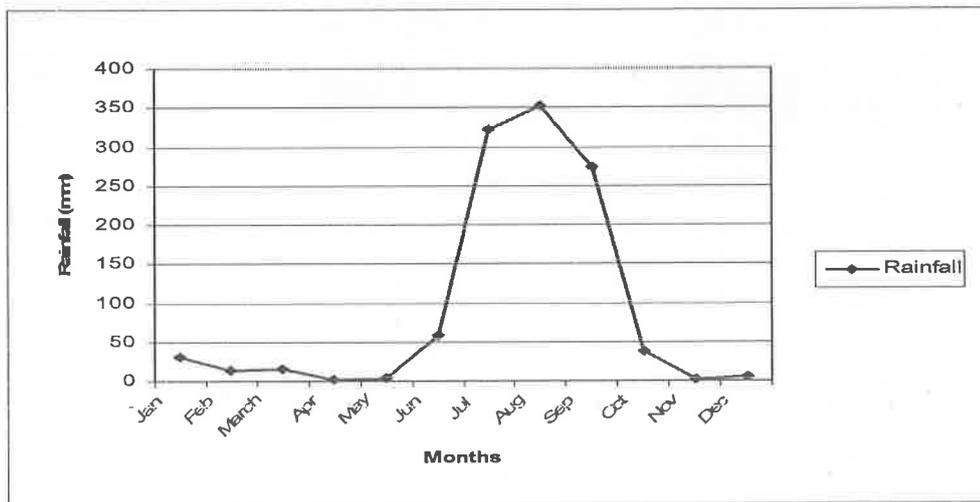
**Table-2.3:**

**Normal annual rainfall data of Sidhi raingauge station**

Month	Jan	Feb	March	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Rainfall	31.2	13.0	15.0	1.9	3.1	57.4	320.9	351.9	273.3	38.2	1.4	5.1	1112.4
Rainy Days	2.1	1.6	0.9	0.2	0.8	5.4	14.9	15.8	10.0	1.0	0.7	0.9	54.3

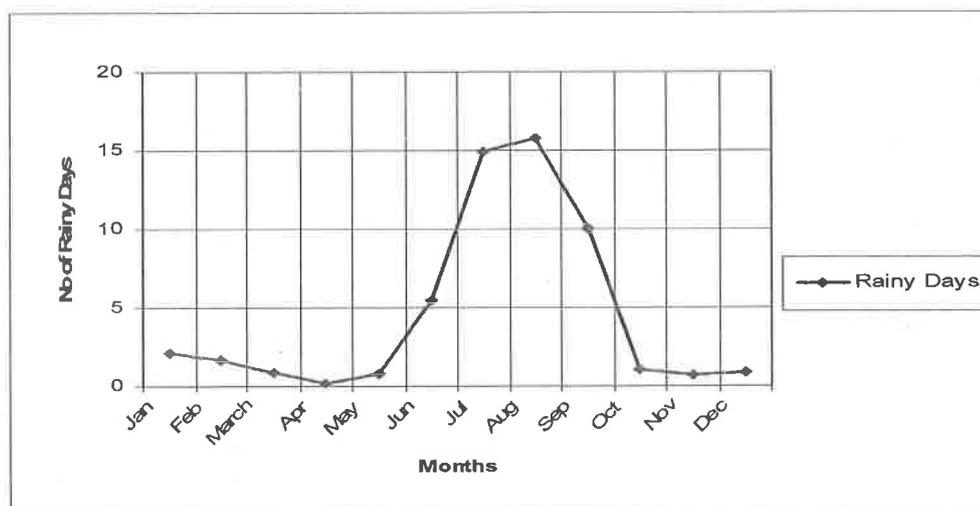
**Figure-2.3:**

**Distribution of normal monthly rainfall**



**Figure-2.4:**

**Distribution of number of rainy days**



The progressive of annual rainfall of Sidhi raingauge station is given below in **Table 2.4**

**A REPORT ON HYDROGEOLOGICAL INVESTIGATIONS & RAIN WATER HARVESTING  
SYSTEM IN M/S D. B. THERMAL POWER PROJECT AT VILLAGE GORGI,  
TEHSIL DEOSAR, DISTRICT SINGRAULI (M. P.)**

**Table-2.4:**

**Progressive of annual rainfall of Sidhi raingauge station**

S. NO.	RAINFALL (MM)	FREQUENCY
1	701-800	2
2	801-900	3
3	901-1000	3
4	1001-1100	5
5	1101-1200	3
6	1201-1300	4
7	1301-1400	2
8	1401-1500	5
9	1501-1600	0
10	1601-1700	0
11	1701-1800	1

**2.02 Temperature**

The nearest IMD observatory located at Sidhi has been taken for the study. The summer commences from March during which temperature begins to rise rapidly. The month of May is the hottest month with the mean daily maximum temperature at 42.0°C. During May and 1<sup>st</sup> half of June the temperature may rise up to 47.4°C. With the onset of south east monsoon during June, there is an appreciable drop in day temperature while at the end of September or in early October, there is slight increase in day temperature but nights become progressively cooler. January is generally the coolest month with the mean daily maximum temperature at 24.3°C and the mean daily minimum temperature at 8.1°C as in given in **Table-2.5**.

**Table - 2.5:**

**Mean maximum and minimum temperature**

Temp °C	Jan	Feb	March	April	May	June	July	Aug	Sept	Oct	Nov	Dec	Average
Max.	24.3	27.8	33.4	39.1	42.0	39.2	32.9	31.7	32.3	32.6	29.5	25.3	32.5
Min.	8.1	10.8	15.5	21.5	25.8	27.5	25.1	24.6	23.8	19.4	13.0	8.3	18.6

**A REPORT ON HYDROGEOLOGICAL INVESTIGATIONS & RAIN WATER HARVESTING  
SYSTEM IN M/S D. B. THERMAL POWER PROJECT AT VILLAGE GORGI,  
TEHSIL DEOSAR, DISTRICT SINGRAULI (M. P.)**

### **2.03 Humidity**

With the rise in temperature the relative humidity of the region lowers, while decrease in temperature results its increase. The average maximum humidity is 85.0% during the month of August and September, while the minimum is 23% in the month of May. During summer it ranges from 46 to 58%, while in rainy season, i.e. June to October its range is in between 53 to 85%. In the winter season however the humidity ranges from 29 to 76 %.

The wind speed is generally light with some strengthening in summer and monsoon season when speed is high and variable in the monsoon season. The wind direction is generally between SW and NE, while during post monsoon and cold season, the direction is mainly between SW and NW. In summer the wind direction changes and wind blows mainly from direction between west and north.

## **CHAPTER – III**

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### **3.0 PHYSIOGRAPHY & DRAINAGE**

#### **3.01 Geomorphology**

The proposed area is located on north eastern boundary of the Madhya Pradesh State. The land is a part of the Kaimore ranges of mountains. The landscape is generally undulating and rocky. The project site is almost plain topography and ground has very gentle slope. The average elevation level of the site area is 361 m above mean sea level. The area has ground slope from south to north direction.

#### **3.02 Soil**

Soil is the most important feature of Physiography, the formation of which largely depends upon the topography, rock type and drainage. The cropping pattern in the area is governed by the thickness of soil mantle, its texture and consistency. The different types of soils occurring in the area is mostly covered with patches of medium brown soil, red sandy soils and mixed brownish red soils. The soils are derived from the granitic gneiss and Gondwana sandstone parent materials and have been classified as tropical red loams which are utilized for cultivation of kharif crops only. Red loams are characterized by argillaceous soils with a cloudy structure and the presence of only a little concretionary material. The soil of the area varies from red sandy soil to light brown in colour. The soil cover of the study area has been found predominantly silty loam in nature.

#### **3.03 Drainage**

Sidhi and Singrauli district are mainly drained by three rivers, Son, Gopad and Banas, which are all perennial in nature. However the study area is drained by Gopad River flowing from south to north and located at a distance of 3.5 km from the project area. Gopad River serves as the principle water sources for irrigations purposes in the study area. A second order stream is passing from the area and meeting Karaundia nala flowing in the northern part of the study area and located at a distance of 3 km from the project site. The Karaundia nala merges to Kandas Nadi at a distance of 7 km from the project site flowing in the eastern part of the study area and ultimately meets to the Gopad River.

## **CHAPTER IV**

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#### **4.0 REGIONAL GEOLOGY**

Singrauli district is situated in Chhattisgarh plain of Ganga basin. The sediments of this basin lie unconformable on the Archaeans basement, associated with meta-volcanic and meta-sediments. In the eastern part of the basin, they are associated with the Gondwana formation. The Chhattisgarh Super group is divisible into Chandrapur Group and Raipur group with an intervening unconformity.

The Chandrapur group is arenaceous, while the Raipur group is mostly calcareous and argillaceous. The Sedimentary rocks of Lower Vindhyan Group lie in succession from Chandrapur sandstone (being oldest and overlying Archaeans unconformably), overlain in order of superposition by Charmuria limestone, Gunderdehi shale and dolomite / limestone of Raipur stage. The laterite and alluvium formation caps these rock formations.

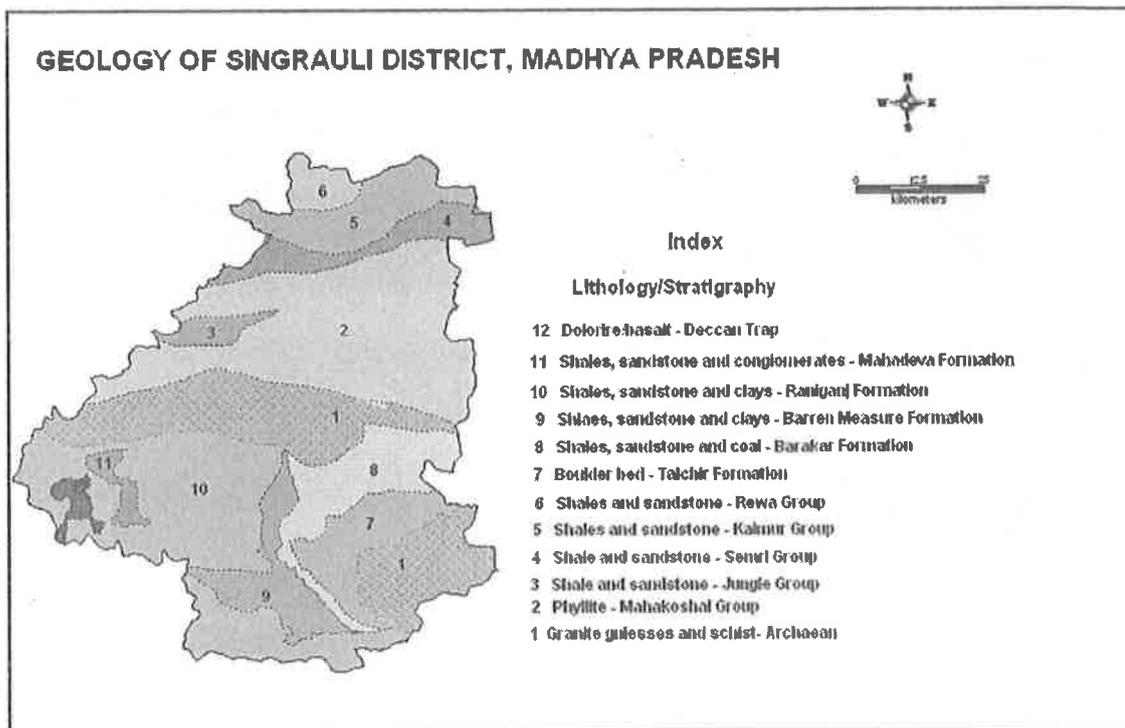
Geologically, Singrauli district forms a part of the ENE – WSW narrow belt of meta-sediments along Son - Narmada lineament which consist of an Archaeans metamorphic complex. This meta-sedimentary sequence occurring along Son – Narmada lineaments have been referred as "Transition" series and Sidhi series.

The sediments belonging to Vindhyan super group and Gondwana sequence occur to the north and south of Son-Narmada belt. The linear patches of granite with enclaves of schist and gneiss are seen exposed below the Vindhyan and Gondwana sequence along the contact. Intrusive of Basalt and occurrence of alluvium at places is seen in Singrauli district.

The entire geological succession of Singrauli district is divided into six major groups and has been given in **Table- 4.1**. The occurrence and distribution of different rock type in the area have been discussed in the following paragraphs.

**A REPORT ON HYDROGEOLOGICAL INVESTIGATIONS & RAIN WATER HARVESTING  
SYSTEM IN M/S D. B. THERMAL POWER PROJECT AT VILLAGE GORGI,  
TEHSIL DEOSAR, DISTRICT SINGRAULI (M. P.)**

**Figure 4.1:  
Geology of Singrauli District of Madhya Pradesh**



**Table-4.1:  
Geological Successions of Singrauli District, Madhya Pradesh**

AGE GROUP	FORMATION	LITHOLOGY
Eocene to Cretaceous	Deccan traps	Basalt
	UNCONFORMITY	
Lower Cretaceous to Carboniferous	Gondwana	Sandstone, shale's coal bearing sandstone conglomerate, glauconite.
Carboniferous to Upper Proterozoic	Vindhyan Super group	Porcellanite, cross bedded sandstone Ortho quartzite and oligomictic conglomerate.
	UNCONFORMITY (Faulted at places)	
Middle Proterozoic	Jungel group	Porcellanite and cherts phyllites, cross bedded sandstone quartzite conglomerate and Greywacke

**A REPORT ON HYDROGEOLOGICAL INVESTIGATIONS & RAIN WATER HARVESTING  
SYSTEM IN M/S D. B. THERMAL POWER PROJECT AT VILLAGE GORGI,  
TEHSIL DEOSAR, DISTRICT SINGRAULI (M. P.)**

	UNCONFORMITY (Faulted at places)	
Lower Proterozoic	Mahakoshal group	Quartz veins basic, ultramafic and intermediate intrusives Banded Hematite – Quartzite, cherts phyllite and cherty Quartzite. Meta basics, tuffs and phyllites, Cherty pebbles (Quartz) and conglomerate dolomitic marble with chert Banda. Quartzite and meta arkose.
	UNCONFORMITY (Faulted and sheared)	
Middle Lower Proterozoic	Archaeans	Granites, Schist and gneisses with high grade schist metabasic sediments intrusive.

### **Archaeans**

Archaeans granites are the oldest rock formation unit in this area. This rock formation comprises granites, schist and gneisses with high grade schist metabasic sediments and intrusive.

### **Mahakoshal Group**

The rocks of Mahakoshal group are dominantly represented by quartzite, dolomite, marble cherty dolomite, phyllite and banded hematite quartzite is seen in the northern and southern parts of the districts. In this group ortho-quartzite (felspathic) occurs as a discontinuous bands and lenses along the granite. Mahakoshal group contact, at places medium to coarse grained marble and cherty dolomite in this group occurs as 50-150 m thick discontinuous bands near the southern contact of the meta sedimentary tract phyllite in this group is intercalated with thin quartz bands forms small linear hills, mounds as seen around Karaki north of meta and around Charki. The intra formational conglomerate of this group is seen occurring 2 km. S.E of Papreri village and 0.75 kms. The metabasic comprise fine to medium grained. Light green to dark greenish colored well foliated basic rocks and white buff colored and light buff colored seoria occur as discontinuous bands/lenses etc. and seen associated with almost all other rock units in the group.

**A REPORT ON HYDROGEOLOGICAL INVESTIGATIONS & RAIN WATER HARVESTING  
SYSTEM IN M/S D. B. THERMAL POWER PROJECT AT VILLAGE GORGI,  
TEHSIL DEOSAR, DISTRICT SINGRAULI (M. P.)**

### **Jungel Group**

Rock types of Jungel group occur as two ENE-WSW trending linear tracts. Exposure of northern tract extends from Sehag in the west to Kham in the east and the south eastern tract extends from Hathwar in the west to Reepalidol in the east. Near Jurar, 3 small linear patches of these rocks are found sandwiched between the rocks of Mahakoshal group.

### **Vindhyan Group**

Vindhyan group rocks unconformable overlies over Jungel group of rocks. Vindhyan group include limestone, sandstone and shale covering an area of about 2490 sq. km in the northern part of the Sidhi and Singrauli districts.

### **Gondwana Group**

The lower Gondwana group of rocks mainly includes the Talchir and Barakar series, occupying an area extent of 3,200 sq. kms in the central part of the Singrauli and southern parts of Sidhi districts. The Talchir series include shale and sandstones. The Shales are micaceous or calcareous and grade into sandstones and grits with occasional conglomerate and beds of shale. They also contain coal seams of workable deposits in the Singrauli area. Generally the topographic lows of Singrauli, tahsil are occupied by rocks of Talchir series, whereas the rock of Barakar series covers the topographic highs. The upper Gondwana rocks occur in the southern part of the district which is a hilly terrain and constitute red and buff colored sandstone and red clays. The Barakar series of the lower Gondwana are traversed by basic intrusive (dolerite) as dykes and sills along the junction of Shales and sandstones. Further these rocks occupies the tectonic troughs and traversed by a series of faults, there by displaying the continuity of the formations, which plays an important role in the occurrence and movement of ground water in the formation of this group.

### **Geology of D B Thermal Power Project Area**

The area is mainly represented by rocks of Gondwana Super Groups and recent alluvial fills. At surface the sandstones are of weathered nature. The thickness of weathering extends up 5 m below ground level. The rocks are medium to coarse grained in nature. The nature of compactness increases with the depths. Along the nala sections recent alluviums are exposed. Ground water is mainly occurs in the weathered and fractured sandstone. Only a small part of the area is covered by the intrusive rocks of dolerite dykes.



## **CHAPTER – V**

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### **5.0 Hydrogeology**

Ground water is the part of precipitation that seeps (infiltrates) deep into the ground. It flows downward by gravity until it reaches a hard layer of rock i.e. impermeable to water. Just above this impermeable rock layer is saturation zone, where all water that has soaked deep underground is stored. Most of the rocks contain numerous open spaces, called interstices, in which water may be stored and can move. The pore spaces (tiny spaces or fractures between pieces of rock or soil) in this zone are completely filled with water.

#### **Depth to water level**

Based on the well inventoried and measurement of water level at the time of field investigation, reported groundwater level in summer season (pre monsoon) and actual ground water level measurement in winter (post monsoon) the following conclusion were drawn.

#### **Post monsoon depth to water level**

Based on field data and well inventoried, depth to water level map of post monsoon period of the investigated area has been prepared. The water level in the post monsoon seasons varies in the range of 3.00 m to 12.0 m bgl. In general average water level ranges between 8 to 10 m bgl. Variation in general ground water level is due to only due to the ground surface slope.

#### **Pre monsoon depth to water level**

The ground water level monitoring of dug wells and bore wells during pre-monsoon season could not be carried out as the field investigation was taken during the month of December 2010. The actual ground water level measurement may be carried out during pre-monsoon 2011. The field information was collected by the enquiry with the local people and farmer and it is inferred that ground water level during pre-monsoon ranges from 15 to 20 m bgl.

#### **Seasonal fluctuation**

It is a fact that in and around area the fluctuation in groundwater level is mainly due to withdrawal, recharge and movement of groundwater. A seasonal ground water level fluctuation has been observed on the basis of field data and inventoried wells. The average ground water level fluctuation in the investigated area is 10 m bgl.



**A REPORT ON HYDROGEOLOGICAL INVESTIGATIONS & RAIN WATER HARVESTING  
SYSTEM IN M/S D. B. THERMAL POWER PROJECT AT VILLAGE GORGI,  
TEHSIL DEOSAR, DISTRICT SINGRAULI (M. P.)**

**5.01 Evaluation of Aquifer Parameter**

For the evaluation of aquifer parameter a pumping test was conducted of a bore well in the area. The details of pumping test conducted and there results are tabulated in table 5.1 and table 5.2 respectively. DTW v/s Time plot of aquifer performance test conducted is given figure 5.1. Corrected recovery v/s t/t' plot of aquifer performance test conducted have been given in figure 5.2.

Analysis of aquifer performance test conducted in the study area is given in table 5.3.

**Table 5.1:**

**The details of aquifer performance test conducted in the study area.**

<b>Aquifer Performance Test</b>			
<b>Data Sheet for Drawdown Test</b>			
<b>Time</b>	<b>Time Since Pump Started</b>	<b>(Depth to water level) in meter</b>	<b>Drawdown in m</b>
10.00	0	11.95	0
10.01	1	12.95	1.00
10.02	2	13.76	1.81
10.03	3	14.56	2.61
10.04	4	15.49	3.54
10.05	5	16.26	4.31
10.06	6	17.00	5.05
10.08	8	17.51	5.56
10.10	10	18.26	6.31
10.15	15	19.10	7.15
10.20	20	19.95	8.00
10.25	25	20.26	8.31
10.30	30	20.57	8.62
10.35	35	20.84	8.89
10.40	40	21.00	9.05
10.45	45	21.09	9.14
10.50	50	21.17	9.22
11.00	60	21.24	9.29
11.10	70	21.31	9.36
11.20	80	21.36	9.41
11.30	90	21.41	9.46

**A REPORT ON HYDROGEOLOGICAL INVESTIGATIONS & RAIN WATER HARVESTING  
SYSTEM IN M/S D. B. THERMAL POWER PROJECT AT VILLAGE GORGI,  
TEHSIL DEOSAR, DISTRICT SINGRAULI (M. P.)**

11.40	100	21.44	9.49
11.50	110	21.47	9.52
12.00	120	21.49	9.54
12.10	130	21.50	9.55
12.20	140	21.50	9.55

**Table 5.2: The details of aquifer performance test conducted in the study area.**

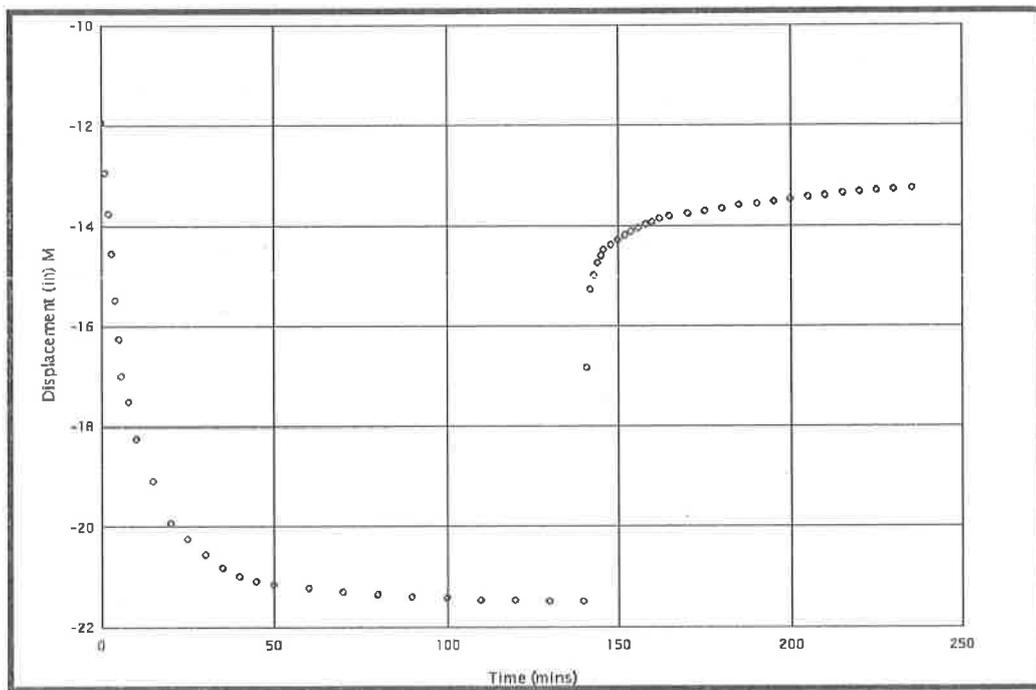
<b>Aquifer Performance Test</b>			
<b>Data Sheet for Residual Drawdown Test</b>			
<b>Time</b>	<b>Time Since Pump Stopped</b>	<b>DTW (Recovery data) (Depth to water level) in meter</b>	<b>Residual Drawdown in m</b>
	0	21.50	9.55
12.20	1	16.84	3.57
12.21	2	15.29	3.34
12.22	3	15.00	3.05
12.23	4	14.75	1.48
12.24	5	14.60	1.33
12.25	6	14.49	1.22
12.27	8	14.38	1.11
12.30	10	14.29	1.02
12.32	12	14.20	0.93
12.34	14	14.12	0.85
12.36	16	14.05	0.78
12.38	18	13.98	0.71
12.40	20	13.93	0.66
12.42	22	13.87	0.60
12.45	25	13.81	0.54
12.50	30	13.77	0.50
12.55	35	13.72	0.45
13.00	40	13.66	0.39
13.05	45	13.61	0.34
13.10	50	13.57	0.30

**A REPORT ON HYDROGEOLOGICAL INVESTIGATIONS & RAIN WATER HARVESTING  
SYSTEM IN M/S D. B. THERMAL POWER PROJECT AT VILLAGE GORGI,  
TEHSIL DEOSAR, DISTRICT SINGRAULI (M. P.)**

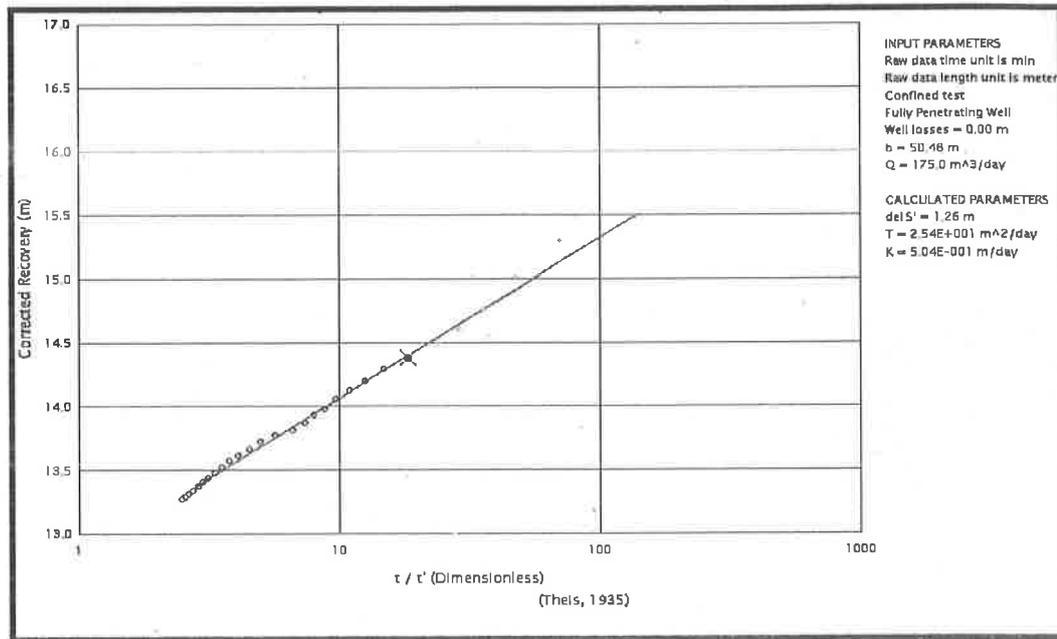
13.15	55	13.52	0.25
13.20	60	13.48	0.21
13.25	65	13.44	0.17
13.30	70	13.40	0.13
13.35	75	13.37	0.10
13.40	80	13.34	0.07
13.45	85	13.31	0.04
13.50	90	13.29	0.02
13.55	95	13.27	0.00

**Figure 5.1:**

**DTW v/s Time plot of aquifer performance test conducted.**



**A REPORT ON HYDROGEOLOGICAL INVESTIGATIONS & RAIN WATER HARVESTING  
SYSTEM IN M/S D. B. THERMAL POWER PROJECT AT VILLAGE GORGI,  
TEHSIL DEOSAR, DISTRICT SINGRAULI (M. P.)**



**Table 5.3: Analysis of aquifer performance test conducted in the study area**

<b>ANALYSIS OF AQUIFER PERFORMANCE TEST DATA</b>			
<b>Selected Time (min)</b>	<b>Selected Draw (meters)</b>	<b>Confined Draw correction (m)</b>	<b>Penetration Draw correction (M)</b>
0	11.95	16.84	16.84
1	12.95	15.29	15.29
2	13.76	15.00	15.00
3	14.56	14.75	14.75
4	15.49	14.60	14.60
5	16.26	14.49	14.49
6	17.00	14.38	14.38
8	17.51	14.29	14.29
10	18.26	14.20	14.20
15	19.10	14.12	14.12
20	19.95	14.05	14.05
25	20.26	13.98	13.98
30	20.57	13.93	13.93
35	20.84	13.87	13.87
40	21.00	13.81	13.81

**A REPORT ON HYDROGEOLOGICAL INVESTIGATIONS & RAIN WATER HARVESTING  
SYSTEM IN M/S D. B. THERMAL POWER PROJECT AT VILLAGE GORGI,  
TEHSIL DEOSAR, DISTRICT SINGRAULI (M. P.)**

45	21.09	13.77	13.77
50	21.17	13.72	13.72
60	21.24	13.66	13.66
70	21.31	13.61	13.61
80	21.36	13.57	13.57
90	21.41	13.52	13.52
100	21.44	13.48	13.48
110	21.47	13.44	13.44
120	21.49	13.40	13.40
130	21.50	13.37	13.37
140	21.50	13.34	13.34
141	16.84	13.31	13.31
142	15.29	13.29	13.29
143	15.00	13.27	13.27
144	14.75		
145	14.60		
146	14.49		
148	14.38		
150	14.29		
152	14.20		
154	14.12		
156	14.05		
158	13.98		
160	13.93		
162	13.87		
165	13.81		
170	13.77		
175	13.72		
180	13.66		
185	13.61		
190	13.57		
195	13.52		
200	13.48		
205	13.44		
210	13.40		

**A REPORT ON HYDROGEOLOGICAL INVESTIGATIONS & RAIN WATER HARVESTING  
SYSTEM IN M/S D. B. THERMAL POWER PROJECT AT VILLAGE GORGI,  
TEHSIL DEOSAR, DISTRICT SINGRAULI (M. P.)**

215	13.37		
220	13.34		
225	13.31		
230	13.29		
235	13.27		

**INPUT PARAMETERS**

Raw data time unit is min

Raw data length unit is meters

Confined test

Fully Penetrating Well

Well losses = 0.00 m

b = 50.48 m

Q = 175.0 m<sup>3</sup>/day

**CALCULATED PARAMETERS**

Del S' = 1.26 m

T = 2.54 m<sup>2</sup>/day

K = 0.5 m/day.

## CHAPTER – VI

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### 6.0 GEOPHYSICAL INVESTIGATIONS

#### 6.01 Electrical Resistivity Methods

- (i) Conducting electrical resistivity sounding in a guided manner in the project area.
- (ii) Interpreting resistivity soundings curve and correlate with lithological logs of nearby boreholes and record major subsurface litho-Stratigraphic units.
- (iii) Bring out the thickness of unsaturated zone in the study area.
- (iv) Making assessment of high resistivity and low resistivity values in relation to occurrence of fresh/brackish groundwater.

Surface electrical resistivity surveying is based on the principle that the distribution of electrical potential in the ground, around a current-carrying electrode, depends on the electrical resistivity of the surrounding soils and rocks. The usual practice in the field is to apply an electrical current between two electrodes implanted in the ground and to measure the difference of potential between two additional electrodes that do not carry current. Usually, the potential electrodes are in line between the current electrodes, but in principle, they can be located anywhere. The current used are either direct current, commutated direct current (i.e., a square-wave alternating current), or AC of very low frequency. All analysis and interpretation are done on the basis of direct currents. The distribution of potential can be related theoretically to ground resistivity and their distribution for some simple cases, notably, the case of a horizontally stratified ground and the case of homogeneous masses separated by vertical planes (e.g., a vertical fault with a large throw or a vertical dyke). For other kinds of resistivity distributions, interpretation is usually done by qualitative comparison of observed response with that of idealized hypothetical models or on the basis of empirical methods.

Mineral grains comprised of soils and rocks are essentially nonconductive, except in some exotic materials such as metallic ores, so the resistivity of soils and rocks is governed primarily by the amount of pore water, its resistivity, and the arrangement of the pores. To the extent that differences of lithology are accompanied by differences of resistivity, resistivity surveys can be useful in detecting bodies of anomalous materials or in estimating the depths of bedrock surfaces. In coarse,

**A REPORT ON HYDROGEOLOGICAL INVESTIGATIONS & RAIN WATER HARVESTING  
SYSTEM IN M/S D. B. THERMAL POWER PROJECT AT VILLAGE GORGI,  
TEHSIL DEOSAR, DISTRICT SINGRAULI (M. P.)**

granular soils, the groundwater surface is generally marked by an abrupt change in water saturation and thus by a change of resistivity. In fine-grained soils, however, there may be no such resistivity change coinciding with a piezometric surface. Generally, since the resistivity of a soil or rock is controlled primarily by the pore water conditions, there are wide ranges in resistivity for any particular soil or rock type, and resistivity values cannot be directly interpreted in terms of soil type or lithology. Commonly, however, zones of distinctive resistivity can be associated with specific soil or rock units on the basis of local field or borehole information, and resistivity surveys can be used profitably to extend field investigations into areas with very limited or nonexistent data. Also, resistivity surveys may be used as a reconnaissance method, to detect anomalies that can be further investigated by complementary geophysical methods and/or drill holes.

The electrical resistivity method has some inherent limitations that affect the resolution and accuracy that may be expected from it. Like all methods using measurements of a potential field, the value of a measurement obtained at any location represents a weighted average of the effects produced over a large volume of material, with the nearby portions contributing most heavily. This tends to produce smooth curves, which do not lend themselves to high resolution for interpretations. Another feature common to all potential field geophysical methods is that a particular distribution of potential at the ground surface does not generally have a unique interpretation. Although these limitations should be recognized, the non-uniqueness or ambiguity of the resistivity method is scarcely less than with the other geophysical methods. For these reasons, it is always advisable to use several complementary geophysical methods in an integrated exploration program rather than relying on a single exploration method.

Electrical resistivity survey was carried out in the area to study the prevailing subsurface hydrogeological conditions beneath the area to pin point the favorable locations for groundwater exploration in the proposed premise. The aim of resistivity survey is to obtain qualitative knowledge of potable water bearing aquifers and overburden thickness in the area. To achieve the objective, the resistivity surveys were conducted in the proposed area.

### **6.02 Basic Principles of Resistivity Survey**

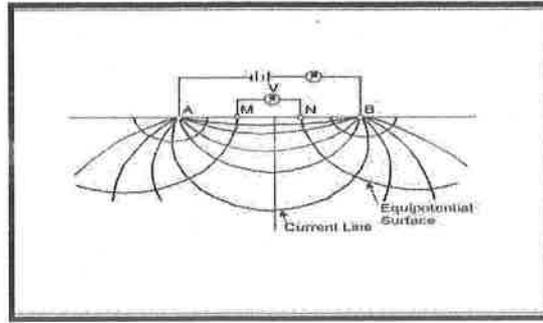
Electrical resistivity of any material is defined as numerically equal to the resistance (Ohm) offered between two opposite faces of a unit cube of the material. It is independent of shape and size. The conventionally used unit of resistivity is Ohm meter. Bulk resistivity of water bearing geologic formation depends on its ability to conduct electric current through interstitial water present in the pore spaces and through matrix. That is, the bulk resistivity varies with the amount, distribution and salinity of interstitial water and lithology. The variations in resistivity of any water bearing formation manifest combined the variations in lithology and characteristics of groundwater present. Thus, the method is used to identify groundwater yielding zones- the aquifers, their geometry, variation in quality (salinity) of groundwater in them and direction of groundwater movement.

Significant contrast in resistivity occurs between dry and water saturated formations, and formations with fresh and brackish/saline water. In general, there are defined ranges of resistivity of different formations, e.g., sands of various grain size, clays, weathered and fractured granites and gneisses, sandstones, cavernous limestone, vesicular basalts etc. As a result of the combined effect of quality of formation water and the formation matrix, there are overlaps in resistivity values of different lithological units.

Using Ohm's law electrical resistivity of sub-surface geologic formation is determined through artificially energizing the subsurface and carrying measurements on the ground surface. Contrast in resistivity value of an individual layer with the surrounding or effective presence (dependent of its relative resistivity and thickness) makes it detectable.

In the electrical resistivity method, a known amount of electrical current (I) is sent into the ground through a pair of electrode (called current electrodes) and the potential ( $\delta V$ ) developed because of the resistance offered by the subsurface due to the passage of this current is measured across another pair of electrodes (potential electrodes) planted into the ground.

**A REPORT ON HYDROGEOLOGICAL INVESTIGATIONS & RAIN WATER HARVESTING  
SYSTEM IN M/S D. B. THERMAL POWER PROJECT AT VILLAGE GORGI,  
TEHSIL DEOSAR, DISTRICT SINGRAULI (M. P.)**



**Figure-6.1: Surface electrical resistivity electrode configuration**

The ratio between the potential measured and the corresponding current sent into the ground yields the resistance "R" of the ground to a depth depending upon the spacing between the two current electrodes. Through the multiplication of this value of 'R' by a geometric factor a parameter called the apparent resistivity " $\rho_a$ " is computed. Both the parameters of apparent resistivity " $\rho_a$ " and the resistance "R" contain the information on the geo-electric characteristics of the subsurface. The conventional electrical resistivity measurement requires a four-electrode arrangement, two of them for sending current into the ground and other two for measuring the resulting potential. In practice, there exist several configurations but most commonly used are the Wenner and Schlumberger configurations. For the present investigation, Schlumberger configuration was used.

In Schlumberger arrangement all the four electrodes are kept in a line symmetrically over a point 'O'. Current is sent through outer electrodes are kept in a line symmetrically over a point 'O'. Current is sent through outer electrodes AB and potential across MN is measured. The separation between the potential electrodes M & N is kept smaller compared to the current electrode distance AB.

The geometric factor 'K' for Schlumberger arrangement is given by

$$K = \pi \left\{ \left( \frac{AB}{2} \right)^2 - \left( \frac{MN}{2} \right)^2 \right\} / MN$$

**Where,** AB is current Electrode spacing  
MN is potential Electrode spacing

For the present investigation both profiling and sounding mode have been used.

### **6.03 Surface Resistivity Sounding**

Resistivity sounding is a process by which the depth investigation is made. In this, the center of configuration is kept fixed and the measurements are made by successively increasing the electrode spacing. The apparent resistivity values obtained with increasing values of electrode separations are used to estimate the thickness and resistivity's of the subsurface formations. In Schlumberger sounding arrangement all the four electrodes are kept in a line symmetrically over a point 'O'; with inner (Potential) electrodes kept closer. For increasing the depth of investigation the current electrodes A and B are moved apart symmetrically about the centre point 'O' keeping the potential electrodes fixed. The separation between the Potential Electrodes is changed only when the potential between them drops to allow value during the course of sounding. The apparent resistivity for each electrode separation is calculated by multiplying the resistance 'R' by Schlumberger configuration factor.

Resistivity profile provides lateral variation in resistivity corresponding to horizontal change in subsurface lithology. Measurement of the apparent resistivity for a fixed current and potential electrode separation is known as Resistivity Profiling. For present investigations 'Gradient configuration' has been used. Resistivity profiling by gradient configuration, in principle, uses uniform electric field. It employs 'stationary' and widely separated current electrodes as point source to produce uniform horizontal electric field in the central part i.e.,  $1/3^{\text{rd}}$ , between the current electrodes. The potential gradient responds to the horizontal component of the electric field. It is assumed in the gradient array that the electric field is uniform and horizontal and the potential electrode separation is infinitely small so that the observed quantity approximate the electric field. In gradient profiling anomalies are simple to interpret but mainly qualitative.

The method of investigation is based on the principle of estimating physical parameters, namely, the electrical resistivity. Electrical resistivity of the subsurface material is from measurements made on the ground and interpretation of the observed variations of this resistivity laterally and also with depth in terms of geology, lithology and structure. Electrical resistivity of the subsurface material depends on the type of soil, rock formation, degree of weathering, presence of fractures and fissures etc. Because of this dependence of the electrical resistivity of the rock formation on such factors, the resistivity method is considered to be the most suitable techniques for investigation of overburden soil characteristics, for

evaluating bed rock conditions, determination of thickness of different lithological units, fractures and fissures etc.

#### **6.04 Equipment**

The equipment used in this investigation is A.C. resistivity meter (*AQUAMETER CRM-20*). This digital resistivity meter has been designed for use in shallow as well as deep resistivity survey. 24 V chargeable batteries power the CRM-20 resistivity meter. Voltage up to 220 volts can be applied and current up to 20 m amp can be sent depending on the ground conditions. The potential can be measured with resolution of up to 0.1 mV. By applying the current into the ground, the equipment provides the direct resistance for particular electrode separation.

#### **6.05 Data Acquisition**

Five Vertical Electrical Sounding (VES) by Schlumberger configuration were conducted to cover the entire area. Depending upon site conditions and the space available the maximum current electrode spacing (AB) of 400 to 800 m was kept. For this both the current electrodes were placed at 500 m apart and in between 160 co-linear distances were scanned through 20 m potential dipole at 10 m station interval.

#### **6.06 Data Analysis and Interpretation**

The observed resistance value from instrument was multiplied with geometric factor (K) to get the apparent resistivity values for electrode spacing. The field apparent resistivity data were plotted on log-log paper against the half current electrode separation to get the VES curves. The apparent resistivity data for different potential dipole were brought to single common potential dipole. The apparent resistivity values for electrode spacing are presented along with VES curves in running text.

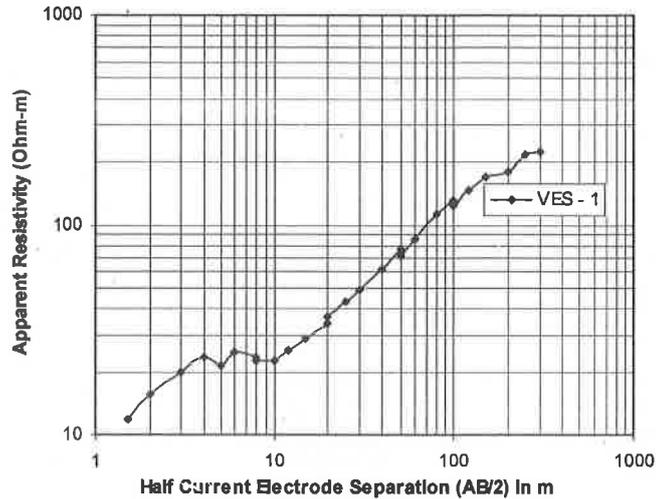
**A REPORT ON HYDROGEOLOGICAL INVESTIGATIONS & RAIN WATER HARVESTING  
SYSTEM IN M/S D. B. THERMAL POWER PROJECT AT VILLAGE GORGI,  
TEHSIL DEOSAR, DISTRICT SINGRAULI (M. P.)**

**Table-6.1:**

**Data and Plot of VES-1 Conducted in the investigated area**

<b>S. No.</b>	<b>AB/2 (m)</b>	<b>MN/2 (m)</b>	<b>G Factor K</b>	<b>Resistance (Ohm)</b>	<b>Resistivity (Ohm-m)</b>
1	1.5	0.5	12.56	0.941	11.81896
2	2	0.5	23.55	0.662	15.59010
3	3	0.5	54.95	0.362	19.89190
4	4	0.5	98.91	0.237	23.44167
5	5	0.5	155.43	0.137	21.29391
6	6	0.5	224.51	0.111	24.92061
7	8	0.5	400.35	0.059	23.62065
8	8	2	94.2	0.239	22.51380
9	10	2	150.72	0.151	22.75872
10	12	2	219.8	0.115	25.27700
11	15	2	346.97	0.083	28.79851
12	20	2	621.72	0.055	34.19460
13	20	5	235.5	0.156	36.73800
14	25	5	376.8	0.115	43.33200
15	30	5	549.5	0.09	49.45500
16	40	5	989.1	0.062	61.32420
17	50	5	1554.3	0.049	76.16070
18	50	10	753.6	0.095	71.59200
19	60	10	1099	0.078	85.72200
20	80	10	1978.2	0.057	112.75740
21	100	10	3108.6	0.042	130.56120
22	100	20	1507.2	0.082	123.59040
23	120	20	2198	0.067	147.26600
24	150	20	3469.7	0.049	170.01530
25	200	20	6217.2	0.029	180.29880
26	250	20	9749.7	0.022	214.49340
27	300	20	14067.2	0.016	225.07520

**A REPORT ON HYDROGEOLOGICAL INVESTIGATIONS & RAIN WATER HARVESTING  
SYSTEM IN M/S D. B. THERMAL POWER PROJECT AT VILLAGE GORGI,  
TEHSIL DEOSAR, DISTRICT SINGRAULI (M. P.)**



**Table-6.2:  
Data and Plot of VES-2 Conducted in the investigated area**

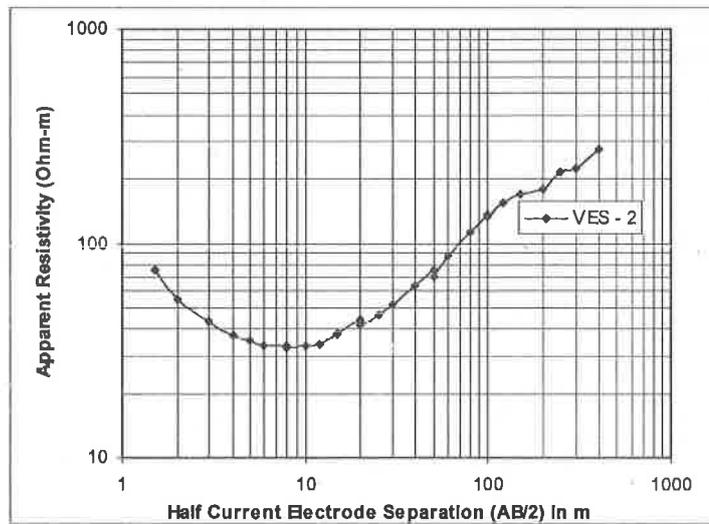
S. No.	AB/2 (m)	MN/2 (m)	G Factor K	Resistance (Ohm)	Resistivity (Ohm-m)
1	1.5	0.5	12.56	6.01	75.4856
2	2	0.5	23.55	2.32	54.6360
3	3	0.5	54.95	0.782	42.9709
4	4	0.5	98.91	0.375	37.0913
5	5	0.5	155.43	0.227	35.2826
6	6	0.5	224.51	0.147	33.0030
7	8	0.5	400.35	0.083	33.2291
8	8	2	94.2	0.346	32.5932
9	10	2	150.72	0.221	33.3091
10	12	2	219.8	0.154	33.8492
11	15	2	346.97	0.11	38.1667
12	20	2	621.72	0.07	43.5204
13	20	5	235.5	0.178	41.9190
14	25	5	376.8	0.123	46.3464
15	30	5	549.5	0.094	51.6530
16	40	5	989.1	0.064	63.3024
17	50	5	1554.3	0.048	74.6064
18	50	10	753.6	0.092	69.3312
19	60	10	1099	0.079	86.8210

**A REPORT ON HYDROGEOLOGICAL INVESTIGATIONS & RAIN WATER HARVESTING  
SYSTEM IN M/S D. B. THERMAL POWER PROJECT AT VILLAGE GORGI,  
TEHSIL DEOSAR, DISTRICT SINGRAULI (M. P.)**

20	80	10	1978.2	0.057	112.7574
21	100	10	3108.6	0.044	136.7784
22	100	20	1507.2	0.089	134.1408
23	120	20	2198	0.07	153.8600
24	150	20	3469.7	0.049	170.0153
25	200	20	6217.2	0.029	180.2988
26	250	20	9749.7	0.022	214.4934
27	300	20	14067.2	0.016	225.0752
28	400	20	25057.2	0.011	275.6292

**Table-6.3:**

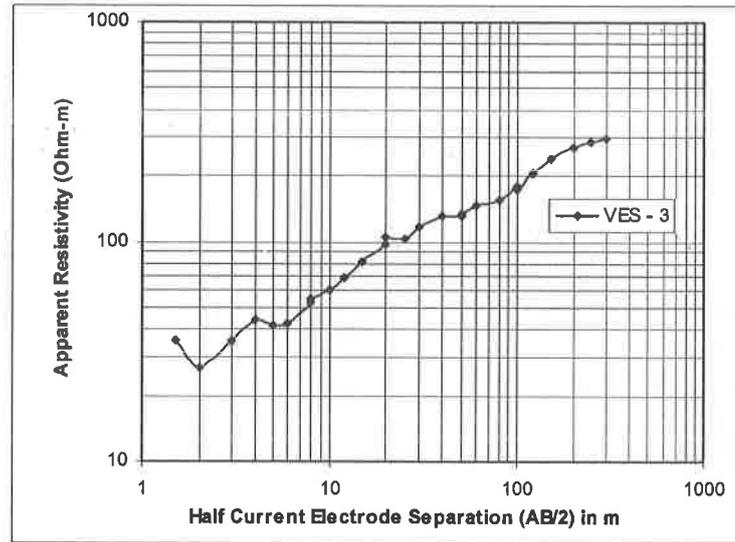
**Data and Plot of VES-3 Conducted in the investigated area**



**A REPORT ON HYDROGEOLOGICAL INVESTIGATIONS & RAIN WATER HARVESTING  
SYSTEM IN M/S D. B. THERMAL POWER PROJECT AT VILLAGE GORGI,  
TEHSIL DEOSAR, DISTRICT SINGRAULI (M. P.)**

<b>S. No.</b>	<b>AB/2 (m)</b>	<b>MN/2 (m)</b>	<b>G Factor K</b>	<b>Resistance (Ohm)</b>	<b>Resistivity (Ohm-m)</b>
1	1.5	0.5	12.56	2.78	34.9168
2	2	0.5	23.55	1.129	26.5880
3	3	0.5	54.95	0.646	35.4977
4	4	0.5	98.91	0.447	44.2128
5	5	0.5	155.43	0.27	41.4961
6	6	0.5	224.51	0.188	42.2079
7	8	0.5	400.35	0.131	52.4459
8	8	2	94.2	0.587	55.2954
9	10	2	150.72	0.398	59.9866
10	12	2	219.8	0.312	68.5776
11	15	2	346.97	0.231	80.1501
12	20	2	621.72	0.156	96.9883
13	20	5	235.5	0.441	103.8555
14	25	5	376.8	0.275	103.6200
15	30	5	549.5	0.231	117.0435
16	40	5	989.1	0.132	130.5612
17	50	5	1554.3	0.084	130.5612
18	50	10	753.6	0.177	133.3872
19	60	10	1099	0.132	145.0680
20	80	10	1978.2	0.078	154.2996
21	100	10	3108.6	0.058	180.2988
22	100	20	1507.2	0.114	171.8208
23	120	20	2198	0.092	202.2160
24	150	20	3469.7	0.068	235.9396
25	200	20	6217.2	0.043	267.3396
26	250	20	9749.7	0.029	282.7413
27	300	20	14067.2	0.021	295.4112

**A REPORT ON HYDROGEOLOGICAL INVESTIGATIONS & RAIN WATER HARVESTING  
SYSTEM IN M/S D. B. THERMAL POWER PROJECT AT VILLAGE GORGI,  
TEHSIL DEOSAR, DISTRICT SINGRAULI (M. P.)**



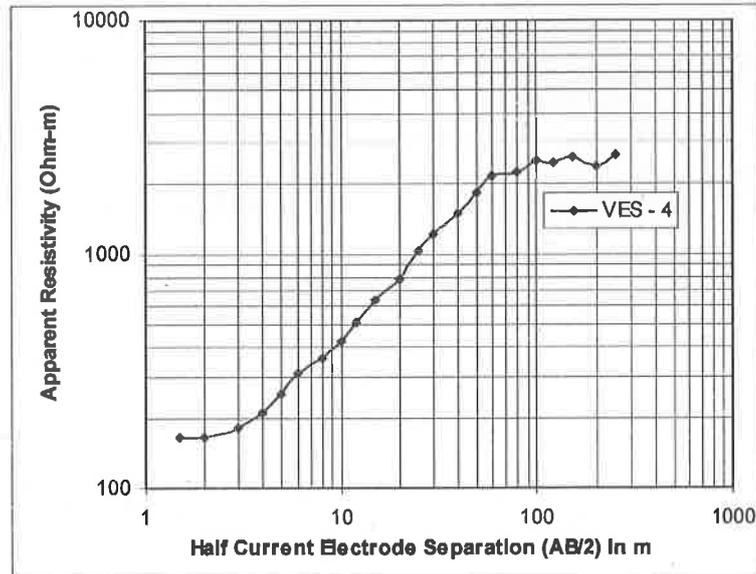
**Table-6.4:**

**Data and Plot of VES-4 Conducted in the investigated area**

S. No.	AB/2 (m)	MN/2 (m)	G Factor K	Resistance (Ohm)	Resistivity (Ohm-m)
1	1.5	0.5	6.28	26.11	164.0
2	2	0.5	11.775	13.93	164.0
3	3	0.5	27.475	6.62	182.0
4	4	0.5	49.455	4.27	211.0
5	5	0.5	77.715	3.24	252.0
6	6	0.5	112.255	2.76	310.0
7	8	0.5	200.175	1.78	357.0
8	8	2	47.1	7.56	356.2
9	10	2	75.36	5.67	427.0
10	12	2	109.9	4.65	511.0
11	15	2	173.485	3.65	634.0
12	20	2	310.86	2.52	784.0
13	20	5	117.75	6.64	782.1
14	25	5	188.4	5.47	1031.0
15	30	5	274.75	4.39	1205.0
16	40	5	494.55	3.03	1497.0
17	50	5	777.15	2.33	1810.0
18	50	10	376.8	4.8	1809.7
19	60	10	549.5	3.9	2143.0

**A REPORT ON HYDROGEOLOGICAL INVESTIGATIONS & RAIN WATER HARVESTING  
SYSTEM IN M/S D. B. THERMAL POWER PROJECT AT VILLAGE GORGI,  
TEHSIL DEOSAR, DISTRICT SINGRAULI (M. P.)**

20	80	10	989.1	2.27	2244.0
21	100	10	1554.3	1.6	2493.0
22	100	25	588.75	4.24	2497.0
23	120	25	865.07	2.85	2469.0
24	150	25	1373.75	1.9	2616.0
25	200	25	2472.75	0.96	2369.0
26	250	25	3885.75	0.68	2661.0



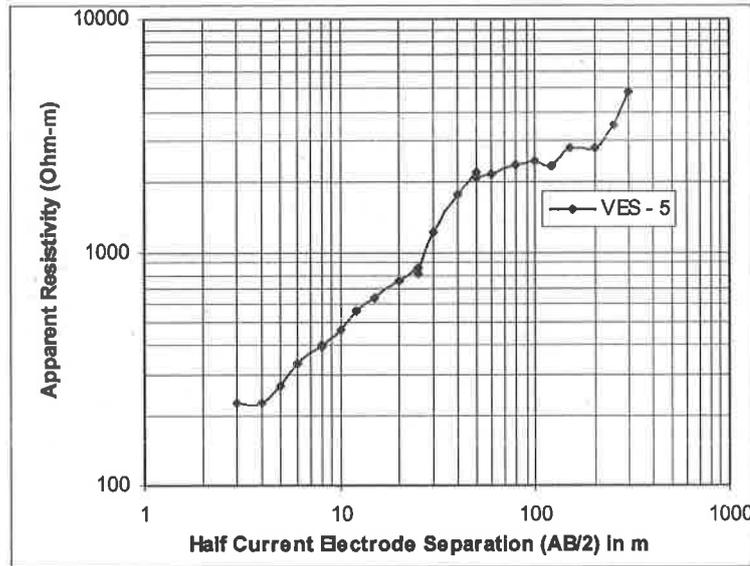
**A REPORT ON HYDROGEOLOGICAL INVESTIGATIONS & RAIN WATER HARVESTING  
SYSTEM IN M/S D. B. THERMAL POWER PROJECT AT VILLAGE GORGI,  
TEHSIL DEOSAR, DISTRICT SINGRAULI (M. P.)**

**Table-6.5:**

**Data and Plot of VES-5 Conducted in the investigated area**

S. No.	AB/2 (m)	MN/2 (m)	G Factor K	Resistance (Ohm)	Resistivity (Ohm- m)
1	1.5	0.5	6.28	29.3	184
2	2	0.5	11.775	14.95	176
3	3	0.5	27.475	8.26	227
4	4	0.5	49.455	4.57	226
5	5	0.5	77.715	3.42	266
6	6	0.5	112.255	2.97	333
7	8	0.5	200.175	1.99	398
8	8	2	47.1	8.41	396
9	10	2	75.36	6.13	462
10	12	2	109.9	5.07	557
11	15	2	173.485	3.67	636
12	20	2	310.86	2.43	756
13	25	2	487.485	1.76	858
14	25	5	188.4	4.31	812
15	30	5	274.75	4.42	1214
16	40	5	494.55	3.56	1759
17	50	5	777.15	2.81	2184
18	50	10	376.8	5.5	2072
19	60	10	549.5	3.95	2172
20	80	10	989.1	2.4	2375
21	100	10	1554.3	1.58	2454
22	100	25	588.75	4.16	2451
23	120	25	865.07	2.7	2337
24	150	25	1373.75	2.02	2773
25	200	25	2472.75	1.13	2804
26	250	25	3885.75	0.89	3468
27	300	25	5612.75	0.86	4822

**A REPORT ON HYDROGEOLOGICAL INVESTIGATIONS & RAIN WATER HARVESTING  
SYSTEM IN M/S D. B. THERMAL POWER PROJECT AT VILLAGE GORGI,  
TEHSIL DEOSAR, DISTRICT SINGRAULI (M. P.)**



The VES cures were interpreted manually by two and three layer master curves and by computer software IPI2Win to get the geo-electric layer parameters. These results were further refined with help of computer aided program SCHLUM through automatic curve matching technique. In this computer aided curve matching technique, an initial model is given for which the computer arrives at the theoretical curve and compares with the field data; then it takes difference between the recomputed and field curves and modifies old model parameters to start with a new model for reducing this difference (error). Again computes new theoretical curve and compares with the field curve, and sets another new model to reduce the differences. This process of iteration goes on till the error is minimized and finally displays the match between the field and theoretical curves giving the final model parameters. The final results were corroborated with the known hydrogeological conditions existing in the area. The final interpreted geo-electrical layer parameters of VES's (layer resistivity and layer thicknesses) are given in **Table-6.1**.

**A REPORT ON HYDROGEOLOGICAL INVESTIGATIONS & RAIN WATER HARVESTING  
SYSTEM IN M/S D. B. THERMAL POWER PROJECT AT VILLAGE GORGI,  
TEHSIL DEOSAR, DISTRICT SINGRAULI (M. P.)**

**Table-6.1:**

**Interpreted geo-electrical layer parameters of VES's (layer resistivity and layer thicknesses)**

VES	Layer Resistivity (m)				Layer Thickness			Total Thickness	Inferred lithology with respect to
	P <sub>1</sub>	ρ <sub>2</sub>	P <sub>3</sub>	ρ <sub>4</sub>	h <sub>1</sub>	h <sub>2</sub>	h <sub>3</sub>		
1	109	340	5560	5540	1.60	7.80	1.20	10.60	Soil, weathered and fractured and compact sandstone
2	22	105	1520	3330	1.3	10.4	2.5	14.2	Soil, weathered and fractured and compact sandstone
3	103	780	2040	8400	1.4	12.6	5.0	19.0	Soil, weathered and fractured and compact sandstone
4	88	40	690	3950	1.3	4.7	14.6	20.60	Soil, weathered and fractured and compact sandstone
6	25	540	3200	8890	1.0	2.4	12.0	15.0	Soil, weathered and fractured and compact sandstone
5	82	128	296	6600	1.8	14.6	2.6	19.0	Soil, weathered and fractured and compact sandstone

CHAPTER – VII

*Estimated Tentative*  
7.0 SURFACE AND GROUND WATER RESOURCES POTENTIAL

**7.01 Surface Water Resources Potential**

Availability of surface water is one of the basic factors for harnessing it. It is basically assumed in terms of non-committed surplus monsoon runoff going out of system unutilized. Runoff (stream flow) is water discharge through streams consisting wholly or in part of water contributed by over land flows expressed quantitatively in terms of volume, percentage of precipitation and depth of water over unit area. Runoff depends on geological, meteorological, topographical, moisture content, intensity, duration, distribution of precipitation, humidity, temperature of atmosphere, density of vegetation and slope of land surface and depth of water table.

The normal annual rainfall of Sidhi rain gauge station is **1076.4 mm**. About 91 % of the annual rainfall occurs during the monsoon period and normal monsoon rainfall is **980.0 mm**. The total thermal power plant area is about **2.97443 Km<sup>2</sup>**. The surface water potential for the entire project area is estimated by using Inglis formula, which arrives to **3.5720 MCM/annum**.

$$\begin{aligned}\text{Surface Rainfall Potential} &= \text{Area} \times \text{Rainfall} \times \text{Surface Runoff Coefficient} \\ &= 2.97443 \times 0.980 \times 0.75\end{aligned}$$

$$\text{Surface Rainfall Potential} = 2.186206 \text{ MCM/annum.}$$

**7.02 Ground Water Resources Potential**

**Ground Water Resources Potential of Deosar Block**

The Net annual ground water available in the Deosar block is **179.09 MCM** and draft from all uses is **17.73 MCM**. Net ground water available for future irrigation use is **158.66 MCM**. The Net annual ground water available and draft from all uses for block is tabulated in **Table-7.1**. The ground water resources development is only **10 %** and block is categorized as **safe Category**.

**A REPORT ON HYDROGEOLOGICAL INVESTIGATIONS & RAIN WATER HARVESTING  
SYSTEM IN M/S D. B. THERMAL POWER PROJECT AT VILLAGE GORGI,  
TEHSIL DEOSAR, DISTRICT SINGRAULI (M. P.)**

**Table-7.1:**

**Ground Water Resources & Stage of Development in Deosar Block**

Block	Command/ non- Command/ Total	Net Annual Ground water Availability	Existing Gross Ground water Draft for Irrigation	Existing Gross Ground water Draft for Domestic	Existing Gross Ground water Draft for All uses	Allocation for domestic & industrial requirement supply up to next 25 Net Groundwater	Availability for future irrigation development	Stage of Groundwater Development (%)
		MCM	MCM	MCM	MCM	MCM	MCM	
<b>Deosar</b>	Command	6.42	0.10	0.45	0.55	0.81	5.51	9
	Non- Command	172.67	12.24	4.94	17.08	7.41	153.02	10
	<b>Block Total</b>	<b>179.09</b>	<b>12.34</b>	<b>5.39</b>	<b>17.73</b>	<b>8.09</b>	<b>158.66</b>	<b>10</b>

(Source CGWB and GWS)

### 7.03 Ground Water Resources Potential of Project Area

#### Water Level Fluctuation (WLF) Method

Groundwater resources potential of the investigated area has been worked out by water level fluctuation method. The rise in water level in the area is due to rainwater infiltration and applied irrigation water. The decline in water level is mainly due to withdrawal for different purposes. The statistical calculation for estimation of total annual groundwater resources is given below.

#### Monsoon Recharge

The monsoon recharge in the study area, water fluctuation in the area suitable for recharge is worked out based on water level fluctuation and specific yield. The specific yield of water bearing formation i.e. weathered/fractured sandstone is considered as 0.03.

**Table-7.2:  
Groundwater resources in the study area.**

Area suitable for groundwater recharge	3.492437 Km <sup>2</sup>
Water table fluctuation (rise) (Based on well invented reported data)	10.00 m
Specific yield in the zone of water table fluctuation	0.03
Year of observation	2010
Monsoon recharge area x water level fluctuation x sp. Yield <b>Ground Water Resources (MCM/annum)</b>	3.492437 x 10 x 0.03 <b>=1.048 MCM/annum</b>

**Recharge due applied irrigation**

As observed during the field studies, nearly 30 % area is reported to be irrigated through ground water in the area and water applied for irrigation for mixed crops is assumed to be average 0.30 m per year. Hence, the total volume of water applied for irrigation works out to be.

$$= 3.492437 \times 0.30 \times 0.30$$

$$= 0.3143 \text{ MCM/annum}$$

Recharge due to applied irrigation in the area having 10 m water level would be 20 % of the water utilized for irrigation of mixed crops as per GREC report 1997, MOWR, Govt. of India.

Hence, recharge due to applied irrigation

$$R_i = 0.3143 \times 0.20 \text{ MCM/annum}$$

$$R_i = 0.063 \text{ MCM/annum}$$

**Total annual recharge**

Total annual recharge = Recharge during monsoon (**1.048 MCM/annum**) + Return flow from irrigation during non-monsoon period (**0.063 MCM/annum**) = **1.111 MCM/annum**

**Total GW Recharge Potential == 1.111 MCM/annum**

**Net Annual Utilizable Groundwater Resources**

Net Annual utilizable groundwater resources = Total Resources x 0.95

$$= 1.111 \times 0.95 \text{ MCM/annum}$$

**Net Annual utilizable groundwater resources = 1.055 MCM/annum**



**A REPORT ON HYDROGEOLOGICAL INVESTIGATIONS & RAIN WATER HARVESTING  
SYSTEM IN M/S D. B. THERMAL POWER PROJECT AT VILLAGE GORGI,  
TEHSIL DEOSAR, DISTRICT SINGRAULI (M. P.)**

**Gross annual GW draft**

Number of groundwater structures = 10

Average GW draft per unit structure (unit draft) = 0.020 MCM/annum

**GW draft per year = 0.2 MCM/annum**

**Groundwater Balance**

Annual utilizable groundwater resources – Net annual Groundwater Draft = **1.055**

**MCM/annum – 0.2 MCM/annum = 1.035 MCM/annum**

**Stage of groundwater Development**

Stage of ground water development =  $\frac{\text{Annual gross ground water draft X 100}}{\text{Net annual ground water availability}}$

$$= \frac{0.20 \times 100}{1.055}$$

**Stage of ground water development = 18.95%**

The stage of ground water development is presently **18.95%** which is very low rate of ground water development and it is categorised as **Safe**.

## **CHAPTER – VIII**

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### **8.0 RAINWATER HARVESTING**

#### **8.01 Recharge Test and Scope of Rainwater Harvesting in Area**

Rain water harvesting and artificial recharge to ground water are the process of adding water to an aquifer through human effort. It is an indispensable measure by which the groundwater reservoir is augmented at a rate exceeding that under natural condition of replenishment. The planned augmentation of water storage in the ground water reservoirs by suitable recharge techniques is useful for reducing over draft, conserving runoff and increasing available ground water supplies.

This has become a very popular method of conserving rainwater especially in the industrial activities. Rainwater harvesting essentially means collecting rainwater in the roof of the building, open catchments and store it on the surface and underground for later use. Not only does this recharging, arrest groundwater depletion, it also raises the declining groundwater. Town planners and civil authority in many cities in India are introducing bylaw making rainwater harvesting compulsory in all new structure.

The objective of rain water harvesting/ground water recharge is

1. To store surplus rainwater in an aquifer to meet demand & overcome in adequacy.
2. To make improvement in groundwater levels and well fields.
3. To make improvement in infiltration and reduction in flooding runoff.
4. To improve groundwater quality by dilution.
5. Conservation of water.

#### **8.02 Methodology**

The plan for artificial recharge has been prepared by considering the hydrogeological parameters and hydrological database. The following aspects are considered for preparation of the project:

- Identification and prioritization of need based areas for artificial recharge to ground water.
- Estimation of sub surface storage space and quantity of water needed to saturate the unsaturated zone (up to 3 m bgl)

**A REPORT ON HYDROGEOLOGICAL INVESTIGATIONS & RAIN WATER HARVESTING  
SYSTEM IN M/S D. B. THERMAL POWER PROJECT AT VILLAGE GORGI,  
TEHSIL DEOSAR, DISTRICT SINGRAULI (M. P.)**

- Quantification of surface water requirement and surplus annual run off availability as source water for artificial recharge in watershed.
- Working out design of suitable recharge structures, their numbers, type, storage capacity and efficiency considering the estimated storage space and available source water for recharge.
- Cost estimates of artificial recharge structures required to be constructed in identified areas.

### **8.03 Assessment of Factor for Harvesting Surplus Monsoon Runoff**

#### **Source water availability**

The normal annual rainfall for Sidhi rain gauge station is **1076.4** mm. About 91 % of the annual rainfall occurs during the monsoon period and normal monsoon rainfall is **980.0** mm. The total thermal power plant area is about **2.97443 Km<sup>2</sup>**. The surface water potential for the entire project area is estimated by using Inglis formula, which arrives to **2.1862060 MCM/annum**.

$$\begin{aligned}\text{Surface Rainfall Potential} &= \text{Area} \times \text{Rainfall} \times \text{Surface Runoff Coefficient} \\ &= 2.97443 \times 0.980 \times 0.75\end{aligned}$$

$$\text{Surface Rainfall Potential} = 2.1862060 \text{ MCM/annum.}$$

#### **Sub-Surface Storage Potential**

The better understanding of lateral extent, thickness and replenishment capacity of the rock is needed to evaluate sub-surface storage potential. To estimate the available storage space for sub-surface storage potential in plant area, a post monsoon depth to water level map is prepared on the basis of reported data. The post monsoon depth to water level represents a situation of minimum thickness of vadose zone available for recharge. The upper 3 meter of unsaturated vadose zone is not considered for recharge to avoid water logging, soil salinity etc. A specific yield of 0.03 for Gondwana sandstone is considered to estimate sub-surface storage recharge potential.

The total land area for setting up the 1320 MW plant is 735 acres including power plant and its all auxiliary system, ash disposal area and colony. The breakup of the each area is given below:

- Plant Area – 1.396165 Km<sup>2</sup>
- Ash disposal Area – 1.363791 Km<sup>2</sup>

**A REPORT ON HYDROGEOLOGICAL INVESTIGATIONS & RAIN WATER HARVESTING  
SYSTEM IN M/S D. B. THERMAL POWER PROJECT AT VILLAGE GORGI,  
TEHSIL DEOSAR, DISTRICT SINGRAULI (M. P.)**

- Green belt area –1.452821 Km<sup>2</sup>
- Staff township –0.238765 Km<sup>2</sup>
- Miscellaneous (Office, stores and other infrastructures) – 0.404686 Km<sup>2</sup>
- **Total Project area – 4.856228 Km<sup>2</sup>**

#### **8.04 Rainwater Harvesting in the Project Area**

##### **Rooftop Rainwater Harvesting in Plant area**

Total Rooftop area = 1.396165 Km<sup>2</sup>

Normal monsoon rainfall = 980 mm (0.980 m)

Catchment factor for rooftop = 0.85 (as per C.G.W.A. norms)

**Total volume of water to be generated = 1.396165 x 0.980 x 0.85 =  
1.163MCM/annum**

##### **Rooftop Rainwater harvesting in staff township and office buildings**

Total Rooftop area = 0.643451 Km<sup>2</sup>

Normal monsoon rainfall = 980 mm (0.980 m)

Catchment factor for rooftop = 0.85 (as per C.G.W.A. norms)

**Total volume of water to be generated = 0.643451 x 0.980 x 0.85 = 0.535  
MCM/annum**

##### **Rainwater harvesting in open and green belt area**

Open and green belt area = 1.452821 Km<sup>2</sup>

Normal monsoon rainfall = 980 mm (0.980 m)

Catchment factor for open and green belt area = 0.15 (as per C.G.W.A. norms)

**Total volume of water to be generated = 1.452821 x 0.980 x 0.15 = 0.214  
MCM/annum**

##### **Impact on groundwater regime**

On the completion of rooftop rainwater harvesting, road runoff rainwater harvesting, open land area rainwater harvesting, the total recharge potential of the project area would be as under:

- |  |                |
|--|----------------|
| <b>1. Rooftop rainwater harvesting in plant area</b>               | <b>= 1.163</b> |
| <b>MCM/annum</b>   |                |
| <b>2. Rooftop rainwater harvesting in colony and office area =</b> | <b>0.535</b>   |
| <b>MCM/annum</b>   |                |
| <b>3. Open and green belt area rainwater harvesting</b>            | <b>= 0.214</b> |
| <b>MCM/annum</b>   |                |
| <b>4. Ground water recharge due to stop dam</b>                    | <b>= 1.500</b> |
| <b>MCM/annum</b>   |                |



**Total Recharge Potential** **= 3.412**  
**MCM/annum**

The ground water recharge potential in the project area before the implementation of project is estimated **1.055 MCM/annum**. After the implementation of artificial recharge schemes in project area, the ground water recharge potential is estimated **3.412 MCM/annum**. By the implementation of ground water artificial recharge scheme in project area there will be net enhance in ground water recharge potential of **2.375 MCM/annum**.

Proposed recharge potential is to be created by the project, would improve ground water regime of the area and would contribute to positive groundwater environment. The total surface water potential for the entire project area is estimated to **3.5720 MCM/annum**. After the implementation of artificial recharge schemes in project area, the ground water recharge potential is estimated **3.412 MCM/annum**. The remaining **0.16 MCM/annum** of available surface water potential will be accounted for evapotranspiration. Thus almost all surface water resources potential available in the project area will be utilized.

**8.05 Water Conservation and Artificial Recharge** Ground Water is also playing important role in augmenting the supply causing depletion of water levels in the area. To avoid over exploitation of ground water resources of the area there is need to conserve water flowing out of the area through local drainage at various places at suitable locations and to adopt roof water harvesting techniques for recharge of depleting ground water resources. Rooftop water harvesting techniques is best technique for artificial recharging of ground water in areas where plenty off rooftop area is available.

**Roof top harvesting can be adopted because of following advantage**

This is an ideal solution of water problem where there is inadequate ground water supply or surface resources are either lacking or insignificant. To utilize the rainfall runoff, which is going to sewer or storm drains, rainwater are bacteria free from organic matter and soft in nature. It will help in reducing the flood hazard. To improve the quality of existing ground water through dilution, rainwater may be harnessed at place of need and may be utilized at time of need.

## CHAPTER – IX

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### 9.0 CONCLUSIONS/SUBMISSIONS

#### 9.01 Conclusions

Based on the hydrogeological, geophysical and hydrometreological studies and field investigation in the project area of M/s D B Thermal Power at Gorgi village in Singrauli district, following conclusions were drawn.

- The normal annual rainfall of nearest raingauge station (Sidhi) for the last 50 years is **1076.4 mm**
- The normal monsoon rainfall of Sidhi raingauge station is **980.0 mm**.
- Maximum rainfall of 1751.6 mm was recorded during 1997 and a minimum of 756.2 mm. in the year 1996.
- The Thermal Power Plant area is **2.1862060 Sq. Km**.
- The monsoon precipitation in the entire project area (Area x rainfall)  
**=2.1862060 x 0.980 m = 2.142 MCM/annum**
- Total surface run off in the entire Project area = Area x Rainfall x Runoff Coefficient  
**=2.142x 0.75 =1.6065 MCM/annum.**
- Total ground water recharge potential before the project is **1.055 MCM/annum.**
- Ground water recharge potential after the completion of project and implementation of artificial recharge schemes would be **3.412 MCM/annum.**
- Net enhance in ground water potential due the implementation of the artificial recharge schemes would be **2.375 MCM/annum.**
- The study area has ground water table at depth of 10-15 m below the ground level.
- The total water requirement of Thermal Power Plant will meet through the Gopad River through the proposed pipe line.
- Thermal Power Project will not utilize ground water for any purposes even during lean period.
- A major part of the area is occupied by Gondwana sandstone of Lower Cretaceous to Carboniferous age. Only a small parts of the project area is covered by the intrusive dolerite rocks.
- Recharge through proposed stop dam may be more effective in the project area as the weathered sandstone rocks are exposed on ground surface.

**A REPORT ON HYDROGEOLOGICAL INVESTIGATIONS & RAIN WATER HARVESTING  
SYSTEM IN M/S D. B. THERMAL POWER PROJECT AT VILLAGE GORGI,  
TEHSIL DEOSAR, DISTRICT SINGRAULI (M. P.)**

**9.02 Submissions**

- Operation of thermal power plant will not have any long term impact on ground water quality as it is proposed minimum discharge from the plant. The water system of the proposed plant has been developed with the maximum recycle and reuse of water, so as to minimize the water requirement for the project as well as to reduce the quantity of effluent generated from the plant to minimum discharge.
- De-mineralization plant will be sized to meet the internal requirement of fresh water in the proposed power plant. Water storage tank will be provided for distribution of potable water to various consumer points. Provision for rain water harvesting will be made and the water will be re-circulated.
- It has been proposed that a suitable storage may be created by constructing a low barrage on Gopad River for augmenting availability of water during the lean period.
- Utmost care has been taken to maximize the recycle /reuse of effluent and minimize effluent quantity.
- The provision like Ash water Recirculation system,(AWRS), Effluent Treatment Plant (ETP), Sewage Treatment Plant (STP) will ensure that most of the treated effluent is reused inside the plant.
- The concept of zero discharge will be adopted by the project.
- No ground water will be drawn during operation for any purposes. So lowering of groundwater table will not be an issue.
- Rainwater harvesting will be implemented at the proposed plant to conserve the storm water.
- The impact on ground water due to power plant operation would primarily result due to likely leaching of toxic metals from the ash pond area. In practice the pH of the ash water is either neutral or alkaline and hence the leaching of heavy metals is unlikely to occur. In view of this contamination of ground water due to leaching is not expected.
- No water bodies including natural drainage system in the area shall be disturbed due to activities associated with setting up and operation of the power plant.
- Additional soil for leveling the proposed site shall be generated within the site so that no natural drainage system of the area is disturbed.

**A REPORT ON HYDROGEOLOGICAL INVESTIGATIONS & RAIN WATER HARVESTING  
SYSTEM IN M/S D. B. THERMAL POWER PROJECT AT VILLAGE GORGI,  
TEHSIL DEOSAR, DISTRICT SINGRAULI (M. P.)**

- Unutilized fly ash shall be disposed off in the ash pond in the form of slurry. Mercury and other heavy metals (As, Hg, Cr, and Pb ect.) will be monitored in the ground water.
- The treated effluents conforming to the prescribed standards only shall be re-circulated and reused in the plant. There shall be no discharge out site the plant boundary even during monsoon. Arrangement shall be made that effluents and storm water do not get mixed together.
- A sewage treatment plant shall be provided and treated sewage shall be used for raising the green belt plantation.
- Regular monitoring of ground water level shall be carried out by establishing by a network of existing wells and constructing new piezometers.
- The monitoring around ash pond area shall be carried out especially for the heavy metal and records shall be maintained and submitted Central Ground Water Authority, Ministry of Water Resources, Govt. of India on a regular basis.
- The data so obtained will be compared with the baseline data so as to ensure that the ground water quality is not being adversely affected due to the project.

**CHAPTER – X**

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**10.0 RECOMMENDATION FOR RAINWATER HARVESTING – TENTATIVE PROPOSAL**

On the basis of the hydrogeological survey and geophysical investigations it is inferred that three aquifer systems exist in study area. On the basis of aquifer allocation following ground water recharge and groundwater monitoring structures are recommended.

**10.1 Ground Water Recharge Structures in Power Plant Area**

**A Storm water drainage structures**

To collect the storm water, 10 number of recharge pit with the dimension of 1.0 m x 1.0 m x 1.0 m filled with filter material is recommended at distance of 100 m along the sloping ground as per the availability of open land. The bottom of the recharge pit will be open. The rainwater collected in form of storm water will be collected in the pit and it will recharge phreatic aquifer system.

**B Rooftop Rainwater Harvesting**

To collect the rooftop rainwater 3 numbers of recharge pit in power plant area and 2 number of recharge pit in staff colony and administrative building with the dimension of 3.5 m x 3.5 m x 3 m filled with filter material is recommended. Rainwater from the rooftop area will be collected from roof through 5" diameter PVC pipe and it will lead to the recharge pit. Through this recharge, the phreatic aquifer system will be recharge. The major part of the proposed roof area is identified for recharging. A 30 m deep and 6" dia bore well recommended to drill inside each recharge pit to enhance the ground water recharge. The locations of rooftop rainwater harvesting structures are given in figure 10.1a. The design of the rooftop rainwater recharge pit is given in figure 10.4.

**C Recharge through stop dam**

A stop dam site is recommended to construct for recharging the phreatic aquifer system. The rainwater will be collected in the stop dam and it will recharge the weathered phreatic aquifer system in the area. Construction of stop dam will also add social corporate responsibility. The location of proposed stop dam has been shown in the figure 10.1b. The design details of R C C stop dam has been given in Annexure-1a. The design calculation of R

**A REPORT ON HYDROGEOLOGICAL INVESTIGATIONS & RAIN WATER HARVESTING SYSTEM IN M/S D. B. THERMAL POWER PROJECT AT VILLAGE GORGI, TEHSIL DEOSAR, DISTRICT SINGRAULI (M. P.)**

C C stop dam has been given in Annexure-1b. The cost estimation of R C C stop dam has been given in Annexure-1c

**D Construction of Piezometers**

One number of shallow piezometer and one number of deep piezometer in Project area may be constructed for monitoring ground water level and ground water quality as per norms laid by CGWA. The locations of proposed piezometers are shown in the figure 10.1a. The designs of shallow and deep piezometer are given in figure 10.2 and figure 10.3 respectively. Monthly ground water level data and water quality data may be collected and submitted to CGWA on regular basis.

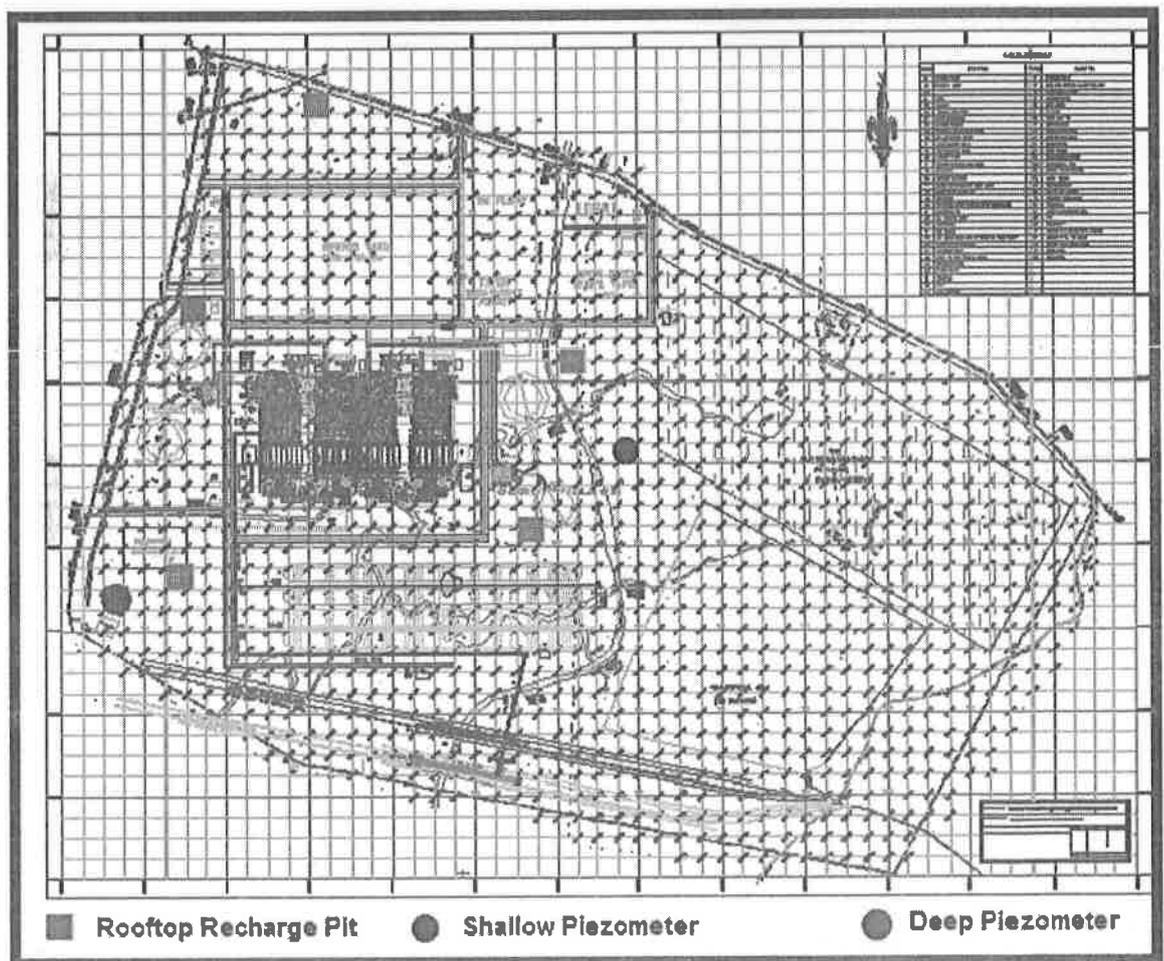


Figure 10.1a: Locations of recommended rainwater harvesting structures in the D B Thermal Power Project Area

**A REPORT ON HYDROGEOLOGICAL INVESTIGATIONS & RAIN WATER HARVESTING  
SYSTEM IN M/S D. B. THERMAL POWER PROJECT AT VILLAGE GORGI,  
TEHSIL DEOSAR, DISTRICT SINGRAULI (M. P.)**

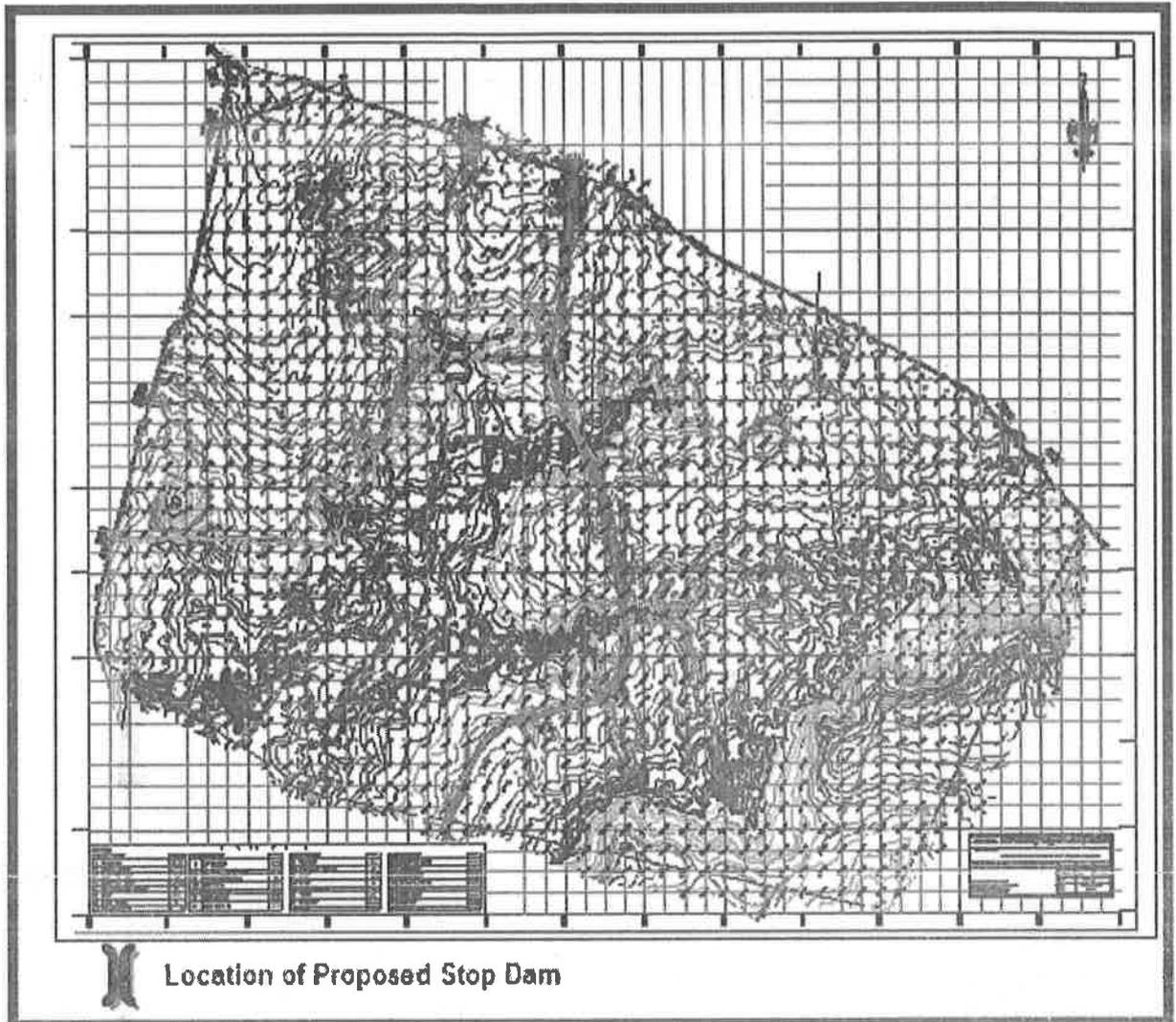


Figure 10.1b: Locations of recommended rainwater harvesting structures in the D B Thermal Power Project Area

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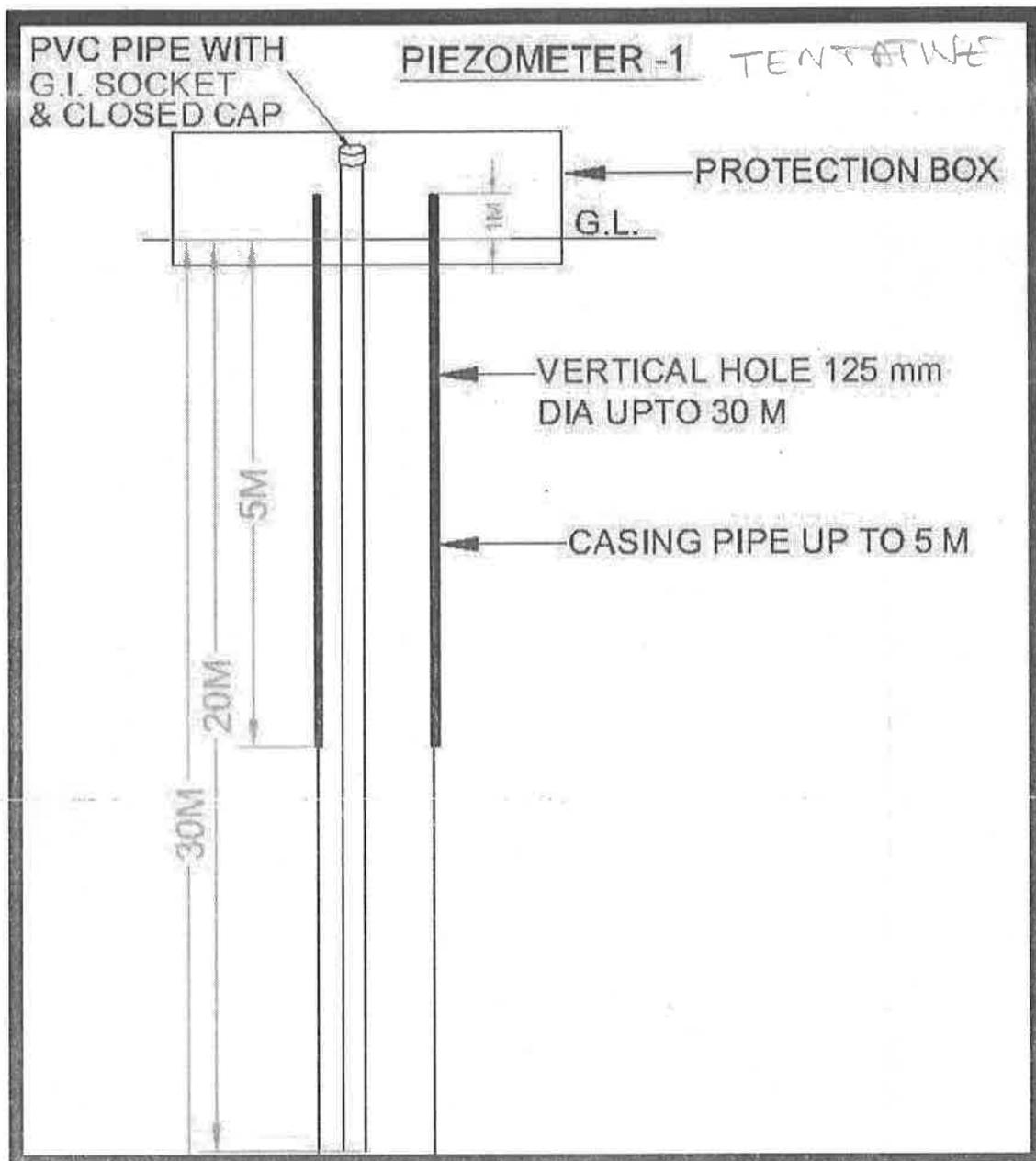


Figure 10.2: Design of proposed shallow piezometer.

**A REPORT ON HYDROGEOLOGICAL INVESTIGATIONS & RAIN WATER HARVESTING SYSTEM IN M/S D. B. THERMAL POWER PROJECT AT VILLAGE GORGI, TEHSIL DEOSAR, DISTRICT SINGRAULI (M. P.)**

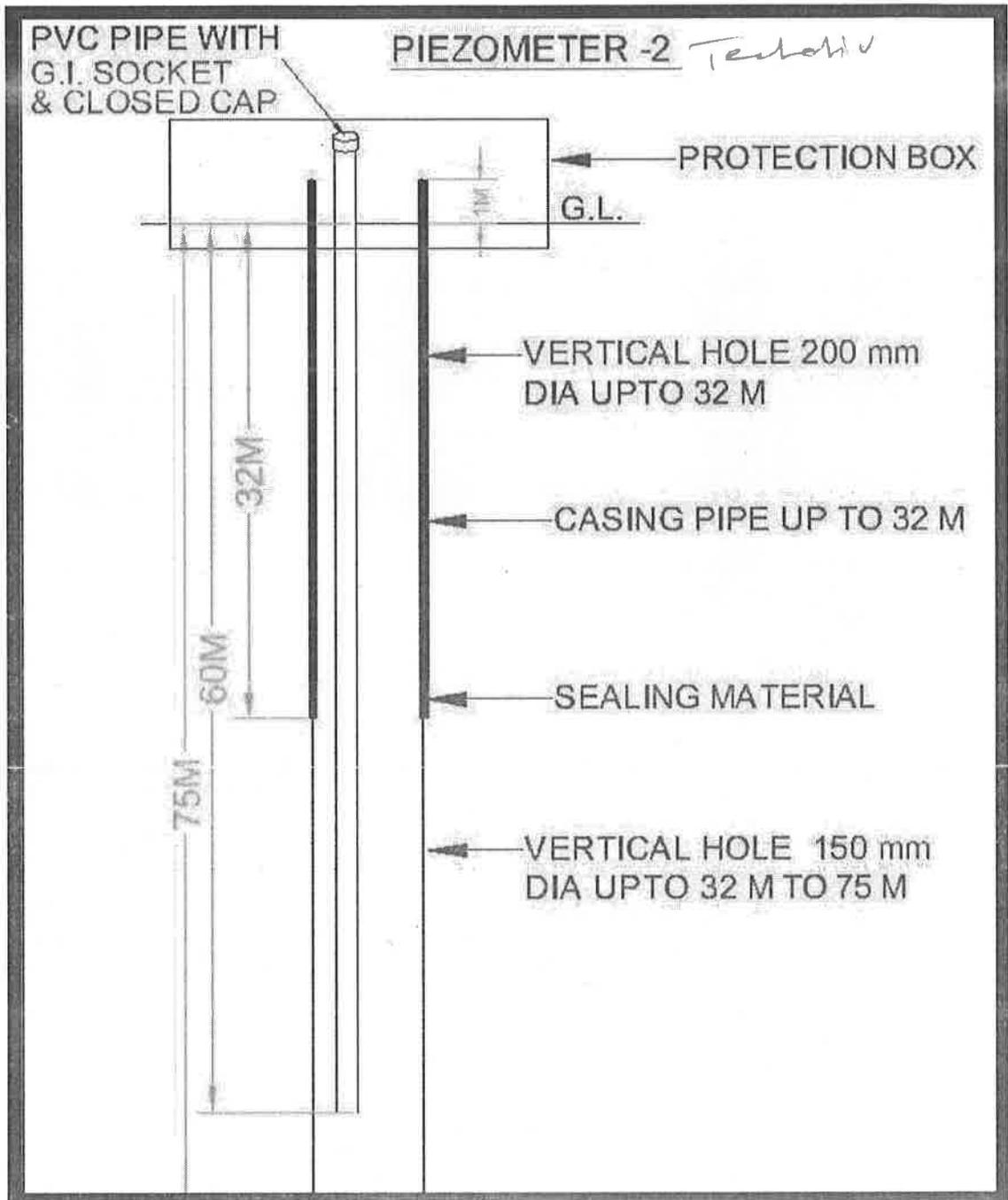
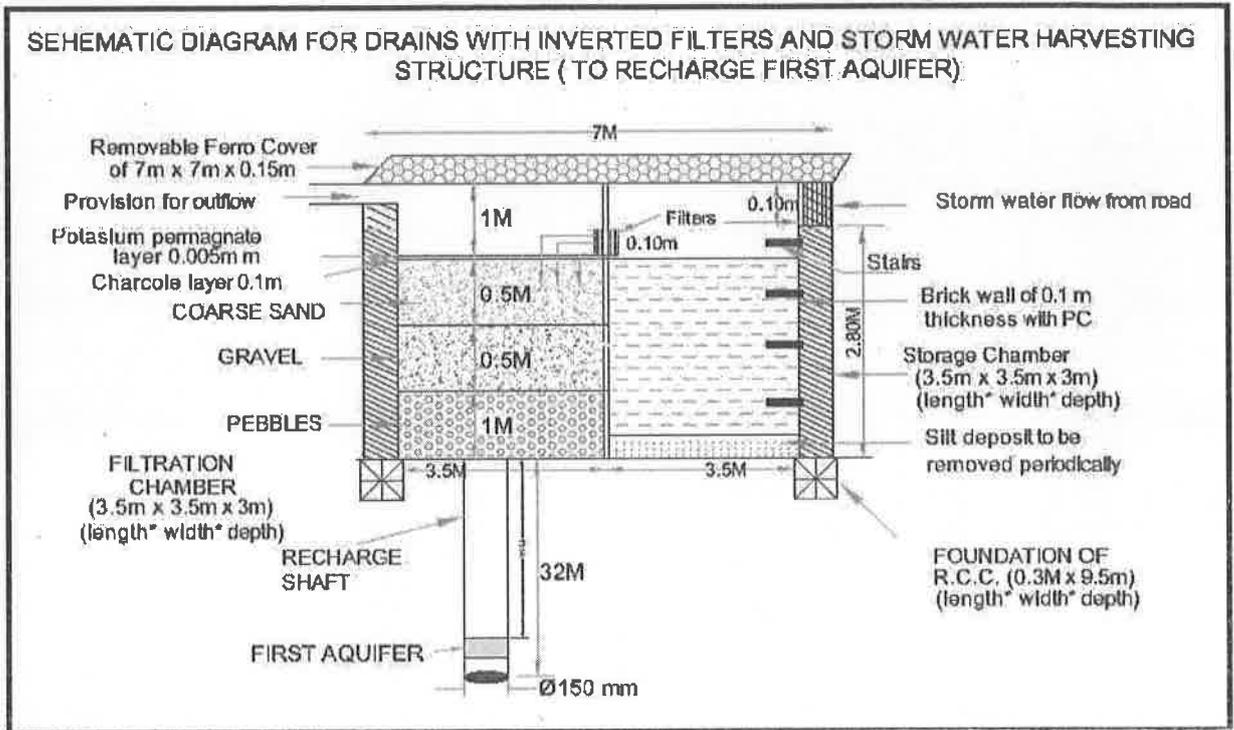


Figure 10.3: Design of proposed deep piezometer

**Figure 10.4:**  
**Design of the storm water harvesting structure (to recharge first aquifer).**

*Teutah*



**A REPORT ON HYDROGEOLOGICAL INVESTIGATIONS & RAIN WATER HARVESTING  
SYSTEM IN M/S D. B. THERMAL POWER PROJECT AT VILLAGE GORGI,  
BLOCK DEOSAR, DISTRICT SINGRAULI (M. P.)**

**Annexure-1a**

<b>Design Details of RCC Stop Dam</b> <i>Tentative Subject</i>			
<b>S. No.</b>	<b>Particulars</b>	<b>Unit</b>	<b>Details of Structure</b>
1	Type of Structure		R.C.C. Stop Dam
2	Toposheet No.		63 H/16
3	Depth of Nallah	metre	4.50
4	Top width of Nallah bank	metre	26
5	Bottom width of Nallah bank	metre	16
6	Width of Nallah bank at impounding level	metre	20
7	Height of impounding water	metre	1.0
8	Height of HFL	metre	0.5
9	Free Board	metre	3.5
10	Total Height of Bund	metre	20
11	Length of outlet	metre	1.6
12	Length of key walls (both sides)	metre	2.3
13	Total length of Bund	metre	21.0
14	Base of Bund	metre	21.0
15	Top of Bund	metre	1.0
16	Length of water cushion	metre	21.0
17	Capacity accumulated in structure in single filling	TCM	2.85
18	<b>Estimated cost</b>		<b>Rs. 4.12 lakhs</b>

*change as per site condition*

**A REPORT ON HYDROGEOLOGICAL INVESTIGATIONS & RAIN WATER HARVESTING  
SYSTEM IN M/S D. B. THERMAL POWER PROJECT AT VILLAGE GORGI,  
BLOCK DEOSAR, DISTRICT SINGRAULI (M. P.)**

**Annexure-1b**

**DESIGN CALCULATION OF R.C.C. STOP DAM**

**(A) Hydrological Design:**

- (i) Catchment Area = 10 Sq miles.
- (ii) Height of weir (Above gl) = 1.20 m.
- (iii) Length of weir = 20 m

Therefore,

$$\begin{aligned} \text{Maximum Discharge } Q &= C_m \frac{3}{4} \\ &= 1400 (10) \frac{3}{4} \\ &= 7873 \text{ cumecs} \\ \text{or} &= 223 \text{ cusecs} \end{aligned}$$

**(B) Hydraulic Design:**

$$\begin{aligned} \text{Providing 2 Nos. openings} &= (1 \times 1.20) \text{ m} \\ Q &= C_1 (H)^{3/2} \\ &= 2.2 \times 2 (1.2)^{3/2} \times 1 \\ &= 6 \text{ cusecs} \\ Q_2 &= Q - Q_1 \\ &= 223 - 6 \\ &= 217 \text{ Cusecs} \end{aligned}$$

Depth of water over crest:

$$\begin{aligned} Q &= C_1 (H)^{3/2} \\ H &= (217 / 2.2 \times 100)^{2/3} \\ &= 1.0 \text{ m} \end{aligned}$$

Provide minimum 0.20 m height of using wall crest level.

$$\begin{aligned} \text{Assume, Top width} &= 0.40 \text{ m.} \\ \text{Base width} &= 0.60 \text{ m.} \\ \text{Height} &= 1.20 \text{ m.} \end{aligned}$$

**Calculation of load for 1 m length of weir:**

Particulars	Load	Lever Arm	Moment
<b>1. Self weight of Dam:</b>			
(a)	(0.4X1.2) X2500 =1200 kg.	(0.2 + 0.2)	(+) 480 kgm.

**A REPORT ON HYDROGEOLOGICAL INVESTIGATIONS & RAIN WATER HARVESTING  
SYSTEM IN M/S D. B. THERMAL POWER PROJECT AT VILLAGE GORGI,  
BLOCK DEOSAR, DISTRICT SINGRAULI (M. P.)**

$$\begin{aligned}
 (b) \quad & (1/2 \times 0.2 \times 1.2 \times 2500) \quad 2/3 (0.2) \quad (+) 40 \text{ kgm} \\
 & = + 300 \text{ kg.} \\
 & = 1500 \text{ kg.} \quad \quad \quad (+) 520 \text{ kgm.}
 \end{aligned}$$

2. Horizontal water pressure:

$$\begin{aligned}
 Wh^2/2 = & 100 \times 1.2^2/2 \\
 & = (-) 720 \text{ kg} \quad 1.2/3 \quad (-) 288 \text{ kgm.} \\
 = & 1/2 \times 1.2 \times 0.6 \times 1000 \quad 2/3 \times 0.6 \quad (-) 144 \text{ kgm.}
 \end{aligned}$$

**Calculation for safety against sliding:**

$$\begin{aligned}
 = \mu \Sigma V / \Sigma V & = 0.75 \times 1150 / 720 \\
 & = 1.18 > 1, \text{ Hence safe.}
 \end{aligned}$$

**Calculation of Stress:**

$$\begin{aligned}
 = X & = \Sigma M / \Sigma U & = 88 / 1140 & = 0.08 \\
 e & = b/2 - X & = 0.6/2 - 0.08 & = 0.22 \\
 & = b/6 & = 0.6/6 & = 0.10 \quad e < b/6
 \end{aligned}$$

$$\begin{aligned}
 \text{Compressive stress at toe } P & = 1140 / 0.691 + 6 \times 0.22 / 0.22 / 0.6 \\
 & = 6080 \text{ by/m}^2
 \end{aligned}$$

$$\begin{aligned}
 \text{Compressive Stress at heel} & = 1140 / 0.6 (1 - 6 \times 0.22) / 0.6 \\
 & = (-) 2280 \text{ by / m}^2
 \end{aligned}$$

The bearing capacity of soil being 20 t/m<sup>2</sup>, the maximum pressure within the safe limit. Also to protect against sliding and over turning wing walls to be provided and steel of weir wall embedded into the wing wall.

**Design of Weir Wall:**

$$\begin{aligned}
 \text{Maximum bending moment per m. length} & = WH^3/6 \\
 & = 1000 \times 2.2^3/6 \\
 & = 1775 \text{ Kgm.}
 \end{aligned}$$

$$\begin{aligned}
 \text{Assuming compressive stress in steel} & = 50 \text{ kg/cm}^2 \\
 \text{Tensile Stress} & = 1400 \text{ kg/cm}^2 \\
 8.5 bd^2 & = 177500
 \end{aligned}$$

$$d = 14.45 \text{ cm.}$$

$$\text{Providing 4 cm. cover, depth} = 20 \text{ cm}$$

$$\text{Ast} = 177500 / (0.87 \times 1400 \times 20)$$

$$= 7.28 \text{ sq cm.}$$

**A REPORT ON HYDROGEOLOGICAL INVESTIGATIONS & RAIN WATER HARVESTING  
SYSTEM IN M/S D. B. THERMAL POWER PROJECT AT VILLAGE GORGI,  
BLOCK DEOSAR, DISTRICT SINGRAULI (M. P.)**

$$\begin{aligned} \text{Spacing of 10 mm } \varnothing \text{ bars} &= 0.785 \times 100 / 7.24 \\ &= 10.8 \text{ cm c/c} \end{aligned}$$

Hence provide 10 mm  $\varnothing$  bar @ 10 cm c/c. If the bars are provided in both faces, the spacing shall be 20 cm c/c.

**Distribution Steel -**

$$\begin{aligned} \text{This will be provided @ 0.15\% of gross area} &= 0.15 / 100 \times (100 \times 80) \\ &= 12 \text{ Sq cm} \end{aligned}$$

$$\begin{aligned} \text{Spacing of 8 mm } \varnothing \text{ bars} &= 0.508 \times 100 / 12 \\ &= 4.12 \text{ cm c/c} \end{aligned}$$

Hence Provide 8 mm  $\varnothing$  bars @ 4 cm c/c. If the bars are provided in both faces, the spacing shall be 8 cm c/c.

**Design of Wing wall -**

$$\begin{aligned} \text{Maximum bending moment per m. length} &= cp \times wH^3/6 \\ &= 1 / 3 \times 1900 \times 2.7^3/6 \\ &= 2078 \text{ kgm.} \\ d &= (207800 / (8.5 \times 100))^{1/2} \\ &= 16.63 \end{aligned}$$

$$\begin{aligned} \text{Providing 4 cm cover, depth} &= 20 \text{ cm} \\ Ast &= 207800 / (0.87 \times 1400 \times 20) \\ &= 8.5 \text{ cm}^2 \end{aligned}$$

$$\begin{aligned} \text{Spacing of 8 mm } \varnothing \text{ bars} &= 0.508 \times 100 \times 8.5 \\ &= 6 \text{ cm c/c alternatively} \end{aligned}$$

**Distribution steel -**

This will be provided @ 0.15% of

$$\begin{aligned} \text{Gross area} &= 0.15 / 100 \times (100 \times 40) \\ &= 6 \text{ sq cm} \end{aligned}$$

$$\begin{aligned} \text{Spacing of 8 mm } \varnothing \text{ bars} &= 0.508 \times 100 / 6 \\ &= 8.4 \text{ cm c/c} \end{aligned}$$

Hence provide 8 mm  $\varnothing$  bars @ 8 cm c/c alternatively

1c

**ABSTRACT CUM ESTIMATE FOR CONSTRUCTION OF R.C.C. STOP DAM (SPAN = 20 m.)****S.O.R. Referred: E-n-c/ Water Resources Department/Bhopal w.e.f. 01/06/2007**

S. No.	Item of Work	No.	L	B	H/D	Qty.	Unit	Rate	Amount
1	2	3	4	5	6	7	8	9	10

1. Surface dressing of the ground incl. removing vegetation and inequalities not exceeding 15cm in depth/height including disposal of rubbish up to 50 m lead and 1.5 m. lift.

For weir wall 1 30.00 20.00 600.00

For wing wall 2 20.00 10.00 400.00

Total 1000.00 Sq. m. 2.00

2000.00

Add extra for excavation in or under water-

For weir wall

20% of Weir wall in item No. 1 400.00

2. Excavation in all types of soils for all types of foundations and disposal of stuff up to 50 m lead and life up to 1.5 m.

a) weir wall 1 20.00 1.00 0.40 8.00

b) Apron 1 20.00 2.00 0.40 16.00

**A REPORT ON HYDROGEOLOGICAL INVESTIGATIONS & RAIN WATER HARVESTING SYSTEM  
IN M/S D. B. THERMAL POWER PROJECT AT VILLAGE GORGI,  
BLOCK DEOSAR, DISTRICT SINGRAULI (M. P.)**

c) Toe wall	1	20.00	0.60	0.40	4.80	
d) Wing Wall	2	6.00	0.60	1.20	8.64	
						<b>Total</b>
						<b>37.44 Cum 31.00 1161.00</b>

Add extra for excavation in or under water -

20% of a, b & c of item no. 2

232.00

3. Excavation in ordinary rocks for all types of foundations & trenches including disposal up to 50 m. lead & 1.5 m. lift.

a) weir wall	1	20.00	1.00	0.60	12.00	
b) Apron	1	20.00	0.60	0.20	2.40	
c) Wing Wall	2	6.00	0.60	0.30	2.16	
						<b>Total</b>
						<b>16.56 Cum 106.00 1755.00</b>

Add extra for excavation in or under water -

20% of item no. 3

351.0

4. Excavation in Hard rocks by chiseling & wedging including disposal of excavated stuff up to 50 m. lead & 1.5 m. lift.

a) weir wall	1	20.00	1.00	0.30	6.00	
b) Wing wall	2	6.00	0.60	0.30	2.16	
						<b>Total</b>
						<b>8.16 Cum 203.00 1656.00</b>

**A REPORT ON HYDROGEOLOGICAL INVESTIGATIONS & RAIN WATER HARVESTING SYSTEM  
IN M/S D. B. THERMAL POWER PROJECT AT VILLAGE GORGI,  
BLOCK DEOSAR, DISTRICT SINGRAULI (M. P.)**

Add extra for excavation in or under water -

20% of item no. 4 331.00

5. Providing & laying  
mechanically mixed c.c.  
1:3:6 with 40 mm metal in  
foundation & plinth

a) weir wall	1	20.00	1.00	0.30	6.00
b) Apron	1	20.00	2.00	0.20	8.00
c) Toe wall	1	20.00	0.60	0.20	2.40
d) Wing Wall	2	6.00	0.60	0.30	2.16

Total 18.56 Cum 1376.00 25,539

Add extra for execution in or under water -

18.56 Cum 136.00 2524.00

6. Providing & laying  
mechanically mixed  
R.C.C. 1:2:4 with 20 mm  
metal in foundation &  
plinth & superstructure  
up to a height of 4.0 m  
above plinth level  
excluding cost of  
centering, shuttering &  
reinforcement.

a) weir wall	1	20.00(0.8+0.4)/22.20	26.40
b) Toe wall	1	20.00(0.3+0.2)/20.50	2.50
c) Wing Wall	2	6.00(0.4+0.2)/22.70	9.72

**A REPORT ON HYDROGEOLOGICAL INVESTIGATIONS & RAIN WATER HARVESTING SYSTEM  
IN M/S D. B. THERMAL POWER PROJECT AT VILLAGE GORGI,  
BLOCK DEOSAR, DISTRICT SINGRAULI (M. P.)**

			Total	38.62
	Deduct for opening of gates	3	1.00(0.6+0.4)/21.20	1.80
			Net	36.82cum 2835.00 1,04,385.00
7.	Add extra for laying of RCC in or under water including cast of pumping or bailing out or water & removing slush.			
	a) weir wall	1	20.00(0.8+0.6)/21.00	14.00
	b) Toe wall.	1	20.00(0.3+0.25)/20.40	2.20
	c) Wing Wall	2	6.00(0.4+0.3)/21.00	4.20
			Total	20.40 cum 136.00 2774.00
8.	Providing & fixing formwork including providing Centering & shuttering etc. complete including its removal.			
	a) weir wall	2	20.00 2.20	88.00
	b) Toe wall	2	20.00 0.50	20.00
	c) Wing Wall	4	6.00 2.70	64.80
			Total	172.80 sq. m.77.0013306.00
9.	Providing & placing in position cold twisted steel and hot rolled deformed steel reinforcement for RCC including cutting, bending			

**A REPORT ON HYDROGEOLOGICAL INVESTIGATIONS & RAIN WATER HARVESTING SYSTEM  
IN M/S D. B. THERMAL POWER PROJECT AT VILLAGE GORGI,  
BLOCK DEOSAR, DISTRICT SINGRAULI (M. P.)**

■ etc. as per drawings including cost of binding wire and all wastage.

1% of item No. 6                      2890.00 kg.    50.001,4,500.00

10. Providing & laying  
mechanically mixed C.C.  
1:2:4 with 20 mm metal in  
foundation.

a) Apron	1	20.00	2.00	0.20	8.00cum	1839.00	14712.00
----------	---	-------	------	------	---------	---------	----------

11. Filling from available  
excavated stuff trenches,  
plinth, sides of  
foundations etc. including  
consolidation.

a) weir wall	2	20.00	0.10	1.00	4.00		
b) Toe wall	2	20.00	0.10	0.40	1.60		
c) Wing Wall	4	6.00	0.30	2.00	14.40		

Total					20.00 Cum.56.00	1120.00	
-------	--	--	--	--	-----------------	---------	--

12. Providing & fixing 1 mm  
thick MS sheet sliding  
shutter with frame and  
diagonal brasses of 40  
X 40 X 6 mm angle iron  
3.15 mm thick (work to be  
mentioned) with MS  
gusset plates at junction  
and corners 2 mm dia.  
pulley 40 X 40 X 6mm.  
angle ant T iron guide at

**A REPORT ON HYDROGEOLOGICAL INVESTIGATIONS & RAIN WATER HARVESTING SYSTEM  
IN M/S D. B. THERMAL POWER PROJECT AT VILLAGE GORGI,  
BLOCK DEOSAR, DISTRICT SINGRAULI (M. P.)**

top and bottom respectively including applying 13 priming coat of red lead paint (Kerri shutters)	6	1.00	1.20	7.20Sq. m.1200.008640.00
	<hr/>			
	Total			3, 33,558.00

Add 20 % extra above SOR as per current market rates	<hr/>	66,712.00
--	-------	-----------

**Total** **4, 00,270.00**

Add 3% for contingencies 12,008.00

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**Grand Total** **= Rs. 4, 12,278.00**

**Say** **=RS. 4.12 Lakhs**

**(Rupees Four Lakhs Twelve Thousand Only)**

\*\*\*\*\*

**EIA STUDY** for 1320MW Coal Based Super-critical Thermal Power Plant at Gorgi, Tehsil Deosar, District Singrauli, Madhya Pradesh

**Project Proponent-** DB Power (Madhya Pradesh) Limited

**9.**  
**RISK**  
**ASSESSMENT**

# 9. RISK ASSESSMENT AND DISASTER MANAGEMENT PLAN

## 9.1 INTRODUCTION

Despite of all precautions and protective measures, emergencies / accidents like fire and explosion due to leakage of fuel oil from the storage premises can occur. Even though such occurrence may be rare and a remote possibility, such accidents will have an adverse effect on the plant, property and people working inside the plant. To cope with and contain such "Emergency", a Risk Analyses exercise has been conducted, based on which a Disaster Management Plan has been developed. Such assessment includes policy issues, programmes, plans, technology, economics and education.

As per the Environment Protection Act, Section 8 and Rules under Manufacturing and Storage of Hazardous Chemical Rules 1994 4(2), an occupier of an existing industrial plant shall have identified the major accident hazards and taken adequate steps to prevent such major accidents; occupier shall provide to the persons working on the site with the information, training and equipment including antidotes necessary to ensure their safety.

Also Rule 10 (4&6) stipulates that the Occupier shall have to update Safety Audit report once in a year by conducting a fresh Safety Audit. The Factories Act 1948, Rule 7A specifies the general duties of occupier such as to ensure the health, safety and welfare of all workers while they are at work in the factory and to maintain all places of work in the factory in condition that is safe and without risk to health.

In light of above, risk assessment is one such tool to identify hazards at industrial site and take engineering and managerial steps to mitigate the same.

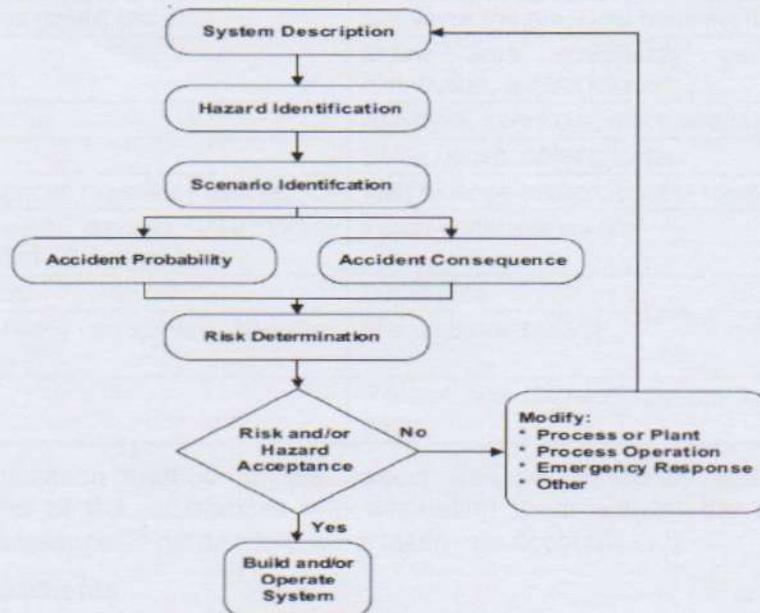
Risk assessments supply information to decision makers and require practical data to provide a foundation for their validity and to establish confidence in their output

## 9.2 APPLICABLE STATUTORY RULES AND REGULATIONS

The responsibility of the management of any thermal power plant is to comply with the provision of various statutory rules and regulations on Safety, Health and Environment which are as follows:

- Environment Protection Act 1986 and Rules made there under including the Manufacture, Storage & Import of Hazardous Chemicals Rules, 1989 (MSIHC) amended in 1994 & 2000.
- Chemical Accidents (Emergency Planning, Preparedness & Response) Rules, 1996
- Public Liability Insurance Act 1991, amended 1992 and the Public Liability Insurance Rules 1991, amended 1993.
- Factory Act 1948 & Factory Rules.
- Petroleum Act 1934 and Petroleum Rules 1981 amended 2002.
- Gas Cylinder rules 2004 and Static & Mobile Pressure Vessels (SMPV) (unfired) Rules 1981 amended in 1993.
- Explosives Act 1984 and Explosive Rules 1983.
- The Electricity Act 2003 and India Electricity Rules 1956.

### 9.3 RISK ASSESSMENT PROCESS



**Fig 9.1- Hazard Identification Process**

The hazards associated with the above are detailed in the following sections. The broad risk assessment methodology for evaluating and assessing risks from handling and storage of above chemicals was:

- Identification of hazards arising from storage and process
- Establish failure frequencies for selected scenarios
- Perform Consequence Analysis
- Assess the Vulnerability
- Provide Risk Reduction Strategies including emergency plans

### 9.4 IDENTIFICATION OF HAZARDS

Hazard identification is one tool by which hazards associated with plant activities can be properly identified for further assessment and more importantly adequate safety measures can be adopted to screen off personnel from exposure to the same.

Another aim of hazard identification is to keep the plant engineering integrity in accordance with the best design principle for safe and reliable operation. There have been many deliberations about hazard identifications by organizations such as HSE of UK, OECD, DNV, etc. Hazard identification can be achieved in various ways

### 9.5 IDENTIFICATION OF ALL HAZARD ASSOCIATED WITH EACH ACTIVITY

The following main hazards may exist in the factory under the situations given in **Table 9.1**.

**Table 9.1: Hazard Associated with Plant Activity**

Hazard	Potential location
High temperature and pressure	Boiler House, Generator Area
Fire & explosions (due to inflammable / combustible materials)	Storage House, Boiler Feed Chamber, testing

Hazard	Potential location
Toxic and corrosive chemicals	Waste water treatment
Toxic and poisonous gases and dust	Conveyor system, Coal handling plant
Electricity	Entire area specifically generator section, distribution, control rooms
Disposal of wastes	Ash dyke, spent oils, electrostatic precipitator
Work at heights	Boiler house, cooling towers
Work in confined spaces / vessels / tank etc.	Maintenance section, control room
Non-working of safety devices, inter locks, failure of high RPM machineries	Turbo-generator section
Failure of boilers etc.	Boiler area
Hazards during heavy equipment handling (Crane, etc.)	Maintenance section
Road accidents	Receipt and dispatch section, loading/ unloading gantry

The hazard identification method for the project was performed by analyzing physico-chemical properties of the substances and evaluating them against the system specific background. The site-specific parameters were taken into account.

#### 9.5.1 Mandatory Requirements

Availability of shock treatment charts, proper rubber mats, sand buckets etc. are mandatory in Electrical Rooms. These should be available in electrical rooms, near and inside Main Control Rooms. The same should be made available in other electrical rooms such as compressor, CW system, Water Treatment Plant etc.

#### 9.5.2 Chemical Hazard

Apart from coal, hazardous chemical handled at the site is Fuel Oil, which has a potential of fire and explosion.

##### 9.5.2.1 Storage Tanks

In normal course of storage, chemical tanks may not pose any risk to the personnel. The storage tanks would also operate under normal atmospheric conditions and hence storage overpressure hazards will not arise. Acid exposure during maintenance cleaning operations and transfer from road tankers could pose a direct health hazard to the operating personnel.

In the event of external damage to tank during maintenance operations, spill could pose a health hazard to the personnel. Statistics involving past incidents indicate that all of the above-ground liquid storage tanks that fail appear to have had defective welds. The failure of liquid storage tanks can stem from inadequate tank design, construction, inspection, and maintenance. Hazard reduction and prevention starts with good design and construction.

The risk to tanks already in service can be reduced through tank maintenance and weld inspection. To minimize effects from possible tank failures, there should be a secondary containment such as a dike surrounding the tank. In each of the tank failures mentioned, welding has been the main cause of failure. To ensure durability and integrity, it is imperative that the tank is welded correctly.

Several standards and specifications outline the proper techniques and procedures for welding including API-653, "Tank Inspection, Repair, Alteration, and Reconstruction." Another cause of storage system failure is the malfunctioning of excess flow valve.

- **Failure of Storage Tanks:** Storage tanks can fail due to very high internal pressure or external pressure (as in case of vacuum). The presence of a hazardous (toxic / flammable) substance only adds to the consequence, if any from the release of the chemical. Shell and side beam failures are a good possibility when there is inflammable vapour building inside a tank. These have caused tank bursting or collapsing the past. Vertical splitting along beam is more probable than tank overturning.
- Rapid build-up of ignitable vapors due to external act as like during maintenance (welding flanging), often cause the storage tank to explode violently. These incidents involve shell to bottom beam failures and are common to old steel atmospheric tanks. Vapors can ignite either outside or inside the tank-causing fire. Corrosion of tank bottoms can also lead to slow spillage, which may lead to tank collapse. A relevant standard for good atmospheric tank design is laid in API -650, welded steel tanks for oil storage, which need to be adopted. The probable cause of failure mode for failure of storage tanks are described in **Table 9.2**.

**Table 9.2: Probability of Failure of Storage Tanks**

S. No.	Failure Mode	Probable Cause	Remarks
1.	Flange / Gasket failure	Incorrect gasket installation.	Attention to be paid during selection and installation of gaskets.
2.	Weld failure	It is normally due to poor quality of welds	Welding to be done by certified welders with right quality of welding rods. Inspection and radiography must also be done.
3.	Pipe corrosion erosion or failure due to stress	Some times fabrication or installation leaves stress in the pipes. Erosion or corrosion also is sometimes the cause.	Pipes material of construction should be selected correctly. Design should take care of erosion effects and installation of pipes should not leave any stress.
4.	Over pressurization of pipeline	Over pressurization can occur due to failure of SRV or incorrect operation.	Necessary procedures should be there to prevent.
5.	Deficient installation of pipes	Pipes design and installation is sometimes not as per appropriate standard.	It must be ensured that installation is as per correct standards completely.
6.	Leaks from valve	A leak from glands, bonnets or failures valves spindle is sometimes the cause.	Right selection of valves and their maintenance should be ensured.
7.	Instruments failure	Multifarious instruments are used for control of process parameters. Any such instrument failure can cause mishap.	Reliability of instruments working must be ensured through proper selection and maintenance.
8.	Failures of protective system	Protective system like SRV, bursting discs, vent header, drain lines etc. are provided to take care of abnormal conditions.	Reliability of protective system must be ensured highest through inspection and proper maintenance.
9.	Operational effort	Plant operational parameters should not be exceeded beyond the permissible limits.	Operating procedures must be complete and strictly followed.
10.	Other failures	There are other external reasons causing the failures.	Design and operating philosophy must consider all possible reasons.

The chemicals and other materials used in thermal power plants usually do not involve banned or phased out materials.

### 9.5.3 Coal

According to available literature sources for coal hazards, coal is susceptible to spontaneous combustion, most commonly due to oxidation of pyrite or other sulphuric contaminants in coal. Coal preparation operations also present a fire and explosion hazard due to the generation of coal dust, which may ignite depending on its concentration in air and presence of ignition sources. Coal dust therefore represents a significant explosion hazard in coal storage and handling facilities where coal dust clouds may be generated in enclosed spaces. Dust clouds also may be present wherever loose coal dust accumulates, such as on structural ledges. Defect Associated with Coal Handling Unit are given in **Table 9.3**.

**Table 9.3: Defect Associated with Coal Handling Unit**

Component	Type of defect	Affecting factor	Reasons
Transfer Chute Liners, Grinding jib of crushers.	Reduction in thickness due to wearing of surface	Continuous coal flow	Friction between coal and component
Transfer Chute Liners, Grinding jib of crushers.	Development of cracks, holes	Impact of coal	Crack generated from the holes for fixing of bolts
Transfer Chute Liners, Grinding jib of crushers	Pitting	Corrosive component of coal	The wet coal when flows through then chances are more.
Conveyor structures	Reduction in thickness due to wearing of surface and pitting	Corrosive component of coal	The accumulation of coal on structures
Conveyor structures	Catastrophic structure failure	Cyclic Loading	A result of manufacturing fabrication defects or localized damage in service,
Crusher Rotors, Motor shafts, Suspension Bars, Arms	Development of cracks	Impact of coal	Due to internal flaw
Bearings	Development of cracks	Improper loading,	Due to internal flaw
Conveyor pulleys	Due to End disc failure	Cyclic loading	Failure of the weld between the hub and the end disc in welded-in hub designs.
Drive foundations	Bolt failure, Frame failure	Cyclic loading	A result of manufacturing fabrication defects or localized damage in service
Conveyor pulleys	Failure of locking assembly	Cyclic loading	Failure of locking bolts

Coal dust (<5% SiO<sub>2</sub>) [TWA 2 mg/m<sup>3</sup> (as the respirable dust fraction)]

Coal dust (≥ 5% SiO<sub>2</sub>) [TWA 0.1 mg/m<sup>3</sup> (as the respirable quartz fraction)]

### 9.5.4 Pool Fire of LDO Storage

A total of two tanks each of capacity 500 KL are envisaged for LDO. In the event of spilling its contents through a small leakage or due to rupture of the pipeline connecting the tank and on ignition, fire will eventuate. As a worst case it is assumed that the entire contents are leaked out.

**9.5.5 Failure Scenarios of LDO tank**

The spill out of LDO on ignition will result in a pool fire. The injuries in this case are mainly caused by heat radiation. The heat radiation intensities due to the pool fire are computed using the Risk Assessment Model for Pool fire.

**Table 9.4: Input data used for Modeling Purpose**

Chemical	Light Diesel Oil
Atmospheric Data	
Wind Speed	2 meters/second
Air Temperature	30.5° C
Relative Humidity	61%
Source Strength - Leak from short pipe or valve in vertical cylindrical tank	

Catastrophic rupture of LDO storage tank could lead to formation of pool on the surface, which on ignition would lead to pool fire. The damage distances computed for 12.5 kW/m<sup>2</sup> and 4 kW/m<sup>2</sup> are 32.1 m and 53.5 m. Similarly, the damage distances computed for various intensities are given in **Table 9.5**.

**Table 9.5: Damage Criteria for heat radiation radius from the centre of the dyke in mts**

Incident Radiation Intensity (kw/m <sup>2</sup> )	Type of damage	LDO
		All 2 tanks on fire
37.5	Sufficient to cause damage to process equipment	15.9
25	Minimum energy required to ignite wood at infinitely long exposure (non piloted)	19.4
12.5	Minimum energy required for piloted ignition of wood, melting plastic tubing etc.	27.5
4.5	Sufficient to cause pain to personnel if unable to reach cover within 20 seconds; however blistering of skin is likely	45.8
1.6	Will cause no discomfort to long exposure	76.8

Catastrophic rupture of LDO storage tanks could lead to formation of pool on the surface, which on ignition would lead to pool fire. The damage distances computed for 37.5 kW/m<sup>2</sup>, 25 kW/m<sup>2</sup>, 12.5 kW/m<sup>2</sup>, 4.5 kW/m<sup>2</sup> and 1.6 kW/m<sup>2</sup> are 15.9 m, 19.4 m, 27.5 m, 45.8 m and 76.8 m.

**9.5.6 Mitigation Measures**

**9.5.6.1 General Mitigation Measures**

- Fire is one of the major hazards, which can result from auxiliary fuel (LDO) storage tanks. Fire prevention and relevant code enforcement is one of the major responsibilities of project proponent. The fire service facility should be equipped with:
  - Smoke and fire detection alarm system
  - Water supply
  - Fire hydrant and nozzle installation
  - Foam system
  - Water fog and sprinkler system
  - Mobile Fire fighting equipment
  - First aid appliances
- Smoke and fire detection, fire hydrant & nozzle installation etc. as indicated above shall be included as part of all major units at the proposed project

- Periodic maintenance of all protective and safety equipment
- Wind socks/wind cock should be installed at suitable height and with proper visibility to check the prevailing wind direction at the time of accident
- Periodical training/awareness should be given to work force at the project to as refresh courses handle any emergency situation
- Periodic mock drills should be conducted so as to check the alertness and efficiency of the DMP and EMP and corresponding records should be maintained
- Signboards including emergency phone numbers and no smoking signs should be installed at all appropriate locations
- Plant shall have adequate communication system
- All major units/equipment shall be provided with smoke/fire detection and alarm system
- All electrical equipments shall be provided with proper earthing. Earthed electrode shall periodically tested and maintained
- Emergency lighting shall be available at all critical locations including the operator's room to carry out safe shut down of the plant, ready identification of fire fighting facilities such as fire water pumps, fire alarm stations, etc.
- In addition to normal lighting each installation shall be equipped with emergency (AC) and critical (DC) lighting
- All electrical equipments shall be free from carbon dust, oil deposits, grease, etc.
- Cable routing shall be planned away from heat sources, gas, water, oil, drain piping, air conditioning ducts, etc.
- Cable route markers shall be provided in the permanent way at the location of changes in the direction of cables at the intervals not more than 30m and at cable joint locations

#### 9.5.7 Project Specific Mitigation Measures

- The LDO storage shall be located away from Railway track inside the plant area for receiving and unloading coal from wagons keeping in view the predicted heat radiation contour distance
- Protective systems with high reliability and availability should be designed to ensure that these physical conditions are maintained
- Dyke would be provided for LDO storage tanks
- Co-ordination with local authorities such as fire, police, ambulance, district administration & nearby industries would be ensured to manage / control meet any eventuality
- To prevent the hazard of static electricity, the fill and recirculation lines to the storage tanks shall discharged below the liquid level.
- The 4.5 kw/m<sup>2</sup> heat intensity radiation will not spread beyond the plant boundary.
- The following arrangements are suggested for LDO storage tanks:
  - One independent high level alarm and trip off liquid inlet-line.
  - One low level alarm with trip off device.
  - Provision of auto deluge water sprinkler system for each bulk storage tank. The auto deluge water sprinkler would be set to start working at a temperature of 66°C.
- The ST turbine building, switchyard, transformer yard, administrative building canteen, first aid center, fire stations etc. should be located safely, if viewed in the light of worst accident scenarios.

- Natural calamities like earthquake, cyclone, landslide etc.
- Air raids / Crashing of aircraft or flying objects.

Incidents, which could also lead to a disaster, are:

- Agitation / forced entry by external group of people
- Sabotage

An important aspect of the disaster is its unforeseen nature. Thus, by definition itself, a disaster is impossible to control completely. However, occurrence of events which lead to a disaster may be minimized through proper technology and engineering practices.

## 9.7 DISASTER MANAGEMENT PLAN ON SITE & OFF SITE

The On-site and Off-site emergency plans cover personnel employed at D B Power (Madhya Pradesh) Limited. The Emergency Plan is aimed to ensure safety of life, protection of environment, protection of installation, restoration of production and salvage operation in the same order of priorities. The objective of the emergency plan is to make use of the combined resources of the plant and the outside service to achieve the following:

- Reliable and early detection of an emergency and careful planning
- The availability of resources for handling emergencies
- Safeguard the personnel located in the premises
- Minimize damage to property and environment
- Organize rescue and treatment of affected persons
- Initially contain and ultimately bring the incident under control
- Identify any casualties
- Provide authoritative information to the news media
- Secure the safe rehabilitation of affected persons
- The command, co-ordination and response organization structure along with efficient trained personnel
- Preserve relevant records and equipment for the subsequent enquiry into the cause and circumstances of emergency.

### 9.7.1 Nature of Hazards and Occurrences

A thermal power plant stores a number of chemical (such as hydrochloric acid, sodium hydroxide, and hydrazine) and flammable/combustible materials (such as furnace oil, light diesel oil, coal, hydrogen) which are hazardous in nature. The hazards are identified along the probable areas of occurrence.

**Table 9.6: Hazards with Probable Areas of Occurrence**

Nature of Hazard	Potential areas/ location
Fire Hazard (slow isolated or ash spreading)	Coal handling plant Cable galleries Fuel oil handling and storage areas. Transformer and switch yard areas. Oil and lubricant stores. Boiler area
Explosion Hazard	Transformers. Boiler. Coal dust in mills and boilers.
Bursting of pipes & vessels	Steam pipes due to high pressure/temperature. Acid and oil pipe lines.

Nature of Hazard	Potential areas/ location
Release of gases/dust	Hydrogen in turbo generators area of main plant and H <sub>2</sub> plant Pulverized coal dust from mills and associated piping. Fly ash from chimneys and ash ponds and ESP hoppers Coal dust in transfer points, coal handling plant crusher and mill area.
Release of liquid	Chemical tanks in water treatment plant. Fuel oil tank in fuel oil handling section.

### 9.7.2 Initial Emergency Response Organization

Shift-in-charge would lead initial response organization in an emergency condition. Upon the detection of an emergency condition, the Shift-in-charge assesses the conditions and, if an Emergency Action Level is exceeded, classifies the emergency, assumes the role of Main Controller. Command and control, at this stage, functions from the Main Control Centre, operating as the Emergency Control Centre. On the direction of the Main Controller, the designated Communications Co-ordinator notifies off-site agencies and plant management. If additional support is required for mitigation, the Main Controller, using weather information available in the Main Control Centre, assesses the extent and area of the hazard and initiates protective action as necessary.

**Table 9.7: Emergency Organization of DB Power (Madhya Pradesh) Ltd.**

- Overall In-charge
- Site Controller
- Incident Controller
- Communication Officer
- Liaison Officer
- Section In-Charge
- Emergency Response Team
- Fire and Rescue Controller
- Security Controller
- First Aid & Medical Controller
- Transport/Civil Supplies Controller

### 9.7.3 Main Controller

Main controller would co-ordinate the response action from the control room with the support of the control room staff. However, as the emergency escalates and the emergency response organization begins to be deployed, the emergency management centre should be moved to the designated Emergency Control Centre (ECC), where the entire response organization would operate. The Main Controller would operate from this location together with his staff, except for such personnel, as the Shift-in-Charge, who may be directly involved at the scene of the accident. He will:

- Relieve the Incident Controller of responsibility of the main Controller.
- Analyze the emergency and decide on the emergency level warning.
- Direct, co-ordinate and supervise the emergency response activities.
- Ensure on-site and off-site personnel protection, safety and accountability.
- Ensure that the casualties if any are given medical attention and that the relatives are informed, if necessary.
- Arrange for relief of personnel when emergency is prolonged.

- Liaise with the off-site emergency response personnel, departments and organizations such as fire and police officials and other statutory bodies and advise them of all likely effects of the incident outside the facility premises (if any).
- Regulate traffic movement within the facility.
- Ensure preservation of evidence for inquiries to be conducted by statutory authorities.
- Authorizes, termination of emergency by sounding of "All Clear" siren, which will be a continuous, long siren for one minute.

#### 9.7.4 Site Controller

The Site Controller operates from the ECC and is responsible for supervising and coordinating the activities of those functions involved in mitigating the consequences of the accident. He will keep the Main Controller informed of the situation from time to time. He will immediately proceed to the scene of emergency and assess the situation. The Incident Controller should be equipped with a distinctive, fluorescent jacket for easy identification (which should be provided in the Emergency Control Centre). He will:

- Help the Main Controller organize and direct the emergency response activities keeping in mind the safety of personnel and minimizing loss and damage to property.
- Formulates strategies and advise the Main Controller of the actions to be taken to mitigate the consequences of the accident.
- Maintain direct communications with the on-site Field Operations Coordinator / incident controller.
- Co-ordinate the activities aimed at organizing, requesting and obtaining additional resources (both as equipment and personnel) to support the field operations.
- Co-ordinate with the Security-in-charge and Safety Officer.
- Check for casualties.
- Arrange for rescue of trapped workers and those in a state of shock.
- Get all non-essential workers safely evacuated after stopping all those jobs, which are not required during an emergency.
- Set up a communication system with the ECC through telephone, wireless and / or messenger system.
- Pending arrival of the Main Controller, direct the shutting down and evacuation from the facility and call outside emergency services, if necessary.
- Allot jobs to the emergency squad.
- Report all developments to the Main Controller.
- Preserve all evidence for use in the subsequent enquiry.

#### 9.7.5 Incident/Field Operations Controller

The Incident Controller or Field Operations Controller is the highest ranking emergency response organization officer at the direct scene of the accident with headquarters located as close as possible to the location where the emergency field operations are carried out, with due regard for safety, of course.

The Field Operations Controller must be a person with good technical expertise and familiarity with the facility. Duties of Incident controller include:

- The direction and co-ordination of all field operations at the scene of the accident.
- On-scene accident assessment.
- The implementation of on-site response actions to protect facility personnel and the public (protective actions).

- The implementation of on-site response actions to bring the emergency under control (support and emergency control actions).
- The co-ordination of these actions with the Site Controller at the ECC.

#### 9.7.6 The Administration Function

This function should provide the necessary administrative and clerical support to relieve the technical personnel from such responsibilities. The Administration Manager would assume the role of the Administration function. The duties include:

- Immediately proceed to the Emergency Control Centre (Control Room / Main gate).
- Work as a liaison officer during the emergency.
- Under the direction of the Main Controller, handle police, press and other enquiries, receive reports of roll call from emergency assembly areas and pass on the absenteeism information to the Incident Controller.
- Ensure that injured receive adequate and immediate medical attention.
- Inform the nearby hospitals and call for ambulance, if required.
- Control traffic in and out of the facility and ensure that alternate transport is available when required for casualties.
- Maintain prior agreed inventory of emergency equipment in the Emergency Control Centre and make up for shortages.

In addition, this function has the important task of keeping chronological records of what is happening during the emergency, and preparing reports for the Main Controller and his staff. This includes:

- Recording any change in the emergency action level status.
- Keeping track of all external agencies notified.
- Keeping track of emergency personnel intervening.
- Keeping track of emergency personnel notified and arriving at the scene.
- Maintaining a record of the changes in the emergency organization structure as higher officials arrive to relieve lower-ranked personnel.
- Keeping a record of all events affecting the emergency.
- Keeping a record of all of the decisions made and emergency actions taken during the emergency operations.
- Updating maps and wall charts displaying the spreading of the emergency (e.g., units affected by fire, areas affected by evacuation orders), and maintaining a record of them.
- Updating the same charts showing the position of the emergency squads or fire fighters, and keeping a record of them.
- Recording the arrival of special emergency materials or equipment (this may be especially important for later financial accountability).
- Recording any fact of relevance occurring during the emergency.

The chronological log is extremely valuable both during and after the emergency. The greatest advantage of such a system is to keep the situation updated. This information can then be used by the emergency co-ordination staff to assess the situation and make appropriate decisions.

In addition, such a log can be used after the emergency is over to assess responsibilities and proper conduct of the emergency operations, and for determining financial liabilities that may

have been incurred in order to bring the emergency under control. Records can also be extremely useful in planning for future emergencies, and for training purposes.

#### 9.7.7 Fire and Rescue Operations

This fire and rescue operation team should be typically composed of personnel from the different facility departments. The team should have basic training in the handling of various types of emergencies. Fire is the most common hazard in the facility. The team members should be capable of recognizing different types of fires and the appropriate extinguishing agent for fighting these fires. They should also be able to handle the available fire fighting equipment including hoses, nozzles, portable extinguishers and fixed fire fighting units.

The fire and rescue team leader (Fire & Safety Officer) should report directly to the Incident / Field Operations Controller and make important decision regarding the response to the particular emergency.

The duties of the fire and rescue team leader include:

- Overall in-charge of the fire fighting operations.
- Inform the Main Controller if external fire tender / fire fighting equipment / materials / Mutual Aid are required.
- Liase with the utilities and arrange for external water supply / diesel for hydrant pump / D.G. Sets, etc.
- Maintaining adequate supplies for fire fighting equipment and facilities.

#### 9.7.8 Logistics Function

This function is responsible for making the necessary supplies available to the response teams during the emergency. Also, the function has the task of organizing and maintaining the staging area and providing temporary storage for emergency supplies and equipment for rapid deployment. The function is also responsible for co-coordinating, hiring, Controlling and operating all emergency vehicles such as ambulances, trucks for transportation of emergency materials and supplies and other emergency transportation vehicles.

The person responsible for this function, the Logistics Coordinator, in this case the Store In-charge, should report to the Site Controller and keep him updated on available supplies and equipment, needed for an emergency. A list of emergency materials and equipment is as follows:

- Fire extinguishers
- Fire hoses and nozzles
- Personal protective equipment, including full protective clothing, self-contained breathing apparatus, and respirators.
- Emergency lights and power generators
- Spill control agents for the decontamination of toxic spills of different classes of chemicals
- Fuel for the operation of emergency vehicles and machinery (if any).

#### 9.7.9 Medical Function

The primary responsibility of the Medical Function during an emergency is to provide first-aid to victims of the accident, and to ensure their prompt transportation to a hospital/ nursing home when required. This function would be assumed by the Medical Officer. In this regard, the Medical Function will work closely with the Logistics Function to organize such as emergency transportation system. In addition, the Medical Function is responsible for the establishment of a first-aid station for the immediate treatment of possible victims, which

- Provide assistance in fire fighting and rescue operations

#### **9.7.11 Emergency Squad Function**

The responsibilities of the emergency squad function are as follows:

- Isolate equipments in accident area.
- Evacuate non-essential personnel and visitors.
- Maintain record of evacuated personnel.
- Act as fire-fighters in controlling the emergency.
- Act as runners and messengers.
- Act as first-aiders and rescuers and handle casualties / persons overcome by fire.
- Provide details of casualties.
- Providing lighting in the area.
- Carry out any other job assigned by the Incident / Field Operations Controller.

#### **9.7.12 Transport in-Charge / Maintenance Manager**

The duties of this function include:

- Keep all the vehicles and drivers ready, maintain constant contact with the Main Controller / Medical Officer and dispatch the vehicles as per their needs.
- All drivers on duty at the facility will, on sounding of the alarm, rush back to their department and await instructions.
- A minimum of two vehicles should be kept standby at the facility for the emergency use and for transporting critically injured to hospital.

#### **9.7.13 Communication Coordinator**

The communication coordinator is assigned to the Telephone Operator. The responsibility of this function would be to:

- Notify the location of emergency to the Security Department, Emergency Squad members, Main Controller, Incident Controller, Safety Officer and Administrative Officer.
- On receipt of instructions from the Main Controller or his designated, notify the fire brigade/police/hospitals/District Collector/Factory Inspector.
- Keep the switchboard open for emergency calls and transmit the same to the concerned personnel effectively.
- Refrain from exchanging any information pertaining to the emergency and refer any queries from authorized persons to the Main Controller.

#### **9.7.14 Personnel of the Affected Area**

They will:

- Continue to handle the emergency as per the laid down procedures and as guided by the Incident Controller.
- Avoid crowding of the affected area by unwanted personnel.
- Stop all non-essential work / unwanted operations.
- Remove unwanted persons from the area to a "Safe Assembly Points / area" (which should be marked on the site plan).

#### 9.7.15 Declaration and Termination of Emergency

The declaration of an On-site or Off-site emergency will be made by the Site Controller. Sirens will be used for annunciation of facility emergency as indicated in the document.

The notification for start and termination of the emergency will be sent to:

- District Magistrate
- Nearby industries, if any
- Police Superintendent of the area

The message will include the following:

- Identification of the emergency e.g. fire, explosion, etc.
- Date and time of the accident.
- Details concerning accident/emergency and probable affected areas.
- Type of the accident

#### 9.7.16 Recovery, Facility Re-entry and Restoration of services

The recovery and re-entry phase will begin after the declaration of termination of emergency. This determination would be made by the Main Controller. The recovery plan should be flexible enough to adapt to existing conditions. Not all of the conditions that may be encountered in an emergency can be anticipated in advance. Detailed plans and procedures for recovery operations should be prepared at the time they are needed.

Re-entry operations should be performed by the Re-entry Team under the leadership of the Main Controller. The team will consist of personnel knowledgeable in procedures and facility layout. In the Re-entry planning process, the team will gather available information on the nature of the emergency and its present status by method such as discussions with the operations personnel on-shift. Necessary protective clothing and equipment should be available for the team before re-entry is authorized.

Specific procedures for recovering from an emergency and re-entering the facility can hardly be provided, since they will have to be determined on a case by case basis. Depending on the type of accident and the severity of the damage suffered. However, Provision should be made for the following:

- Organizing a re-entry team.
- Inspecting the damaged area.
- Declaring the emergency concluded and making the "all clear" known to the facility employees and the community.
- Deciding which employees should report to work and notifying them.
- Beginning an investigation into the causes of the emergency.
- Assessing the damage to the facility.
- Transferring necessary operations to alternative locations.
- Decontaminating the damaged area.
- Restoring services to the damaged area.
- Clearing up the debris.
- Salvaging material and equipment affected by the emergency.
- Restoring the parts of the facility affected by the emergency.
- Determining responsibilities and instituting possible insurance and damage claims.

#### 9.7.17 Off-site (notifying external agencies)

Depending on the type and severity of emergency, the Main Controller should notify the appropriate external agencies. The major emergencies should be notified to:

- Law enforcement departments – Factory Inspectorate, Pollution Control Board, Police station.
- Fire departments and other response teams – Fire Brigade
- Hospital and emergency medical services
- Ambulance services
- Local Government officials
- Local environmental agencies

#### 9.7.18 Making the Emergency Known to the General Public

In a situation where the public can be affected by the accident, two possible courses of action can be taken - evacuation or sheltering inside buildings and houses. Whichever action is decided upon, the public must be informed of it. This can be quite a challenging task, to the point of becoming nearly impossible if an effective communication procedure is not already in place.

Siren system can only be effective if the public is already aware of what actions to take if the alarm is sounded. The content of the messages should be as brief and clear as possible, and provide information on the action to be taken. In addition, the public should be asked to refrain from using the telephone (to minimize the potential for line overload), and to notify neighbors of the emergency (again, without using the phone). Should evacuation be recommended, the messages should inform the public of where the designated relocation areas are, and which evacuation routes to follow.

#### 9.7.19 Training and Education

Regular training will be provided to all personnel who have a role in planning and operational response to an emergency. The main goal of training for emergencies is to enable the participants to understand their roles in the response organization, the tasks associated with each position and the procedures for maintaining effective communications with other response functions and individuals.

The training objectives are:

- To familiarize personnel with the contents and manner of implementation of the DMP and its procedures.
- To train personnel in the performance of the specific duties assigned to them in the DMP and in the applicable implementing procedures.
- To keep personnel informed of any changes in the DMP and the implementing procedures.
- To maintain a high degree of preparedness at all levels of the Emergency Response Organization.
- Train new personnel who have moved within the facility organization.
- Test the validity, effectiveness, timing and content of DMP.
- Update and modify the plan on the basis of experience acquired through exercises and drills.

#### 9.7.20 Emergency Response Plan Review

The Emergency Response Plan and associated implementing procedures should be reviewed to ensure compliance with relevant regulations and applicable state and local emergency plans and written agreements with mutual aid agencies also.

The DMP should be reviewed under the direction of the Plant -In-charge which should encompass the plan, response procedures, equipment, training, drills and interfaces with local emergency management agencies. The need for changes is based upon the following aspects:

- Written evaluations of drills and exercises which identify deficiencies or more desirable methods, procedures, or organizations
- Changes in key personnel involved in the organization
- Changes in the facility organization structure
- Changes in state regulations
- Modifications to the facility which could affect emergency planning
- Recommendations received from other organizations and state agencies.

#### 9.8 HEALTH SAFETY AND ENVIRONMENT POLICY

A sound HSE policy forms the backbone in deciding a company's attitude and commitment towards safety assessment.

##### 9.8.1 Policy Statement

The Company, starting from a baseline of legal requirements, commits itself to promote, maintain and improve upon, a safe and healthy environment for its employees, customers, neighbours and the general public.

If further recognizes its responsibilities for protection of the environment from the consequences of its operations and will control the use of materials and equipment in a manner consistent with these responsibilities. It will provide the resources necessary and actively seek the cooperation of everyone to execute this policy.

##### 9.8.2 Principles

The company believes that good Health, Safety and Environmental performance is an integral part of efficient and profitable business management and these matters rank equally in importance with other management responsibilities and that success in these areas depends in the involvement and commitment of everyone in the organization.

##### 9.8.3 Commitment

As a consequence to the Company's overall commitment to preserve Health, Safety, and a Sound Environment the company has a responsibility to:

- Provide and maintain healthy and safe working conditions, equipment and systems of work for all employees.
- Ensure the protection of the health and safety of people who may be affected by its operations e.g. contractors, visitors, customers and the general public.
- Prevent, or if that is not practicable, minimize and make safe releases to air, water and land of substances which could adversely affect human health or the environment.
- Reduce waste and source by careful use of materials, energy and other resources and maximize recycling opportunities.
- Set targets for improving health and safety at work and environmental protection, carry out regular assessments and report annually on performance.

- Ensure that each of its locations adopts policies and commitments which also describe the local organization and arrangements for putting them into practice.

#### **9.8.4 Organization Perspectives**

The Company regards Health, Safety and Environmental matters as mainstream management responsibilities.

- Executive and the line managers at all levels within the company are directly responsible through the normal management structure for Health, Safety and Environmental matters in the operations under their control.
- All employees have a responsibility to take reasonable care of themselves and others while at work and to participate positively in the task of preserving workplace health and safety and a sound environment.

#### **9.8.5 Review**

This policy is subject to review from time to time and depending on factors internal and external, necessary changes would be incorporated.



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NABL ACCREDITED  
& CEGB APPROVED  
LABORATORY

To,  
**DB Power (MP) Limited,**  
**2 X 660 MW,**  
**Village - Gorgi, Tahsil - Deosar,**  
**District - Singrauli (M.P.)**

REPORT NO	UES/TR/18-19/04100	
LAB REF NO	UES/18-19/AAQM/4100	
DATE OF SAMPLING	18/01/2019	
DATE OF RECEIPT	19/01/2019	
DATE OF REPORT	28/01/2019	
DATE OF ANALYSIS	START: 21/01/2019	END: 27/01/2019

## SAMPLE DETAILS

Monitoring For	Ambient Air Quality Monitoring
Customer Ref. No.	Verbal Communication With Mr. Kailash Tripathi.
Sampling Location	1. Papal Site Area 2. Gorgi Site Area 3. Village-Niwas 4. Village Office Gorgi
Duration Of Sampling	As per CPCB norms
Sample Collected By	Laboratory Chemist
Sampling Procedure	As Per Method Reference
Sample Quantity/Packing	Filter Paper (PM <sub>10</sub> ): 1X1 No., Filter Paper (PM <sub>2.5</sub> ): 1X1 NO. SO <sub>2</sub> : 30mLX1 No. PVC Bottle, NO <sub>2</sub> : 30mLX1 No. PVC Bottle Rubber Bladder: 1X1 No.

## TEST REPORT

PARAMETER	UNIT	METHOD REFERENCE	NAAQM STANDARD	RESULT			
				Papal Site Area	Gorgi Site Area	Village-Niwas	Village Office Gorgi
Particulate Matter size less than 10 microns (PM <sub>10</sub> )	µg/m <sup>3</sup>	IS 5182 (Part 23): 2006 & CPCB Guidelines Vol.-I	100	65	72	69	80
Particulate Matter size less than 2.5 microns (PM <sub>2.5</sub> )	µg/m <sup>3</sup>	CPCB Guidelines Vol.-I	60	32	38	36	39
Sulphur Dioxide (SO <sub>2</sub> )	µg/m <sup>3</sup>	IS 5182 (Part 2): 2001, RA 2006 & CPCB Guidelines Vol.-I	80	11	13	17	15
Nitrogen Dioxide (NO <sub>2</sub> )	µg/m <sup>3</sup>	IS 5182 (Part 6): 2006 & CPCB Guidelines Vol.-I	80	24	22	26	29
Carbon Monoxide (CO)	mg/m <sup>3</sup>	IS 5182 (Part 10): 1999, RA 2003	4.0	0.9	1.0	0.8	1.1

## REMARKS:

## Terms &amp; conditions

- > The report for publication, arbitration or as legal dispute is forbidden.
- > Test sample will be retained for 07 days after issue of test report unless otherwise agreed with customer.
- > This is for information as the party has asked for above test(s) only.

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For ULTIMATE ENVIROLYTICAL SOLUTIONS

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-----End of the test report-----



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To,  
**DB Power (MP) Limited,**  
**2 X 660 MW,**  
**Village - Gorgi, Tahsil - Deosar,**  
**District - Singrauli (M.P.)**

REPORT NO.	UES/TR/18-19/04101
LAB REF NO.	UES/18-19/N/4101
DATE OF REPORT	28/01/2019
DATE OF SAMPLING	18/01/2019 to 19/01/2019

## SAMPLE DETAILS

Monitoring For	Noise Level Monitoring		
Customer Ref. No.	Verbal Communication With Mr. Kailash Tripathi.		
Sampling Location	As Described Below		
Sample Received On	Monitoring At	Sample Collected By	Laboratory Chemist
Sampling Procedure	Manufacturer's Instruction		
Sample Quantity/Packing	Not Applicable		

## TEST REPORT

LOCATION	UNIT	RESULT		LIMIT (RESIDENTIAL AREA)	
		DAY TIME	NIGHT TIME	DAY TIME	NIGHT TIME
Papal Site Area	dB(A)	44	28	55	45
Gorgi Site Area	dB(A)	46	32		
Village-Niwas	dB(A)	50	36		
Village Office Gorgi	dB(A)	48	26		

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*Chandrasekhar*  
28/01/19  
PREPARED BY



For **ULTIMATE ENVIROLYTICAL SOLUTIONS**

*Chandrasekhar*  
28/01/19  
AUTHORIZED SIGNATORY

-----End of the test report.....



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<b>To,</b> <b>DB Power (MP) Limited,</b> <b>2 X 660 MW,</b> <b>Village - Gorgi, Tahsil - Deosar,</b> <b>District - Singrauli (M.P.)</b>	REPORT NO	UES/TR/18-19/04102
	LAB REF NO	UES/18-19/W/4102
	DATE OF SAMPLING	18/01/2019
	DATE OF RECEIPT	19/01/2019
	DATE OF REPORT	28/01/2019
	DATE OF ANALYSIS	START: 21/01/2019    END: 27/01/2019

## SAMPLE DETAILS

Sample Type	Surface Water & Ground Water
Order /Reference:	Verbal Communication With Mr. Kailash Tripathi.
Customer Sample Id	1. River Water (Gopat) Near J.P. Nigri 2. Pond Water Near Plant Area Gorgi 3. Hand-Pump Water Village - Mahuagaon West 4. Hand-Pump Water Village - Mahuagaon East 5. Hand-Pump Water Hardi-Niwas Border 6. Hand-Pump Water Hardimodh
Packing Of Sample	2 L X 1 NO. PVC CAN, 1 L X 1 NO. PVC CAN, 1 L X 1 NO. GLASS BOTTLE    SEALED
Sample Collected By	Laboratory Chemist
Sample Condition At Receipt	OK
Sampling Procedure	IS:3025(PART I):1987 RA 2003; APHA 22ND ED. 2012, 1060-B, 1-39

REPORT NO. - 04102

## TEST REPORT

Sr. No.	Parameter	Unit	Method Reference	Limits as per Consent	Result					
					River Water (Gopat) Near J.P. Nigri	Pond Water Near Plant Area Gorgi	Hand pump water Village Mahuagaon West	Hand pump water Village Mahuagaon East	Hand pump water Hardi Niwas Border	Hand pump water Hardimodh
1	Colour	Hazen	IS:3025: (Part-4)	5 (max)	2	3	<1	<1	<1	<1
2	Turbidity	NTU	IS 3025: (Part-10)	1.0 (max)	17.2	6.95	0.8	0.6	0.81	0.61
3	pH	-	IS:3025: (Part-11)	6.5 To 8.5	7.12	6.75	7.28	7.24	7.15	7.45
4	Residual Chlorine	mg/l	IS 3025 (part-26)	0.2 (max)	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
5	Total Dissolved Solids	mg/l	IS:3025: (Part-16)	500 (max)	96	255	398	389	322	265
6	Alkalinity Total (as CaCO <sub>3</sub> )	mg/l	IS 3025: (Part-23)	200 (max)	54	138	274	187	221	148
7	Total Hardness ( as CaCO <sub>3</sub> )	mg/l	IS 3025: (Part-21)	200 (max)	46.6	118	195	292	264	166
8	Calcium (as Ca)	mg/l	IS 3025: (Part-40)	75 (max)	16.2	44.4	49.8	106	63.2	46.4
9	Magnesium (as Mg)	mg/l	IS 3025: (Part-46)	30 (max)	7.2	19.6	28.1	18.7	22.8	19.4
10	Chloride (as Cl)	mg/l	IS 3025: (Part-32)	250 (max)	11.9	17.9	34.9	53.2	13.9	9.6
11	Sulphate (as SO <sub>4</sub> )	mg/l	IS 3025: (Part-24)	200 (max)	7.6	18.2	13.8	18.0	5.8	6.8
12	Nitrate (NO <sub>3</sub> )	mg/l	IS 3025 (part-34)	45 (max)	1.4	2.1	N.D.	N.D.	N.D.	N.D.
13	Boron (as B)	mg/l	IS 3025 (part-57)	0.5 (max)	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
14	Iron (as Fe)	mg/l	IS 3025 (part-53)	0.3 (max)	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
15	Fluoride (as F)	mg/l	IS 3025 (part-60)	1.0 (max)	0.12	0.29	0.18	0.24	0.18	0.24
16	Manganese (as Mn)	mg/l	IS 3025 (part-59)	0.1 (max)	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
17	Lead (as Pb)	mg/l	IS 3025 (part-47)	0.01 (max)	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
18	Zinc (as Zn)	mg/l	IS 3025 (part-49)	5.0 (max)	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
19	Copper (as Cu)	mg/l	IS 3025 (part-42)	0.05 (max)	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
20	Aluminium (as Al)	mg/l	IS 3025 (part-55)	0.03 (max)	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
21	Mercury (as Hg)	mg/l	IS 3025 (part-48)	0.001 (max)	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
22	Arsenic (as As)	mg/l	IS 3025 (part-37)	0.01 (max)	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.



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REPORT NO. - 04102

## TEST REPORT

Sr. No.	Parameter	Unit	Method Reference	Limits as per Consent	Result					
					River Water (Gopat) Near J.P. Nigri	Pond Water Near Plant Area Gorgi	Hand pump water Village Mahua-gaon West	Hand pump water Village Mahua-gaon East	Hand pump water Hardi Niwas Border	Hand pump water HardiM odh
23	Selenium (as Se)	mg/l	IS 3025(part-56)	0.1 (max)	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
24	Chromium (as Cr)	mg/l	Annex J of IS:13428	0.001 (max)	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
25	Sulphide (as S)	mg/l	APHA 22nd Ed.2012,4500-S-C,4-175 & F 4-178	0.01 (max)	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
26	Cyanide (as CN)	mg/l	IS 3025(part-27)	0.05 (max)	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
27	Anionic Detergent (as MBAS)	mg/l	Annex K of IS:13428	0.02 (max)	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
28	Phenolic Compound (as C <sub>6</sub> H <sub>5</sub> OH)	mg/l	IS 3025(part-43)	0.001 (max)	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
29	Poly-nuclear Aromatic Hydrocarbon (PAH)	mg/l	APHA 22nd Ed.2012,6440-6-93	0.0001 (max)	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
30	Mineral Oil	mg/l	IS 3025(part-39)	0.05 (max)	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.

### MICROBIOLOGICAL ANALYSIS

1	Total Coliforms	MPN/100 ML	APHA 22nd Ed.2012,9921-B & C, 9-66 & 69	Shall not be detectable in any 100 ml sample	32	46	N.D.	N.D.	N.D.	N.D.
2	E - Coli	MPN/100 ML	APHA 22nd Ed.2012,9921-B & C, 9-66 & 69	Shall not be detectable in any 100 ml sample	6.8	9.8	N.D.	N.D.	N.D.	N.D.

### PESTICIDES ANALYSIS

1	p,p DDT	µg/L	US EPA 508-1995	1	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
2	o.p DDT	µg/L	US EPA 508-1995	1	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
3	p,p DDE	µg/L	US EPA 508-1995	1	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
4	p,p DDD	µg/L	US EPA 508-1995	1	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
5	O,p DDD	µg/L	US EPA 508-1995	1	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
6	Gamma-HCH (Lindane)	µg/L	US EPA 508-1995	2	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
7	Alpha-HCH	µg/L	US EPA 508-1995	0.01	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
8	Beta-HCH	µg/L	US EPA 508-1995	0.04	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
9	Delta HCH	µg/L	US EPA 508-1995	0.04	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
10	Alpha-Endosulfan	µg/L	US EPA 508-1995	0.4	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
11	Beta-Endosulfan	µg/L	US EPA 508-1995	0.4	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
12	Endosulfansulphate	µg/L	US EPA 508-1995	0.4	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
13	Monocrotophos	µg/L	US EPA 8141A-1994	1	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
14	Ethion	µg/L	US EPA 8141A-1994	3	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
15	Chloropyrifos	µg/L	US EPA 8141A-1994	30	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.



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REPORT NO. - 04102

## TEST REPORT

Sr. No.	Parameter	Unit	Method Reference	Limits as per Consent	Result					
					River Water (Gopat) Near J.P. Nigri	Pond Water Near Plant Area Gorgi	Hand pump water Village Mahua-gaon West	Hand pump water Village Mahua-gaon East	Hand pump water Hardi Niwas Border	Hand pump water HardiM odh
16	Phorate	µg/L	US EPA 8141A-1994	2	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
17	Phoratesulphoxide	µg/L	US EPA 8141A-1994	-	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
18	Phoratesulphone	µg/L	US EPA 8141A-1994	-	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
19	2,4-D	µg/L	US EPA 515.1-1995	30	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
20	Alachlor	µg/L	US EPA 508- 1995	20	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
21	Atrazine	µg/L	US EPA 532-2000	2	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
22	Methyl parathion	µg/L	US EPA 8141A-1994	0.3	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
23	Methyl paraxone	µg/L	US EPA 8141A-1994	-	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
24	Malathion	µg/L	US EPA 8141A-1994	190	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
25	Malaoxon	µg/L	US EPA 8141A-1994	-	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
26	Aldrin	µg/L	US EPA 508- 1995	0.03	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
27	Dieldrin	µg/L	US EPA 508-1995	0.03	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.

Note: mg/lit.: milligram per liter.  
µg/L : Microgram per litter

**REMARKS: N.D.- NOT DETECTED**

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