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ENVIRONMENT CLEARANCE
FOR
DEVELOPMENT OF PROPOSED
2X800 MW GODDA THERMAL POWER PROJECT
AT MOTIA, GANGTA, GAYGHAT & OTHER ADJACENT VILLAGES OF GODDA & PORAIYAHAAT TEHSILS, GODDA DISTRICT IN JHARKHAND

VOLUME-I

FINAL EIA & EMP REPORT

CHAPTER-7
ADDITIONAL STUDIES

7. ADDITIONAL STUDIES

7.1 INTRODUCTION

As per the requirements of the Terms of reference (TOR) given by MoEF&CC vide letter no. **J-13012/01/2016 - IA. I (T) dated 26.07.2016**, for preparation of the environment impact assessment report for development of 2x800MW Thermal Power Plant in Jharkhand, several studies have been carried out. The studies of the project area regarding land-use distribution, hydrogeology, socio-economy, earthwork requirement, technology options for achieving water use efficiency, land optimization etc. have been helpful in understanding the environmental impacts of the project in the study area in a better ways. Summary of all the additional studies have been presented in this chapter with the detailed reports annexed as Volume II of the Final EIA/EMP report.

- Public Hearing and Consultation
- Risk Assessment
- Disaster Management
- Topographical Study
- Geo-hydrological & Rainwater Harvesting Study
- Social Impact Assessment, R&R Action Plan and CSR Plan
- Study of impact on hydrology of Chir River and downstream flow due to the proposed drawl of water

7.2 PUBLIC HEARING AND CONSULTATION

7.2.1 PUBLIC HEARING

As per the conditions of the TOR issued by MoEF&CC dated 26th July, 2016 and the EIA Notification 2006, public hearing for the project was conducted on 5th March, 2017 from 11 a.m. at the campus of the Motiya High School in Godda District of Jharkhand.

A notification for the Environmental Clearance was issued by the Jharkhand State Pollution Control Board, Ranchi, which was published in Hindi newspapers, including Dainik Jagran, Indian Punch, Hindustan and English Newspapers Times of India and The Hindu dated 30 and 31. 01. 17.

The Public Hearing was organized under the chairmanship of Mr. Anil Kumar Tirki, Additional Collector, Godda.

In the public hearing, Mr. Mithilesh Jha, Scientific Assistant of Jharkhand State Pollution Control Council Board, headquarters Ranchi, Mr. Ravindra Prasad, Regional Officer, Dumka and Mr. Ravi Kumar, Research Assistant, Jharkhand State Pollution Control Council Board, Dumka as well as villagers of the nearby villages were present.

At the beginning of the public hearing, Mr. Santosh Kumar Singh, Environment Head of Adani Power (Jharkhand) Limited provided a detailed description about the project, such as possible environmental effects due to establishment of the project and use of the state of the art scientific equipments to control the environmental impacts, while Mr. Rahul Singh, Environmental Consultant, Greencindia Consulting Private Limited explained the environmental scenario.

The main issues raised during public hearing are summarized in **Table 7.1**.

Table 7-1: Issues raised during Public Hearing

Sl. No.	Name and Address	Questions asked	Answers provided /Action Plan proposed
1	Prashant Mandal - Baksra	Expectation from the project is that they should carry out tree plantation drive in 73 villages under CSR. The company should leverage the most modern technology available in the world to protect the environment.	Under CSR, tree plantation drive in the villages linked to the project will be carried out in collaboration with the villagers and the respective Panchayat. The company will invest nearly **INR 2200 Crores** for the environment management, which will be utilized for the installation and deployment of equipments such as SCR, FGD, ESP, and Bag Filter, ETP, STP etc, among others. An amount of **Rs. 10.60** Crores has been kept aside for greenbelt development.
2	Ashok Chaudhri - Motiya	The people, who have given the land for the project, have also provided their consent for the project.	-
3	Premnandan Mandal - Sondiha	It is a matter of pleasure that the company will contribute in the all-round development of the region. People are wrongly confused and worried that there will be breathing problem and the water level will go down, which are not correct. The company will have to assure that the proposed resources will be rightfully utilized in the project. The Company will have to reveal the number of trees that will be planted. The company should not only focus to plant trees in power-plant area, but it should also extend its support to people who want to plant trees. The depth of the ponds, located within area of 10 km should be increased by digging them up. Additionally, local people should be given 100 percent preferences in the jobs. Jobs should be	For the operation of the plant, water will be brought from Chir River during the Monsoon. The Water Resources Department, Government of Jharkhand has granted permission to draw 36 MCM water per annum from Chir River during the period of Monsoon. Ground water will not be utilized. Plantation will be carried out in nearby villages in association with the villagers and the concerned Panchayats for which an amount of **Rs. 50 lakhs** has been provided as capital cost. For the first five years, 10000 plants per year will be planted in nearby villages. Under CSR programme, the company together with the Government will work to increase the depth of the existing ponds and to develop the new ponds in the area. 69 Ponds have been identified in 13 Villages for deepening during the

Sl. No.	Name and Address	Questions asked	Answers provided /Action Plan proposed
		provided after providing training to operate the new machines.	project stage. A budget of **Rs. 143 lakhs** has been provided for pond deepening purpose as a part of Capital Cost under the CSR budget. Apart from these, skill development programs such as ITI, tailoring training, computer training, agriculture and animal husbandry as well as other vocational courses will be organized. Local people will be given preference in the jobs based on their educational qualification and experience.
4	Bindu Mandal - Purvedih	The area will be developed. Santhal Pargana is very backward. Electricity should be provided. Compensation for the land acquired should be maximum and given in lump sum. Deep bore well should not be done in the area	Compensation for the land is being carried out under a separate regulation, which is being vigorously followed by the company. Ground water extraction is not proposed and thus no boring is proposed.
5	Hemant Kumar - Baksra	State of the art machines should be installed to control the pollution in the 10 km area and trees should be planted. Youths should be trained.	The company will invest **nearly INR 2200 Crores** for the environment management, which will include installation and deployment of equipments such as SCR, FGD, ESP, and Bag Filter, ETP, STP etc. along with other measures. Trees will be planted in the plant premises as well as in nearby villages with the help of villagers and respective Panchayat. One of the focus areas under the CSR is Livelihood development. The Company under its CSR programme has considered promotion of Professional Education by supporting students of educational institutions offering courses in Dipl. Engg., Nursing, Management, Medicine and in other technical subjects etc. for which an amount of **Rs. 138 lakhs** has been kept aside. The Company will also organize skill development programs as well as other vocational courses in the area.

Sl. No.	Name and Address	Questions asked	Answers provided /Action Plan proposed
			Skill development programs such as ITI, tailoring training, computer training, agriculture and animal husbandry as well as other vocational courses will be organized
6	Ramaraman Jha (Munchun Jha) - Dumariya	Local laborers should be given employment. All the governmental standards should be followed for the protection of environment.	Local people will be given preference in the direct and indirect jobs based on their educational qualification and experience. The Company will adopt state of art technologies for environmental protection and also will abide by the instructions of Ministry of Environment and Forests Climate Change, Government of India for the same.
7	Sacchinand Saha - Patwa	Factories should be established in Santhal Pargana. Almost 33 percent plantation should be carried out in 10 Mauza to keep the environment clean.	Under CSR programme, tree plantation drive in the villages linked to the project will be carried out in collaboration with the villagers and the respective Panchayats.
8	Raman Kumar - Petvi	Government standards must be implemented to keep the environment clean.	The Company will install advanced technologies for pollution control and also will abide by the instructions of Ministry of Environment and Forests Climate Change, Government ofIndia
9	Shudhanshu Chaudhri - Motiya	Government standards must be implemented to keep the environment clean. Additionally, government standards and instructions should be followed regarding use of water.	Using the state of the art technologies, the company will follow the instructions of the Ministry of Environment and Forests Climate Change, Government of India.
10	Sunil Chandra Jha - Dumariya		
11	Kundan Kumar - Petwi	Employment should be provided. Deep boring should not be carried out. 100 percent of the government standards must be implemented to keep the environment clean. Trees should be planted.	Local people will be given preference in the direct and indirect jobs based on their educational qualification and experience. Ground water extraction is not proposed. The Plant will be constructed and operated to comply with all the statutory standards. Using the state of the art technologies, the company will follow directions of the Ministry of Environment and Forests Climate Change, Government of India.
12	Neetu Kumari - Motiya	Trees plantation should be	Under CSR, tree plantation drive in the

Sl. No.	Name and Address	Questions asked	Answers provided /Action Plan proposed
		organized to keep the environment clean.	villages linked to the project will be carried out in collaboration with the villagers and the respective Panchayat.
13	Anjana Chaudhri - Motiya	Employment should be provided. Government standards must be implemented to keep the environment clean. More and more trees should be planted.	Local people will be given preference in the direct and indirect jobs based on their educational qualification and experience. Using the state of the art technologies, the company will follow the instructions of the Ministry of Environment, Forests and Climate Change, Government of India.
14	• Some villagers present in the Public hearing were also shouting slogans not to provide the land to support the project. • Mukhiya, Gram Pradhan, Members of PanchayatSamiti, Upmukhiya, ward members and more than 5000 villagers / citizens of a number of Mauja / villages / blocks have submitted their signed and sealed consent letter to Jharkhand State Pollution Control Board, Ranchi stating their support, whose copy has been attached herewith.		

At the end of the public hearing, Mr. Anil Kumar Tirki, Additional Collector, Godda, informed the people present during the public hearing that their suggestions and objections will be incorporated in the minutes of the Public Hearing and video recording CD and photographs will be sent to the Ministry of Environment and Forests Climate Change, Government of India, New Delhi. After that, the District Additional Collector expressed his gratitude to the people for their participation and announced the end of the public hearing.

The entire proceedings of Public Hearing are attached as **Volume III**.

7.3 RISK ASSESSMENT

7.3.1 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 (DMP) has been developed. Such assessment includes policy issues, programs, 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) of the Hazardous chemical Rule 1994 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 and the recently notified Factory Act 2013, 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.

7.3.2 APPLICABLE STATUTORY RULES AND REGULATIONS

The responsibility of the management of any thermal power plant is to comply with the provision of various statuary 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 (PLI) Act 1991, amended 1992 in and the Public Liability Insurance Rules 1991, amended in 1993
- Factory Act 1948 & Factory Rules and the Factory Act 2013, Ministry of Heavy Industry, Govt. of India
- Petroleum Act 1934 and Petroleum Rules 1981 amended in 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

7.3.3 RISK ASSESSMENT 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.

7.3.4 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.

The following main hazards may exist in the factory under the situations given in **Table 7.2**.

Table 7-2: Hazard Associated with Plant Activity

Hazard	Potential location
High temperature and pressure	Boiler House, Generator Area
Fire & explosions (due to inflammable / combustible materials)	Oil & Gas Storage Tank, Boiler Feed Chamber, Testing Labs
Toxic and corrosive chemicals	Waste Water Treatment
Gases and dust	Conveyor system, Coal handling plant
Electricity	Entire area specifically generator section, distribution, control rooms
Disposal of wastes	Ash Dyke, spent oils, Electro Static Precipitator

Hazard	Potential location
Work at heights	Boiler House, Cooling Towers (CTs)
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, Work Shops
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.

7.3.5 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, Transformer Bays, Water Treatment Plant etc.

7.3.6 CHEMICAL HAZARD

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

7.3.7 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 the 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 acts which may be encountered 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 fires. 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 for welded steel Tanks for oil storage, which need to be adopted. The probable cause of failures and mode for failures of storage tanks have been produced in **Table 7.3**.

Table 7-3: Probability of Storage Tanks

Sl. No.	Failure Mode	Probable Cause	Remarks
1.	Flange / Gasket failure	Incorrect gasket / Incorrect 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 of valve spindles 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.

Sl. No.	Failure Mode	Probable Cause	Remarks
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 do not involve banned or phased out materials.

7.3.8 HAZARDS ASSOCIATED WITH COAL STORAGE

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. Defects leading to or associated with fire and explosion hazards in Plants are given in **Table 7.4**.

Table 7-4: 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 and 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

Component	Type of defect	Affecting factor	Reasons
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_2) [TWA 2 mg/m³ (as the respirable dust fraction)]
Coal dust (≥ 5% SiO_2) [TWA 0.1 mg/m³ (as the respirable quartz fraction)]

7.3.9 LDO STORAGE

The identification of specific scenarios is based on the assessment of likely events andincidence of failures. In most of the cases stored quantities of liquid fuel and chemicals areconsidered in hazard identification.The annual requirement of secondary fuel (LDO/HSD) is estimated to be around 15,000 KL per annum. **Table 7.5** provide the detail of storage of fuel.

Table 7-5: Maximum Stored Quantities of Fuels

Sl. No.	Material Stored	Maximum Storage	Mode of Storage	Storage Conditions	
				Pressure	Temperature
1	LDO	4000 KL (2x2000 KL)	Two vertical cylindrical storage tanks	Atmospheric	Ambient

7.3.10 LIKELY EVENTS DUE TO VARIOUS HAZARDS

Fire release may occur due to the storage of fuel and chemicals. In case of failure of the systems, the likely incidents to occur are listed in **Table 7.6**.

Table 7-6: Likely Incidents in case of System Failure

Sl. No.	Material Stored		Incident		
	Item	Fire Ball	Pool fire	Toxic Release	Explosion
1	LDO	No	Yes	No	No

7.3.11 SELECTED FAILURE CASES

In view of plant layout developed for the site and hazard identification, failure cases asselected for consequence analysis are provided in **Table 7.7**.

Table 7-7: Incident Considered for Consequence Analysis

Sl. No.	Fuel	Incident
1	LDO	Pool Fire due to shell rupture

7.3.12 MITIGATION MEASURES OF FIRE & EXPLOSION HAZARDS

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:

i. Smoke and fire detection alarm system
ii. Water supply
iii. Fire hydrant and nozzle installation
iv. Foam system
v. Water fog and sprinkler system
vi. Mobile Firefighting equipment
vii. 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 shall be done.
- 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 in order to 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 and for ready identification of firefighting 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

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 and 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 be located below the liquid level.
- The 4.5 kw/m^2 heat intensity radiation having a distance of Concentration of 39m 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 66ºC.
- The Steam Turbine (ST) building, switchyard, transformer yard, administrative building canteen, first aid center, fire stations etc. should be located at safe distance from each other and should be provided with necessary safety provisions.
- In case of any Tank on fire or fire in the vicinity, the cooling of adjoining Tank should be resorted promptly in addition to Tank on fire so that the affected Tanks well as the neighboring Tanks does not give away.
- The night vision wind stocking be mounted on top of administrative building, main plant building and Storage Tanks is preferred so that people can move in upwind directions in the event of massive spillage from Tank on fire.
- No machinery of vital importance like firefighting pump house, Hydrant and Fuel oil pump house should be placed at radiation contours of 37.5 kW/m^2 heat intensity.
- Maintenance plays a vital role in proper upkeep of plant. One important function is the monitoring of equipment health, pipelines and machines. Adoption of system like thickness survey (including supports) maintenance practices will improve plant performance and safety. Normally, failure rates of equipment and pipes are influenced by maintenance practices especially when plant starts aging.

It is recommended that strict adherence to standards and accepted maintenance and operation of the plant plays a vital role in proper up-keep of the plant. Regular checking and monitoring of the health of equipment, pipeline and machines, thickness survey etc. will improve plant performance and safety.

7.4 DISASTER MANAGEMENT PLAN

It will have the synonymous meaning as that of an emergency which may affect several sections within the plant and/or may cause serious injuries, loss of lives, extensive damages to properly or serious disruption of works inside and/or outside the plant premises. Such a situation may occur due to a malfunction of the normal operating procedures, but may also be caused due to cyclone, flood, or deliberate act of arson or sabotage.

Emergency planning is an integral part of the overall loss control program and is essential for any well run organization. This is important for effective management of an accident / incident to minimize losses to people and property, both in and around the facility.

The important aspect in emergency management is to prevent by technical and organizational measures, the unintentional escape of hazardous materials out of the facility and minimize accidents and losses. Not only are unrecognized hazardous conditions which could aggravate an emergency situation be discovered, the emergency planning process shall be adopted to bring to notice the deficiencies such as lack of resources necessary for effective emergency response. Emergency planning shall further demonstrate the organization's commitment to the safety of employees and shall Increases the organization's safety awareness.

The format and contents of the Emergency Response Plan (ERP)/On-Site Disaster Management Plan (DMP) has been developed taking into consideration the regulatory guidelines, other applicable documents and accepted good industrial practices formulated as a result of lessons learned in actual emergencies requiring extensive emergency response.

Disaster can be defined as an "occurrence of undesired events of such magnitude so as to create a situation in which normal pattern of life within the facility is suddenly disrupted, adversely affecting not only the personnel and property within the facility but also in its vicinity."

As per the Manufacture, Storage and Import of Hazardous Chemical (Amendment) Rules, 2000, "major accident" means – an incident involving loss of life inside or outside the installation, or ten or more injuries inside and / or one or more injuries outside or release of toxic chemicals or explosion or fire or spillage of hazardous chemicals resulting in On-Site or Off-Site emergencies or damage to equipment leading to stoppage of process or adverse effects to the environment; such an occurrence may result in on-site / off-site implications. An onsite implication may occur due to:

On-Site Incidents:

- Leakage of flammable material,
- Fire and/or explosion

Off-Site Implication:

- Incidents having off-site implications can be:
- Natural calamities like earthquake, landslide etc.
- Air raids / Crashing of aircraft or flying objects.
- Chlorine leak.
- 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.

7.4.1 ON-SITE DISASTER MANAGEMENT PLAN

7.4.1.1 Objectives

The On-Site emergency plans cover personnel employed at the proposed project. 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:

- 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
- Regular review and updating of the DMP
- Preserve relevant records and equipment for the subsequent enquiry into the cause and circumstances of emergency.

7.4.1.2 Nature of Hazards and Occurrences

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

Table 7-8: Potential Hazards

Type of Hazards	Potential Area/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 Hazards	Hydrogen generation plant. Turbo Generator where hydrogen is used for cooling. Transformers. Boilers. Coal dust in Mills and Boilers.
Bursting of Pipes& vessels	Steam pipes due to high pressure/temperature. H_2 gas line, acid and oil pipe lines.

Type of Hazards	Potential Area/Location
Release of gases/dust	Chlorine in Water Treatment Plant Hydrogen in Turbo Generators area of main plant and H_2 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 areas.
Release of liquid	Chemical Storage Tanks in Water Treatment Plant. Fuel Oil Tank in fuel oil handling section.

7.4.1.3 Capability Analysis

The proposed 1600 MW TPP shall keep adequate capability to protect its property and manpower in the event of any emergency, as discussed in the following sections:

- The project shall be well equipped with fire protection system and a full-fledged fire station operated by Security Force (Fire Wing). The fire station will have sufficient staff with round the clock service. Various firefighting equipment such as foam tender, Dry Chemical Powder (DCP) tender, High Pressure Portable Pump, Pump Mounted Jeep etc. shall be deployed to handle the fire promptly and actively. Fire hydrant fitted with valves will be provided at various locations of the plant to supply water for fire-fighting work.
- Portable and mobile fire extinguisher of various types (CO_2, DCP, Soda Acid, Foam type, Water etc.) shall be installed at strategic locations of the plant including main plant, control rooms, switch gears, laboratories, office sites and administration building.
- Heavy Fuel Oil (HFO) and Light Diesel Oil (LDO) Tank shall be provided with fixed foam system. A mixture of water and foam concentrate, thrown on to the top surface of oil converts into foam and extinguish the fire.

Medical Assistance Capabilities

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, The First-Aids station shall be appropriately equipped with medical supplies, oxygen, resuscitators, and other supplies and the emergency response personnel are familiar with First Aid administration.

Depending on the types of hazards present at the facility, the function will provide information on the nature and properties of the substances responsible for possible injuries, and on the type of most appropriate emergency treatment of injured or exposed personnel. This type of information is contained in the Material Safety Data Sheets (MSDS) for the substances of concern.

The duties of the Medical Officer also include:

- Arrange for first-aid treatment.
- Establish contact and co-operate with local hospitals also ensure that the most likely injuries (e.g. cuts, burns etc.) can be adequately treated at these facilities.
- Advise the Main Controller and his staff on industrial hygiene matters
- Make arrangements for treating and transporting the injured to the hospitals wherein arrangements are made to handle such emergencies.
- Inform the above hospitals of the situation and apprise them of the antidotes that would be necessary for treatment.
- Maintain the list of blood group of each employee with special reference to the rare blood groups.

Communication System

Communication system envisaged includes

- Public address system in the main plant area.
- Telephone and intercom facilities deplaned at common places and all desks and officials.
- Intercom telephone connections with facilities of incoming P&T call at residences to all officers and other important persons.
- Mobile Phones are also provided to important officials.
- Cable TV and Internet facilities provided in the entire township for internal communication.

Emergency Power Supply

Emergency lights shall be provided at all vulnerable points for lighting arrangements as well as to operate basic minimum equipments for operating the plant safely. All Power plant units shall be provided with DG sets and battery systems, which get switched on automatically in case of power failure.

Emergency Safety Equipments

Various emergency safety equipments (such as self-contained breathing apparatus, canister gas mask, emergency suits, gumboots, face shield, hand gloves, aprons, chlorine sealing kit etc.) shall be made available in areas like Water Treatment Plant, and near all sections of the project.

Alarm System

The project shall have various alarm systems to denote different kind of emergencies and restoration of normalcy. The purpose of the alarm is to advice all persons on the outburst of major emergency. Other than this alarm, a siren audible to a distance of 5 km range shall also be installed.

Emergency Control Center

A permanent Emergency Control Center (ECC) shall be established, which will be manned by the Chief Incident Controller, the officials nominated as key personnel and Sr. Executives of outside services duly nominated shall be called in for assistance if required in emergencies. No other shall have access to the control center. ECC will be equipped with adequate means of communication.

Evacuation and Assembly Points

In an emergency, it may be necessary to evacuate non-essential workers from areas likely to be affected as precautionary measure and should the emergency escalate. The evacuation will be effected on getting necessary message from the Civil Incident Controller. On evacuation, all the persons shall assemble at pre-identified and notified Assembly Points.

7.4.1.4 Action Plan for On-site Emergency

Identification of Responsibilities: The onsite disaster management plan identifies Chief Incident Controller (General Manager of the Project), Works Incident Controller (AGM/DGM) and Designated Key Personnel of emergency control center. The plan also specifies responsibilities of these personnel in case of an emergency and draws an action plan to be followed. Chief Incident Controller and Works Incident Controller shall be assisted by two support teams as follows:

Support team to Chief Incident Controller (CIC)	Consisting of heads of Personnel, Material and Finance Divisions to function in consultation with CIC for the following: • Contacting Statutory Authorities. • Arranging for relievers and catering facilities • Giving information to media. • Contacting media centers and nursing homes • Providing all other supports as necessary. • Arranging for urgently required materials through • Cash purchase or whatever means.
Support team to Work Incident Controller (WIC)	Consisting of Sr. Manager (Admin), Sr. Supdt. (Operation), Sr.Supdt. (Elect. Maintenance), Sr.Suptd. (Mech. Maintenance) and other persons depending upon the need to assist the WIC in manning communication and passing Instruction to the team. One steno secretary shall also be available with WIC for recording all information coming in and instruction going out.

In addition to the support teams mentioned above, there will be a team for each functional area, as described below:

Task Force	• To identify source of hazard and try to neutralize/contain it. • To isolate the remaining plant and keep that in safe condition. • To organize safe shutdown of plant, if necessary. • To organize all support services like operation of the fire pump, sprinkling system etc.
Maintenance Team	• To rush to fire support and extinguish fire. • To seek help from outside firefighting agencies. • To evacuate persons effected.
Auto base team	• To make the auto base vehicles ready to proceed for evacuation or other duties, when asked for; • To send at least one mechanic at the site of incidence where he may

	• help in attending minor defects in ambulance, fire tenders or other vehicles • To arrange petrol / diesel supply • Make all arrangements regarding transportation.
Communication team	• To provide two men at all gates. • To ban entry of unauthorized persons. • To allow the ambulance /evacuation vehicles etc. to go through the gates without normal check.
Administration team	• To rescue the casualties on priority basis • To transport casualties to first aid post, safe place or medical centers • To account the personnel. • To pass information to the kith and kin of fatal or serious injured persons.
Safety Team	• To arrange required safety equipment • To record accidents. • To collect and preserve evidences in connection with accidents injuries • To guide authorities on all safety related issues.
Medical Team	• To arrange first aid material / stretchers immediately and reach to site of incidents • To arrange for immediate medical attention. • To arrange for sending the casualties to various hospitals and nursing homes etc. • To ask specific medical assistance from outside including through medical specialist in consultation with CIC / WIC
Monitoring Team	• To measure gas concentration, in case of gas leakage at various places.

Essential Staff: In the plant immediately affected or likely to be affected as decided by Chief Incident Controller (CIC), efforts will be needed to make shut down of the plant and make process units safe. This work will be carried out by plant supervisor and the earmarked essential operators without exposing themselves to undue risk. Some workers/ supervisors (for example Attendants, Messengers, Drivers, First-aiders, and Steno-Typist etc.) will also be required to help the above works. These will be essential staff and it is the responsibility of the WTC centers so that they can be readily contacted. It is the responsibility of the WIC to remove all non-essential staff to assembly points.

First Information: The first person who observes/ identifies the emergencies shall inform by shouting and by telephone to the Shift Engineer and Fire Station about the hazards. The Shift Engineer will inform to the WIC, Chief Incident Controller and also telephone operator/Plant control cell, who shall communicate it to all key officers about the emergency.

7.4.1.5 Evaluation of Function of Disaster Plan

In order to evaluate the functioning and effectiveness of procedure laid down in Disaster Management Plan (DMP); regular Mock Drills should be conducted. The Mock Drills should be carried out step by step as stated below.

First Step	Test the effectiveness of Communication System.
Second Step	Test the speed of mobilization of the Plant Emergency Team
Third Step	Test the effectiveness of search, rescue and treatment casualties
Fourth Step	Test emergency isolation and shut down the balance plant remedial measure.
Fifth Step	Conduct a full rehearsal of all the actions to be taken.

Here are Two Types of Mock Drills have been recommended in the Disaster Management Plan of the 2x800 MW Project- full Mock drill (to be conducted at least once in every 6 months) and Disaster Management Efficiency Drill (to be conducted at least once in 3 months). The details of these drills are presented as follows:

Full Mock Drill: This shall be conducted with Plant Head as Chief: Head of O&M as Deputy Chief; head of the Operation, Maintenance, Medical, personnel, CISF, Auto base and Materials Department as members and Head of Safety as Convener to oversee the following functions:

- Functioning of emergency control center, periodically verify availability of all facilities as mentioned in the plan and its functional healthiness.
- Evaluate communication system of the Disaster plan to all segments of employees, to familiarize them about their responsibilities in case of any disaster including evaluation of behavior of the employees and other key personnel.
- Ensure availability of all facilities as required under the plan from within or from nearby industries /aid centers under mutual assistance scheme or otherwise as available.
- Ensure that the necessities under material assistance scheme are properly documented and the concerned employees are fully aware in this regard.
- Ensure awareness among the employees to fight any emergency like sealing of chlorine leakage, firefighting and other emergency occurrences.

Disaster Management Efficacy Drill: This shall be conducted with Head of (O&M) as Chief and Heads of Personnel, Communication, CISF and Medical as Members and Head of Safety as Convener and it shall check and ensure the following aspects:

- All employees are trained about their responsibilities / duties. They all are aware about evacuation routes, direction of evacuation, use of machineries to be used during evacuation and the method of evacuation.
- All employees are fully trained to rescue their colleagues, who are effected due to cause of disaster. In case they are unable to rescue their colleagues, they should know as to whom they have to inform about such persons for help.
- All employees are fully trained in First Aid use of desired equipments including breathing apparatus. First Aid Box etc. is available at the desired location.
- All warning alarms are functional. Public Address system is in healthy condition.
- All telephone lines/ communication systems are provided in control rooms and there is no removal of the facilities (as prescribed) for the control rooms.
- It is very clear amongst the concerned managers who shall call for assistance under mutual aid scheme or the facilities from within.

- It is clear to all staff of the plant about the authorized person to declare emergency.
- It is clear to all staff of the plant, who shall inform the District Authorities, State Authorities and Corporate Center.
- The Disaster Management Plan (DMP) shall be periodically revised based on experiences gained from the Mock Drill.

7.4.1.6 Off-site Disaster Management Plan

In the 1600 MW TPP, the following conditions can ordinarily constitute an Off-Site emergency:

- Heavy release of chlorine, due to rupture of the shell, explosion in chlorine cylinder due to fire, or otherwise; resulting in spread to neighboring areas.
- Major fire involving combustible materials like oil, and other facilities.

Under the Environmental (Protection) Act 1986, the responsibility of preparation of Off-Site Emergency Plan lies with the State Government. The Collector/ Deputy Collector by virtue of their occupation are normally nominated by the concerned State Government to plan Off-Site Emergency Plan.

The District Collector or his nominated representative would be the Team Leader of the planning team, who shall conduct the planning task in a systematic manner. The members of planning team for Off-Site emergencies are Collector / Deputy Collector, District Authorities in charge of Fire Services and Police and members drawn from Medical Services, Factory Inspectorate, Pollution Control Board, Industries and Transport Department. In addition to these members, there are Co-opted Members also from district authorities concerned, Civil Defense, Publicity Department, Municipal Corporation, and non-official such as elected representative (MPs, MLAs, Voluntary Organization, Non- Governmental Organizations etc.).

7.4.1.7 Post Emergency Relief to the Victims

The Public Liability Insurance (PLI) Act, 1991 provides for the owner who has control over handling hazardous substances to pay specified amount of money to the victims as interim relief by taking insurance policy for this purpose. The District Collector has definite role in implementation of this act. After proper assessment of the incident, he shall invite applications for relief, conduct an enquiry into the claims and arrange payment of the relief amount to the victims.

7.4.1.8 Disaster Prevention and Reduction

AP(J)L recognizes, and accepts its responsibility for establishing and maintaining a safe working environment for all its employees. This responsibility arises from:

- Company's moral responsibility to its employees, to provide the best practicable conditions of work from the point of view of health and safety.
- The obligation to consult with its staff and their representative to implement policies and procedures developed as a result of discussions
- Statutory responsibility in respect of health, safety and welfare of employee emanating from relevant legislations such as the Factories Act., The Indian Electricity Act, The Explosive Act and The Boiler Act etc.

7.4.1.9 Responsibilities of the Company

The Company shall take all such steps which are reasonably practicable to ensure best possible conditions of work, and with this end in view, the company shall do the following: -

- To allocate sufficient resources to provide and maintain safe and healthy conditions of work
- To take steps to ensure that all known safety factors are taken into account in the design, construction, operation and maintenance of plants, machinery and equipment.
- To ensure that adequate safety instructions are given to all employees.
- To provide wherever necessary Personnel Protective Equipment (PPE), safety appliances and clothing, and to ensure their proper use.
- To inform employees about materials, equipment or processes used in their work, which are known to be potentially hazardous to health and safe working.
- To keep all operations and methods of work under regular review for making necessary changes from the point of view of safety in the light of experience and up-to-date knowledge.
- To provide appropriate facilities for first aid prompt treatment of injuries and illness at work.
- To provide appropriate instruction, training, retraining and supervision in health and safety and first aid and ensure that adequate publicity is given to these matters.
- To ensure proper implementation of fire prevention and an appropriate firefighting service, together with training facilities for personnel involved in this service.
- To ensure that professional advice is made available wherever potentially hazardous situations exist or might arise.
- To organize collection, analysis and presentation of data on accident, sickness and incident involving personal injury or injury to health with a view for taking corrective, remedial and preventive action.
- To promote through the established machinery, joint consultation in health and safety matters to ensure effective participation by all employees.
- To publish/notify regulations, instructions and notices in the common local language of employees
- To prepare separate safety rules for each type of occupation/process hazard involved in a project.
- To ensure regular Safety Inspection by a competent group of persons from all disciplines at suitable intervals of all buildings, equipments, work places and installations.
- To co-ordinate the activities of the company and of its contractors working on the Company's premises for the implementation and maintenance of safe working systems to comply with their legal obligations with regard to the health, safety and welfare of their employees.

7.4.1.10 Responsibilities of the Employees

The establishment and maintenance of best possible conditions of work is, no doubt, the responsibility of the Project Management. It is also necessary that each employee follows prescribed safe methods of work. He should take reasonable care for the health and safety of himself, or his fellow employees and of other persons who may be affected by his action at work. With this in mind, employees shall be trained to be health and safety conscious in the following aspects:

Report	Potential Hazards
Observe	Safety rules, procedures and codes of practice
Use	Tools and equipments with all care and responsibility
Participate	In safety training course when called upon to do so.
Make Use	Of safety suggestion schemes.
Take	An active and personal interest in promoting health and safety

7.4.1.11 Responsibilities for Implementation

The ultimate responsibility for ensuring the implementation of the policy on health and safety at work rests on the Project Proponent i.e. AP(J)L Management. This action shall be carried out by Corporate Personnel Division at the corporate level and the concerned General Managers at the Project/Station level. The Officers in charge of safety will be functionally responsible to the Corporate Headquarter for ensuring that the policy is promulgated, interpreted and carried out in the manner expected.

Immediate responsibility for safety at work is that of the Management/Executives of each department/section who are primarily responsible to prevent accidents involving members of their staff and other persons. It is their responsibility to issue clear and explicit working instructions, compliance with which will ensure safe working and ensure effective use of approved equipment.

Accepted rules, procedures and codes of practice, which are formulated with proper regard to health and safety considerations, would be strictly observed by all concerned. Contracting Agencies, executing works, shall be made responsible through various measures including appropriate provisions in the contract for discharging their safety obligations.

In designated areas of particular hazard, the appropriate Executives will authorize, in writing, the commencement of any work and, before doing so, personally satisfy themselves that all necessary safety precautions have been carried out. Such executives shall be authorized, in writing as competent to perform these duties.

Safety Officers will be appointed to advise Management on questions of safety at work including advice on the application in particular local situations of the system of work, implementation of Company's Rules and Relevant Codes of Practices in consultation with area officer In-charge. They will be consulted in the interpretation of rules and codes being formulated by the Corporate Management and shall assist Management in the investigation and analysis of accidents and circulation of appropriate statistics.

7.4.1.12 Major Site Incidents

The General Manager of Project/ Station will ensure that plans are devised for action in the event of fire, major site incident or necessity for evacuation procedure. These plans must be communicated to all staff and rehearsed from time to time.

Firefighting training and the formation of fire-fighting team on a voluntary basis will be encouraged by the Project Station Management.

All accidents and dangerous occurrences will be reported immediately to the General Manager who will implement an established procedure to ensure that an investigation takes places and recommendations are made to prevent recurrence.

7.4.1.13 Accident Emergency Response Procedure/Measures

Procedure for reporting of accidents and dangerous occurrences shall be framed. Separate procedures will be formulated for accidents causing injuries/fatalities and dangerous occurrences. Prompt reporting of accidents and dangerous occurrences to comply with requirements/obligations under different statues and also the concerned authorities within the organization will be ensured. Complete information of accidents shall be kept for record and analysis and necessary preventive actions.

7.4.1.14 Recovery Procedure

The contents of this section are indicative for the formulation of detailed recovery procedure**. Figure 7.1** presents Disaster Management Cycle wherein recovery phase assumes significance after the intervention phase.

The duration of recovery phase would depend upon the extent of damage caused due to disaster and the interventions initiated, thereafter. The management could restore normalcy only when speedy actions on the earlier phases are initiated. Some of the issues to be addressed in recovery phase are:

- Treatment of patients after disaster due to psychological breakdown (operators/residents around the facility);
- Assessment of damages and rectification;
- Lacuna experienced in invention phase, suggestion on improvement in DMP.

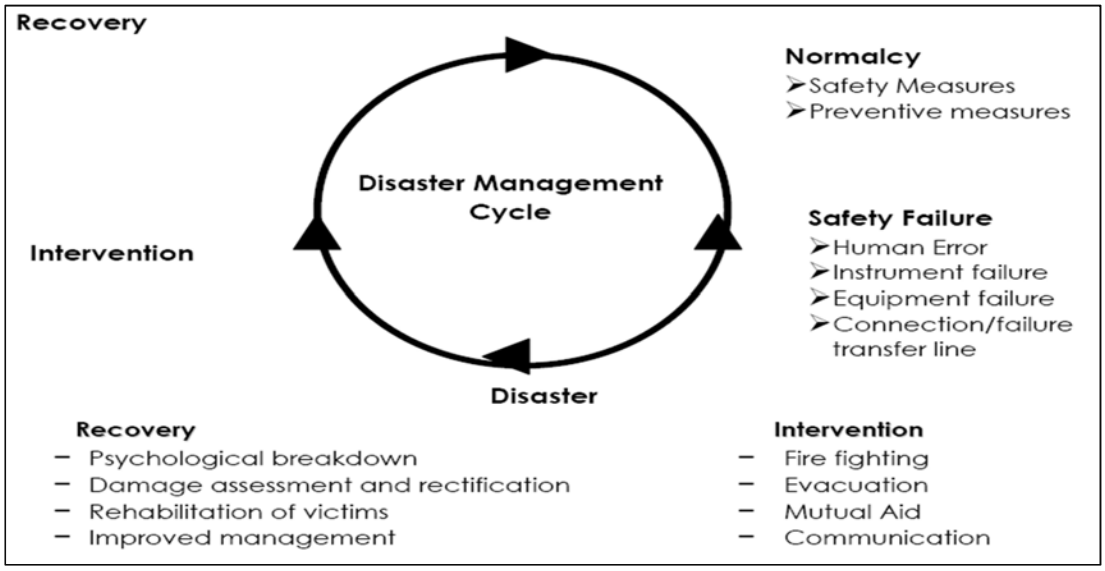

Figure 7.1: Disaster Management Cycle

7.4.1.15 On-site Crisis

On-site crisis management is the responsibility of Power Plant, for which APRL should identify following persons for the assessment of responsibilities on specific function as the coordinating authority. In order to combat the emergencies, an organizational chart for On-Site emergency **Figure 7.2** shall be periodically reviewed and updated. Following co-coordinators are required to co-ordinate various activities during the emergency.

Chief Coordinator: He shall be the Superintending Engineer (SE) and Incident Control Coordinator (ICC). The ICC shall be assisted by a team comprising of members from following sections/wings.

- Fire fighting
- Safety
- Security
- Medical
- Material Management
- Relief Service
- Transport and Communication
- Public Relation

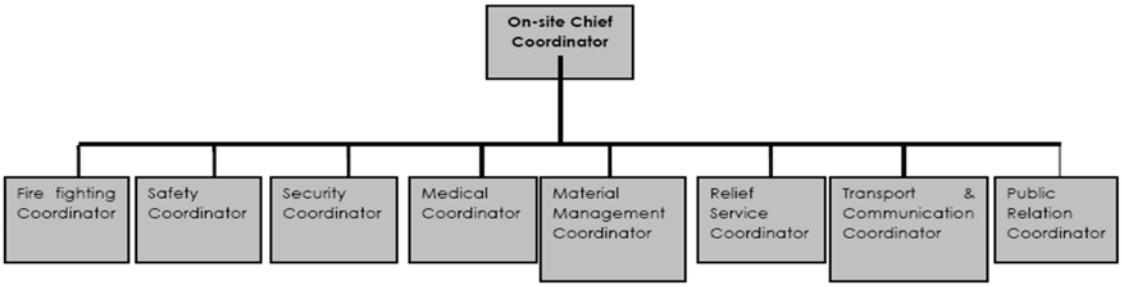

Figure 7.2: Organizational Chart Depicting Sequence of Action to be taken by Concerned Person on an On-site Crisis

7.4.1.16 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 shall 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 followed.

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/cell phone (to minimize the potential for improper communication), and to notify neighbors of the emergency, should evacuation be recommended. The messages should convey the public about the designated relocation areas and the evacuation routes to be followed.

7.4.1.17 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.

7.4.2 EMERGENCY RESPONSE PLAN REVIEW

The Emergency Response Plan and associated implementing procedures shall 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 shall be based upon written evaluations of drills and exercises which identify deficiencies or more desirable methods, procedures, or organizational restructuring as under:

- 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.

7.5 TOPOGRAPHICAL STUDY

- As per topographical studies carried out by Tecdatum Infoservices Private Limited using the Digital Elevation Model (DEM) of ortho-rectified IRS Cartosat-1 PAN stereo data, the study area elevations range from 77m to 103m AMSL.
- According to DEM and ground truth information, the core zone is mostly plain without any steep or moderately steep slopes. No undulations or elevated ridges or hills are observed in the area

The southern part of the core zone is elevated comparing to the northern part. The southern part has elevation levels of 90m -103m, where the northern part has 77m to 88m.

The details of the study along with study carried out for land-use land-cover is attached as **Annex B** of **Volume II Final EIA/EMP Report**.

7.6 GEO-HYDROLOGICAL & RAINWATER HARVESTING STUDY

A detailed study has been carried out by **Aksar Geo Services for Geo-Hydrological & Rainwater Harvesting Study** for the study period i.e. **October to December, 2016** which is enclosed as **Annex C of Volume II of Final EIA & EMP Report**.

Geologically, the study area comprises of metamorphic rocks granitic gneiss below the thin layer of alluvium. The study area is a part of Precambrian geological formation consists of metamorphic consolidated rocks of granitic gneiss, mica schist and amphibolites. The study was conducted using primary data from measurement of water level, taking global co-ordinates, collection of ground water samples, conducting electrical resistivity test and pumping test and secondary data from reputed National International Organization and Government agencies.

Well inventory carried out in 10 locations reveal that the deepest water was encountered at Parsana well i.e 3.50m and shallowest water level encountered at 1.10m depth from the existing ground surface of Motia village open well.

As calculated, the rainwater available for harvesting is 844690 m^3 or 0.84 MCM per annum. It is understood from the study that the water available for roof top rainwater harvesting is less than the water consumption per annum. The area considered 80% in case of main plant area while in case of township area 100% area and 30% in case of other area considered for rainwater harvesting run off calculation. Reservoir and Recharge well of 45m depth suggested.

7.7 SOCIAL IMPACT ASSESSMENT, R&R PLAN & CSR PLAN

The study has done by AFC India Ltd. in October 2016. The Social Impact Assessment has been carried out as per the provisions of Jharkhand Right to Fair Compensation and Transparency in Land Acquisition Rehabilitation and Resettlement Rules, 2015. These rules are in line with Right to Fair Compensation and Transparency in Land Acquisition, Rehabilitation and Resettlement Act, 2013 (Act 30 of 2013).

The Resettlement Action Plan is based on the principle that the population affected by the project will be assisted to at least restore their former living standards. The rationale behind preparing RAP is not only to restore the standard of living of PAPs but also bring qualitative changes in their life. The study has been conducted in accordance with the guidelines of Government of India/ Government of Jharkhand. The study is primarily based on field data generated by the Consultant during social survey and secondary data were collected from the census handbooks / gazetteers / other relevant texts. The methodology for conducting socio-economic study of the proposed project involves review of drawings, field visits, data collection and stakeholder consultations.

7.7.1 POTENTIAL RESETTLEMENT IMPACTS

A Socio-economic survey has been carried out in August- September 2016 to assess the impacts of the proposed Power Project on the socio-economic conditions of the Project Affected Families (PAFs). The

information compiled are type of impact, type of ownership, social profile of the affected people, poverty status, the presence of titleholders and non-titleholders in the project area. The views/opinion of the people about the project and project options for rehabilitation and resettlement has also been obtained. The project impacts have been classified into different categories such as impacts on land, impacts on the affected families and their livelihood resources, impacts on structures and impacts on the common property resources.

The proposed Project may bring positive impacts like Generate Employment opportunity, Economic Growth of persons at this area the anticipated negative impacts on these people include Loss of Land, Loss of Livelihood, and Loss of Common Property Resources and Loss of Public Utility structures.

7.7.2 BASELINE SOCIO-ECONOMIC STUDY

The interviewers interacted with the social groups involved for the purpose and disclosed the information required for filling the questionnaires format for data collection. The survey was conducted within the proposed land to be acquired. The socio-economic survey has been carried out for the PAFs losing land. The socio-economic analysis of surveyed household has been presented here. The social survey generated baseline data for socio-economic information about the project affected families.

Sex trade and spread of sexually transmitted diseases (STDs) also considered as critical socio-cultural and health issue, which needs to be addressed to ensure that the construction of the project is a socially responsible development project. Most of the respondents have shown awareness about HIV/AIDS.

During the socio-economic survey, some questions were asked to the PAPs regarding the awareness, source of information and opinion about the proposed project. It has been reported by PAPs that they were aware of the project before the first visit of this team. Moreover, many of them categorized the project as good for them. The options on resettlement and rehabilitation measures have also been collected from Project Affected Families. Different people have opted for different type of compensation to them. Some have asked to provide jobs to the family members in the organization. Some people have asked to provide them training for skill development.

However, Resettlement and Rehabilitation has been worked out as per the provisions as per Jharkhand Right to Fair Compensation and Transparency in Land Acquisition, Rehabilitation and Resettlement Rules, 2015 which are in line with “The Right to Fair Compensation and Transparency in Land Acquisition, Rehabilitation and Resettlement Act, 2013".Although it is reported that efforts have been made to keep land requirement to the minimum. As per CEA norms power projects should not require so much land. Adani Power (Jharkhand) Limited shall optimize the plant layout to reduce the land requirement as minimum as possible. Therefore, it is advised that AP (J) L, shall further optimize the project land requirement to the barest minimum.

7.7.3 PROJECT AFFECTED FAMILY

There are 5339 PAPs of 841 families comprising of 2883 males and 2456 females with sex ratio of 852.

Table 7-9: Village-wise Project Affected Families

Sl. No.	Village	Land Owners	Project Affected Persons		
			Male	Female	Total
1	Motia	257	883	789	1672
2	Patwa	25	73	71	144
3	Gangta	21	69	53	122
4	Nayabad	39	148	120	268
5	Sondiha	163	505	452	957
6	Ranganiya	16	62	54	116
7	Balliyakita	123	408	350	758
8	Petbi	93	334	252	586
9	Gayghat	42	140	112	252
10	Malin	62	261	203	464
Total		**841**	**2883**	**2456**	**5339**

Source: Social Impact Assessment Study for Godda TPP Done by AFC India Ltd. (Formerly Agricultural Finance Corporation Ltd.)

7.7.4 VILLAGE-WISE SOCIAL DISTRIBUTION OF PAFS

It has been found that among PAPs majority is that of other backward castes, whereas, the PAPs belonging to SC and ST categories are 6.90 % and 8.56 % respectively. The PAPs belonging to general category are 16.88%.

7.7.5 VILLAGE-WISE SOCIAL DISTRIBUTION OF PAP FAMILIES BY SIZE

The family size for about 39% families is 5 to 7 persons, about 32 % are large families having more than 7 family members. About 27% families are small families having two to five members. However, it is also found that about 2 % are single member families.

7.7.6 VILLAGE-WISE SOCIAL DISTRIBUTION OF PAPS BY EDUCATION LEVEL

It is revealed by the data that most of the PAPs are having education of secondary level (34.86%) followed by graduates and above (23.84%). Among others 21.15% are illiterates and 20.15% are having primary level education. Sex-wise education level revealed that about 28% males are graduate and above, about 36% are secondary level, about 19% primary level and about 17% illiterates. On the other hand, among females graduate and above are about 19%, Secondary level about 33 %, primary level about 22% and illiterates about 26%. There is no person with technical or vocational training in the villages among PAPs.

7.7.7 VILLAGE-WISE OCCUPATIONAL PATTERN OF PAPS

The analysis of occupation of villagers reveals that most of them are agriculturists amounting to 87%. A few are also found to be working as agricultural workers. Some are involved in Govt. services (6.38%) mostly from Motia and Petbi village. A few are also involved in service in private sector. Additionally a few are involved in business/ trade.

7.7.8 ELIGIBILITY AND ENTITLEMENTS

The basic eligibility and entitlements framework gets divided based on the ownership of land i.e. in the form of Titleholder (owners, lessees, and legal tenants) and Non-titleholder (encroachers, squatters, unauthorized occupants of public lands) PAPs. The titleholder PAPs will only be those who are affected due to acquisition of private land required for the project and will be eligible for compensation and R&R benefits as per the Right to Fair Compensation and Transparency in Land Acquisition, Rehabilitation and Resettlement (RFCTLARR) Act, 2013.

There are also some land settlements exist between villagers as Danpatri, Kharid-Bikri, Ucchediv& etc. which are to be resolved by DC. The cut-off date for those who have legal title is the date of notification for acquisition of land as per the RFCTLARR Act. The entitlement matrix provides category wise details regarding the entitlements in relation to the R&R principles enumerated above.

7.7.9 INSTITUTIONAL FRAMEWORK

The implementation of Resettlement Action Plan (RAP) requires involvement of various institutions at different stages of project cycle. This section deals with roles and responsibilities of various institutions for a successful implementation of the RAP. The institutions to be involved in the process shall be Project Proponent. Project Authority will be responsible for coordinating with other concerned government departments for land acquisition, planning and implementation of RAP which will include the disbursement of compensation, assistance, shifting and relocation of affected people.

Project Authority will have a division which shall be looking after the social safeguards activities. The Social Development Cell (SDC) of Project Proponent will work closely with other staff of the Project and will be specifically looking after the social safeguards issues. The SDC shall ensure that all land acquisition issues are handled according to the LA policy/guidelines as it is laid down in this report. It will also monitor that all the procedural and legal issues involved in land acquisition are fulfilled. Grievances not redressed by SDC will be brought to the Grievance Redressal Committee (GRC).The GRC will address eligibility and entitlement issues of individual PAPs. Grievances related to ownership rights and land compensation can be dealt in court as per LAA. All activities related to the land acquisition and resettlement must be planned to ensure that 80% land required for the project is obtained prior to commencement of any civil works.

7.7.10 PUBLIC CONSULTATION

Public consultations/ Focus Group Discussions were held with various sections of affected persons in the areas likely to be affected by land acquisition. During social survey, meetings and focus group discussions were conducted to get public input from the primary and secondary stakeholders. This consultative approach led to identification of a range of issues related to the project and improvements before construction of Project. Perhaps more importantly, the affected communities strongly felt a sense of participation in the decision-making process.

Focus group discussions have been done at in villages. Discussion findings were similar at all the places. People wanted just compensation and Job opportunity in the project etc. During public consultations, issues

related to land acquisition, compensation, income restoration, employment generation, information flow, grievance redressal, safety, role of administration etc. were discussed. The RAP addresses issues raised during public consultation and recommends institutional strengthening measures as well. During project implementation, Project Implementation Unit (PIU) with the help of Project proponent will conduct Information and Community Consultation Program (ICCP) in the project area before starting the process of land acquisition. Several additional rounds of consultations with PAPs will form part of the project implementation. During resettlement plan implementation consultations will cover aspects related to compensation and assistance options and entitlement package. Another round of consultation will occur before compensation and assistance are provided.

7.7.11 RESETTLEMENT ASSISTANCE PLAN AND COST

Land requirements have been kept to the barest minimum and worked out on area basis. Acquisition of private land has to be minimized as far as possible. Private land for Thermal Power Project shall be acquired by respective Government and the compensation shall be paid as per Jharkhand State Govt. Resettlement and Rehabilitation Policy/"The Right to Fair Compensation and Transparency in Land Acquisition, Rehabilitation and Resettlement Act, 2013 (No. 30 of 2013)"& Jharkhand LARR act, 2015.

7.7.12 COST ESTIMATE

The total cost for resettlement and rehabilitation has been estimated to be about **Rs. 507 Crores**.

Table 7-10: Details of Cost Compensation, Resettlement and Rehabilitation (Rs. In Lac)

Sl. No.	Description	Entitlement	Unit	Quantity	Rate	Amount
1	Acquisition of Permanent land Private Land *	Total Replacement Cost of land (2x Cost of Land as per land rates determined by the Committee)	Acres	1214.49		19656.99
2	Solatium	100% as per LARR Act 30 of 2013.	Acre	1214.49		19656.99
3.	Interest for interim period	@ 12% per annum for one year				4717.68
4	GM Land on Lease basis	Total Premium Cost of land (Value of Land + 5% Lease + Cess on Lease)	Acres	148.66		1024.25
5.	Replacement of Community Structures & Facilities	Community	L.S			1000.00
6	Annuity or Employment (Rayyat)	In lieu of loss of job opportunity due to acquisition of their land	Per Family	841 Families	5.00	4205.00
7	Acquisition of structures					
7.1	Residential PAPs	Area equivalent to affected area 20.91 m^2 free of cost	Per unit	Nil-		Nil

Sl. No.	Description	Entitlement	Unit	Quantity	Rate	Amount
7.2	Commercial PAPs	Area equivalent to affected area 20.91 m^2 free of cost	Per unit	Nil		Nil
8.	Subsistence Allowance (to displaced families)	For a period of one year @Rs.3000/ month	Family	families	0.36	Nil
9	Vulnerable Families among displaced families	Additional amount to SC, ST, families	Per Family	-	-	Nil
10.	Shifting Allowance for displaced families	A lump sum shifting allowance of Rs.50,000/-	No.	Nil	0.50	Nil
11.	One-time resettlement/ rehabilitation allowance	For All the affected families	Per Family	841	0.50	420.50
12.	Independent Evaluation		LS		10.00	10.00
13.	Miscellaneous		LS		10.00	10.00
	Total Cost					**50,701.41**

7.7.13 MONITORING AND EVALUATION

Project proponent will be responsible for internal monitoring through their office and will prepare quarterly reports on the progress of RAP implementation. An Independent Evaluation Consultant may be hired by Project proponent for mid and end term evaluation of RAP implementation. Internal monitoring will focus on measuring progress against the schedule of actions defined in the RAP. Activities to be undertaken by the Project Authority will include:

- Liaison with the Land Acquisition team, construction contractor and project affected communities to review and report progress against the RAP;
- Verification of land acquisition and compensation entitlements are being delivered in accordance with the RAP;
- Identification of any problems, issues, or cases of hardship resulting from resettlement process;
- Collection of records of grievances, follow up that appropriate corrective actions have been undertaken and that outcomes are satisfactory;

Monitoring is a continuous process and will be carried out by SDC on regular basis to keep track of the R&R progress. Field Offices will be responsible for monitoring the day-to-day resettlement activities of the project. Baseline socio-economic census and the land acquisition data provide the necessary benchmark for field level monitoring. As mentioned earlier, an Independent Evaluation Agency (IEA) will be hired by Project Authority for mid and end term evaluation.

Project Authority will be responsible for supervision and implementation of the RAP. Project authority will prepare quarterly progress reports on resettlement activities. The Independent Evaluation Consultant will submit mid and end term evaluation report to Project Authority and determine whether resettlement goals have been achieved, more importantly whether livelihoods and living standards have been restored/ enhanced and suggest suitable recommendations for improvement. A detailed study has been carried out as Social Impact Assessment Study and R&R Report which has been submitted to the Government of Jharkhand. The Final R&R package will be decided and awarded by the Government of Jharkhand.

7.7.14 CORPORATE SOCIAL RESPONSIBILITY (CSR)

Corporate Social Responsibility for the Adani Group is handled by Adani Foundation. Since its inception in 1996, Adani Foundation has been working in a number of prominent areas to extend its support to people in need. Working closely with the communities, the foundation has been able to assume the role of a facilitator by creating an enabling environment for many. With the human-centric vision the foundation has always thrived to make the processes sustainable, transparent and replicable. Adani foundation is currently operational in 7 states and is working towards an integrated development of the entire society with its core focus on Education, Community Health, Sustainable Livelihoods Development and Rural Infrastructure Development.

The CSR activity for the Adani group will be done through Adani Foundation. A detailed Need Assessment Study was conducted and activities were developed as per the needs of the people.

Core Areas of Activities

- Education Development
- Community Health and Health Care
- Sustainable Livelihood Development
- Rural Infrastructure Development

Wherever possible, AP(J)L shall provide infrastructure to help setup local schools, centers for primary learning and education, repair/construction of primary schools in neighboring villages. AP(J)L is committed to inclusive development and will further strengthen its activities for improvement in education, sanitation and health, livelihood, rural infrastructure and rural sports. AP(J)L plans to provide an outlay of **about 0.4% of the project cost** in the coming years under its CSR program during construction period. It is usually envisaged that setting up of an industry helps in developing the infrastructure of the locality.

AP(J)L is committed to develop the surrounding area in a well-coordinated and balanced manner while safe guarding the environmental and social aspects.

Training would be provided to the eligible local people for attaining skills in construction field with recognized institutions. AP(J)L shares the amenities and facilities with members of the local community. This includes sharing education and medical facilities, sports and recreation. A separate study report on Need Assessment and CSR Action Plan is enclosed as **Annex E of Volume II of Final EIA & EMP Report**.

The CSR Budget is given in **Table 7.11**.

Table 7-11: Budgetary Estimate for CSR Activities

Sl. No.	Scope	Estimated Cost (in lakh Rs.)
1	Educational Facilities	368.00
2	Drinking Water Supply including rain water harvesting	563.21
3	Health Care Facilities	883.21
4	Rural Environmental Improvement – Ecological Park, Conservation of Biodiversity, Afforestation, Low Cost Sanitation, etc.	375.42
5	Economic Empowerment/Sustainable Livelihood	276.97
6	Rural Electricity Supply / Solar Light, etc.	403.21
7	Sports and Culture	93.81
8	Infrastructure Development – Road Network,	2127.13
	Culverts/Bridge, Drainage, Community Hall, Bathing	
	Ghat/River Embankment, Panchayat Bhavan, etc.	
9	Community Development Programme and Other	471.03
	Miscellaneous Activities including Relief to Natural	
	Calamities Victims, etc.	
Total		**5562.00**

Source: Need Assessment Study & Development of CSR Action Plan

7.8 STUDY OF IMPACT ON HYDROLOGY OF CHIR RIVER AND DOWNSTREAM FLOW DUE TO THE PROPOSED DRAWL OF WATER

Total water requirement for the 2x800 MW Godda TPP shall be 4000 m^3/hr: 96000 m^3/day, which is in line with the latest MoEF&CC norms (7th December 2015) of 2.5 m^3/MW/hr. The quantity indicated includes the water requirement for Flue Gas Desulphurization System as well.

The water requirement has been optimized and the feasibility of near zero discharge has also been carried out as per the Terms of Reference for EIA Study for Godda TPP.

To minimize the water consumption, following designs are being adopted:

- Recirculating type of cooling water system with mechanical draft cooling towers is being adopted. The cooling water system is designed considering Cycles of Concentration (COC) of 5. COC 5 is based on the CEA guideline and past experience. However, during plant operation, all the measures will be taken to operate the plant above 5 COC which help further reduce water consumption. Further, to reduce the drift loss in the cooling towers, multiple layers of drift eliminators will be installed in the towers.
- Cooling Water (CW) System's blow down water is a major effluent in the plant. Hence, CW Blow down water recycling and reutilization is proposed. By adopting CW Blow down recycle plant, appx. 41% (237 cu.m/hrout of 572 cu.m/hr) Blow down water will be recycled back as cooling tower make up and the reject water (335 cu.m/hr) will be used in Ash handling system. No fresh water will be utilized for Ash handling system except for seal cooling and compressors.
- CW Blow down recycle plant will serve the purpose for minimization of water consumption and also to achieve near zero liquid discharge.

- In the water pre-treatment (PT) plant, thickener will be installed to recover underflow water of the PT plant clarifiers and Side Stream Filters back wash water. Approximately 75% water is recovered from the thickener.
- Effluent collected from various sources will be utilized in the Coal Handling Plant dust suppression system after necessary treatment.
- High Concentration Slurry Disposal System will be adopted for ash disposal which will reduce the water requirement substantially.

By adopting the above, water consumption is optimized and also near zero liquid discharge is also achieved.

Various sources of water have been explored including Sunder Dam Reservoir at Deonapur, which is at a distance of 30 km from the proposed site, but there is not sufficient water storage and also water from this reservoir is used for irrigation purpose. By water availability study of surrounding areas, it has been emerged that water requirement for the proposed project can be met from Chir River. Detailed study has been carried out and enclosed as Study of Impact on Hydrology of Chir River and downstream flow due to the proposed drawl of water for proposed Godda Thermal Power Project as **Annex D of Volume II of Final EIA/EMP Report**.

7.9 LAND OPTIMIZATION

As per ToR, land requirement for the project shall be optimized and in any case shall not be more than the CEA specified requirements. In view of the above, an analysis has been made and the details are as follows:

Land requirement for thermal power projects depends on many factors viz.

a. Unit size and number of units
b. Type of coal (indigenous or imported)
c. Location (pit-head or coastal), etc.

Besides there are site specific issues which determine the land requirements. These include:

a. Land Profile
b. Coal storage capacity planned depending on the location of plant and certainty of coal receipts
c. Mode of coal receipt i.e., rail (marshalling yard or MGR) or conveyor
d. Water storage capacity planned depending on source of water and its availability
e. Type of condenser cooling system: While cooling towers are must for inland stations, both options (once through or cooling tower) are possible in coastal stations
f. Requirement of FGD system

In the CEA's Land Requirement Report, land required for 2x800MW is not included, hence for comparison purpose land required for 5x800MW Coastal Plants based on Imported coal (with MGR and Cooling Tower) have been considered. For comparison purpose, for 2x800MW Godda TPP, 60% of the land recommended for 5x800 MW in CEA report is considered. However, as the proposed Godda plant is not a coastal plant (Godda plant is a "Load center station based on Imported coal"), one to one comparison is not feasible (since large area is required for water storage, GCV of coal is much lower compared to the imported coal (the GCV range is 3500- 5000 kCal/kg) and ash % is also much higher (up to 25% against less than 10%).

In this context, it shall be noted that the CEA report for land requirement is prior to the issue of new MoEF Norms issued on 7th Dec, 2015 and due to the reduced limits of SO_2, NOx & particulate matter, the land requirement for the upcoming plants will be higher than the requirements indicated in the CEA's land requirement report dated Sept.2010.

7.9.1 LAND REQUIREMENT

Main Plant Area

Total area with chimney on one side to transformer yard on the other end is considered as the main plant area and the land requirement depends on-

a. Boiler size, which depends on the coal characteristics
b. Electrostatic precipitator (ESP) size, which depends on the ash content in coal and emission levels allowed
c. The number and arrangement of coal mills depends upon the calorific value of the coal
d. The arrangement and size of maintenance bay which depends on the number of units.
e. The distance to be kept between the units
f. Exhaust ducting layout for multiple units
g. Control room location / configuration.
h. Type of mill arrangement front mill or side mill
i. Road between MPH & Boiler and Boiler & ESP

Size of the ESP will be larger than the earlier unit sizes due to the lower particulate emission compared to the earlier limit (50mg/Nm^3 limit is reduced to 30mg/Nm^3).

To meet the low NO_x limit specified in the latest Gazette (100mg/Nm^3), DeNOx system to be provided due to this the area required for Main plant will increase and also additional area is required for ammonia / urea receipt, storage and handling system.

Coal Handling System

The land requirement for coal handling system depends on-

a. Location of the power plant
b. Type of coal unloading system
c. Storage requirement
d. Redundancies to be kept for the system

For Godda TPP, rail receipt and unloading system (with marshalling yard) with wagon tipplers (3 nos.) is envisaged for coal receipt. For coal storage, 4 stock piles to cater for the 15 days plant requirement is envisaged.

Raw Water Reservoir

The capacity of the raw water reservoir depends upon the source of water for the station and also on the type of cooling system adopted. For imported coal based plants, the plants are considered as coastal plants by CEA

and hence no land area is recommended by CEA. Considering the scarcity of water in the region where the plant is proposed, raw water reservoir for 8 months storage is envisaged considering water requirement of 2.5cu.m/MWh. However, to optimize the land area, the reservoir with higher depth (approximately10-12m against CEA recommendation of 8m depth) is considered for Godda TPP.

Water System

Water system includes the pre-treatment and clarification plant, water treatment plant, circulating water system with cooling towers and effluent treatment system. The land requirement for the water system depends largely on the type of cooling towers selected for the plant and the quality of raw water. The natural draught type of cooling towers (NDCT) require large area whereas the induced draught type of cooling towers (IDCT) need relatively less space.

For Godda TPP, Cooling water system with IDCTs is envisaged and the water system is designed considering the latest norm of 2.5cu.m/MWh (including the FGD water requirement). Further, the water system is designed to achieve the near zero discharge with elaborate effluent treatment plant to conserve water.

Switchyard

Land requirement for switchyard depends on type of scheme, voltage level and number of bays.

For Godda TPP, 1½ breaker system is adopted and the voltage level is 400kV which is in line with CEA transmission planning criteria.

Ash Handling System

The ash handling plant consists of bottom ash & fly ash collection and disposal systems.

For Godda TPP, wet bottom ash evacuation & transfer system is envisaged with dewatering bins to collect & reuse the water and dry fly ash evacuation & transfer system with HCSD system is envisaged to minimize the water consumption and also the area required for ash dyke.

Flue Gas Desulphurization (FGD) System

In the CEA recommendations, only space provision is envisaged for FGD. However, considering the latest MoEF Notification, to meet 100mg/Nm^{3}SOx level, FGD is to be provided. Hence, for Godda TPP, Lime stone based FGD system is envisaged. Accordingly, space is provided for FGD system equipment and for the storage of limestone, a by-product.

Miscellaneous Station Facilities

In addition to the main unit/station facilities indicated above, there are number of miscellaneous station facilities such as: Administrative Building, Service Building, Compressor house, Fire station, First aid centre, Fire water tanks & pump house, Laboratories, DG set room, Auxiliary boiler building, Workshop, Canteen and Security office building. The space requirement of these miscellaneous facilities is also included in the Godda TPP Plot Plan.

Landscaping & Green Belt

As per the stipulations of MoEF&CC, total green area (including landscaping area) of 1/3rd of the plant area is envisaged for Godda TPP.

Land Requirement for Facilities outside the Power Plant

The facilities such as, raw water pump house including desilting basin, marshalling yard and corridors for MGR system, ash slurry pipelines & water pipelines which are outside the main power plant are also to be considered while arriving at the total land requirement for the station. The area required for pipeline corridors shall remain same irrespective of the pipes are laid underground or over-ground depending upon the terrain of the site.

Township

To optimize the land required for the township, multi-story type buildings are envisaged for residential accommodation for the employees and also for other facilities such as school, hospital, recreation club, etc. In Godda TPP, only 27% of the area is envisaged with respect to the recommendation given by CEA.

From the above and also from the comparison presented below, it can be observed that the land area considered for Godda Thermal Power Project is highly optimized in comparison to CEA recommendations. The major land requirement in Godda TPP, when compared to CEA recommendations is raw water reservoir due to very high water storage (8 months vs No Storage).

Table 7-12: Area Comparison-CEA vs Godda TPP

	Land Required in acres for 5x800 MW as per CEA (For Coastal Stations based on imported coal – With MGR & Cooling Tower)	Land Required in acres for 2x800 MW as per CEA (Considering 60% of the area indicated for 5x800MW)	Land proposed in acres for 2x800MW Godda TPP	Remarks
Facilities inside Power Plant boundary				
Main Plant	65	39	31	
Coal Handling System	180	108	58	
Railway Yard	--	--	54	In plant Railway yard area
Water System	112	67	42	
Switchyard	95	57	14	
Miscellaneous BOP facilities, stores, roads	86	51	44	

	Land Required in acres for 5x800 MW as per CEA (For Coastal Stations based on imported coal – With MGR & Cooling Tower)	Land Required in acres for 2x800 MW as per CEA (Considering 60% of the area indicated for 5x800MW)	Land proposed in acres for 2x800MW Godda TPP	Remarks
Sub-total of Project Area	**538**	**322**	**243**	
Water reservoir			441	In Godda TPP, area requirement for water reservoir is high, considering drawl of water during monsoon only.
Ash disposal Area	220	132	200	Including green belt.
Township	150	90	45	
Green Belt	180	108	252 (80+172)	33.33 % of project area of 243 acre and including 172 acres of water reservoir, ash dye and township.
Total	**718**	**430**	**1181**	
Facilities outside Power Plant boundary				
Laydown area for canal and road drainage	140	84	74	
Grand Total	**1228**	**736**	**1255**	

7.10 HARNESSING SOLAR POWER

An exercise has been carried out to explore the possibility of harnessing solar power, as per the requirement of the Terms of Reference for EIA Study for Godda TPP. A proposal has been made to utilize the roof space of all

buildings for installation of solar roof top panels. The installation of solar roof top is intended to reduce the plant auxiliary marginally as local lighting loads can be fed from solar generation.

Assumptions:

- 50% of Available Roof has been considered for installation for Solar Roof top panels. Also the building sizes indicated are for complete package. Actual sizes may reduce while detailing.
- 30 % of available water surface is considered for installation for solar panels.
- 12 Sq.mtr/Kwac required space for Solar Roof top panels has been considered.
- Buildings with enough area availability for installation of solar panels for 25 KW and above are considered.

Table 7-13: List of Buildings for Installation of Solar Rooftop

Sl. No.	Description	Length (m)	Width (m)	Area in m^2	Space availability for Roof Top	Solar Roof Top Capacity (kWac)
1	TG Building	264	44	11616	0.5	484
2	Switch Yard Control Room	17	30	510	0.5	21
3	Plant Air Compressor	15	26	390	0.5	16
4	FGD Control Room	30	20	600	0.5	25
5	AHP Compressor House	24	40	960	0.5	40
6	Permanent Store	50	100	5000	0.5	208
7	Bottom Ash Slurry Cum HCSD Pump House	45	22	990	0.5	41
8	Canteen	30	15	450	0.5	19
9	Work Shop	60	25	1500	0.5	63
10	C.W. Pump House Cum Ct MCC/LCR Room	25	70	1750	0.5	73
11	Ash Water Pump House	20	50	1000	0.5	42
12	Fire Station	15	30	450	0.5	19
13	WT Plant Including Raw Water Chlorination	130	60	7800	0.5	325
14	F.O.P.H. Cum Local Control Room	15	50	750	0.5	31
15	CHP Main Control Room & MCC-A	30	60	1800	0.5	75
16	CHP MCC-B	40	16	640	0.5	27
17	Loco Shed	15	30	450	0.5	19
18	Admin. Building	50	25	1250	0.5	52
19	Security Office & Time Office	15	30	450	0.5	19
20	Raw Water Pump House	20	40	800	0.5	33
21	Site Office	20	30	600	0.5	25
22	Stores-1	50	40	2000	0.5	83
23	Stores-2	50	40	2000	0.5	83
24	Stores-3	50	15	750	0.5	31

Sl. No.	Description	Length (m)	Width (m)	Area in m^2	Space availability for Roof Top	Solar Roof Top Capacity (kWac)
Total						1740

7.11 AREA DRAINAGE STUDY

Area drainage study conducted by **Matrix Geo Solutions Private Limited, New Delhi** shows that the project area is less affected to the floods. The area is drained by the tributaries of Chir Nadi.

The project site is located in the "North and Central Eastern Plateau Zone" agro-climatic zones of Jharkhand. The area has low susceptibility to flooding. However, flash floods occur frequently due to monsoon surge during SW monsoon season.

The project area is almost has gentle slope except hillocks, natural slope gradient varies 0.25-3 percent. The general trend of the drainage of the area is from SE-NW. On the different points quantity of water was calculated to assess the run-off volume at the given point. The power function equation derived using area and discharge relation at 100 year return period is useful for discharge estimation.

Log Pearson type-III method was used to calculate rainfall at 25, 50 and 100 year return period. One day maximum rainfall data were used for return period calculation and it has been observed that rainfall is increasing from east to west across the basin area.

Rainfall at Different Return Periods (in cm)			
Station	**25**	**50**	**100**
Godda	26.5	32.6	39.5
Poraiyahaat	24.4	27.7	30.7

Source: IMD, Pune

The existing first order drains passing through the site will be made RCC as part of internal drainage system which will be well inter-connected to the main drainage to drain out excess volume of water that may accumulate during rainy days.

The unlined (kachha) canal that is passing through the project site will be aligned along the western boundary keeping the incoming and outgoing points same.

The detailed study is attached as **Annex F** of **Volume II** of **Final EIA/EMP Report**.