Environmental Audit and Due Diligence Assessment – Final Report

Panipat Thermal Power Station (HPGCL)

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List of Abbreviations

Notation	Expansion
AAQ	Ambient Air Quality
AQM	Air Quality Monitoring
BMD	Boiler Maintenance Division
CE	Chief Engineer
CEA	Central Electricity Authority
CENPEEP	Centre for Power Efficiency & Environment Protection
CHM	Coal Handling and Maintenance Division
CHP	Coal Handing Plant
CO	Carbon Monoxide
CO2	Carbon Dioxide
CPCB	Central Pollution Control Board
CPPRI	Central Pulp and Paper Research Institute

CTE	Consent to Establish
CTO	Consent to Operate
CW	Cooling water
DGFASLI	Directorate General Factories Advisory Services & Labour Institutes
DM	Demineralised
EADD	Environmental Audit and Due Diligence Assessment
EC	Environmental Clearance
EIA	Environmental Impact Assessment
EMD	Electrical Maintenance Division
ESP	Electrostatic Precipitators
FD	Forced draft
FG	Flue Gas
FGD	Focus Group Discussion
GCV	Gross Calorific Value by bomb calorimeter
Heat Rate	Gross Heat Rate
HFO	Heavy Fuel Oil
HPGCL	Haryana Power Generation Corporation Limited
HSPCB	Haryana State Pollution Control Board
ID	Induced Draft
KVA	Kilo Volt Ampere
mmHg	Millimetre of mercury
mmwc	Millimetre of water column
MoEF	Ministry of Environment and Forest
MU	Million Units
NAAQS	National Ambient Air Quality Standards
NOx	Nitrogen Oxides
NTPC	National Thermal Power Corporation
O & M	Operation and Maintenance
OHS	Occupational Health and Safety
PA	Primary Air
PIC	Public Information Centre
PM	Particulate Matter
PMS	Paryavaran Monitoring System
PPAH	Pollution Prevention and Abatement Handbook
PPE	Personal Protective Equipment
PTPS	Panipat Thermal Power Station
QA / QC	Quality Assurance and Quality Control
R&M	Renovation and Modernization
RLA	Residual Life Assessment
Rs.	Indian Rupees
RSPM	Respirable Suspended Particulate Matter
RW	Raw Water
SA	Senior Analyst
SE	Superintending Engineer
SOX	Sulphur Oxides
SPM	Suspended Particulate Matter
TDS	Total Dissolved Solids
VOC	Volatile Organic Compound
Xen	Executive Engineer

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Executive Summary

Government of India has launched a program for Renovation and Modernization (R&M) of old coal fired power plants in the country. This program, the Partnership for Excellence, includes a financing window, funded by the World Bank and GEF, for renovation projects that prioritize energy-efficient outcomes. Panipat Thermal Power Station (PTPS) an existing coal-fired power plant, owned by Haryana Power Generation Corporation Limited (HPGCL), is being considered for rehabilitation as part of the program. R & M is proposed for Unit 3 & 4 of 110 MW capacity.

Before understanding any rehabilitation measures, it is critical to understand the existing performance of the plants in respect of energy, efficiency, and environment among other techno-economic aspects, with respect to which, the gains to be achieved through rehabilitation could be assessed. HPGCL has appointed Enzen Global Solutions Private Limited to avail consultation services for Environmental Audit and Due Diligence Assessment (EADD).
The next sections summarise observations of EADD and interventions proposed along with investment required for implementations.

Regulatory compliance

- Units 1 to 5 were installed prior to the Notification of Environmental Impact Assessment (EIA) (issued on 27.1.1994) and hence did not require Environmental Clearance from MoEF. HPGCL has Environmental Clearance (EC) for establishment of Unit 7 & 8 accorded on August 23, 2002.
- Units 1 to 8 were installed after the notification of Water Act, 1974 and hence come under the purview of Water Act. However, PTPS has CTO under the Water Act twice, once 2001-02 and then 2007-08. PTPS has not been issued with CTE / CTO under Air Act 1981 since its inception. The recent application (2009-2010) to the HSPCB requesting for consents has been refused. HPGCL has been accorded with Authorization under Hazardous Waste (Management & Handling) Rules, 1989, valid till 31/2/2010. PTPS to some extent complies with the conditions specified in the EC and CTO. The following areas/ issues to be addressed to improve PTPS compliance with conditions of EC/CTO
    - Maintenance and operation of ESPs to meet 150 mg/nm3 PM emission standards
    - Maintenance and operation of dust suppression and extraction systems at coal handling plants
    - Providing proper and safe access to stack emissions monitoring
    - Setting up of permanent air quality monitoring system to monitor SPM, SO2 and NOx regularly
    - Setting up sewage treatment plant to treat colony sewage
    - Providing energy meters and monitoring energy consumption for pollution control
    - Detailed scheme for avoiding water logging in near by villages
    - Maximising water reuse and monitoring quality & quantity of effluent discharged from PTPS

Pollution Prevention and Control Assessment

<u>Air quality and air emissions</u>

- PTPS in association with accredited labs has been monitoring ambient air quality regularly at five locations – three in plant premises, one in PTPS colony, and one in Khukharana village. As part of EADD primary air quality was conducted at 7 locations, 4 in villages and 3 inside the plant.

Results 24-hourly SPM and RSPM concentration at all the locations in villages are above NAAQS except on two occasions; levels specifically high at downwind location Sutana.

- Coal characteristics: Sulphur Content: 0.49 to 0.75 %, Ash Content (Monthly average - Feb 2010): 37-38%
- Practices adopted at PTPS to improve coal quality and burning & heat recovery are: High Performance Milling System (HPMS) for improving coal grinding efficiency, blending of imported coal with Indian coal – 10 to 15 % on an average, multifunctional solid fuel additive is tried in Unit 3 & 4 to improve coal combustion properties.
- There are six stacks connected to coal boilers. Electrostatic precipitators are installed to mainly control PM emissions. There are no other air pollution control devices/ systems for NOx or SO2 emissions.
- Emission from stack is monitored by accredited labs on regular basis using conventional and approved methods (CPCB/IS Standard methods). Online analysers for combustion parameters and air pollutants are installed in some units. Past monitoring records indicate the following:
    - PM is monitored on regular basis, along with SO2 and NOx.
    - PM emissions from stacks of units 5, 6, 7 & 8 have been well below emission norms till March, 2009 and on many occasions below 100 mg/ nm3; only Unit 8 has exceeded the emission norms twice, Whereas PM emissions from Units -1 to4 have exceeded in some occasions
    - Post March 2009, monitoring is carried out on 2-3 occasions, including monitoring by HSPCB, results show high levels of PM emissions
- Primary monitoring was conducted as part of EADD; baseline parameters in mg/ Nm3, (based on primary measurement using 3 different grab samples) are given the table below:

Parameter	Unit	Unit 2	Unit 3	Unit 4	Unit 5	Unit 6	Unit 7	Unit 8
SPM	mg/Nm3	292 - 589	1620-1697	1131-1198	367-662	966 - 1240	601-958	1699 - 4238
PM 10	mg/Nm3	231-441	1105-1171	724-791	304-569	751-909	442-715	1160-4102
Sulfur Dioxide (SO_2)	mg/Nm3	454 - 485	618-683	386-421	498 -623	480-890	867-7011	577 - 697
Nitrogen Oxides (NOx)	mg/Nm3	315 - 318	257-271	112-123	287 -365	307-387	309-373	298 - 329
Carbondioxide (CO_2)	% v/v	4.5 - 7.8	5.6-5.8	5.1-5.6	8.4 -8.6	8.2-9.7	7.4-8.0	7.9 - 8.3
Oxygen (O_2)	% v/v	11.3 - 12.0	10.6-10.8	10.7-10.9	9.6 - 10.7	10.1-10.8	12.1 - 12.5	9.9 - 10.5
Carbonmonoxide (CO)	PPM	396 - 402	209-213	62-65	132-160	160	112 - 172	203 - 242
Moisture Content	v/v	1.6-2	1.2-1.5	1.1-1.3	2-2.3	1.6-2.1	1.4 - 1.9	1.2 - 1.7
Total Hydrocarbon (as CH_4)	ppm	632-754	337-453	548-575	637-713	645 - 1083	547 - 719	610 - 830

- Electrostatic precipitators (ESP) are used to control particulate emissions from coal combustion. Routine operation and maintenance is carried out by BMD & EMD. Need based assessment and tuning is also carried out. ESP efficiency is monitored occasionally. As part of EADD efficiency assessment was carried out for PM collection; Low efficiency of ESPs of Unit 7 & 8 was observed which may be due to number of fields available/ working during monitoring; 15 out of 28 & 10 out of 28 fields were working in ESPs of Units 7 & 8 respectively. PTPS also tried Ammonia injection in Unit 2 ESP, in Nov 2007; results show no substantial gain (increase in PM concentration from 242 to 269 mg/nm3). This might indicate fly ash resistivity is not the only factor affecting performance of ESP

- Measures in place/ under implementation in CHPs to control fugitive emissions: Pre-wetting and wetting in coal tippler area, on-belt dust suppression systems, and dust extraction systems at crusher house, new dust suppression system is under installation in CHP I to be operational by Aug, 2010. Field observations indicate:
    - Ambient air quality monitored at CHP I under EADD show PM -10 levels in excess of 350 µg/m3
    - Difficulty in handling of wet coal is being experienced, system is getting choked and tippling is delayed; dust extraction systems are not working at CHP I; Selective wetting & pre-wetting is carried out depending on the quality of coal; dust is generated while stacking raw coal in CHP II; dust is emanating in CHP III near roller screen before the crusher; ventilation is very poor at CHP I crushed coal transfer point (Belt 13 A & B); ventilation, lighting, seepage are key issues in below ground areas in CHP I.
- Noise levels at compressor house Unit 3 & 4 is consistently high, workers in the area complained of high levels of noise; Noise levels at all the source generators are within 90 dBA except at Unit 2 turbo-generator

Water and wastewater systems

- The main source of raw Western Yamuna Canal which is about 9 km away. There are two parallel canals convey water from the source to the raw water pond, which also facilitates primary sedimentation. The Haryana Irrigation Department has permitted the withdrawal of 106.5 cusecs (10857 m3/hour) of water from the source.
- Key features of water usage in PTPS - cooling water system provided are open recirculation type with natural draft cooling towers and there is provision for ash water recovery and reuse
- Based on inflow and outflow water balance summary is shown in table below.

Water In		Water Out	
Location	Flow (m3/hr)	Location	Flow (m3/hr)
Unit 1 to 4 intake	3064	DM nuetralization	36
Unit 5 & 6 intake	3591	Sewage	168
Unit 7 & 8 intake	1872	Boiler heatcycle makeup	245
Ashwater recovered from 1 to 6 units	736	CT evaporation	3443
Ashwater recovered from 7 & 8 units	245	Ashpond evaporation	399
		Plant final discharge	2070
		Other losses	3148
Total	**9508**		**9508**

- Ash slurry is taken into ash pond and 60 % of ash water is recovered & reused in ash handling. Part of recirculating cooling water is used for ash handling and there is no blow down or discharge from cooling water.
- Acid and alkaline streams from DM plants of Unit 1 to 6 are taken separately and neutralized in neutralization pit and disposed off to the drains. Floor washing and cleaning wastewater are disposed directly into the drains.
- DM effluent, boiler blow down and floor washing effluents from Unit 7 & 8 are treated in separate effluent treatment plant.
- Domestic wastewater from the plant is disposed of directly into the drains. Oxidation pond for treatment of waste from colony is planned to be revived. PTPS has awarded contract for installation of three skid mounted sewage treatment plant to treat domestic effluent from plant.

Fly ash and solid waste management

- Solid waste generated at PTPS include fly ash, coal rejects, stones & boulders in the received coal, oily sludge/ waste oil, used batteries, and sludge from water & wastewater treatment.
- PTPS at present is using both wet and dry systems for managing and disposal of fly ash. Cement companies have entered into long term agreement with PTPS for evacuation and utilization of dry fly ash. Utilization of dry fly ash from Units 6, 7 and 8 has started, whereas in the remaining units it is likely to start from April-May, 2010. In the absence of utilisation, fly ash is pumped in slurry form into the ash pond.
- Approximately 5000 tons/ month of coal rejects generated from mills of Unit 1 to 5. Current stored quantity - 1, 80,000 tons at CHP yard. Rejects are sold through competitive bidding.
- Stones are received along with coal (around 2%) even after entering into Fuel Supply Agreement (FSA) with Coal Companies. Presently stored in CHP areas and other low lying area, a committee has been formed to address disposal issues
- Hazardous wastes generated at PTPS are dirty traction oil – 86 kl and dirty oil with sludge – 110 kl in store for the past two years; stored in segregated area and disposed off through HSPCB authorized vendor
- Vehicle battery cell – numbers -151 & 8257 kg and dry battery cell – numbers- 419 & 11,406 kg; Disposed off to the manufacturer

Resource efficiency

The specific fuel oil consumption, unit heat rate and auxiliary consumption of Unit –3 and Unit -4 compared to the benchmarking figures of CEA is provided in the Table below.

Description	Average parameter of all Indian power plants (2007-08)	Average parameter of all Indian power plants (2008-09)	Performance of PTPS (Unit-3)		Performance of PTPS (Unit-4)	
			2007-08	2008-09	2007-08	2008-09
Specific coal consumption in kg/kWh	NA*	NA*	0.850	0.876	0.88	0.878
Specific fuel oil consumption in ml/kWh	1.47	1.93	2.42	2.64	2.58	2.36
Unit Heat Rate Kcal/KWh	2747	2747	3455.10	3410.28	3455.106	3400.39
Auxiliary consumption %	8.17	8.32	12.13	11.48	12.13	11.48

Key assumptions made in calculation of performance: specific coal consumption and auxiliary consumption is assumed to be equal and is not monitored separately for each unit.

Occupational Health & Safety Assessment

Occupational Health and Safety (OHS) provisions at PTPS are were assessed against the rules and regulations specified under applicable OHS laws. Listed below are the observations made during the site visit and through review of secondary data on PTPS' OHS system:

- Information on issues of safety is provided through the 'Quality, Environment, Health and Safety Policy' and a Safety Booklet which provides a brief description of certain safety instructions.
- No comprehensive Safety Manual was available at the plant.
- No standard operating procedures were displayed or available.
- An emergency management plan has been developed, which covers few of the points listed in the Schedule-III of the draft regulations.

- All fatal and non-fatal accidents occurring on site are recorded, however no analysis of the accidents recorded is carried out to gain an understanding on causes, frequency rate, severity rate, incidence rate and man days worked / lost.
- Exposure based classification of work is not carried out in PTPS.
- There is one appointed Chief Safety Officer and a J.E. who functions as Safety Officer / Assistant Safety Officer (but not appointed).
- A Safety Committee has been constituted with 23 members various departments and includes three presidents of workers unions and one member from the Forman association.
- There is no detailed manual / procedure on PPE. Only few employees use certain PPE such as hard-hats, steel-capped boots, masks (but not of the prescribed standards), ear muffs, ear plugs, gloves and goggles.
- There are two doctors, 17 other staff and two ambulance for PTPS' 3,742 employees.
- PTPS Dispensary located at the Colony (500m from the main entrance of the plant) is the main provision of medical services available for its employees.
- First aid boxes are available in all control rooms and divisions.
- A large number of employees across all divisions in the plant have been trained by the Red Cross Society in first aid.
- Pre-employment physical fitness test and a few health camps have been held at the plant, as mentioned by the CMO.
- There is no programme of periodic medical check up for employees.
- The fire fighting system at PTPS is the responsibility of the Fire Department which falls under the Chief Safety Officer's purview. The department is currently headed by a J.E. and has around 81-85 employees in total.
- The Fire Department is responsible for providing training and instructions to all other departments within the plant regarding fire fighting. The department's responsibility also includes the operation and maintenance of all fire fighting equipment.
- PTPS has provided training for operation of various types of extinguishers.
- All fire calls are recorded including details such as date, time of call, messenger designation, area, and vehicle number, material used to extinguish fire and back time.

The existing OHS system at the plant needs to be reviewed and improved significantly.

Community Health and Environmental Impacts

A review of health and environmental impacts of the plant on the nearby communities and the PTPS colony was undertaken through a combination of field investigations, Focus Group Discussions (FGDs), available secondary data and analysis of environmental monitoring surveys. Potential liabilities and risks to the power plant based on consultations with key stakeholders have been highlighted along with a review of court cases against the plant.

The list of these FGDs (i.e. location, schedule and participants) held at the villages are provided below:

Village	Distance & Direction from PTPS	Date	Time	Total No. of Participants
Khukhrana	2.5km, East	09/03/10	a.m.	40
Untla	2.5km, West	09/03/10	p.m.	40
Sutana	3.75km, Southeast	10/03/10	a.m.	28
Asan Khurd	0.75km, North	10/03/10	p.m.	38
Jatul	6.5km, Southeast	11/03/10	a.m.	25
PTPS Colony	1.5km, Southwest	12/03/10	p.m.	10

Main constraint faced during the FGDs was the over exposure of the communities to consultations resulting in their indifference and scripted answers.

Key observations from the FGDs, monitoring analysis and review of secondary data:

- Similar accounts of health problems were observed across all villages.
- Communities perceive the water and air pollution to be affecting their cattle and other livestock as well.
- Health problems are mostly attributed to air (mainly due to fly-ash) pollution.
- In some villages availability of electricity (albeit intermittent), employment opportunities for community members and availability of water for irrigation (although there were complaints against the quality) were credited to PTPS.
- The main needs expressed by the communities include:
    - Health infrastructure: adequately equipped and staffed local health centres / dispensaries that are more accessible than at present.
    - Employment for village residents
    - 24hrs electricity
    - Reduced pollution
- Some village communities claim to have taken legal action by filing a case against the state at the High Court they have approached the District Commissioner and SE at PTPS to voice their issues and problems,
- Five cases were filed by residents of villages surrounding PTPS between 2004 and 2009. The cases essentially relate to the following main claims:
    - Agriculture land becoming uncultivable due to waste water / water logging from PTPS;
    - Air and water pollution from PTPS; and
    - 24-hrs electricity supply.
- Ambient air quality was monitored in four of the villages situated around PTPS in Feb-March 2010. The results show that the PM levels are above the NAAQS (which are less stringent than the latest legislation on ambient air quality issued by Ministry of Environment and Forests) whereas other pollutants are well within the standards

Institutional Capacity

PTPS was assessed in relation to its institutional capacity to fulfil its environmental responsibilities. This review was carried out through meetings with plant officials and supplemented with an analysis of secondary information.

These environmental roles and responsibilities of different divisions are described below:

- Civil Engineering division takes the lead role in managing environmental regulatory requirements of PTPS.
- Senior Analyst (SA) under the guidance of Xen/ CMD & SE/Civil is involved in planning and execution of environmental quality monitoring.
- For the financial year 2010 -11, Central Pulp and Paper Research Institute (CPPRI) has been engaged for monitoring. SA coordinates with third party labs for implementation of monitoring schedule and does quality checks on monitoring methods adopted, sampling & analysis, and reporting. There are no documented procedures Quality Assurance and Quality Control (QA/QC).
- Present monitoring schedule covers:

- Ambient air & noise
- Air emissions & performance of pollution control devices
- Groundwater
- Liquid effluents from PTPS
- Fly ash

- Civil engineering division coordinates with CE, PTPS and other divisions for managing environmental compliance. Key activities carried out as part of compliance management are:
  - Applying and follow up of consents & authorizations under Environmental Acts, filing returns, regular monitoring reporting to regulatory agencies
  - Internal communication on environmental issues based on results of monitoring and regulatory requirements
  - Implementation, operation & maintenance of pollution prevention/ control measures: areas covered are ash pond, plant peripheral drains, sewage treatment plant and green belt.
- O & M division is responsible for the operation and maintenance of pollution control equipment such as ESPs, dry fly ash management and utilisation systems operation, process water, operation & maintenance online monitoring systems such as combustion parameters & pollution sensors.
- Fuel division co-ordinates coal quality and long term fuel supply agreements, operation and maintenance of coal handling plants, pollution prevention & control from coal handling operations such as dust suppression and extraction.
- General Services division is in charge of fire & safety management.
- Monitoring & Training division is responsible for plant performance & efficiency assessment and occupational health.

Interventions and investment, benefits & implementation action plan

The interventions identified were presented and discussed with HPGCL and PTPS officials. Detailed discussion with the Top Management of HPGCL was held on 3rd September 2010 based on which investment and implementation action plan was prepared. The following table discusses investment and implementation action plan.

Sl	Intervention	Investment	Benefits	Action plan
1	Third party lab has set up continuous meteorological station at field hostel for this financial year – PTPS can either continue hiring services of external labs or set up automated micrometeorological station. Train Senior Analyst on air quality and met-data analysis and interpretation.	Investment may not be required if present engagement of third party lab to be continued.	Meet regulatory and PPAH requirement, use met-data for air quality interpretation, wind direction information for emergency preparedness,	Present system may be continued with Third Party Laboratory.
2	Review present monitoring schedule to meet the new NAAQ requirements, setup monitoring stations where AQ likely to be impacted such as Khukharana and train staff on AQM & data management & analysis.	Investment may not be required if present engagement of third party lab to be continued.	Meet regulatory and PPAH requirement	Third party lab approved by HSPCB has already been engaged to monitor air quality including locations such as Khukharana.

Sl	Intervention	Investment	Benefits	Action plan
3	Provide sampling ports at ESPs of Unit 1 to 6 according to CPCB requirements and specifications provide safe access to all stack monitoring points and train staff on comprehensive data analysis.	Cleaning and gas leak control along with elevator maintenance at stacks of Unit 5-8 to be taken up as part of Regular O &M, Stack of Unit 5 &6 external elevators could be provided	Safe and better working conditions for monitoring team, better monitoring results	Sky climbers for Unit 5-6 stack is provided, stack monitoring team to assess its efficacy
4	Overall performance of the ESP to be continuously monitored, components of the ESP and their operation are to be periodically inspected Isolation issues needs to be addressed to maintain ESPs of running units, install energy meters to monitor energy consumption at all ESPs and other pollution control equipment. Returns to be filed to regulatory authorities.	Isolation issues and O & M practices to be taken up as part of routine O & M, Cost per energy meter is **0.1 lakhs, 16** meters are required	Gates have advantage over dampers as they are not exposed continuously to the corrosive environment. Isolation is better achieved with gates than dampers so that ESP problems in running plants could be addressed	PTPS has already started addressing ESP isolation issues, ESPs at Unit 1to 5 work has already started
5	Commission dust suppression system at CHM -I coal stock yard	Work order already issued	Reduced fugitive emissions and better air quality	Implementation under progress
6	Dust extraction system at CHM –I to be renovated	Investment to be worked out as part of technical assessment, this could be taken up as part of R & M of Unit 3 & 4	Reduced fugitive emissions and better air quality	To be carried out under Technical Assessment (Design Consultancy work)
7	Provision of primary crusher for CHM-I, grating size to be increased to handle big coal lumps.	Investment to be worked out as part of technical assessment, this could be taken up as part of R & M of Unit 3 & 4	Better coal flow, reduced demurrage charges	To be carried out under Technical Assessment (Design Consultancy work)
8	Provide adequate ventilation at below ground operational areas at CHM	To be taken up as part of regular O & M	Reduced occupational hazards, Better working conditions	The length of duct for ventilation to be increased; Other issues to be addressed in phased manner
9	Green belt around CHP area to be increased, some of the space after clearing rejects and boulders to be used for green belt		Suppression for fugitive dust	HPGCL has a policy on Plantation. Action to be taken internally by PTPS.
10	Commission STP to treat colony sewage	Tender has been invited for making oxidation pond functional.	Meet regulatory requirement	Oxidation pond to be re-commissioned.

Sl	Intervention	Investment	Benefits	Action plan
11	Efforts in dissemination of technical and financial benefits of fly ash among users (Through Press, Seminars, Circulation of material, IS codes etc.).	Dissemination tools for fly ash such as advertisements, pamphlets etc.	Direct revenue from fly ash selling, reduced negative environmental impact of ash pond , meet MoEF notification timelines	According to MoEF guidelines, concerned department of PTPS to carryout these activities.
12	Operate coal mill at 90% of rated capacity, monitor & correct mill fineness	Part of routine operation; Technical study to suggest investment required; to be taken up as part of Unit 3 & 4 R &M	Improved combustion, present unburnt carbon in fly ash is high	PTPS to discuss and decide.
13	Quantity of primary air and secondary air needs to be monitored. Primary air control should be maintained to get better combustion and flame control. Secondary air control needs to be introduced.	Part of routine operation	Improved combustion control can increase the efficiency by 0.84%, maintaining the required secondary air, the exit flue gas temperature and dry gas losses can be reduced.	PTPS to discuss and decide.
14	Options to increase air preheater efficiency to be assessed and implemented – which might be retrofitting extra surface area in the air preheater, retrofitting with modified design of baskets	Technical study to suggest investment required; to be taken up as part of Unit 3 & 4 R &M	Heat loss minimization	PTPS to discuss and decide
15	Develop Safety Manual as per CEA Draft Regulations, 2008 Ensure PTPS 'Quality, Environment, Health and Safety Policy' and all other safety booklets and on sign boards displayed in the local languages along with English Introduce a comprehensive safety awareness and training programme which are recorded properly as recommended by the Safety Audit report	Part of routine work, assign responsibilities	Meet regulatory requirements, minimise near misses and accidents	Safety department of PTPS to prepare safety manuals.
16	Division heads to develop division-specific documents, based on the Safety Manual, containing procedures for: obtaining permission for operations and maintenance of equipment, and safety in operation and maintenance of various electro-mechanical equipments as per recommendations of manufacturers	Part of routine work, assign responsibilities	Meet regulatory requirements, minimise near misses and accidents	Division heads to co-ordinate with safety team and develop comprehensive manuals
17	Revise and update the existing onsite EMP and ensure the EMP addresses all requirements stipulated within the CEA Draft Regulations, 2008	Safety team to take up this exercise	Meet regulatory requirements	Safety department of PTPS to take up this exercise

Sl	Intervention	Investment	Benefits	Action plan
	Conduct mock drills of the EMP every six months Maintain record of mock drills Prepare an offsite EMP and submit details to District Emergency Authority			
18	Include detailed description of accidents recorded within the accidents' register PTPS to carry out an analysis of the accidents recorded to gain an understanding on causes, frequency rate, severity rate, incidence rate and man days worked / lost	Safety team to take up this exercise	Meet regulatory requirements, minimise near misses and accidents	Safety department of PTPS to take up this exercise
19	Classify work areas based on exposure type and intensity Devise mechanism for identification of thresholds in each work area Monitor exposure levels and develop programme for rotation of work	Division heads in association with Chief Medical Officer to take this exercise	Minimize occupational exposure, reduction in health costs, better worker productivity	PTPS to discuss internally and devise exposure minimization plan
20	PTPS to appoint three Safety Officers to support the CSO Ensure qualifications of CSO and Safety Officers are as per Section 40-B of the Factories Act, 1948 and rules made there under	Investment will depend on HPGCL salary scale for Safety Officers or equivalent rank	Meet regulatory requirements	HPGCL to provide training to the existing staff on safety at national institute and depute them for this purpose
21	PTPS to increase the number of employees to equal the number management members in the Plant Central Safety Committee Ensure a proper record of the Safety Committee meetings is maintained Ensure meeting minutes record action points, which are to be reviewed regularly to assess whether decisions and recommendations of the Committee are implemented	Safety team to take up this exercise	Meet regulatory requirements, better decision making on safety issues	As on 25/05/2010, 21 member committee has 7 workers; HPGCL and PTPS to discuss internally decide on worker representation
22	Develop a detailed manual / procedure on PPE as per rules stated in the Factories Act CE / SE officers of each division develop division-specific list of appropriate PPE (as prescribed by BIS) required and a manual on its usage, maintenance and storage. PTPS should carry out a study with the aim of understanding and implementing measures against non-adherence to use of PPE	Safety team to take up this exercise along with division heads	Meet regulatory requirements, minimise near misses and accidents	Safety department of PTPS to take up this exercise
23	PTPS to ensure all Medical Officers are appropriately qualified and certified in Industrial Health as required by the CEA Draft Regulations, 2008. Develop a comprehensive programme for regular		Meet regulatory requirements	HPGCL and PTPS to discuss internally decide on medical check ups, CMO to maintain records

Sl	Intervention	Investment	Benefits	Action plan
	medical check-ups and tests for employees as per CEA Draft Regulations, 2008. Maintain record of all medical tests and camps held for employees			
24	Conduct an in-depth audit of the existing system against the regulations as well as BIS standards for equipment. Conduct regular inspection and maintain a record of equipment quality, availability and maintenance. Conduct comprehensive and regular training sessions that raise awareness of employees regarding fire fighting and emergency situations.	Safety team to take up this exercise along with division heads	Meet regulatory requirements, minimise near misses and accidents	Safety department of PTPS to take up this exercise
25	Continue working closely with the communities on health issues through camps and other awareness raising activities. Consider improving the conviviality of PTPS Colony by providing civic amenities such as play ground and parks, improving the cleanliness and increasing greenery in the area	Allocate funds for CSR which may range from 5 lakhs – 20 lakhs per annum depending on type of initiatives	Better/ improved community relationship	HPGCL to organise frequent medical camps in adjoining villages; other activities to be part of the CSR policy.
26	Conduct comprehensive analysis of emissions associated with PTPS operations, meteorology and other sources to changes in AAQ levels; and Adopt air quality monitoring system for measuring ambient levels outside plant boundary where maximum concentrations are expected.	Part of routine environmental quality monitoring	Better/ improved community relationship	Third party lab has already been engaged for this purpose by PTPS. PTPS to continue with this set up.
27	Advanced training and background enhancement of existing staff on environmental monitoring, process safety aspects, environmental management Depute new staff for managing environmental, occupational and safety issues – for environmental; typical qualified staff recruited in other plants include post graduation in engineering/ technology with specialization in environmental engineering/ industrial pollution control	To be part of HPGCL routine training programme		HPGCL as per their training policy provide regular training to the officers at NPTI, PMI, and NTPC. HSE training to be integrated as part of this training programme.
28	Data modelling exercise is suggested to understand base data, interrelationship and reporting requirements, based on which comprehensive data management solution could be prepared		Better decision making	Existing EPCD and Safety divisions of PTPS to maintain comprehensive data on environment and safety respectively.
29	Training staff on regulatory reporting needs, data analysis for decisions	To be part of HPGCL routine training programme		

1 Introduction

Government of India has launched a program for Renovation and Modernization (R&M) of old coal fired power plants in the country. This program, the Partnership for Excellence, includes a financing window, funded by the World Bank and GEF, for renovation projects that prioritize energy-efficient outcomes. Panipat Thermal Power Station (PTPS) an existing coal-fired power plant, owned by Haryana Power Generation Corporation Limited (HPGCL), is being considered for renovation as part of the program.

Before understanding any renovation measures, it is critical to understand the existing performance of the plants in respect of energy, efficiency, and environment among other techno-economic aspects, with respect to which, the gains to be achieved through renovation could be assessed. HPGCL has appointed Enzen Global Solutions Private Limited to avail consultation services for Environmental Audit and Due Diligence Assessment (EADD).

Separate studies on energy audit and project design are also being carried out for the PTPS, which would evaluate the technical performance of the plant and establish the various plant efficiency parameters.

1.1 Objectives of the Assignment

The objectives of the proposed assignment are to establish and assess the baseline environmental performance of PTPS with respect to compliance with regulatory requirements, adequacy and effectiveness of pollution prevention and control measures , waste minimization and resource conservation measures , environmental management organization and capacity and occupational health and safety management systems, with a view to identify appropriate technical, financial, institutional and management measures to improve the environmental performance of the plant including mitigation of potential/perceived environmental risks/liabilities as part of the proposed renovation program.

1.2 Scope of the Assignment

The scope of Environmental Audit and Due Diligence Assessment covered under each category of work is as follows:

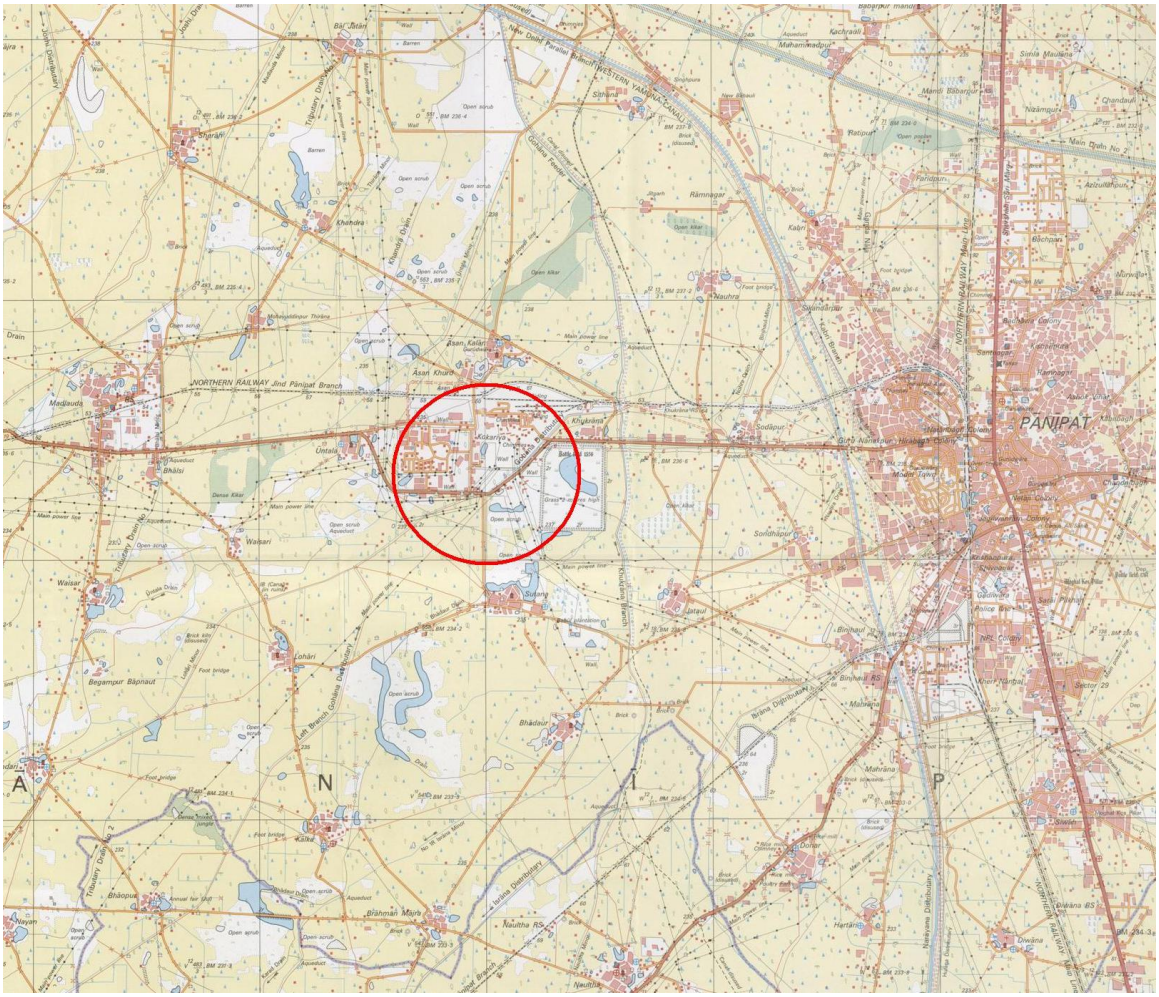
- Baseline Environmental Performance.
  - Regulatory Compliance Assessment
  - Pollution Prevention and Control Assessment
  - Resource Efficiency Assessment
  - Occupational Health and Safety Assessment
  - Community Health and Environmental Impacts
- Data Collection and Analysis
  - Site visit and identification of data gaps
  - Monitoring and Analysis
- Institutional Capacity Assessment
- Preparation of Investment Plan & Action Plan for implementation
- Transfer of Knowledge and capacity building

1.3 Description of PTPS

HPGCL was incorporated as a company during March, 1997 and is responsible for operating and maintaining the State's own generation project. It is also entrusted with the responsibility of setting up of new generating stations to meet the increasing demand for power.

PTPS is a generating unit of the HPGCL located about 8 km from the town of Panipat. The plant covers an area of 396 hectares and is predominantly surrounded by agricultural land. Other industrial facilities located in vicinity of PTPS includes Jaypee Cement factory, IOCL Panipat Refinery, National Fertilizers Limited and Nestlé India Limited.

The map below shows the location of the PTPS (encircled in red):



There are eight conventional coal fired units comprising of four units of 110 MW each commissioned during the 1980s, two units of 210 MW and two units of 250MW each, resulting in a total generation capacity of 1,360MW. There are six stacks for all eight units. One stack is attached to units 1 & 2, the second serves units 3 & 4, the third is a multi-flue stack attached to units 5 & 6 and units 7 & 8 have one stack. Each unit has its own natural draft cooling tower. Other infrastructure and auxiliary facilities include three coal handling systems, two raw water storage ponds, two common raw water pump-houses (one each for units 1-6 and units 7 & 8), five DM water Plants (one each for Units 1 & 2, 3 & 4, 5,

6, 7 & 8), ash handling system and ash pond area, switch yard and two common administrative building. The plant generates electricity using coal-fired boilers coupled with steam-turbine generators. PTPS receives coal from four sources namely Central Coalfields Limited, National Coalfields Limited, Western Coalfields Limited, and Bharat Coking Coal Limited.

The detailed layout of the plant is given in Annexure 1.

2 Regulatory Compliance Assessment

2.1 Introduction

Regulatory compliance assessment was carried out for the entire plant covering all the units (units 1 to 8), all common facilities and the ambient environment. Regulatory compliance is assessed against the following:

- Environmental clearances / consents applicable under various environmental regulations and compliance to conditions stipulated in available clearances / consents.

- Compliance to applicable environmental standards / stipulations for various environmental aspects such as coal consumption, water consumption, stack emissions, noise levels, effluent quality and disposal, ambient air quality, pollution in water bodies receiving effluent from the plant, disposal / utilization of ash and any other specific stipulations that are applicable to the plant.

Assessment of PTPS compliance with the applicable World Bank Pollution Prevention and Abatement Handbook (PPAH) guidelines was also carried out.

Compliance assessment also took into consideration all the special requirements / conditions that were stipulated for the units vide various consents / clearances as well as all new notifications / regulations currently in force that are applicable to the plant.

2.2 Environmental Clearances / Consents

Following are the environmental clearances required for the PTPS:

1. Environmental Clearance from Ministry of Environment and Forest (MoEF) based on the Environment Impact Assessment study done by the PTPS
2. Consent to Establish (CTE) by HSPCB
3. Consent to Operate by HSPCB (CTO) (during first operation)
4. Renewal of Consent to Operate under the Water (Prevention and Control of Pollution) Act, 1974 and the Air (Prevention & Control of Pollution) Act, 1981.
5. Authorization under Hazardous Waste (Management & Handling) Rules, 1989.

The first unit of PTPS was established in 1.11.1979 and subsequently units were added. Units 1 to 6 [1]were installed/ execution work started prior to the Notification of Environmental Impact Assessment (EIA) (issued on 27.1.1994 under the provisions of Environment (Protection) Act, 1986 making EIA mandatory for 29 categories of developmental projects including thermal power plants, which was notified via MoEF No. S.O. 319(E) dated 10th April, 1997) and hence did not require Environmental Clearance from MoEF.
HPGCL has Environmental Clearance from the expert committee for Thermal Power Projects, MoEF for establishment of two units (unit 7 & 8) of 250 MW capacities each at existing PTPS (accorded on August 23, 2002).

[1] Execution work of Unit 6 started in the year 1993-94, but commissioned in 2001 as per HPGCL communication Sr. No. 11 memo No. Ch27/CE/SE/Plg-II/A-10/Vol-II dated 15.12.2010

Units 1 to 8 were installed after the notification of Water Act, 1974 and hence come under the purview of Water Act, thus making it mandatory for PTPS to get CTE from the HSPCB. However, PTPS has acquired CTO under Water Act twice, once 2001-02 and then 2007-08. PTPS has not been issued with CTE / CTO under Air Act 1981 since its inception. The recent application (2009-2010) to the HSPCB requesting for consents under both these acts has been refused.

HPGCL has been accorded with Authorization under Hazardous Waste (Management & Handling) Rules, 1989, valid till 31/2/2010.

An attempt has been made to check compliance against the stipulated conditions under the available consents (2001-02 & 2007-08, under Water Act) and Environmental Clearances (unit 7 & 8).

The Environmental Clearance accorded by MoEF expert committee for Thermal Power Projects includes certain terms and conditions. PTPS' compliance against these requirements is discussed in the table below:

Table 1 Compliance Status for MoEF Environmental Clearance

Conditions under EC	Observation and Evidences	Compliance Status
Land and Green belt development		
• Utilization of land to be restricted to 136 ha and acquisition to 51.5 ha (41.5 ha for ash disposal and 10 ha for construction yard)	• Compliant	Compliant
• Maintenance of green belt in 44 ha; ensuring a density of 1500-2000 tress per ha; budgetary allocation of green belt (Oct 2002)	• As per the 'Development of Green Belt at PTPS' scheme, 35 hectares is covered under afforestation programmes. 61685 trees were planted maintaining an average density of 1700 trees per hectare.	
Air and Noise Environment		
• A single bi-flue stack of 220m height should be provided with continuous on line monitoring equipments and data collected should be analysed and submitted regularly to HPCB	• For unit 7 & 8, a single bi-flue stack of 220 m is provided and online monitoring is installed.	Partial compliance
• SPM emissions from ESPs should be reduced by upgrading and retrofitting of micro processors and ESP should comply with prescribed standards of 150 mg/m^3	• Emissions monitored by third party lab are reported to HSPCB regularly since February 2010. • Retrofitting of ESPs has been carried out	

Conditions under EC	Observation and Evidences	Compliance Status
• Noise levels should be maintained at 75 dBA; provision of earplugs for people working in high noise areas	• Except occasional incidences, noise levels are maintained at 75 dBA	
• At least one permanent air quality monitoring system to monitor SPM, SO_2 and NO_x regularly	• Air quality monitoring is currently being carried out by third party labs.	
Water and Waste Water Environment		
• Detailed scheme should be drawn for avoiding water logging in nearby villages (geo hydrological study)	• Hydrogeological study has not been carried out, but PTPS has planned measures to control water logging at Khukhrana village.	Partial compliance
• Water for the project to the tune of 18.5 cusecs should be drawn out of total allocated water for the plant is 106.5 cusecs for Western Yamuna Canal	• Present water consumption as per records is approximately 88 cusecs	
• Water quality (including heavy metals) should be regularly monitored around ash pond and project area to ascertain the change in the water quality	• Occasional monitoring done earlier. PTPS has engaged CPPRI for routine monitoring from Feb. 2010.	
Coal handling and fly ash management		
• Coal consumption should be 6000 TPD for the units 7&8 having a calorific value of 4000 K. Cal/kg and sulphur content of 0.35%; ash content of the coal should not exceed 34%; sprinkling water on coal should be practised	• Sprinklers are installed	Partial compliance
• 7.43 lakh tonnes of ash generated should be utilized as per the Notification on Fly Ash Utilization issued by the Ministry; end of 2014-2015 full fly ash utilization should be ensured • Available 710 acres of ash disposal unit should be used; proposed	• 710 acre land is being used for ash disposal of Unit-1 to 6 and approx 116 acre land out of earlier proposed 340 acre land is being used for disposal of ash from Unit-7 & 8. However, PTPS shall	

Conditions under EC	Observation and Evidences	Compliance Status
340 acres should be used only when it is necessary; • Decanted water from the ash pond should be circulated and discharge to the drain should be stopped	make efforts to utilize 100% ash in next 5 years • Though ash recovery plants for units 1-6 and 7 & 8 are installed, there is further scope for increasing reuse of decanted water	
Safety		
• Establishment of mock drill system, safety alarms at strategic points, first aid centres, environmental laboratory	• PTPS has established first aid centre, an environment laboratory and safety alarms at some strategic points. • During our discussion with the officials it was learnt that mock drills were conducted and records are maintained	Partial compliance
• A monitoring committee should be constituted for reviewing the compliance of various safeguard measures by involving recognised local NGOs, Pollution Control Board, Institutions, experts etc.	• No such monitoring committee was found functional	

In addition to the general conditions stipulated by HSPCB during issuance of CTE / NOC for additional 2 X 250 MW (units 7 & 8) plants at PTPS, the following specific conditions were included:

- *'Unit will take remedial measures to address grievances of KhuKhrana village/ Unit will ensure that there is no water logging in the area.'*
  In response to this PTPS has installed few tube-wells for evacuation of ground water from village Khukhrana with a view to lower the water table in the area have been established. The other grievances addressed are detailed in the Chapter 6 Community Environment and Health Impacts.
- 'Unit will maintain the existing ESPs so as to achieve the prescribed standards.'
  The existing ESPs are not maintained to achieve regulatory standards. This aspect is discussed further under Chapter 3 Pollution Prevention and Control.
- *'Unit will install proper pollution control devices in the coal handling section.'*
  The installed pollution control devices like dust suppressors and extractors are found not functional.

The compliance status for the conditions stipulated by HSPCB in its Consent for discharging effluent (under Water Act) during year 2007-08 is given in the table below:

Table 2 Compliance Status of Consent for discharging effluent

Consent conditions	Observation and Evidences	Compliance Status
Water Environment		
• The daily quantity of domestic effluent from the plant should not exceed 500 m^3/day • The daily quantity of industrial effluent shall not exceed 2970 m^3/day.	• Quantity of effluent discharged is not monitored, Estimates during EADD indicate volumes in excess on 2970 m^3/day	Partial compliance
• Unit will operate and maintain ETP/APCN regularly and ensure that various characteristics of the effluent remain within the tolerance limits as specified in EPA standards and at no time the concentration of any characteristics should not exceed these limits for discharge into drain.	• All the units of PTPS have air pollution control devices; only 7 & 8 has an ETP. The existing oxidation pond to treat colony sewage to be re-commissioned; tender has been invited for making oxidation pond finctional.	
• Unit shall install sewage treatment plant and submission of report to HSPCB	• PTPS has recently (July 2010) installed skid-mounted STPS (3 numbers) to treat plant sewage; after commissioning PTPS to take up routine O & M, report treated effluent characteristics to HSPCB.	
• Unit will operate ETP of units 7 & 8 regularly and submit energy meter reading of the ETP to the Board.	• Energy meter readings are not recorded and submitted regularly	
• The unit shall reuse/ re-circulate the ash pond water in the plant and ensure that the discharged water should not affect the agriculture fields adversely.	• Though ash recovery plants for units 1-6 and 7 & 8 are installed, there is further scope for increased reuse of decanted water	
Air Environment		
• The industry shall obtain consent under Air Act and authorization under Hazardous Waste Management and Handling Rules.	• Consent under Air Act has not been accorded since its inception; • Authorization under HW (M&H) Rules was issued	Partial compliance

Consent conditions	Observation and Evidences	Compliance Status
	recently	
Waste		
• The industry shall provide non-leached storage facilities for storage of Hazardous waste of dispose off same in the common facilities	• The HW such as transformer oil is stored in steel drums in paved surfaces.	Compliant
Others		
• The industry shall submit Annual Report once in 3 months	• Reports were submitted till April 2008. PTPS is using the services of third party labs to carry out the water monitoring and analysis, and has now engaged CPPRI for the same	Partial compliance
• The industry shall submit Environmental Audit Report once in a year • Unit will submit analysis report of trade effluent and air emissions once in a year and keep all the parameters within the limit	• Environment statement is submitted	
• The unit shall comply with CREP guidelines of CPCB	• Some of the guidelines of CREP are being followed	

The status of compliance for few of the conditions stipulated by HSPCB in its Authorization (2009-2010) for collection, storage and disposal of hazardous wastes under Hazardous Waste Management & Handling) Rules, 1989 are given in the table below:

Table 3 Compliance Status for conditions under HSPCB Authorization

Consent conditions	Observation / evidences	Compliance
• The collection, reception and transportation of HW shall be carried out by the authorized person fully trained and should ensure proper usage of safety measures. • The unit shall maintain the record the Hazardous wastes at the facility on Form –III, submit reports regarding disposal of HW Form IV, statement regarding accident etc and measures taken in emergencies on form –V, notification and movement of Documents on Form VI and record of import of HW on Form VII. • The occupier of the unit shall give an undertaking on the Non-Judicial Stamp Paper of Rs. 3 duly attested by the 1st Class Magistrate that the occupier shall dispose of HW only within the site developed by it and not at any place/public place. • Unit shall comply with all conditions and the guidelines issued by CPCB vide. No. HAZWAMS/31/2005-06, HAZWAMS/32/2005-06 and No. HAZWAMS/33/2005-06 • Unit shall do segregation/pre-treatment for heavy metals before incineration • Unit shall submit annual return under HW (M&H) Rules 1989.	• HSPCB has recently issued the Authorization under HW (H&M) rules 1989. Some of the procedure are complying with the stipulated and there is still scope for improvement	Partial compliance

3 Pollution Prevention and Control Assessment

3.1 Air Quality and Air Emissions

The impact on air quality due to PTPS operations may be due to emissions from coal handling, coal combustion and fly ash handling operations. The primary emissions to air from the combustion of coal are sulphur dioxide (SO_2), nitrogen oxides (NO_X), particulate matter (PM) and carbon monoxide (CO). Depending on the fuel type and quality, other substances such as heavy metals (i.e. mercury, arsenic, cadmium, etc.), halide compounds (including hydrogen fluoride), unburned hydrocarbons and other volatile organic compounds (VOCs) may be emitted in smaller quantities, but may have a significant influence on the environment due to their toxicity and/or persistence. Sulphur dioxide and nitrogen oxide are also implicated in long-range and trans-boundary acid deposition.

The following approach was adopted for air quality and air emissions audit/ assessment

- Understanding meteorology of the area from air quality perspective
- Assessment of air quality management systems based on current practices and past records
- Air emission sources, emission control/ prevention systems assessment based on current practices and past records
- Primary monitoring for validation
- Gap analysis

3.1.1 Meteorology

PTPS uses the services of third party laboratories for meteorological data generation. At present CPPRI, lab is providing monitoring services to PTPS and has setup micro-meteorological station at Field Hostel shown in Figure 1. EIA-EMP report (Mecon, 2001) of Unit 7 & 8 suggests that that data generated at PTPS site is comparable with the nearest IMD observatory at Karnal, about 32 km from PTPS.
Past records available at PTPS indicate that meteorological data is not generated on continuous basis and meteorological parameters are limited to wind velocity and direction, temperature and rainfall.

Wind rose for the month of Feb, 2010 is shown in Figure 2. The predominant wind direction during this period was from the NW.

Issues concerned with meteorological data generation include:

- Discontinuous and inadequate data generation on site, and
- Lack of interpretation and usage of meteorological information in air quality management & safety management specifically during worst case meteorological conditions.

It is recommended that PTPS either continue hiring services of the third party lab for continuous meteorological station at field hostel for this financial year external labs or set up an automated micrometeorological station. PTPS should also train its Senior Analyst on air quality and met-data analysis and interpretation.

Figure 1 Micro-meteorological Station at PTPS Field Hostel

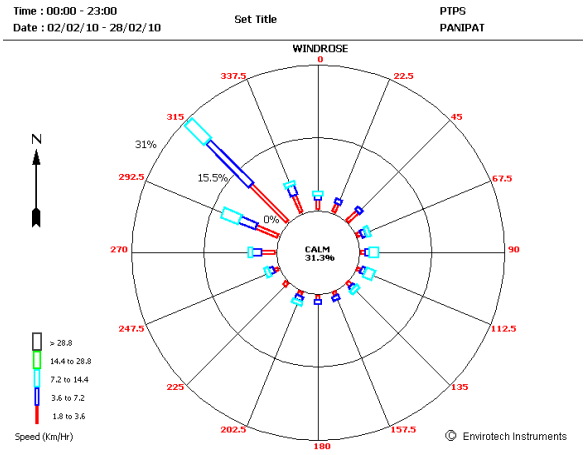


Figure 2 Wind-Rose for Feb 2010

3.1.2 Air quality monitoring

PTPS has been monitoring ambient air quality in this area regularly at five locations – three within plant premises, one in the plant residential area and one in the residential area near Khukharana village. Occasional monitoring is carried out in other villages such as Untla. No other ambient air quality stations such as ones owned and operated by HSPCB, industries or research institutes are located within 10 km radius. The stations nearest to PTPS might be operated by IOCL, Panipat and NFL.

AAQ monitoring has been regular for the past ten years except for the last 10 months as a result of HSPCB withdrawing recognition of private labs. PTPS appointed CPPRI for AAQ monitoring in Feb, 2010.

Past records indicate the following (See Annexure 2 for details):

- 24-hourly SPM and RSPM concentration at Khukharana and Field Hostel exceed NAAQS[2] most of the monitored days in 2007

- 24-hourly SPM and RSPM concentration at Fire station and CHM exceed NAAQS at least 15 % of the monitored days in 2007

- 24-hourly SO_2 and NO_x concentration at all locations are within NAAQS on all monitored days in 2007

For this assessment privately owned third party laboratories were involved for AAQ monitoring and parameters monitored were SPM, RSPM, SO_2 and NO_x.

Primary monitoring was conducted at four AAQ locations (shown in Figure 3) outside the plant:
- Station 4 – Upwind – Asan Khurd
- Station 5 – Crosswind – Khukhrana
- Station 6 – Downwind – Jatul or Sutana
- Station 7 – Crosswind – Untla

The following were the three monitoring locations inside the plant:
- Station 1 – CHM 1
- Station 2 – Fire station
- Station 3 – Clarifier house near Unit 7 & 8

The AAQ levels are presented in Annexure 2 along with results of CPPRI for almost same time period.

Comments on primary monitoring:
- Predominant wind direction during the monitoring period was from the NW, based on which AAQ stations outside the plant were located as part of EADD.
- 24-hourly SPM and RSPM concentration at all the locations in villages are above NAAQS except on two occasions; levels specifically high at downwind location Sutana
- 24-hourly SPM and RSPM concentration at clarifier house near unit 7 & 8 located upwind from emission sources is well within the NAAQS, whereas the other two locations show levels above NAAQS; CHP station showing very high levels of PM might indicate contribution from coal handling operations
- 24-hourly SO_2 and NO_x concentration at all locations are within NAAQS
- There are other contributing sources for air pollution which might include but not limited to dust re-suspension and automobile emissions from state highway, cement grinding mill, naphtha cracker plant located behind Assan Khurd, local burning such as cooking fuels, garbage, agricultural residue
- Primary monitoring results corroborate with CPPRI results for the same period

Issues related to ambient air quality monitoring include:
- Lack of quality and continuity of past records;
- Lack of systematic calculations, data storage and retrieval system;
- Downwind representative station requires reassessment;

[2] NAAQS referred here are not the latest standards.

- Community AAQM limited only to Khukhrana;
- Monitoring program is not based on the latest NAAQ standards;
- Lack of comprehensive data analysis and feedback/ decision support to link AAQ level changes with PTPS operations, meteorology and other contributing sources; and
- Lack of automatic air quality monitoring systems for measuring ambient levels outside the plant boundary where maximum ambient concentration is expected or where there are sensitive receptors such as protected areas and population centres.

PTPS should review present monitoring schedule to meet the new NAAQ requirements, and train staff on AQM, and data management and analysis.

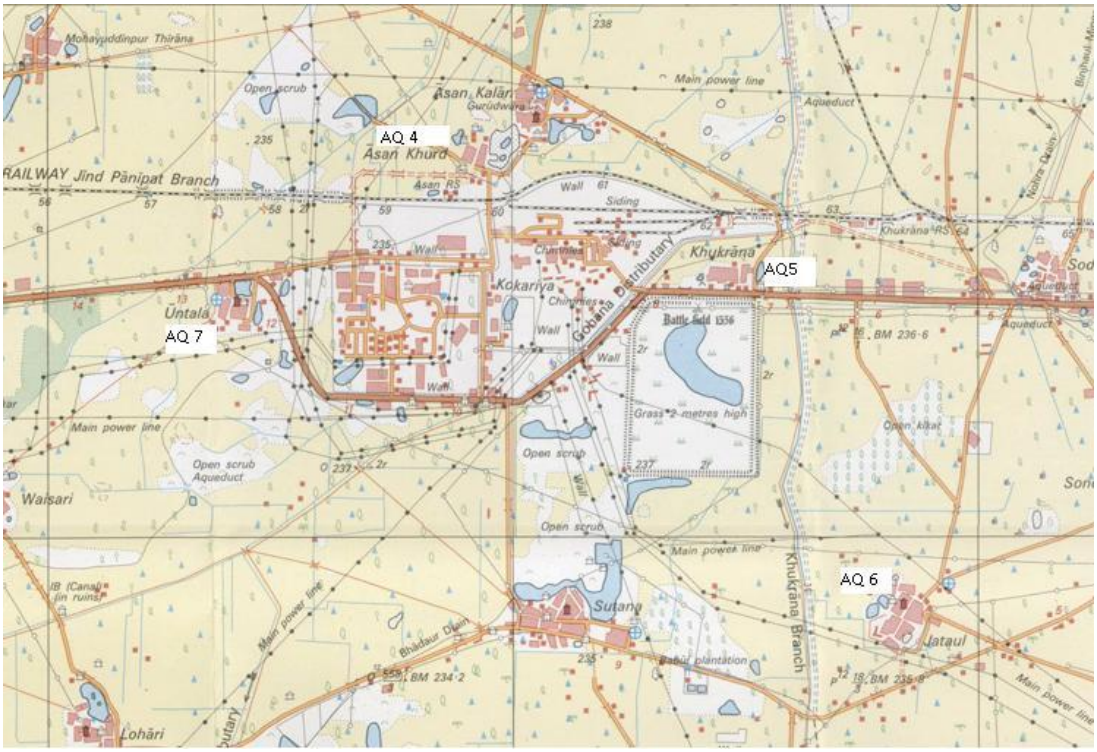


Figure 3 AAQ locations outside the plant

3.1.3 Stack emissions

PTPS has six stacks connected to its coal boilers. Apart from electrostatic precipitators installed to mainly control PM emissions, there are no other air pollution control devices/ systems for NO_x or SO_2 emissions.

It must be noted that coal used at PTPS has sulphur content ranging from 0.49 to 0.75 % and ash content (Monthly average - Feb 2010) of 37-38%.

Emission from stack is monitored on regular basis using conventional and approved methods (CPCB/IS Standard methods). In Units 1 &2, 6, 7 & 8 there are online analysers for gaseous pollutants. All units have online analysers for combustion parameters such as CO_2, O_2, and temperature etc.

Monitoring is carried out by a third party and occasionally by HSPCB. Third party monitoring arrangements and the issues concerning it are the same as those mentioned under AAQ monitoring. The past results of monitoring and, stack and monitoring port details are summarised in Annexure 2.

Past monitoring records indicate the following:

- Emissions data is generated based on primary monitoring
- Theoretical estimation/ calculations based on surrogate techniques are not adopted
- PM is monitored on regular basis along with SO_2 and NO_x
- PM emissions from stacks of units 5, 6, 7 & 8 have been well below emission norms till March, 2009 and on many occasions below 100 mg/ nm^3
- Unit 8 has exceeded the emission norms twice
- PM emissions from Units -1 to 4 have exceeded the standards on several occasions
- Post March 2009 monitoring was carried out on 2-3 occasions, including monitoring by HSPCB, results show high levels of emissions

Primary monitoring was conducted as part of EADD, the results of which is in Annexure 2. The results of primary monitoring of air emissions were used for establishing baseline parameters. Baseline parameters in mg/ Nm^3, tons/day and g/kWhe (based on primary measurement carried out during EADD using 3 different grab samples and with Unit 1 under shutdown) are given the table below:

Table 4 Baseline parameters for stack emissions

Parameter	Unit	Unit 2	Unit 3	Unit 4	Unit 5	Unit 6	Unit 7	Unit 8
SPM	mg/Nm3	292 - 589	1620-1697	1131-1198	367-662	966 - 1240	601-958	1699 - 4238
PM 10	mg/Nm3	231-441	1105-1171	724-791	304-569	751-909	442-715	1160-4102
Sulfur Dioxide (SO_2)	mg/Nm3	454 - 485	618-683	386-421	498 -623	480-890	867-7011	577 - 697
Nitrogen Oxides (NOx)	mg/Nm3	315 - 318	257-271	112-123	287 -365	307-387	309-373	298 - 329
Carbondioxide (CO_2)	% v/v	4.5 - 7.8	5.6-5.8	5.1-5.6	8.4 -8.6	8.2-9.7	7.4-8.0	7.9 - 8.3
Oxygen (O_2)	% v/v	11.3 - 12.0	10.6-10.8	10.7-10.9	9.6 - 10.7	10.1-10.8	12.1 - 12.5	9.9 - 10.5
Carbonmonoxide (CO)	PPM	396 - 402	209-213	62-65	132-160	160	112 - 172	203 - 242
Moisture Content	v/v	1.6-2	1.2-1.5	1.1-1.3	2-2.3	1.6-2.1	1.4 - 1.9	1.2 - 1.7
Total Hydrocarbon (as CH_4)	ppm	632-754	337-453	548-575	637-713	645 - 1083	547 - 719	610 - 830
SPM	Tons/day	7.32-14.80	11.59-12.12	9.37-9.92	5.61-11.02	10.78 - 20.75	14.57 - 27.62	53.46 - 190.51
PM 10	Tons/day	5.79-11.08	7.90-8.36	6.00-6.55	4.65-9.47	8.36-15.21	10.72-20.62	36.50-114.50
Sulfur Dioxide (SO_2)	Tons/day	11.39-12.18	4.41-4.89	3.20-3.49	7.61 - 11.12	8.03 -9.93	25.00 - 167.68	17.36 - 19.46
Nitrogen Oxides (NOx)	Tons/day	7.90-7.99	1.84-1.94	0.93-1.02	4.78 - 5.58	3.49 - 5.14	7.41 - 8.39	8.32 - 10.35
SPM	g/kWhe	2.77-5.66	4.60-4.81	4.24-4.49	1.11 - 2.31	2.14 - 4.12	2.38 - 4.51	9.90 - 35.28
PM 10	g/kWhe	2.19 -4.20	3.14-3.32	2.72-2.97	0.92-1.98	1.66-3.02	1.75-3.37	6.76-21.20
Sulfur Dioxide (SO_2)	g/kWhe	4.31	1.75-1.94	1.45-1.58	1.51 - 2.17	1.59 - 1.97	4.08 - 27.47	3.22 - 3.60
Nitrogen Oxides (NOx)	g/kWhe	2.99-3.03	0.73-0.77	0.42-0.46	1.00 - 1.34	0.69 - 1.02	1.21 - 1.76	1.54 - 1.92

The following are issues related to stack emissions:

- Recent emissions monitoring results exceed regulatory and PPAH standards/ guideline values;
- Lack of safe access to ports for monitoring specifically at Unit 7 &8 and Unit 5 &6 bi-flue stack;
- Lack power supply at sampling ports;

- Sampling point in bi-flue stack of Unit 5 & 6 is inaccessible due to flue gas leaks into enclosure; and
- Lack of continuous measurement of combustion parameters for optimal operations, analysis & interpretation of emission data in relation to ambient air quality & pollution prevention/ control performance.

PTPS should provide sampling ports at ESPs according to CPCB requirements and specifications. It is essential that PTPS ensures safe access to all stack monitoring points and trains staff on comprehensive data analysis.

3.1.4 Particulate collection system

Electrostatic precipitators (ESP) are used to control particulate emissions from coal combustion. In all the units the flue gases after exchanging heat in the boiler pass through electrostatic precipitators (ESPs) in which the particulate matter gets separated and settles in a series of hoppers. Design parameters are summarised in Annexure 2. Routine operation and maintenance is carried out by BMD & EMD. Need based assessment and tuning is also carried out by PTPS such as tuning of ESP BAPCON controllers of Unit-1&2 was carried out by M/s BHEL in Sep, 2007

ESP efficiency was monitored occasionally in the past. Present monitoring arrangement with CPPRI has provisions for regular monitoring. As part of the EADD, an efficiency assessment was carried out for PM collection, summary of results along with past efficiency assessment conducted by PTPS is in Annexure 2.

Comments on ESP efficiency:

- Low efficiency of ESPs of Unit 7 & 8 may be due to number of fields available/ working during monitoring;
- 15 out of 28 & 10 out of 28 fields were working in ESPs of Units 7 & 8 respectively; and
- PTPS also tried Ammonia injection in Unit 2 ESP, in Nov 2007. Results showed no substantial gain (increase in PM concentration from 242 to 269 mg/nm3). This might indicate fly ash resistivity is not the only factor affecting performance of ESP.

Issues concerning ESP efficiency include:

- Continuous deterioration of coal quality with increase in ash content is cited as primary reason for poor performance of ESP along with high resistivity of fly ash;
- Inability to maintain ESP in running units in some cases;
- Maintenance of components appears inadequate as it was observed that some collecting motors and emitting electrodes, hopper heaters were not working during site visit

In order to improve the performance of particulate collection systems, PTPS should ensure that overall performance of the ESP is continuously monitored by devices such as voltage meters and transmission meters. The components of the ESP and their operation are to be periodically inspected by plant personnel as part of a preventive maintenance program. In this way, problems can be detected and corrected before it causes a major shutdown of the ESP. Good recordkeeping should be an integral part of any maintenance program.

Isolation issues needs to be addressed to maintain ESPs of running units. OEMs provide dampers or gates for isolation of paths. Gates have advantage over dampers as they are not exposed continuously to the corrosive environment. Replacement of dampers with gates is suggested depending on the life and maintenance needs of dampers. Some components such as rapping motors, ESP transformers can be attended without isolation needs. These have to be immediately rectified if there is a problem.

There is a need to integrate ESP maintenance into routine maintenance schedule, shutdown/ breaks and include maintenance requirements into "defect register". Once in 15 days a check of key components of ESP such as motors, transformers, heating elements at hoppers should be carried out.

On a daily basis the following operational practices should be implemented:

- Ash evacuation and checks for accumulation of ash at ESP hoppers;
- Manage timing of bottom ash and fly ash evacuation in case of wet ash handling as both use same handling system; and
- Manage time distribution of ash evacuation of all ESP hoppers.

3.1.5 Dust control and fugitive emissions

Major sources of fugitive emissions at PTPS are:

- Dust from coal storage, handling & operations at transfer points, crushers;
- Dust re-suspension from roads, paved and unpaved surfaces in CHP, plant area due to wind & vehicular movements;
- Uncovered areas in fly ash pond;
- Transfer of coal rejects, specifically at Unit 5 – coal reject hopper near junction tower ; and
- ESP area.

Measures in place or under implementation in CHPs to control fugitive emissions include:

- Pre-wetting and wetting in coal tippler area;
- On-belt dust suppression systems;
- Dust extraction systems at crusher house; and
- New dust suppression system is under installation in CHM – I covering 100m by 226 m stock pile to be operational by Aug, 2010.

Issues concerning dust control and fugitive emissions include:

- Ambient air quality monitored at CHP – I under EADD show very high levels of PM-10; PM-10 is in excess of 350 $\mu g/m^3$;
- Difficulty in handling of wet coal is being experienced;
- System is getting choked and tippling is delayed;
- Dust extraction systems are not working at CHP I;
- Selective wetting & pre-wetting is carried out depending on the quality of coal;
- Dust is generated while stacking raw coal in CHP II;
- Dust is emanating in CHP III near roller screen before the crusher;
- Ventilation is very poor at CHP I crushed coal transfer point (Belt 13 A & B); and
- Ventilation, lighting, seepage are key issues in below ground areas in CHP I.

The following recommendations to improve dust and fugitive emissions control systems are proposed to PTPS:

- Commission dust suppression system;

- All the control rooms are to be kept clean and free of dust by providing appropriate air conditioners of suitable capacity;
- Pre-wetting of coal to be carried out irrespective of quality of coal received;
- Provide primary crusher in CHP to handle big boulders and stones;
- Grating size to be increased to handle big coal lumps;
- 6.6 KV switch gears are to be provided with mat and sealed to avoid entrance of dust;
- Provide adequate ventilation at below ground operational areas at CHM;
- Proper illumination to be provided in the yard and in control room;
- Green belt to be provided at strategic locations;
- Drinking water facility to be provided for the staff;
- Good toilet facilities to be provided;
- Proper storm drainage facility to be established;
- Periodical removal of weeds and grass to be done;
- Proper concrete pavement approaches to be taken up to the important location;
- Separate entrance and exit points to be identified for removing the rejected coal;
- Replacement of vibrating feeders instead of roller screen to be carried out immediately in the CHP III (Materials are lying in stores, but shut down is not permitted. Time required is around 20 days);
- Good field offices to be located including storage facility for spares; and
- Labour camps are to be removed and shifted outside the plant so as to keep the place environmentally clean.

3.1.6 Operational Practices/Systems for improvement of coal quality, burning efficiency, and heat recovery

High performance milling system (HPMS) was installed in Unit 2 for improving coal grinding efficiency. In HPMS, specially developed grinding rolls having special carbide inserts are provided along with a compatible design of bull ring segments for improved grinding action. This has resulted in significant improvement in coal mill reject, outage of coal mills and guaranteed life of grinding equipment has been achieved.

PTPS blends imported coal with Indian coal. On an average 10 to 15 % of imported coal is mixed with Indian coal.

Multifunctional solid fuel additive is tried in Unit 3 & 4 to improve coal combustion properties; preliminary result indicates 1 % reduction in un-burnt carbon in fly ash and is expected to achieve 2% reduction in heat rate.

3.1.7 Noise control systems

Major sources of noise in PTPS include the turbine generators and auxiliaries; boilers and auxiliaries, such as coal pulverisers, fans and ductwork; pumps, compressors, condensers, precipitators, including rappers and plate vibrators; piping and valves; motors; transformers; circuit breakers; and cooling towers. Noise from coal handling includes wagon tippling, crusher house, coal transfer/ loading equipments.

PTPS has adopted noise control techniques such as:

- Acoustic machine enclosures;

- Using sound absorptive materials in walls and ceilings; Double glazing and
- Using vibration isolators and flexible connections.

PTPS is monitoring both ambient and source noise levels and has in-house capability to carry out the monitoring. Noise levels monitored by PTPS for Nov, 2009 is in Annexure 2. Noise was monitored as part of EADD and the results are in Annexure 2.

Based on the monitoring and assessment of past records and practices, the following gaps/ Issues have been identified:

- Noise levels at compressor house Unit 3 & 4 is consistently above standards. Workers in the area complain of consistently high levels of noise.
- Noise levels at all the source generators were found to be within 90 dBA except at Unit 2 turbo-generator.

It is recommended that a technical consultant be appointed to carry out a detailed assessment of compressors of Units 3 & 4.

3.2 Water and Wastewater

3.2.1 Water intake and usage pattern

The main source of raw water for the PTPS is the Delhi Parallel Branch of the Western Yamuna Canal which is about 9 km away. There are two parallel canals convey water from the source to the raw water pond. Water is stored in raw water pond which also facilitates primary sedimentation. There are two raw water ponds each with an approximate capacity of 1, 35,000 m3 and 1,50,000 m^3. The Haryana Irrigation Department has permitted the withdrawal of 106.5 cusecs (10857 m^3/hour) of water from the source. Raw water is pumped from the ponds to the clarifiers. There are two raw water pump house, one for units 1-6 and other for units 7 & 8. Water intake as per PTPS is shown table below:

Month	Cusecs average assumed (Assumption by PTPS)	m^3/hr	Water bill (Rs /lakhs)
Nov 2009	80	8155	207
Oct 2009	83	8427	214
Sep 2009	80	8155	207
July 2009	83	8427	214
June 2009	76	7721	196
May 2009	77	7816	199
April 2009	83	8506	216
March 2009	75	7677	195
Feb 2009	42	4328	110
Jan 2009	40	4123	105
Dec 2008	41	4214	107

3.2.1.1 Water balance

Raw Water Usage is defined as the water from a raw water source and used in the plant processes for any and all purposes, such as cooling tower makeup, condenser makeup, slurry preparation makeup, ash handling makeup. Water Loss is defined as the water exiting the system and represents the overall "loss" of water to the environment.

Key features of water usage in PTPS

- All cooling water system provided are open recirculation type with natural draft cooling towers
- Ash water recovery and reuse

Inflow

Based on raw water pumping flow data obtained from primary measurement during the energy audit and normal operational hours; the raw water intake is shown in table below.

Table 5 Raw Water Intake

Pump	Measured flow (m3/hr)	Design (m3/hr)
RW 1B	756	1200
RW 1C	756	1200
RW 2A	0	1200
RW 2B	776	1200
RW 2C	776	1200
RW 5A	0	1200
RW 5B	791	1200
RW 5C	825	1200
RW 6A	995	1098
RW 6B	980	1098
RW 6C	0	1098
RW 78A	936	1100
RW 78B	936	1100
RW 78C	0	1100
Total	**8527**	

The other source of inflow is recovered water from ash water. There are two ash water recovery systems one for Unit 1 to 6 and another recently installed for Unit 7 & 8. Details of ash water recovery system are provided in Annexure 3. Water recovered from ash water recovery system of Unit 1 to 6 is 736 m^3/hr. Water recovered from ash water recovery system of Unit 8 & 7 could not be quantified; discussion with PTPS officials indicated quantity might be 245 m^3/hr.

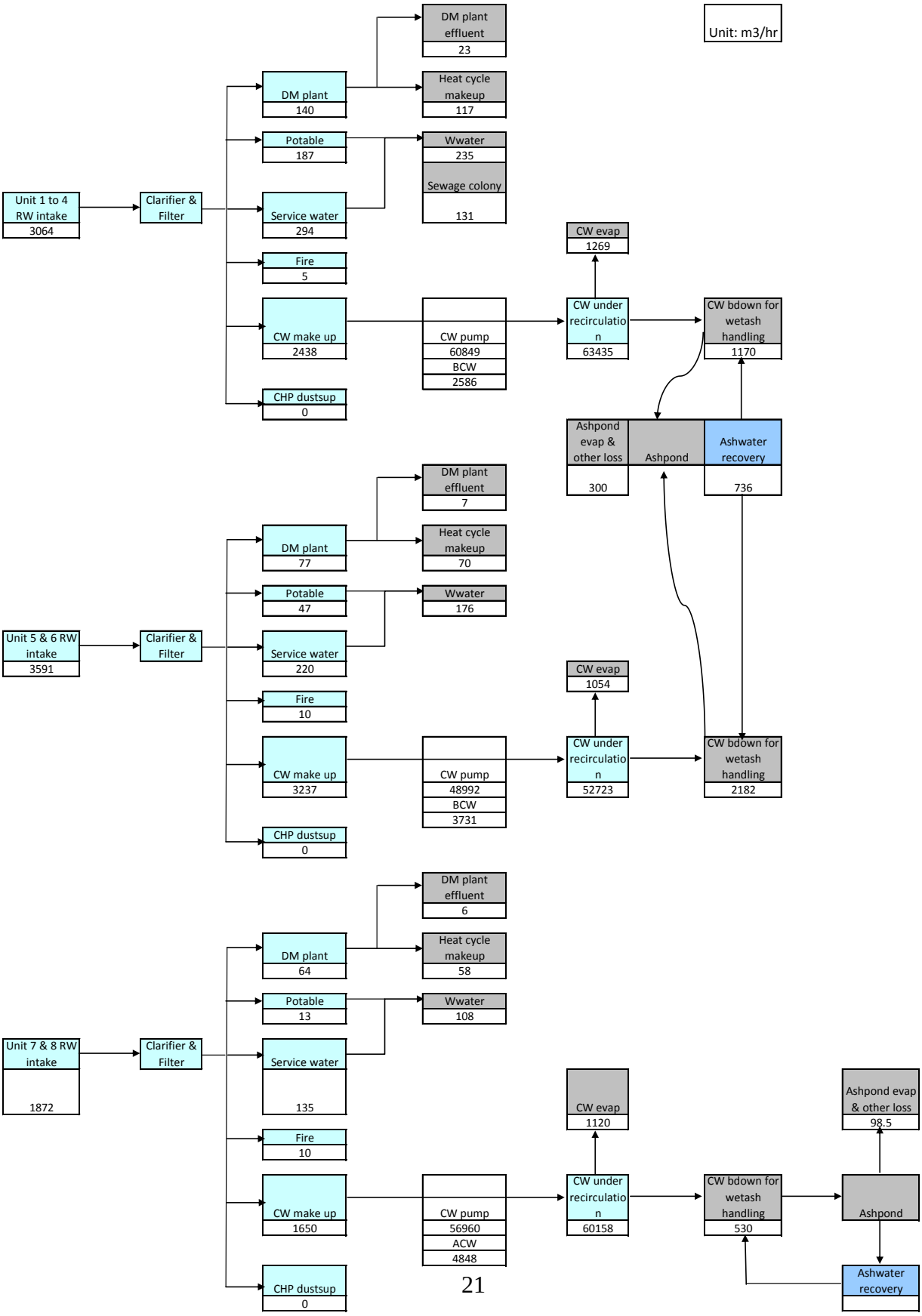
Out flow

There are two major out flow from PTPS which joins Untala drain. These are two branches of the periphery drain and mainly contain floor wash (plant), oil storage tank floor wash, effluent from ETP, domestic wastewater and storm water. During site visit flow from these drains was quantified using area-velocity method, approximate quantity discharged is:

- Plant rear side drain – 1300 m^3/ hr
- Drain near main gate – 770 m^3/hr

Other major outflows are evaporative losses from cooling towers, ash pond percolation/ leaks & evaporative losses.

Detailed water balance for PTPS is shown in the schematic below.



Based on inflow and outflow water balance summary is shown in table below.

Table 6 Summary of Water Balance

Water In		Water Out	
Location	Flow (m3/hr)	Location	Flow (m3/hr)
Unit 1 to 4 intake	3064	DM nuetralization	36
Unit 5 & 6 intake	3591	Sewage	168
Unit 7 & 8 intake	1872	Boiler heatcycle makeup	245
Ashwater recovered from 1 to 6 units	736	CT evaporation	3443
Ashwater recovered from 7 & 8 units	245	Ashpond evaporation	399
		Plant final discharge	2070
		Other losses	3148
Total	**9508**		**9508**

Please refer to Sr. No. 5 of addendum.

3.2.2 Wastewater treatment

Wastewater streams from PTPS include:

- DM plant effluent
- Boiler blow down
- CT blow down
- Ahs slurry/ Ash water
- Washing and cleaning
- Domestic

As part of EADD these streams were characterised and the results are shown is Annexure 3.

Ash slurry / ash water is taken into ash pond and 60 % of ash water is recovered and reused in ash handling. All cooling water systems provided are of the open recirculation type with natural draft cooling towers. Part of the recirculation water is used for ash handling and there is no blow down or discharge from cooling water.

Acid and alkaline streams from DM plants of Unit 1 to 6 are taken separately and neutralized in neutralization pit and disposed off to the drains. Floor washing and cleaning wastewater are disposed directly into the drains.

DM effluent, boiler blow down and floor washing effluents from Units 7 & 8 are treated in a separate effluent treatment plant.

Domestic wastewater from the plant is disposed of directly into the drains. Oxidation pond for treatment of waste from colony was not functioning during the site visit. However, since then PTPS has commenced the process for making the oxidation tanks functional. PTPS has awarded a contract for installation of three skid mounted sewage treatment plant of capacity 150, 60 and 25 m^3/day capacity to treat domestic effluent from plant.

Issues concerning wastewater and its treatment include:

- Water flow measurement specifically at intake and effluent outlets and other critical areas are not carried out;
- Only a limited recovery of ash water specifically from Units 7 & 8;
- Inadequate ETP operation and maintenance; and
- Inadequate reuse of treated effluent.

Recommendations to improve water/ wastewater management at PTPS include, water flow measurement/ quantification at strategic locations such as inlet, outlet and recirculation lines. PTPS should commission oxidation pond to treat colony sewage. It should maximise recovery of ash water and reuse in ash handling/ other uses.
Please refer to Sr. No. 4 of addendum.

3.3 Fly Ash and Ash Pond Management Systems

PTPS at present is using both wet and dry systems for managing fly ash. Utilization of dry fly ash from Units 6, 7 and 8 has started, whereas from the remaining units it is likely to start from April-May, 2010. In the absence of utilisation, fly ash will be pumped in slurry form into the ash pond.

3.3.1 Dry fly ash utilization at PTPS

Dry fly ash generation and utilization is shown in table below.

Table 7 Dry Fly Ash Generation and Utilization

	Units 7 & 8			Units 6		
Time period	Dry ash generated (tons)	Dry ash utilized (tons)	Percentage of utilization	Dry ash generated (tons)	Dry ash utilized (tons)	Percentage of utilization
2005-06	473900	76000	16%			
2006-07	678000	82400	12%			
2007-08	680000	168600	25%	281032	50295	18%
2008-09	674853	411868	61%	449690	148270	33%
2009-10	685599	468856	68%	417778	163886	39%

Current plans for fly ash utilization include:

- Dry fly ash evacuation system exists for Units 7 & 8 along with two Silos. The dry fly ash from these units has been allotted to M/s Gujrat Ambuja Cement Ltd.
- Fly ash evacuation system for Unit 6 along with silos is operational and fly ash is lifted by M/s Shree Cement.
- Dry fly ash evacuation system for Units 3, 4 & 5 is in under installation by M/s Jai Prakash Associates, which has set up cement grinding Unit nearby PTPS and shall be lifting the dry fly ash from these units.
- Dry fly ash evacuation system for Units 1 &2 is under installation by M/s Shree Cement who shall be utilizing the fly ash from these units.
- PTPS is in consultation with infrastructure / express corridor developers for utilization of pond ash for road / embankment development.

Please refer to Sr. No. 1 and Sr. No. 6 of addendum.

3.3.1.1 Requirements under latest Fly Ash Notification

The amendment to the Fly Ash Notification (S.O. 2804 (E)) defines fly ash as all ash generated at the thermal power plant such as ESP ash, dry fly ash, bottom ash, pond ash, and mound ash. The objective of this notification is to utilise all ash that is generated.

PTPS is free to sell fly ash subjected to certain conditions. Conditions/ targets for units in operation before 3rd November 2009 include:

- Pond ash should be made available free of any charge on "as is where basis" to certain category of users.
- At least 20% of dry ESP fly ash shall be made available free of charge to units manufacturing fly ash or clay-fly ash bricks, blocks & tiles on priority basis.
- Fly ash obtained from the thermal power station should be utilized only for the purpose for which it was obtained from the thermal power station/ plant failing which no fly ash shall be made available to the users.

Table 8 Fly Ash Utilization Targets

At least 50% of fly ash generation	One year from the date of issue of this notification (3rd Nov 2009)
At least 60% of fly ash generation	Two years from the date of issue of this notification
At least 75% of fly ash generation	Three years from the date of issue of this notification
At least 90% of fly ash generation	Four years from the date of issue of this notification
At least 100% of fly ash generation	Five years from the date of issue of this notification

3.3.2 Ash pond management

There are two ash ponds to manage wet fly ash. Ash pond -1 with an area of 625 acres and bund height 12.25 m is used to manage ash slurry from Units 1 to 6. Its estimated present capacity to handle fly ash is 1.1 million tons. Ash pond -2 with an area of 200 acres and bund height 15.25 m caters to Unit 7 & 8. Its estimated capacity to handle fly ash is 1.3 million tons. Ash generation and storage capacity of the ash pond is shown in the table below.

Units	Coal consumption (million tons/ year)	Ash (milliion tons/year) assuming 40% ash in coal*	Current capacity for storage (millioin tons)
1 to 6	4.80	1.9584	1.1
7 & 8	2.21	0.8832	1.3

Assuming 50% dry ash utilization the current capacity of Unit 7 & 8 ash pond might cater for 2.5 to 3 years, Units 1-6 ash pond 1 to 1.5 years. The future plans are:

- Unit 1to 6 ash pond – bund height increase by 4 m is planned, which could generate additional capacity of 3.5 million tons
- Unit 7 & 8 ash pond: feasibility study to increase bund height by 4m is proposed to be carried out by IIT Roorkee, alternate option of additional land acquisition is also being explored.

Water from ash pond is to some extent recovered and reused; details of which is discussed in section 3.2.2 and Annexure 3.

**Please refer to Sr. No. 2 of addendum.*

It is recommended that PTPS ensure:

- PTPS dry fly ash utilization is limited only to cement manufacturing, at least 20% of dry ESP fly ash shall be made available free of charge to units manufacturing fly ash or clay-fly ash bricks, blocks & tiles on priority basis,
- Proper grinding of coal to be ensured;
- Optimum combustion of coal in furnace by continuously monitoring the air flow, fire ball etc. to minimize low un-burnt carbon in the fly ash;
- 24 hour support from plant to fly ash lifting;
- Efforts in dissemination of technical and financial benefits of fly ash among users (through Press, Seminars, Circulation of material, IS codes etc.);
- Ensure nil or minimal emissions throughout fly ash transfer operations such as silo to transportation vehicles, closed container transportation;
- Use fly ash for in-house needs such as high volume fly ash concrete roads;
- Utilization of pond ash mixed with clay as per guideline of CBRI, Roorkee (ash and clay ratio is about 60:40) in bunds;
- Use of fly ash bricks for construction in plant and colony premises;
- Appropriate MoUs with users such as cement manufacturers covering new systems installation, upgrade existing systems, O & M of systems;
- Lifting of fly ash and dispatching by rail by owning your own wagons by the bidders;
- Opportunities for ash utilization are tracked and developers pursued;
- Theme based advertisements (e.g. NTPC); and
- Dissemination of success stories such as Kota thermal power station, which has achieved 98.48% dry fly ash utilization during 2007-08.

Please refer to Sr. No. 3 of addendum.

3.4 Solid Waste Management

Solid Waste Management at PTPS essentially pertains to coal rejects, stones and boulders from coal, hazardous waste, and metal scrap.

Coal rejects:

- Approximately 4000 - 5000 tons per month of rejects generated from coal mills of Unit 1 to 5
- Mill reject coal from Unit 1 to 4 is transferred through tractor trolley loading with manual labour and transferred to Reject Coal Stock Yard-A of CHP-1. Similarly, mill reject coal of Unit-5 is collected in the rejected coal hopper through conveyer belt system and then transferred to Reject Coal stock yard-A of CHP-1 by means of tractor trolleys.
- Rejects are sold through competitive bidding.
- Current stock of mill reject coal in CHP-1 stock yard A is approx 1.10 lacs MT & in CHP-II stock Yard- B is approx. 0.70 lacs MT.
- Quality of mill reject coal of stock yard “B” is very poor and no firm is coming forward to purchase the same. The case for disposal of mill reject coal of Stock Yard-“B” of CHP-II is under consideration and it is likely to be spread in between the railway lines of PTPS Marshalling Yard.

Stones and boulders from coal:

- Huge stones are received along with coal (around 2%) even after entering into Fuel Supply agreement with Coal Companies.

- Presently stored in CHP areas and other low lying area, a committee has been formed to address disposal issues

Hazardous waste:

- Lubricant /dirty oil
  - Dirty traction oil – 86 kl and dirty oil with sludge – 110 kl in store for the past two years
  - Disposed off through HSPCB authorized vendor
  - Stored in segregated area
- Battery cell
  - Vehicle battery cell – numbers -151 & 8257 kg
  - Dry battery cell – numbers- 419 & 11,406 kg
  - Disposed off to the manufacturer

Metal scrap:

- Primarily Iron – 1800 tons, value based segregation and storage
- Disposed off through competitive bidding

Domestic waste

- Domestic waste is collected and disposed in low lying areas and near ash pond area

The main issues faced by PTPS with regard to solid waste management include:

- The large amount of storage space occupied by coal rejects and the resulting fire hazard it poses.
- Significant storage space is occupied by stones and boulders.
- Improper storage and, poor house-keeping and handling of metal scrap.

It is recommended that:

- Exhausted rejects to be spread in railway line spacing, as a precautionary measure analyse rejects for carbon/CV content before this is initiated
- Stones, boulders to be disposed off – potential users include cement industry located close by and infrastructure development companies
- Some of the space available after disposal of rejects and boulders could be used for green belt development as CHPs are one of the major sources of fugitive emissions
- Organic waste generated at PTPS and colony could be segregated, and along with dried sludge from STPs converted into compost using windrow aerobic composting technology

Please refer to Sr. No. 7 of addendum.

4 Resource Efficiency Assessment

4.1 Introduction

Coal – the primary fuel, auxiliary power, auxiliary fuel and water are the key resources used by PTPS for power generation. Efficient use of these resources was assessed based on resource use per unit output. This chapter reviews approach adopted by PTPS for collection of data for establishing the resource efficiency parameters, historical performance of these parameters, and benchmarks against design and industry best practices. Based on the secondary data available with PTPS and energy audit carried out by M/S Evonik, energy balance was drawn to identify losses which could be minimized. This assessment is limited only to Units 3 and 4 which have been proposed for rehabilitation.

4.2 Approach adopted by PTPS and historical performance

Data on efficiency parameters such as primary fuel use (kg/KWhe), auxiliary fuel use (ml/KWhe), and auxiliary power use and unit heat rate were collected during the site visit. These parameters are presently calculated at unit level. The energy consumption for all auxiliary loads at equipment level is not monitored and maintained. Data on specific water consumption for different processes such as ash handling, etc is presently not collected. Since historical data on specific water consumption (monthly Basis) is not available, it is not covered in historical analysis.

Key assumptions made in calculation of performance include:

- Specific coal consumption is assumed to be same for both the Units 3 & 4. Coal consumption is not measured / monitored separately for each unit.
- Historical data indicate auxiliary consumption is same for Units 3 & 4; the total consumption is equally apportioned between the two units.

4.2.1 Historical Data Analysis

Annexure 4 has historical data & Annexure 5 shows variation of performance parameters over the last 10 years.

Performance highlights Unit 3:

- Specific oil consumption is the lowest in 2007-08 that is 2.42 ml/KWh.
- The auxiliary consumption 11.05 % in 2003-04 is the lowest.
- The specific coal consumption 0.813 kg/kWh in 2003-04 is the least. The plant load factor is 75.84 %.
- The station heat rate is 3418 kcal/KWh in 2008-09, which is the lowest.

Performance highlights Unit 4:

- Specific oil consumption is the lowest in 2006-07 that is 1.89 ml/KWh.
- The aux consumption is 11.05 % in 2003-04 is the least.
- The specific coal consumption 0.813 kg/kWh in 2003-04 is the lowest.
- The lowest generation is 583.59 in 2005-06. The PLF is 60.56 %. The availability factor is correspondingly low that is 72.31%. Number of days of outage is app 79 days.
- Unit has generated a maximum record generation of 78.16 MU in July 2003.

- The station heat rate is 3332 KCal/KWh in 2006-07, which is the lowest compared to previous years.

Performance Parameters of Unit-3 for the last three years is provided in the tables and graphs below.

Table 9 Unit 3-Performance during 2007-08

Month	Coal Consumption (MT)	Primary Fuel Use (Kg/Kwh)	Fuel Oil Consumption (ml/KWh)	Unit Heat Rate (UHR)	Auxiliary Power Consumption (%)	C.V. of coal Kcal/Kg	Power Generation (MU)
April-07	55,079.350	0.870	0.96	3442.59	12.18	3957	63.309
May-07	60,018.440	0.855	0.37	3346.47	12.52	3914	70.197
June-07	57,006.650	0.860	1.15	3353.14	12.42	3899	66.286
July-07	52,738.310	0.840	4.09	3332.28	12.57	3967	62.783
Aug-07	54,440.380	0.850	2.45	3320.10	12.68	3906	64.047
Sept-07	55,004.360	0.911	2.35	3578.40	12.75	3928	60.378
Oct-07	56,862.990	0.910	2.98	3524.43	12.04	3873	62.486
Nov-07	56,222.910	0.900	1.65	3580.20	11.56	3978	62.469
Dec-07	54,315.900	0.910	6.32	3557.19	11.79	3909	59.687
Jan-08	57,900.640	0.890	1.93	3508.38	11.36	3942	65.056
Feb-08	51,143.230	0.875	2.37	3473.75	11.82	3970	58.449
Mar-08	47,102.320	0.870	2.98	3444.33	11.41	3959	54.140
Average	**54,819.620**	**0.878**	**2.46**	**3455.10**	**12.08**	**3933.5**	**62.441**

Table 10 Unit 3-Performance during 2008-09

Month	Coal Consumption (MT)	Primary Fuel Use (Kg/Kwh)	Fuel Oil Consumption (ml/KWh)	Unit Heat Rate (UHR)	Auxiliary Power Consumption (%)	C.V. of coal Kcal/Kg	Power Generation (MU)
April-08	59418.477	0.865	1.77	3514.80	11.51	4040	68.297
May-08	58734.823	0.870	1.70	3404.61	11.58	3982	68.695
June-08	46203.414	0.900	3.37	3298.10	11.92	3835	53.724
July-08	51227.820	0.880	1.91	3287.76	11.78	3914	60.985
Aug-08	51513.230	0.865	1.39	3401.70	11.91	4002	60.603
Sept-08	46470.747	0.870	5.67	3539.23	12.00	3885	51.010
Oct-08	42135.912	0.860	2.37	3650.01	11.22	4011	46.303
Nov-08	5805.000	0.870	36.56	3501.00	11.13	3890	6.450
Dec-08	57232.630	0.885	3.12	3468.92	11.25	3812	62.893
Jan-09	52845.530	0.885	2.41	3372.21	11.26	3789	59.377
Feb-09	49365.750	0.870	1.16	3282.12	11.25	3751	56.418
Mar-09	54569.760	0.840	1.26	3202.92	11.30	3813	64.964
Average	**47960.257**	**0.871**	**5.22**	**3410.28**	**11.50**	**3893.66**	**54.976**

Table 11 Unit 3-Performance during 2009-10

Month	Coal Consumption (MT)	Primary Fuel Use (Kg/Kwh)	Fuel Oil Consumption (ml/KWh)	Unit Heat Rate (UHR) Kcal/Kwh	Auxiliary Power Consumption (%)	C.V. of coal Kcal/Kg	Power Generation (MU)
April-09	56988.514	0.830	1.55	3222.883	10.51	3883	68.6610
May-09	52229.184	0.840	2.53	3236.180	11.91	3852	62.1680
June-09	55564.218	0.834	0.75	3248.359	11.65	3893	66.5910
July-09	52871.395	0.833	3.39	3211.323	12.45	3853	63.4360
Aug-09	50114.594	0.844	1.77	3220.272	12.42	3817	59.4010
Sept-09	40793.660	0.864	8.99	3218.825	13.60	3727	47.2340
Oct-09	50442.319	0.873	1.69	3229.866	12.47	3699	57.7690
Nov-09	31410.516	0.873	2.17	3256.080	13.81	3728	35.9630
Dec-09	12938.926	0.864	18.54	3291.739	18.82	3811	14.9800
Jan-10	Shutdown						
Feb-10							
Mar-10							
Average	**44817.036**	**0.850**	**8.27**	**3237.281**	**13.07**	**3807**	**52.9114**

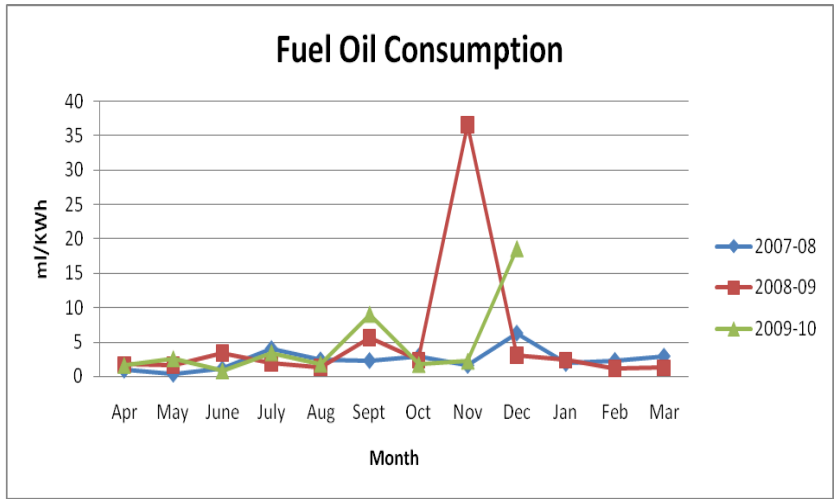


Figure 4 Primary Fuel Use Pattern for the Year 2007-08

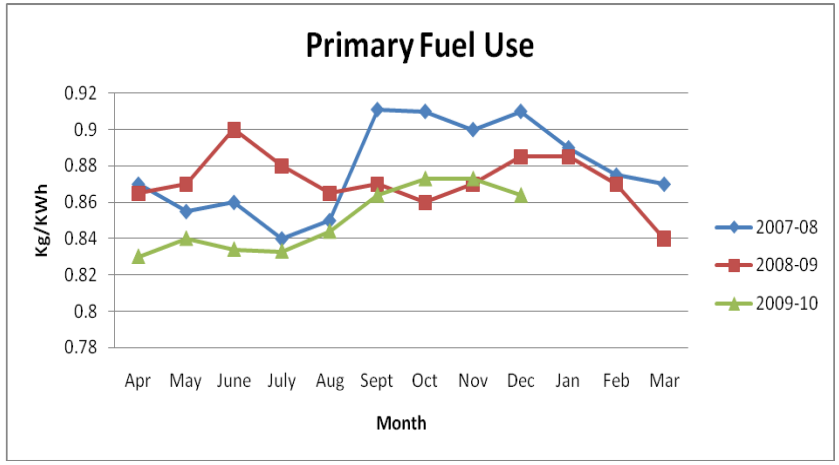


Figure 5 Fuel Oil Consumption Pattern for the Year 2007-08

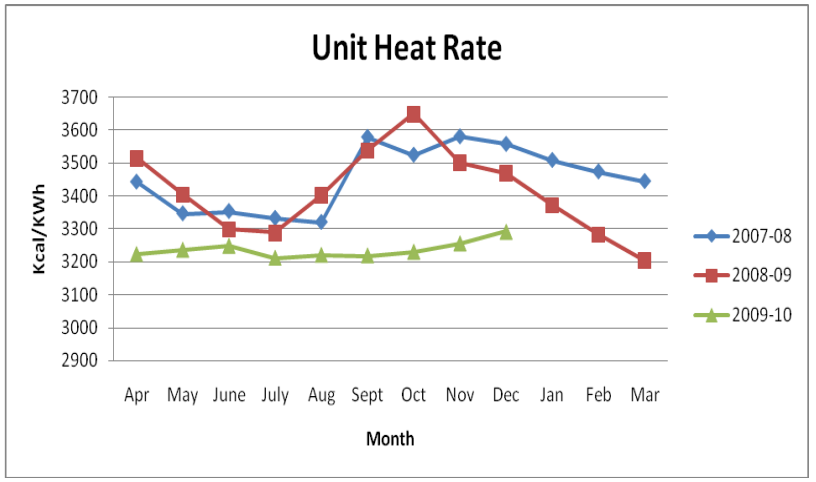


Figure 6 Unit Heat Rate Pattern for the Year 2007-08

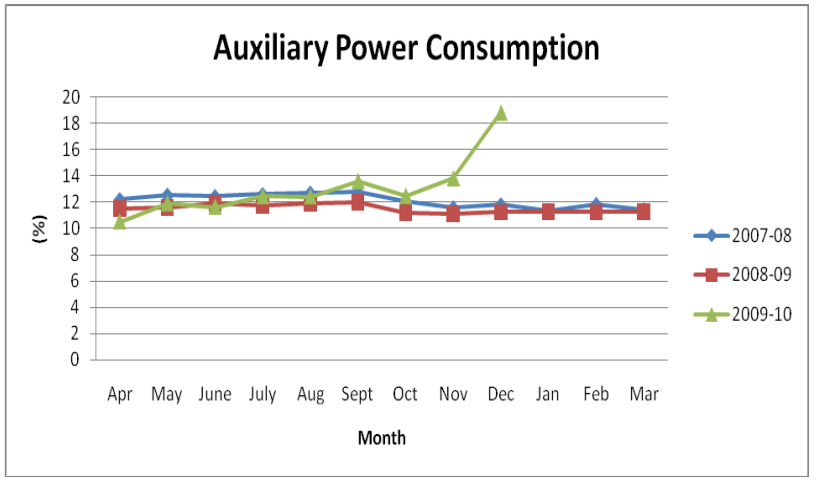


Figure 7 Auxiliary Consumption Pattern for the Year 2007-08

Analysis of the performance of Unit -3 (2007-08)

- Specific oil consumption is the lowest in 2007-08 that is 2.42 ml/kwh.
- The average coal consumption is 0.850 kg/KWh, which is higher due to lower calorific value Coal i.e. GCV is 3765 Kcal/Kg.
- Considering all the months of operation, average auxiliary consumption is 13.07 %. This is higher than the average consumption rate of 9 % for 120 MW as given by CEA.
- Unit heat rate is estimated using coal consumption, power generated and calorific value of coal; unit heat rate for this year is 3224 Kcal/Kwh which is higher than CEA target value 2747 Kcal/Kwh.
- Average auxiliary fuel use is 4.59 ml/kwh, which is higher compared to specific fuel consumption 2.0 ml/Kwh as per the CEA CO2 Baseline Database and also higher than all India average 1.47 ml/kwh.
- The Unit has achieved least fuel oil consumption 0.75 ml/KWh in June-2009.

Analysis of the Performance of Unit -3 (2008-09)

- Average specific coal consumption for the year 0.876 Kg/Kwh, which is higher than All India specific coal consumption 0.743 kg/kWh
- Average auxiliary consumption is 11.48 %. This is higher than the average consumption rate of 9 % recommended by CEA for Units of 120 MW capacity
- Fuel Oil consumption is 2.64 ml/kWh which is higher compared to specific fuel consumption 2.0 ml/kwh as per the CEA CO2 Baseline Database and also higher than all India average 1.47 ml/kwh.
- Plant Load Factor 68.46 % compared to all India average 77.22 %.

Analysis of the Performance of Unit -3 (2009-10)

- The average coal consumption is 0.850 kg/KWh, which is higher due to lower calorific value Coal i.e. GCV is 3765 Kcal/Kg.
- Considering all the months of operation, average auxiliary consumption is 13.07 %. This is higher than the average consumption rate of 9 % considered for 120 MW by CEA.
- Unit heat rate is 3224 which is higher than CEA's 2747 Kcal/Kwh.
- Average auxiliary fuel use is 4.59 is which is higher compared to specific fuel consumption 2.0 ml/Kwh as per the CEA CO2 Baseline Database and also higher than all India average 1.47 ml/kwh.
- The Plant has achieved least fuel oil consumption 0.75 ml/KWh in June-2009.

Performance Parameters of Unit-4 is provided below:

Table 12 Unit 4-Performance during 2007-08

Month	Coal Consumption (MT)	Primary Fuel Use (Kg/Kwh)	Fuel Oil Consumption (ml/KWh)	Unit Heat Rate (UHR)	Auxiliary Power Consumption (%)	C.V. of coal Kcal/Kg	Power Generation (MU)
April-07	52156.500	0.870	1.16	3442.59	12.18	3957	59.95
May-07	44203.500	0.855	2.13	3346.47	12.52	3914	51.70
June-07	48504.000	0.860	1.16	3353.14	12.42	3899	56.40
July-07	48661.200	0.840	1.51	3332.28	12.57	3967	57.93
Aug-07	46971.000	0.850	1.38	3320.10	12.68	3906	55.26
Sept-07	54669.100	0.911	1.07	3578.40	12.75	3928	60.01
Oct-07	50878.100	0.910	6.75	3524.43	12.04	3873	55.91
Nov-07	48582.000	0.900	4.55	3580.20	11.56	3978	53.98
Dec-07	41723.500	0.910	4.01	3557.19	11.79	3909	45.85
Jan-08	56159.000	0.890	1.77	3508.38	11.36	3942	63.10
Feb-08	46095.000	0.875	2.91	3473.75	11.82	3970	52.68
Mar-08	33486.300	0.870	3.51	3444.33	11.41	3959	38.49
Avge	47674.100	0.878	2.65	3455.10	12.09	3933.5	62.44

Table 13 Unit 4-Performance during 2008-10

Month	Coal Consumption (MT)	Primary Fuel Use (Kg/Kwh)	Fuel Oil Consumption (ml/KWh)	Unit Heat Rate (UHR)	Auxiliary Power Consumption (%)	C.V. of coal Kcal/Kg	Power Generation (MU)
April-08	0	0	0	--	0	4040	0
May-08	0	0	0	--	0	3982	0
June-08	20902.386	0.86	11.32	3298.100	11.92	3835	24.305
July-08	57005.760	0.84	2.06	3287.760	11.78	3914	67.864
Aug-08	56185.000	0.85	1.76	3401.700	11.91	4002	66.100
Sept-08	51699.250	0.91	1.92	3539.235	12.00	3885	56.750
Oct-08	52657.150	0.91	2.83	3650.010	11.22	4011	57.865
Nov-08	59786.100	0.90	1.33	3501.000	11.13	3890	66.429
Dec-08	54034.890	0.91	3.09	3468.920	11.25	3812	59.379
Jan-09	56380.610	0.89	1.51	3372.210	11.26	3789	63.349
Feb-09	50841.875	0.88	0.71	3282.125	11.25	3751	58.105
Mar-09	53443.320	0.84	1.40	3202.920	11.30	3813	63.623
Avge	51293.634	0.878	2.793	3400.398	11.502	3893.667	58.376

Table 14 Unit 4-Performance during 2009-10

Month	Coal Consumption (MT)	Primary Fuel Use (Kg/Kwh)	Fuel Oil Consumption (ml/KWh)	Unit Heat Rate (UHR)	Auxiliary Power Consumption (%)	C.V. of coal Kcal/Kg	Power Generation (MU)
April-09	53338.181	0.830	0.68	3222.88	10.51	3883	64.263
May-09	51594.490	0.869	1.98	3345.71	12.02	3852	59.402
June-09	55978.344	0.863	0.55	3358.30	11.23	3893	64.891
July-09	52838.455	0.862	1.70	3320.01	12.11	3853	61.321
Aug-09	50098.610	0.872	1.95	3329.26	12.49	3817	57.438
Sept-09	40006.452	0.893	9.39	3327.76	13.57	3727	44.806
Oct-09	29235.695	0.903	6.77	3339.18	14.39	3699	32.386
Nov-09	47590.321	0.903	3.76	3366.28	11.22	3728	52.704
Dec-09	65140.303	0.893	1.11	3403.15	10.21	3811	72.947
Jan-10	53965.029	0.895	3.39	3459.11	12.29	3863	60.266
Feb-10	53905.168	0.866	0.73	3300.42	11.86	3810	62.228
Mar-09	NA	NA	NA	NA	NA	NA	NA
Avge	50335.549	0.877	2.91	3342.91	11.99	3812.36	57.513

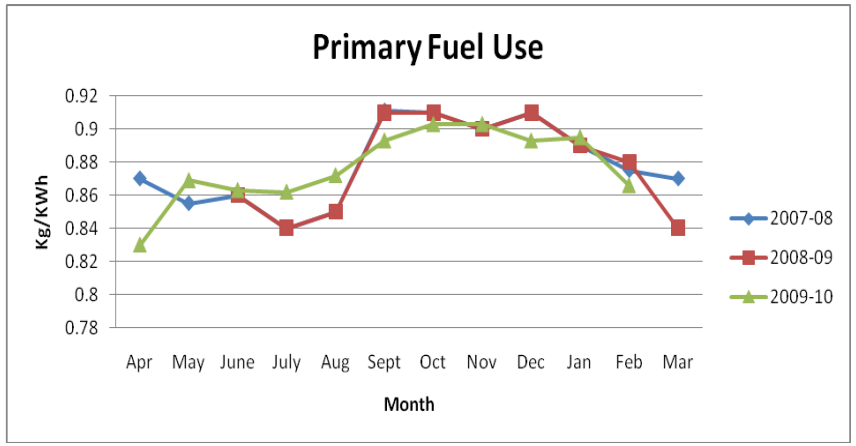


Figure 8 Primary Fuel Use Pattern for last 3 Years

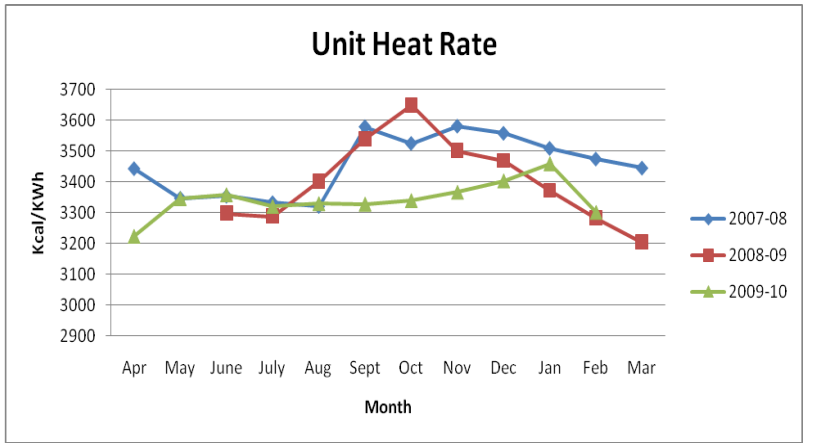


Figure 10 Unit Heat Rate Pattern for last 3 Years

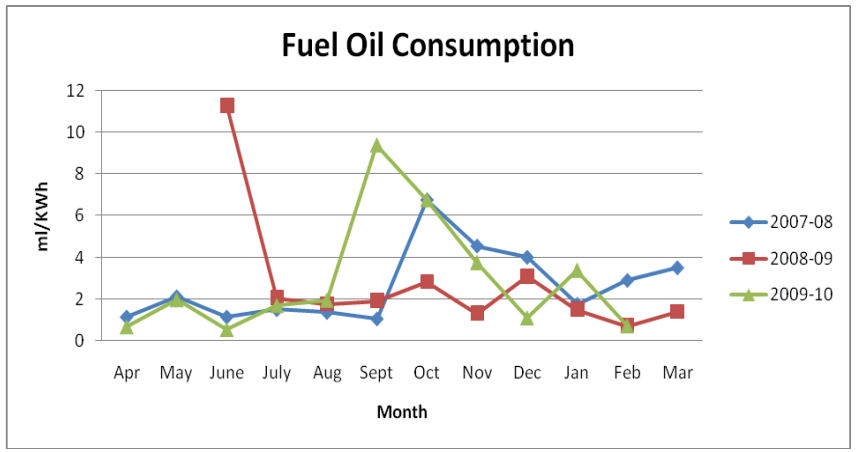


Figure 9 Fuel Oil Consumption for last 3 Years

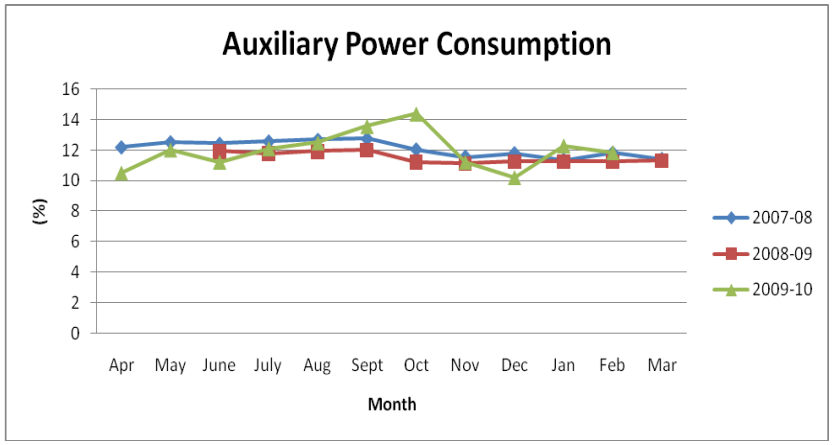


Figure 11 Auxiliary Power Consumption Pattern for last 3 Years

Analysis of the Performance of Unit -4 (2007-08)

- Average specific coal consumption for the year 0.88 Kg/KWh, which is higher than all India specific coal consumption 0.731 kg/kWh
- Average auxiliary consumption is 12.13 %. This is higher than the average consumption rate of 9 % considered for 120 MW as given by CEA & also higher than all India Avge of 8.17 %.
- Specific fuel consumption for unit 4 is 2.58 ml/KWh.
- Plant Load Factor remained 67.40 % compared to all India avarage 78.75 %.
- Net heat rate is 3410.28 which is higher than CEA's general assumptions for new units which is 2747 Kcal/KWh

Analysis of the Performance of Unit -4 (2008-09)

- Average specific coal consumption for the year 0.878 Kg/Kwh, which is higher than All India specific coal consumption 0.743 kg/kWh
- Average Auxiliary consumption is 11.48 %. This is higher than the average consumption rate of 9 % considered for 120 MW by CEA & which is also higher compared to all India average 8.32 %.
- Fuel oil consumption for unit 4 is 2.36 ml/kWh which is higher compared to specific fuel consumption 2.0 ml/Kwh as per the CEA CO2 Baseline Database and also higher than all India average 1.47 ml/kwh.
- Plant Load Factor 60.56 % compared to all India average 77.22 %
- Net heat rate was 3400.48 Kcal/KWh which is higher than CEA's general assumptions for new units which is 2747 Kcal / KWh.

Analysis of the Performance of Unit -4 (2009-10) As per Table-16 & Figures (8 to 11)

- The average coal consumption is 0.877 kg/KWh, which is higher due to lower calorific value Coal i.e. GCV is 3765 Kcal/Kg.
- Considering all the months of operation, average auxiliary consumption is 11.99 %. This is higher than the average consumption rate of 9 % considered for 120 MW as given by CEA.
- Unit heat rate is 3336.54 which is higher than CEA's 2747 Kcal/Kwh.
- Average auxiliary fuel use is 2.91 ml/Kwh which is higher compared to specific fuel consumption 2.0 ml/Kwh as per the CEA CO2 Baseline Database and also higher than all India average 1.47 ml/kwh.
- Average DM Water Consumption for Unit -4 During 31st Jan-10 to 11th March-2010 is 339.14 MT
- The Plant has achieved least fuel oil consumption 0.55 ml/KWh in June-2009.

4.3 Benchmarking

CEA has carried out Energy Efficiency study in Thermal Power Plants in India in 2007-08 & 2008-09. The specific consumption, Unit Heat Rate and Auxiliary consumption of Unit –3 and Unit -4 are compared with the industry best benchmarking figures provided by CEA's study.

Sources used for Benchmarking:

- CO2 Baseline Database for the Indian Power Sector User Guide Version 5.0 November-2009, Government of India, Ministry of Power, Central Electricity Authority.
- Review of Performance of Thermal Power Plants (2007-08 & 2008-09), Ministry of Power Govt. of India.

Table 15 Benchmarking PTPS's Performance Parameters with All India Average

Description	Average parameter of all Indian power plants (2007-08)	Average parameter of all Indian power plants (2008-09)	Performance of PTPS (Unit-3)		Performance of PTPS (Unit-4)	
			2007-08	2008-09	2007-08	2008-09
Specific coal consumption in kg/kWh	NA*	NA*	0.850	0.876	0.88	0.878
Specific fuel oil consumption in ml/kWh	1.47	1.93	2.42	2.64	2.58	2.36
Unit Heat Rate Kcal/KWh	2747	2747	3455.10	3410.28	3455.106	3400.39
Auxiliary consumption %	8.17	8.32	12.13	11.48	12.13	11.48

NA* - Benchmark figures not avilable

4.4 Energy Balance

A separate energy audit was carried out for Units 1 to 6 in April 2010. PTPS provided relevant additional information based on which efficiency parameters were analysed and energy balance was drawn. The detailed energy balance covering different processes of power production is shown in the schematic below. Present overall efficiency of generation is around 39%.

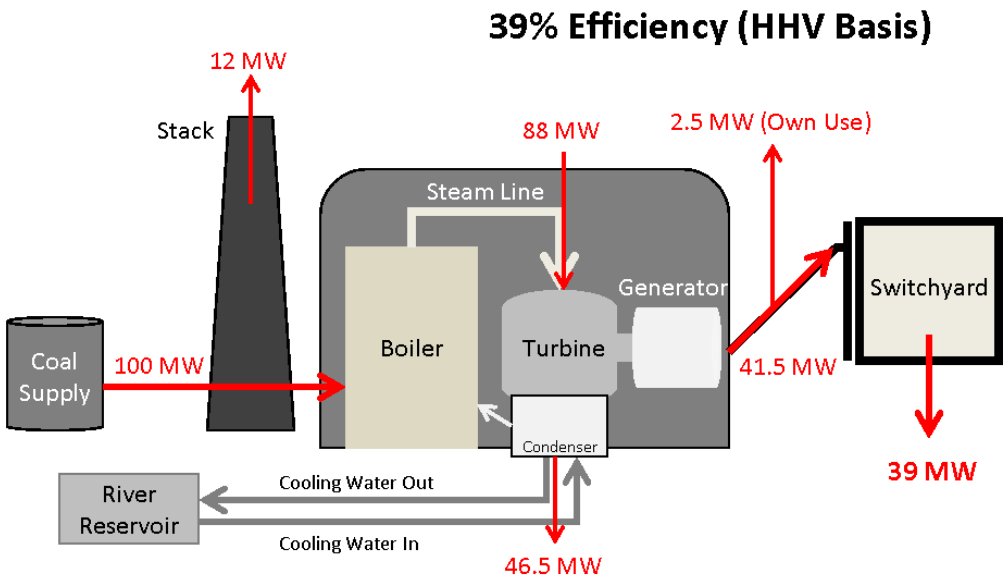


Figure Energy balance schematic for Unit 3 and 4

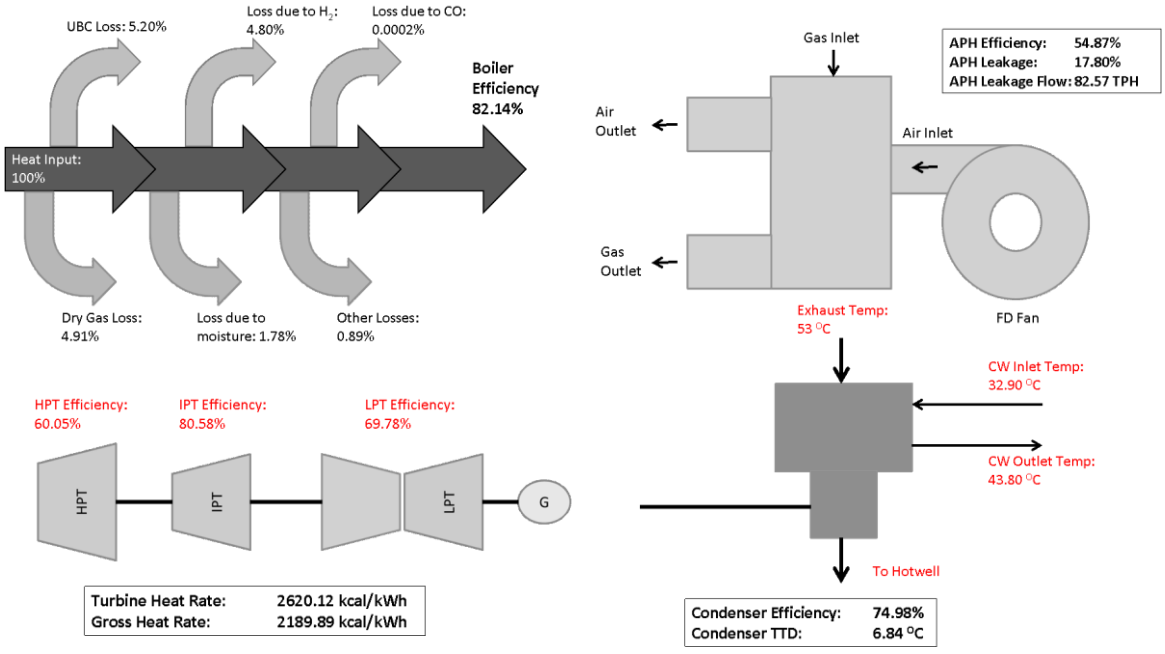


Figure Efficiency and losses in key power generation processes

Table below shows present energy performance of different processes and equipments assessed against respective design parameters.

Component	Design	Losses/Energy Consumption	Performance	Losses/Energy Consumption	Performance
Boiler					
Boiler Efficiency	87.5 % - Unit 3 85.21 % - Unit 4	17.87 %	82.10 %	17.86 %	82.14 %
Dry Gas Loss		5.49 %	---	5.20 %	---
Hydrogen In Fuel Loss		4.85 %	---	4.80 %	---
Loss Due to Unburnt Carbon		5.17 %	---	5.20 %	---
Other Losses		2.37 %	---	3.00 %	---
Air Preheater					
Air Preheater Efficiency	85%	---	38.05 %	---	54.93 %
Air Preheater Leakages		24.38 %	---	15.95 %	---
PA Fans					
PA Fan A	75%	719.00 KW	51.05 %	714.00 KW	58.62 %
PA Fan B	75%	717.46 KW	51.84 %	709.00 KW	56.08 %
FD Fans					
FD Fan A	78%	132.44 KW	60.77 %	137.44 KW	62.97 %
FD Fan B	78%	140.75 KW	53.47 %	139.48 KW	61.80 %
ID Fans					
ID fan A	82%	457.21 KW	67.80 %	577.21 KW	59.94 %
ID Fan B	82%	520.21 KW	65.96 %	570.21 KW	62.81 %
ID Fan C	82%	451.21 KW	67.04 %	561.21 KW	59.78 %
Turbine					
HPT efficiency	83%	---	62.11 %	---	64.00 %
IPT Efficiency	88%	---	84.36 %	---	80.58 %
LPT Efficiency	82%	---	67.35 %	---	69.78 %
Turbine Heat rate	2080.00 Kcal/kWh	---	2687.96 Kcal/kWh	---	2700.01 Kcal/kWh
Gross Heat rate	2377.14 Kcal/kWh	---	3274.01 Kcal/kWh	---	3287.15 Kcal/kWh
Condenser					
Condenser Efficiency	87	---	76.05 %	---	74.98 %
Condenser TTD	5.00 K	---	5.03 K	---	6.84 K
Boiler Feed Pump					
BFP A	82%	2588 KW	67.09 %	3018.36 KW	70.66 %
BFP B	82%	2599 KW	63.75 %	2999.98 KW	66.93 %
Condensate Ext Pump					
CEP A	79%	189.52 KW	48.53 %	188.40 KW	55.30 %
CEP B	79%	187.95 KW	47.20 %	185.41 KW	55.22 %
CEP C	79%	191.15 KW	48.01 %	190.00 KW	56.14 %
CW Pumps					
CW Pump A		720.17 KW	69.46 %	695.02 KW	58.86 %
CW Pump A		737.44 KW	67.75 %	677.64 KW	57.81 %
Cooling Tower		---	63.84 %	---	51.76 %

Issues:

- Boilers are presently operating at an efficiency of around 82 % against the design efficiency of 87%. An important operational deviation is that the calorific value of coal currently used is 3799 Kcal/Kg against the design value of 3850 Kcal/Kg. Dry gas losses and unburnt carbon could also be contributing to reduction in efficiency.
- Air preheater is currently operating at an efficiency of 38.05 % against the design 85 %. Heavy air leakages in the basket might be contributing to the energy loss and decrease in efficiency of air preheaters.

4.5 Recommendations:

- Operating the coal mill at 90% of the rated capacity might produce better fineness; regular monitoring of mill fineness and corrective actions might improve combustion
- The quantity of primary air and secondary air needs to be monitored. Primary air control should be maintained to get better combustion and flame control. Secondary air control needs to be introduced. Improved combustion control can increase the efficiency by 0.84%
- Stopping the steam leakages can improve the efficiency by 1.1 %.
- Minimizing the boiler tram air can lead to 0.42 % improvement in efficiency.
- By maintaining the required secondary air, the exit flue gas temperature and dry gas losses can be reduced.
- Options to increase air preheater efficiency to be assessed and implemented – which might be retrofitting extra surface area in the air preheater, retrofitting with modified design of baskets
- It is recommended to install online monitoring system with integration of sub-meters at equipment level to monitor auxiliary power consumption

5 Occupational Health and Safety Assessment

5.1 Introduction

This chapter reviews the existing status of Occupational Health and Safety (OHS) provisions at PTPS against statutory requirements. The review takes into consideration the adequacy of the safety provisions, their operation and maintenance.
The gap analysis has been based on a site visit, field observations, discussions with management and secondary data collected from PTPS. Based on the analysis certain recommendations have been made with the aim of improving the OHS system at PTPS.

5.2 Statutory requirements

The main OHS Laws applicable to PTPS include the following:

- The Factories Act, 1948;
- The Electricity Act, 2003;
- The Building and Other Construction Workers Act, 1996 and rules made thereunder; and
- Central Electricity Authority (CEA) (Safety requirements for construction, operation and maintenance of electrical plants and electric lines) Regulations, 2008 – DRAFT (hereinafter referred to as CEA draft regulations).

Additionally, PTPS is required to adhere to provisions made under other acts / rules / regulations listed under section 5 of the CEA draft regulations, 2008 (see Annexure 6).

The statutory requirements regarding OHS framed under the above-mentioned acts / rules / regulations (where applicable) have been reviewed against the existing status of safety provisions at PTPS.

The plant was granted the Factory License with validity until December 2008. PTPS has now applied for renewal (see Annexure 7).

5.3 Gap Analysis and Recommendations

5.3.1 Safety Manual and Education

The CEA draft regulations states that the Owner as part of setting a *'sound and scientific safety management system'* should include a site-specific Safety Manual. This manual should comply with the statutory requirements, manufacturers' recommendations, BIS standards and any other relevant standards and codes.

The details of the matters to be covered by the Safety Manual are given in the CEA draft regulations' Schedule-I: Minimum contents of Safety Manual for Construction of Electrical Plants and Electric Lines and Schedule-II: Minimum contents of Safety Manual for Operation and Maintenance of Electrical Plants and Electric Lines (see Annexure 6).

During the site visit to PTPS it was observed that no Safety Manual was available. PTPS has provided some information on issues of safety albeit in an adhoc manner.

PTPS has a 'Quality, Environment, Health and Safety Policy' (see Annexure 8) which is displayed only in the main administration building. The policy is written in English which is not easily understood by most employees.

A Safety Booklet has been published by the safety department, which provides a brief description of certain safety instructions, including the following:

- Safety instructions for electricians and is use of electricity;
- Fire – types, methods to prevention and fire control;
- Instructions in handling / use of Chlorine;
- First-aid instructions;
- Safety instructions for crane operator;
- Instructions in use of Hydrogen; and
- Safety Tags.

The safety department has also held a seminar for its employees in 2009, providing information on the following key areas in safety:

- Disaster Management,
- Electrical Safety,
- Fire Prevention, and
- Accident Prevention.

However, there is no record of the number of attendees to the seminar and no programme of conducting the seminar at regular intervals. During the site visit it was observed that a few safety posters were displayed in some of the main buildings and a few sign boards were scattered around the plant.

Although the policy, booklet and seminar have touched upon certain critical subjects, they do not appear to be comprehensive enough.

It is recommended that PTPS prioritise the development of a comprehensive Safety Manual which adheres to the standards prescribed by the draft regulations. As far as possible all important safety information should be translated into the local language. It also imperative that the safety department introduced a more comprehensive safety programme as recommended by the Safety Audit report which covers all training, education and promotion aspects.

5.3.2 Standard Operating Procedures

As mentioned above CEA draft regulations PTPS is required to prepare a detailed Safety Manual, from which each division head should prepare standard operating procedures for the reference of on-site employees.

The standard operating procedures should contain procedures for obtaining permission for operations and maintenance of equipment and safety in operation and maintenance of various electro-mechanical equipments as per recommendations of manufacturers.

During the site visit no such standard operating procedures were displayed or made available. It is therefore, suggested that PTPS prepare division-specific standard operating procedures.

5.3.3 Onsite Emergency Management Plan

The CEA draft regulations state that each Electrical Plant is required to formulate an on-site emergency management plan for quickly and effectively dealing with probably emergencies like fire, explosion, gas leakages, landslides, floods etc and reducing response time.

A mock drill of the on-site emergency management plan should be conducted at least once every six months. PTPS is also required to furnish details as listed is section 11 of the CEA draft regulations (see Annexure 6) to the District Emergency Authority for the off-site emergency management plant.
The details of the contents of the plan are provided in Schedule-III of the CEA draft regulations, 2008 (see Annexure 6).

The PTPS' emergency management plan covers only the following of all points listed in the Schedule-III of the draft regulations:

- Specific to Thermal Generating Stations:
    - (b) Toxic gas dispersion caused by uncontrolled chlorine toner leakage
- On-site Emergency Management Plan shall include the following:
    - (b) Alarm System and method of Reporting/ declaring emergency
    - (d) Details of the key personnel of the emergency team and their responsibilities
    - (f) Risk assessment information giving possible nature of incidents/events giving rise to emergency conditions, risk analysis and impact assessment (a separate risk assessment study has been carried out by PTPS)
    - (g) Details about the site:
        - (i) Locations where emergency can arise
        - (ii) Emergency control room/Alternate Emergency Control Room
        - (iii) Demarcation of safe assembly zone relevant to each type of emergency condition
    - (h) Description of hazardous chemicals and fuels at plant site:
        - (i) Chemicals (Quantities and toxicological data)
        - (iii) Material Safety Data Sheets
    - (i) Internal and external communication plan during emergency
    - (j) Details of fire fighting and other facilities available to deal with emergency conditions
    - (k) Details of first aid and hospital services available and their adequacy

There is no indication of the date of publishing on the document and no record of any revisions or updates made to the plan. In addition, no record of mock drills of emergency plan was made available. The Safety Audit report's comments on PTPS' emergency procedure mention the same points.

On assessing the onsite emergency plan prepared by PTPS against requirements stipulated in the CEA draft regulations it is judged to be inadequate and incomplete. PTPS should aim to revise / update the plan immediately to address the gaps.

5.3.4 Accident Reporting, Investigation and Analysis

Section 10 of the CEA draft regulations specifies situations under which accidents need to be reported to the statutory authority within a given time (see Annexure 6). The procedure does detail the information that needs to be recorded and reported.

At PTPS fatal and non-fatal accidents are recorded including the following details (see Annexure 9):

- Name of injured person,
- Date of accident or dangerous occurrence,
- Date of report in Form No. 18 to Inspector,
- Nature of accident or dangerous occurrence, and
- No. of days injured person was absent from work.

For fatal accidents details are filed along with Form 18 which is submitted to the Inspector. The file contains:

- Case study brief
- Written communication to the Chief Safety Officer from concerned authority (where accident has occurred)
- First Information Report
- Post-mortem report
- Sub-division communication
- Location plan of accident
- Form 18

Minor injuries and near-misses are not recorded or reported by PTPS.

On reviewing PTPS' accidents register for the last 14 years (1995-2009) it was found that there were 34 fatalities. In that period 27 fatal accidents occurred between 1999 and 2005. The reason for this period of high incidence was unascertained as information on the details of these fatalities was not available for review. In comparison, Koradi Thermal Power Station in Maharashtra has recorded a total of 4 fatalities between 2002 and 2006.

PTPS has not carried out any analysis of the accidents recorded to gain an understanding on causes, frequency rate, severity rate, incidence rate and man days worked / lost.

It is recommended that this analysis is carried out at the earliest to better focus the safety interventions and improve safety performance standards of the plant.

5.3.5 Rotation of Work and Minimisation of Exposure

Exposure based classification of work is not carried out in PTPS.

5.3.6 Safety Officer

As per CEA draft regulations, PTPS is required to have one Chief Safety Officer and three other Safety Officers for its 3,742 employees. The appointed officers should be qualified as given under Section 40-B of the Factories Act, 1948 and rules made there under (see Annexure 10). The act also specifies that duties and responsibilities of the officers.

PTPS currently has one appointed Chief Safety Officer and a J.E. who functions as Safety Officer / Assistant Safety Officer (but not appointed). The qualifications and job specifications of the two officers were not available for review.

Discussions with the Safety Officer revealed that this shortage in staff has caused an overburden in responsibilities and duties to be performed, resulting in inadequate implementation.
For an efficient safety department, PTPS should expedite the appointment of the required number of qualified safety officers with clearly specified roles and responsibilities. The officers should also be provided with facilities as per statutory requirements in order for them to perform their duties effectively.

5.3.7 Safety Committee

Statutory requirements state that the Safety Committee should be constituted by equal number of representatives of management and employees to promote co-operation for maintaining proper safety and health at work. The committee is required to meet at least once in three months during the operation and maintenance of the plant (see Annexure 6).

The Safety Committee at PTPS is constituted of 23 members from various departments and includes three presidents of workers unions and one member from the Forman association. The list of members does not clearly indicate an equal number of management and employees on the committee (see Annexure 11).

No record of Safety Committee meetings being held at regular intervals was available for review. One of the Committee's meeting minutes held on 14.10.09 was reviewed, wherein the issue of poor attendance of members was discussed.

PTPS should consider increasing the number of employees on the Committee to equal the number of management members. A record of meetings should be maintained to review whether the decisions and recommendations of the Committee are being complied with.

5.3.8 Personal Protective Equipment

The Directorate General Factories Advisory Services and Labour Institutes (DGFASLI) states that Personal Protective Equipment (PPE) plays an important role in safe-guarding the health of the industrial workers from various occupational diseases provided they meet the requirements of the specified standard of BIS.

The use of PPE by the employees in factories under different situations, are stated as statutory provisions made under Sections 35 and 36 of the Factories Act, 1948. Rule 80 and 81 of Model Rules under the Factories Act, 1948 (corrected up to 31.3.1987), Government of India, prescribes the use of various PPE (see Annexure 12). The BIS Standard advises user industries on the following aspects:

- Type of PPE;
- Quality and performance;
- Workers' views/suggestions towards the acceptability/suitability of PPE;
- Managements' views; and
- Awareness to proper selection, use, care and maintenance of PPE.

The Bureau of Indian Standards (BIS) has brought out many standards on Personal Protective Equipment for protection of eyes, face, ears, feet, legs, hand, head, etc. in addition to guidelines for selection and use of such equipment.

PTPS does not have any detailed manual / procedure on PPE. During the field visit it was found that only few employees used certain PPE such as hard-hats, steel-capped boots, masks (but not of the prescribed standards), ear muffs, ear plugs, gloves and goggles. Overall the use and management of PPE at PTPS was found to be lacking and inadequate in accordance with stipulated standards. The Safety Audit report has based its recommendations on similar findings.

PTPS will need to develop a comprehensive PPE system as per rules stated in the Factories Act. It is also recommended that CE / SE officers of each division develop division-specific list of appropriate PPE (as prescribed by BIS) required and a manual on its usage, maintenance and storage. It is imperative that employees are provided adequate equipment and training. PTPS should also aim to understand and implement measures against non-adherence to use of PPE.

5.3.9 Medical Facilities

The CEA draft regulations, 2008 states the following:

> *'The Owner shall provide medical facilities:*
>
> *a) to prevent and control occupational diseases*
>
> *b) to prevent and reduce disability*
>
> *c) to provide immediate relief to accident victims*
>
> *An Occupational Health Centre with the services and facilities as per scale laid down [...] shall be provided for all electrical plants and electric lines and maintained in good order [...]'*

Details of the Occupational Health Centre and additional medical / first-aid requirements as stipulated within the draft regulations and rules on first-aid appliances and ambulance room stated with the Factories Act, 1948, are provided in Annexure 13.

The onsite emergency plan states that PTPS Dispensary located in the PTPS Colony (500m from the main entrance of the plant) is the main provision of medical services available for its employees. The document lists the following facilities available at the dispensary:

- Ambulance – 2
- Bed Capacity – 2
- Doctors – 2
- Other Medical Staff – 17

The emergency plan also states that first aid boxes are available in all control rooms and divisions. A large number of employees across all divisions in the plant have been trained by the Red Cross Society in first aid.

However, the Safety Audit report observes that there is insufficient provision of first-aid boxes is all departments.

The regulations also require the plant to be equipped with an ambulance room as well as an Occupational Health Centre that employs one full-time Medical Officer for 500 employees and one more Medical Officer for every additional 1,000 employees. As on 2008 for the 3,742 employees at PTPS there are only 2 doctors available. The Safety Audit report also notes that appointed Medical Officer does not possess the required Certificate of training in Industrial Health.

Periodic health check-up for workers
As per CEA draft regulations PTPS is required to put in place a programme of periodic medical check-up for its employees. The frequency of check-ups varies based on the type of tests needed to be carried out (see Annexure 6). Based on discussion with the Chief Medical Officer at PTPS it is understood that the pre-employment physical fitness test is being carried out and a few health camps have been held at the plant. However, records of any tests or camps were not available.
In appraising the existing facilities against requirements stipulated by the draft regulations and the Factories Act, PTPS is found to be lacking in its provision of adequate medical facilities to its employees.

PTPS should improve its provision of medical facilities by meeting the requirements stated within the rules and regulations. The plant will need to appoint additional doctors with necessary qualifications and certificates.

5.3.10 Fire Fighting System

Section 38 'Precautions in case of fire' of the Factories Act, 1948 (see Annexure 14) encapsulates the statutory compliance requirements in case of fire for PTPS. The statute consists of four clauses of which the first two essential ones are stated below:

'(1) In every factory, all practicable measures shall be taken to prevent outbreak of fire and its spread, both internally and externally, and to provide and maintain -

- *safe means of escape for all persons in the event of fire, and*
- *the necessary equipment and facilities for extinguishing fire.*

(2) Effective measures shall be taken to ensure that in every factory all the workers are familiar with the means of escape in case of fire and have been adequately trained in the routine to be followed in such cases.[...]'

The above statute is supplemented with Module Rule 68 – Fire Protection framed under the Factories Act. This rule (see Annexure 14) details the provisions for the fire fighting system, which PTPS is required to adhere to.

The existing fire fighting system at PTPS is the responsibility of the Fire Department which falls under the Chief Safety Officer's purview. The fire department is currently headed by a J.E. and has around 81-85 employees in total. Employees are recruited to the department via the staff selection board at the Haryana Government, who are provided with the job specifications according to the department's requirements.

The Fire Department is responsible for providing training and instructions to all other departments within the plant regarding fire fighting. The department's responsibility also includes the operation and maintenance of all fire fighting equipment. This is with the exception of the fire hydrant system installed at the PTPS which is maintained by each department[3] and only the operation of the system is the responsibility of the fire department.

The existing fire fighting equipment and vehicles available at PTPS is provided in the table below:

Table 16 List of fire fighting equipment at PTPS

Fire Fighting Equipment	Number
Trailer Fire Pump	3
Long Range Foam Monitor	2
Exhaust Blower	2
Breathing Apparatus Set	13
Submersible Pump	1
Aluminised Suit	2
Fire Entry Shoes	2
Fire Protection Ladder	1
Fire Proof Blanket	4
Foam CO2 Fire Tender	4
DCP Fire Tender	1
Bullet Motorcycle	1

Source: PTPS

[3] This order was passed by the CE O&M in 2005.

In addition to the above equipment, PTPS also possess 1,597 fire extinguishers of which the plant maintains a location-wise record of their maintenance (see Annexure 15). The list and details of extinguishers are given in the table below:

Table 17 Details of fire extinguishers at PTPS

Fire Extinguisher Type	Capacity	Number
Foam	10	274
Foam	45	2
DCP	10	230
DCP	22.5	47
DCP Trolley	300	7
DCP (SGP)	10	262
Water fire extinguisher	-	25
Water CO_2 (SGP)	9 liter	30
Water CO_2 (SGP)		15
CO_2	45	9
CO_2	22.5	95
CO_2	9	5
CO_2	6.8	194
CO_2	5	11
CO_2	4.5	179
CO_2	3.8	72
AFFF	9 liter	115
AFFF		25

Source: PTPS

PTPS also maintains a record of all fire calls which includes details such as date, time of call, messenger designation, area, vehicle number, material used to extinguish fire and back time (see Annexure 16). A detailed report of incident is recorded separately, which was not available for review.

Discussions with the JE in-charge of the fire fighting department regarding the existing status and shortfalls of the system revealed that the main issue faced by the department is inadequacy of equipment to deal with fire emergencies.

It is recommended that the PTPS gives prominence to improving the adequacy of the fire fighting system at the plant. This would require a thorough inspection of equipment quality, availability and maintenance. The Safety Audit report's recommendations also focus on improving the adequacy of the protection system with particular emphasis on improving the maintenance and use of fire extinguishers and protection system when dealing with electrical cables.

The current training record shows that training was mainly provided for operation of various types of extinguishers (see Annexure 17). The record shows five training sessions were organised in the year 2003, followed by one in 2004, one in 2006 and two in 2009. Hence, PTPS

will also need to focus on comprehensive and regular training sessions that raise awareness of employees regarding fire fighting and emergency situations.

It is also recommended that PTPS review the fire protection rules laid out in Module 68 of the Factories Act, 1948 (see Annexure 14) and ensure that the plant's fire fighting system adheres to the all prescribed rules and standards. This may require an in-depth audit of the existing system against the regulations as well as BIS standards for equipment.

5.3.11 Summary of Recommendations

Area	Interventions Recommended
Safety Manual and Education	• Develop Safety Manual as per CEA Draft Regulations, 2008 • Ensure PTPS 'Quality, Environment, Health and Safety Policy' and all other safety booklets and on sign boards displayed in the local languages along with English • Introduce a comprehensive safety awareness and training programme which are recorded properly as recommended by the Safety Audit report
Standard Operating Procedures	• Division heads to develop division-specific documents, based on the Safety Manual, containing procedures for: o obtaining permission for operations and maintenance of equipment, and o safety in operation and maintenance of various electro-mechanical equipments as per recommendations of manufacturers
Onsite Emergency Management Plan	• Revise and update the existing onsite EMP and ensure the EMP addresses all requirements stipulated within the CEA Draft Regulations, 2008 • Conduct mock drills of the EMP every six months • Maintain record of mock drills • Prepare an offsite EMP and submit details to District Emergency Authority
Accident Reporting, Investigation and Analysis	• Include detailed description of accidents recorded within the accidents' register • PTPS to carry out an analysis of the accidents recorded to gain an understanding on causes, frequency rate, severity rate, incidence rate and man days worked / lost
Rotation of Work and Minimization of Exposure	• Classify work areas based on exposure type and intensity • Devise mechanism for identification of thresholds in each work area

	• Monitor exposure levels and develop programme for rotation of work
Safety Officer	• PTPS to train and depute three Safety Officers to support the CSO • Ensure qualifications of CSO and Safety Officers are as per Section 40-B of the Factories Act, 1948 and rules made there under
Safety Committee	• PTPS to increase the number of employees to equal the number management members on the Safety Committee • Ensure a proper record of the Safety Committee meetings is maintained • Ensure meeting minutes record action points, which are to be reviewed regularly to assess whether decisions and recommendations of the Committee are implemented
Personal Protective Equipment	• Develop a detailed manual / procedure on PPE as per rules stated in the Factories Act • CE / SE officers of each division develop division-specific list of appropriate PPE (as prescribed by BIS) required and a manual on its usage, maintenance and storage. • PTPS should carry out a study with the aim of understanding and implementing measures against non-adherence to use of PPE
Medical Facilities	• PTPS to consider strengthening the team of Medical Officers and ensure all Medical Officers are appropriately trained and certified in Industrial Health as required by the CEA Draft Regulations, 2008 • Develop a comprehensive programme for regular medical check-ups and tests for employees as per CEA Draft Regulations, 2008 • Maintain record of all medical tests and camps held for employees
Fire Fighting System	• Conduct an in-depth audit of the existing system against the regulations as well as BIS standards for equipment • Conduct regular inspection and maintain a record of equipment quality, availability and maintenance • Conduct comprehensive and regular training sessions that raise awareness of employees regarding fire fighting and emergency situations

6 Community Health and Environmental Impacts Assessment

6.1 Introduction

A review of health and environmental impacts of the plant on the nearby communities and the PTPS colony was undertaken through a combination of field investigations, Focus Group Discussions (FGDs), available secondary data and analysis of environmental monitoring surveys.

The section below describes the method use to conduct the assessment. A synopsis of relevant responses from community members during the FGDs is included in the discussion below. Results from monitoring analysis have been included to provide context to some of the claims.

Potential liabilities and risks to the power plant based on consultations with key stakeholders have been highlighted along with a review of court cases against the plant.

Recommendations have been included to enhance PTPS' social responsibility and aid the plant in improving its relation with surrounding communities, thereby not exposing itself to liabilities and risks in the future.

6.2 Approach

A region within a 10-km radius around PTPS was considered as the region of impact on air, water and soil environments due to the operation of PTPS and consequently on community health. An EIA report for the 2x250 MW expansion of PTPS carried out in 2001 indicates an influence region of a six-km radius around the plant for air impacts and a seven-km radius for socio-economic impacts.

Hence, consultations in the form of FGDs were held with five village communities in the region and at PTPS colony to identify the perceived impacts of PTPS on community health and environment. The list of these FGDs (i.e. location, schedule and participants) held at the villages are provided below:

Table 18 Focus Group Discussions

Village	Distance & Direction from PTPS	Date	Time	Total No. of Participants
Khukhrana	2.5km, East	09/03/10	a.m.	40
Untla	2.5km, West	09/03/10	p.m.	40
Sutana	3.75km, Southeast	10/03/10	a.m.	28
Asan Khurd	0.75km, North	10/03/10	p.m.	38
Jatul	6.5km, Southeast	11/03/10	a.m.	25
PTPS Colony	1.5km, Southwest	12/03/10	p.m.	10

Prior notice was given to the village heads (sarpanch) for consultation and to arrange for the community to participate in the consultations. The consultations were held either early mornings or late evenings to ensure greater participation from the residents of the villages. Due to community customs, wherein women do not appear in public or in front of men (not related),

separate discussions were held with them. Although a majority of the participants in the FGDs were middle-aged men, representatives of other age groups such as young adults and old men / women were also involved.

All discussions were recorded with a hand-held voice recorder and photographs of discussions were taken. The entire consultation process is documented and sample questionnaire, photos and sign-up sheets are included in Annexure 18.

6.2.1 Constraints

The main constraint faced during the FGDs was the over exposure of the communities to consultations. The communities around PTPS have been subjected to frequent consultations regarding the same issues over the years. This has created a sense of indifference amongst the villagers towards consultations. This attitude resulted in participants giving scripted answers to the questions which they were very familiar with. Although most answers would appear to be more or less representative of ground realities, they need to be corroborated with field investigations and monitoring surveys.

During the discussions we also faced some constraints in interacting with women. Due to the communities' traditional customs of women not appearing in public or in front of male members (not related), very few women attended the focus group discussions. Separate discussions were held with women only. However women were generally involved in household work and hence were difficult to gather in greater numbers in some of the villages.

6.3 FGD Observations

This section provides a synopsis of the observations from FGDs. It should be noted that these observations are essentially based on the perceptions of the village / colony residents (i.e. participants). The following section analyses these responses along with information from field investigations, monitoring and secondary data.

6.3.1 Health and Environmental Problems

Across all villages, similar accounts of health problems were observed. A list of the diseases perceived to be prevalent in the villages is provided below:

- Asthma
- Common cold and cough
- Allergy (Skin)
- Eye irritation
- Acidity
- Stomach infection
- Affected hearing
- Heart-related ailments
- Blood sugar
- Body ache
- Malaria
- Typhoid
- Tuberculosis
- Cancer (type not specified, only mentioned in Khukhrana)
- Shortened life span

Most villages suggested that the type of diseases they face have remained the same whereas the severity has increased over the years. In some villages participants perceived that over the year many families have migrated away due to health problems and increasing pollution.

Noise and dust pollution due to the movement of vehicles, kutcha roads and the power plant was also mentioned during the discussions.

Residents of the PTPS colony were mainly concerned with lack of civic amenities, green belt and cleanliness in the colony.

6.3.2 Causes

Health problems are mostly attributed to air (mainly due to fly-ash) pollution. All communities claim that the quality air has deteriorated over the years and is currently inconsumable.

6.3.3 PTPS

The cement factory situated close the plant was also blamed for some of the problems faced mainly by the residents of Khukhrana village.

Not many positive impacts were associated with the PTPS. Although in some discussions participants mentioned increased land values in the area, they did not attribute it to PTPS. In some villages availability of electricity (albeit intermittent), employment opportunities for community members and availability of water for irrigation (although there were complaints against the quality) were credited to PTPS.

6.3.4 Needs

When participants were asked what it is they would like the PTPS to do for them? Or how their problems could be alleviated? The following responses were found to be common across the villages:

- Health infrastructure: adequately equipped and staffed local health centres / dispensaries that are more accessible than at present.
- Employment for village residents
- 24hrs electricity
- Reduced pollution

At Khukhrana, many of the participants demanded that the village be shifted away from its present location.

6.4 Potential Liabilities and Risks

In addition to the consultations with communities and primary monitoring, other stakeholders such as the Pollution Control Board (PCB) were interviewed and all court cases (including pending) and claims or complaints lodged against PTPS were reviewed. This assessment was carried out to highlight the issues raised by the communities as well as other new issues as potential liabilities and risks to the plant.

The five cases registered against the plant reinforce the residents' serious concern about the air and water pollution affecting their health as well as their livestock and their crops. Of the five cases, one was registered by a resident of Sutana and two from Khukhrana, both villages were consulted during the FGDs. The cases were filed by the petitioners between 2004 and 2009 and essentially relate to the following main claims:

- Agriculture land becoming uncultivable due to waste water / water logging from PTPS;
- Air and water pollution from PTPS; and
- 24-hrs electricity supply.

Three of the five cases relating have been disposed. The case wherein the petitioner has claimed his land has become uncultivable the court has ordered PTPS to purchase the land. The case has been disposed off after purchase of land by HPGCL.[4] Only one case is pending against the PTPS which also alleges that PTPS has rendered their land uncultivable due to overflow of water from PTPS drains and water logging. The court has appointed a local commissioner to submit a report on the issue.

Discussions with the PCB revealed that there was no secondary data available on ambient air quality and ground water quality. However, it was mentioned that one water sampling exercise that was carried did not flag up any issues but no record of this was available.

6.5 Monitoring Analysis

The results of the monitoring exercise carried out have been used to provide a context in terms of primary data to some of the responses / issues raised during the FGDs.

Ambient air quality was monitored in four of the villages situated around PTPS in Feb-March 2010. The table below shows the monitoring results.

Table 19 Primary AAQ monitoring conducted outside PTPS

Location		Concentration (µg/m^3)			
		PM_{10}	SPM	SO_2	NO_X
Khukhrana	Day 1	130	537	9	19
	Day 2	207	465	10	13
	Day 3	226	554	12	15
Untla	Day 1	135	403	19	17
	Day 2	155	700	35	21
	Day 3	83	410	13	19
Asan Khurd	Day 1	145	358	7	15
	Day 2	155	460	7	14
	Day 3	88	284	7	13
Sutana	Day 1	331	740	28	21
	Day 2	306	647	36	23
	Day 3	294	570	35	22

[4] Based on HPGCL communication Sr. No. 9 memo No. Ch27/CE/SE/Plg-II/A-10/Vol-II dated 15.12.2010

The results show that the PM levels are above the NAAQS (which are less stringent than the latest legislation on ambient air quality issued by Ministry of Environment and Forests) whereas other pollutants are well within the standards.

Results from noise monitoring show that the noise levels around PTPS are above prescribed standards for residential areas. When monitoring was carried out no major noise events such as steam release for boiler safety occurred, during which time noise is expected to be much higher. The monitoring results are only based on a grab sample and continuous measurement is considered more appropriate for robust results.

PTPS has implemented ash water recovery system to recover & reuse water form ash pond. To address water logging issues in the surrounding village, currently PTPS has adopted a mechanism of pumping out water from Khukhrana village. Annexure 3 has results of groundwater quality of two locations.

An attempt was made to collect health records of the communities around PTPS from local Primary Health Centre. However, no information was easily available for review.

Mercury (Hg)

There is an increased attention to mercury pollution issues of thermal power plants; therefore an attempt to assess of Hg pollution from PTPS was made to understand presence of Hg in coal, in stack emissions, in ash (both in dry ash and in slurry), and in the receiving water bodies and analyses the levels vis-à-vis the mercury levels / standards in various other plants across the globe.
Hg concentration in coal depends on the source/ origin of coal; higher concentration (>1.0 µg/g) is rare. Literature review suggests that Indian coal contains low mercury which ranges from 0.18 to 0.61 (Mean 0.376 µg/g) microgram of mercury per gram of coal. It is also suggested in literature that during combustion Hg in the coal is primarily transformed into three species:

- particle-bound mercury (Hg-p);
- vapour-phase elemental mercury (Hg0), and
- vapour-phase oxidized mercury (Hg2+),

At lower temperatures (350–400 deg C) in the flue gas duct part of the Hg vapor is oxidized into Hg2+, and/or reacts with carbonaceous ash particles and is deposited as Hg-p. Hence, fly ash particle surface provides an important site for Hg absorption. Based on this review, to understand mercury pathway from coal to environment, sampling and analysis was carried out for Hg in coal, bottom ash and fly ash, ash slurry, and particle phase stack emissions.

Coal sampled from CHP – I of PTPS analysed for Hg indicated concentration 0.38 µg/g. Unit 3 and 4 ash slurry and bottom ash Hg analysis results showed levels below detection limits - 0.005 mg/ l and 0.01 µg/g respectively, where as fly ash Hg levels were 0.19 µg/g.

There are no specific guideline values restricting mercury emissions from thermal power plants in the Indian context. World Bank PPAC guidelines currently do not specify any limits on mercury

emissions from coal based power generation. In India, the risk of Hg exposure in children from coal based thermal power plant emissions has not been quantified so far.
The levels measured as part of EADD of PTPS are comparable with other studies (Table below) but there is no information on emissions or health/ environmental impact in these studies.

Table 20 Mercury content in Indian coal used for power generation

Sl	Name of power plant	Mercury in Coal (micrograms/ gram)
1	GHTTP, Lehra, Mohabatt	0.26
2	Anpara, UP (BTPS)	0.26
3	North Chennai	0.33
4	NLC-TPS II	0.18
5	Chandrapura TPS	0.33
6	Kilghat TPS	0.61
7	Talchar TPS	0.33
8	Gandhinagar TPS	0.42
9	**PTPS, Panipat***	0.38

Source: BHEL,2004. Report No. PCI/001/2004 "Assessment and Development of Environmental Standards of Heavy Metals and Trace Elements Emissions for Coal based Thermal Power Plants", Pollution Control Research Institute (PCRI), Bharat Heavy Electricals (BHEL), Haridwar, India.
Reported in the article 'Initiatives taken for Estimation and Control of Mercury from Various Sources in India'. Dr. G.K. Pandey, Adviser, Ministry of Environment and Forests, Government of India, New Delhi

Also, analysis carried out as part EADD, ambient levels in surface water, groundwater show below detection (<0.0005 mg/ l). The ambient air mercury levels are in the range of 0.001–0.005 µg/m3. The exposure to mercury from outdoor air at these air levels is not expected to have direct effects on human health (WHO Air quality guidelines, Second Edition).

6.6 PTPS CSR

HPGCL as part of its CSR has carried out a few initiatives for the communities situated around the plant.

HPGCL along with the Haryana Government has conducted regular medical camps for the residents of villages including Khukhrana, Untla, Sutana, and Assan Khurd. The last time a camp was organized was in September 2008 at Khukhrana which was attended by 147 people. Medicines were distributed free of cost to the patients during the camp.

PTPS has also made an effort to employee people from the nearby villages. Approximately 70 people from work at the plant and around 150 unskilled workers are employed with various contractors of the plant.

To improve the literacy levels of children of nearby villages, PTPS has helped them gain admission in the Govt. Senior Secondary School and D.A.V. School situated in the PTPS Colony premises. A total of 850 students from nearby villages are currently study at these schools.

A green belt has been developed in an area of 40 Hectares around the plant colony and ash dyke. About 62,000 plants have been provided so far and planting of hedges around parks is in progress. Plantation has also been done along boundary of PTPS gate No.1 up to the main entry road.

To deal with the water logging issue, PTPS has installed 4 deep tube-wells and 2 shallow tube-wells, which are used for pumping out groundwater water from village Khukhrana. This is being done to lower the water table in the area. In addition, several mitigation measures have been taken to ensure that there is no seepage of water from the Ash dykes. These measures include providing garland drain around the ash dykes which are connected to the drain of the irrigation department; and an ash water recovery system for optimum use of discharged water.

PTPS also monitors the PM levels continuously and the units are being tuned during over-hauling of the units.

6.7 Recommendations

During the FGDs participants repetitively expressed that need for improving health infrastructure in the area. It is not within the remit of this study to conduct an in-depth analysis of the existing status of the health facilities and it would be the responsibility of the state to ensure adequate provision of infrastructure for the communities.

However, PTPS should aim to implement the following recommendations to address the problems faced by the communities and to avoid liabilities and risks:

- Continue working closely with the communities on health issues through camps and other awareness raising activities;
- Consider improving the conviviality of PTPS Colony by providing civic amenities such as play ground and parks, improving the cleanliness and increasing greenery in the area;
- Develop green belt around CHP and ash pond areas to curb fugitive emissions;
- Reassess current mechanism of reducing water logging in Khukhrana;
- Reduce water consumption by adopting dry ash management system;
- Conduct comprehensive analysis of emissions associated with PTPS operations, meteorology and other sources to changes in AAQ levels;
- Develop long term plan for measuring Hg in coal, fly ash and consider restricting Hg content in coal especially for imported coals while entering into fuel supply agreements and
- Adopt air quality monitoring system for measuring ambient levels outside plant boundary where maximum concentrations are expected.
- Considering that the mercury emissions regulation in India is in the development stage it is suggested that PTPS should develop programme to monitor Hg content in coal once in a month/ six months based on origin/ source of coal. Mercury content in stack emissions, ash may also be monitored to understand conversion pathways. Ambient air and water should also be monitored for Mercury as part of the routine environmental monitoring programme.

- Heavy metal content such as mercury restriction should also be considered along with ash content while entering into Fuel Supply Agreement. Any regulation on mercury emission that is applicable at later date should be part of overall environmental compliance.

7 Institutional Capacity Assessment

7.1 Introduction

PTPS was assessed in relation to its institutional capacity to fulfil its environmental responsibilities. This assessment was undertaken to determine whether the power plants is adequately equipped to – meet regulatory requirements and improve its environmental performance.

This review was carried out through meetings with plant officials and supplemented with an analysis of secondary information.

7.2 Approach

A series of meetings were held with relevant plant officials / stakeholders to gain an understanding of the following existing aspects of PTPS:

- Management systems – environment and occupational health & safety;
- Human resources – organisational structure, manpower and technical capacity;
- Training and capacity development resources;
- Redressal mechanisms; and
- Physical infrastructure – laboratories and monitoring stations.

These meetings were substantiated with a review of all secondary information (records) available with PTPS and the Pollution Control Board (where appropriate). Through the meetings, the perceived effectiveness of the existing institutional capacity of PTPS was assessed. The information gathered with respect to the above aspects includes details of documentation, data management, monitoring, reporting, analysis, planning and decision-making practices and procedures adopted and followed at PTPS.

The analysis of regulatory requirements undertaken as part of baseline environmental performance tasks of the EADD highlight all environmental compliance needs of PTPS. These needs were mapped against the existing status of PTPS' institutional aspects to identify issues and inadequacies. Outcomes of this assessment are used for formulation of appropriate measures for improving PTPS' institutional capacity to enhance its environmental performance.

7.3 Present Setup

PTPS has an Environmental Management System is in place adhering to the ISO 14001 standards and some of its current practices are certified as per these standards. The existing organizational setup of PTPS is shown in Annexure 19. The roles and responsibilities of different divisions are described in this section:

7.3.1 Civil Engineering Division

Civil Engineering Division is taking the lead role in managing environmental regulatory requirements of PTPS. Brief description on environmental issues managed by this division is given below:

Environmental quality monitoring: Senior Analyst (SA) under the guidance of Xen/ CMD & SE/Civil is involved in planning and execution of environmental quality monitoring. Present focus of environmental monitoring is to meet the regulatory monitoring requirements.
PTPS has set up environmental lab with SA as in charge of the lab. The lab has basic infrastructure such as BOD incubators, noise level meter, high volume air sampler etc which is not adequate to carry out all regulatory monitoring needs. Therefore, PTPS is using the services of HSPCB/ MoEF accredited labs. For the financial year 2010 -11, Central Pulp and Paper Research Institute (CPPRI) has been engaged for monitoring. Monitoring schedules driven by regulatory needs are decided by Senior Analyst under the guidance of Xen/ CMD & SE/Civil. SA coordinates with third party labs for implementation of monitoring schedule and does quality checks on monitoring methods adopted, sampling & analysis, and reporting. There are no documented procedures Quality Assurance and Quality Control (QA/QC). Present monitoring schedule covers:

- Ambient air & noise
- Air emissions & performance of pollution control devices
- Groundwater
- Liquid effluents from PTPS
- Fly ash

Environmental compliance management: Civil engineering division coordinates with CE, PTPS and other divisions for managing environmental compliance. Key activities carried out as part of compliance management are:

- Applying and follow up of consents & authorizations under Environmental Acts, filing returns, regular monitoring reporting to regulatory agencies
- Internal communication on environmental issues based on results of monitoring and regulatory requirements

Implementation, operation & maintenance of pollution prevention/ control measures: Areas covered are ash pond, plant peripheral drains, sewage treatment plant and green belt.

7.3.2 Operation and Maintenance (O & M) division

Operation and maintenance of pollution control equipment such as ESPs, dry fly ash management and utilisation systems operation, process water, operation & maintenance online monitoring systems such as combustion parameters & pollution sensors.

7.3.3 Fuel Division

Co-ordinates coal quality and long term fuel supply agreements, Operation and maintenance of coal handling plants, pollution prevention & control from coal handling operations such as dust suppression and extraction.

7.3.4 General Services Division

Fire and safety management are under the purview of the general services division. There is a safety cell headed by the Chief Safety Officer who also oversees the fire management department.

7.3.5 Monitoring and Training Division

This division is responsible for plant performance, efficiency assessment and occupational health. There is an energy efficiency cell headed by Executive Engineer Efficiency. Occupational health is managed by the Chief Medical Officer.

7.4 Analysis of Existing Institutional Capacity

Strengths:

- Top management commitment towards managing environmental issues
- Basic institutional set up exists
- Adoption of systems approach such as ISO-14001 for environmental management, CIPMS for performance management
- Separate cell for plant efficiency monitoring

Weakness:

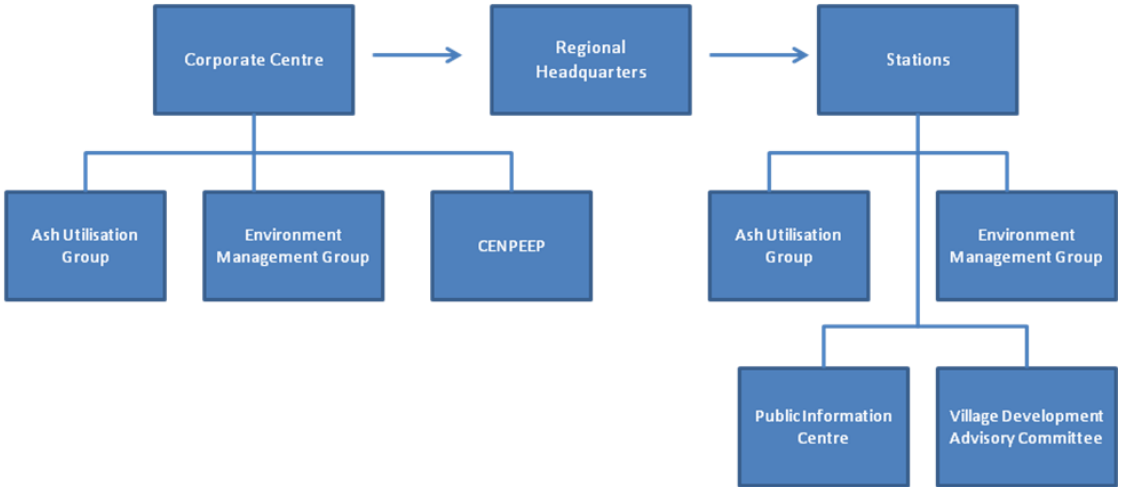
- Integrated approach for managing environment, health and safety issues are not practised
- Trained man power with adequate skill sets to manage environmental issues associated with PTPS operation; people with comprehensive understanding of environmental air quality & meteorology, air pollution, air pollution control technologies, hydrogeology, water & wastewater technologies, environmental monitoring, process safety, personal safety and occupational health.
- Lack of comprehensive training programme - identifying and imparting training at different levels
- EHS data storage and retrieval mechanism (PTPS is implementing CIPMS, provisions for environmental data needs to be understood)
- Data analysis - such as trend, linking with process, development of plant specific empirical tools and surrogate tools, benchmarking, linking ambient quality/ health impact due to PTPS operations

- In-house environmental and occupational testing facilities to carry out environmental monitoring and validation third party labs
- Monitoring/ measurement beyond regulatory needs – focusing on resource efficiency improvement such as water

7.5 Case Study: NTPC Institutional Framework

National Thermal Power Corporation (NTPC) has constituted different groups at station, regional and Corporate Centre level to carry out specific environment related functions. At the Corporate Centre level three groups function, namely - Environment Management Group, Ash Utilisation Group and Centre for Power Efficiency & Environment Protection (CENPEEP). These groups initiate measures to mitigate the impact of power project implementation on the environment and preserve ecology in the vicinity of the projects. Environment Management and Ash Utilisation Groups established at each station, look after various environmental issues of the individual station.

NTPC INSTITUTIONAL FRAMEWORK



Group Functions

The Environment Management Group has the responsibility of providing thrust to the environment functions of the operational stage of the plants, formulating the environmental policy of the organization, complying with the statutory norms and initiating suitable mitigation measures to minimize pollution.

The Ash Utilization Division formulates the policy, plans and programs for ash utilization. Each station has a dedicated Ash Utilization Coordinator. The division controls and monitors the progress of ash utilization at each station.

CENPEEP has been established in NTPC with the assistance of United States Agency for International Development (USAID) to focus on improvement of availability of resources for power generation for sustained operation, attainment of optimum efficiency and protection of environment. The centre acts as a resource for assimilating, disseminating and demonstrating technical know-how to other utilities to bring about improvement in the Indian Power Sector.

Online Database Management System

An online database management system, namely "Paryavaran Monitoring System" - PMS, which could provide reliable storage, prompt and accurate flow of information on environmental performance of Stations was developed and installed at NTPC. This software facilitates direct transfer of environment reports and other environment related information from stations to the Regional Headquarters and Corporate Centre. The PMS has already been implemented at Corporate Centre, the Regional Headquarters and most of the Stations.

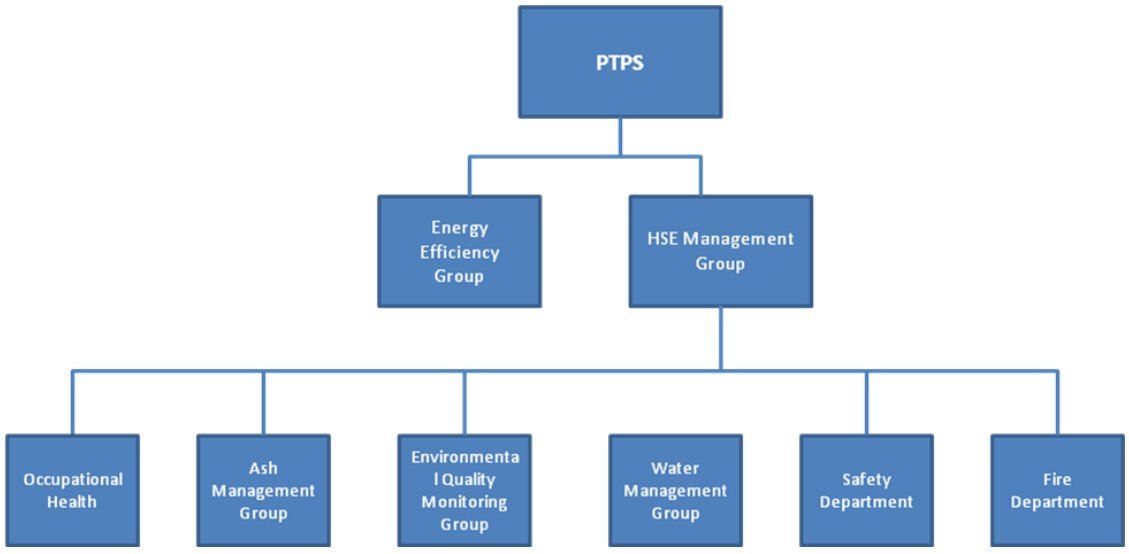
Redressal

The Grievance Redressal Mechanism for each station encourages PAPs to approach the Public Information Centres (PICs) if dissatisfied with the arrangements.

To disseminate information on the project, PICs at Corporate Centre and the projects house an array of documents- survey reports, action plans, land records, policy etc. The PAPs are able to glean information on various facets of the project and also submit any query or grievance.

7.6 Recommendations

Proposed Institutional Structure for HSE Management



Group	Responsibilities
Occupational Health	• Ensure adherence to all occupational health requirements stipulated within regulations • Ensure occupational health and safety requirements are included in contractual agreements between PTPS and contractors; and oversee implementation • Identify exposures and develop management plan for rotation to minimise exposure
Ash Management Group	• Ensure dry fly ash utilisation is implemented as per regulatory requirements • Explore other potential uses and identify other end-users of fly ash • Based on dry fly ash utilisation process develop wet management system
Environmental Quality Group	• Adhere to environmental regulatory needs such as monitoring, reporting and clearances • Provide corrective feedback to other divisions within PTPS to adhere to environmental quality standards
Water Management	• Monitor water use in terms of quantity for different processes • Develop and implement plan for water use and minimise wastewater generation
Safety Department	• Ensure adherence to all safety requirements stipulated within regulations
Fire Department	• Ensure adherence to all fire management requirements stipulated within regulations

- Reorganise existing staff and assign roles and responsibilities as mentioned in the table above
- Provide training and background enhancement of existing staff on environmental monitoring, process safety aspects, environmental management
- Train and depute staff for managing environmental, occupational and safety issues and ensure health and safety staff are qualified as per regulatory requirements
- EHS team to understand base data, interrelationship and reporting requirements, based on which comprehensive data management solution could be prepared
- Training staff on regulatory reporting needs, data analysis for decisions

8 Interventions

Based on due diligence assessment specific measures/interventions were identified to improve the overall environmental performance of the plant. These interventions are listed in the table below under different areas such as pollution prevention and control, resource efficiency, occupational health and safety, community health and environment, and institutional capacity.

Area	Issues	Suggested Interventions
Pollution Prevention and Control	Meteorology	• Third party lab has set up continuous meteorological station at field hostel for this financial year – PTPS can either continue hiring services of external labs or set up automated micrometeorological station. Train Senior Analyst on air quality and met-data analysis and interpretation.
	Air quality monitoring	• Review present monitoring schedule to meet the new NAAQ requirements, and train staff on AQM & data management & analysis.
	Stack emissions	• Provide sampling ports at ESPs according to CPCB requirements and specifications provide safe access to all stack monitoring points and train staff on emission data analysis.
	Particulate collection system	• Overall performance of the ESP to be continuously monitored by devices such as voltage meters, the components of the ESP and their operation are to be periodically inspected by plant personnel as part of a preventive maintenance program. In this way, problems are detected and corrected before they cause a major shutdown of the ESP. Good recordkeeping should be an integral part of any maintenance program.

Area	Issues	Suggested Interventions

		• Isolation issues needs to be addressed to maintain ESPs of running units. OEMs provide dampers or gates for isolation of paths. Gates have advantage over dampers as they are not exposed continuously to the corrosive environment. Replacement of dampers with gates is suggested depending on the life and maintenance needs of dampers.
		• Some components such as rapping motors, ESP transformers can be attended without isolation needs. These have to be immediately rectified if there is a problem.
		• There is a need to integrate ESP maintenance into routine maintenance schedule, shutdown/ breaks and include maintenance requirements into "defect register". Once in 15 days check key components of ESP such as motors, transformers, heating elements at hoppers
		• Daily basis operational practices:
		  ○ Ash evacuation and checks for accumulation of ash at ESP hoppers
		  ○ Manage timing of bottom ash and fly ash evacuation in case of wet ash handling as both use same handling system
		  ○ Manage time distribution of ash evacuation of all ESP hoppers
		• PTPS to install energy meters to monitor consumption at all ESPs and other pollution control equipment. Returns to be filed to regulatory authorities.

Area	Issues	Suggested Interventions
	Dust control and fugitive emissions	• To commission dust suppression system • All the control rooms are to be kept clean and free of dust by providing split air conditioners of suitable capacity. • Sprinkler system to be put to use immaterial of quality of coal received. • To provide primary crusher in stage III CHP to handle big boulders and stones and increase grating size to handle big coal lumps. • 6.6 KV switchgears are to be provided with mat and sealed to avoid entrance of dust. • Provide adequate ventilation at below ground operational areas at CHM • Proper illumination to be provided in the yard and in control room. • Green belt to be provided at strategic locations • Drinking water facility to be provided for the staff.
	Water intake and usage pattern & Wastewater treatment	• Plan for regular water audit and record water consumption at strategic points, Commission STP to treat colony sewage, maximise recovery & reuse of ash water
	Dry fly ash utilization at PTPS	• Proper grinding of coal to be ensured • Optimum combustion of coal in furnace should be ensured by continuously monitoring the air flow, fire ball etc. to minimize low un-burnt carbon in the fly ash • 24 hour support from plant to fly ash lifting • Efforts in dissemination of technical and financial benefits of fly ash among users (Through Press,

Area	Issues	Suggested Interventions
		Seminars, Circulation of material, IS codes etc.). • Ensure nil or minimal emissions throughout fly ash transfer operations such as silo to transportation vehicles, closed container transportation • Use fly ash for in-house needs such as high volume fly ash concrete roads, utilizing the pond ash mixed with clay as per guideline of CBRI, Roorkee (ash and clay ratio is about 60:40) in bunds, construction in plant & colony premises by fly ash bricks, install fly ash brick/ tiles demo projects • Appropriate MoUs with users such as cement manufacturers covering new systems installation, upgrade existing systems, O & M of systems • Lifting of fly ash and dispatching by rail by owning your own wagons by the bidders • PTPS is in consultation with infrastructure/ express corridor developers for utilization of pond ash for road embankment filling – PTPS should keep track of such opportunities and pursue developers for ash utilization • Theme based advertisements (NTPC example) • Dissemination of success stories such as Kota thermal power station: achieved 98.48% dry fly ash utilization during 2007-08
Resource efficiency	Boiler efficiency	• Operate the coal mill at 90% of the rated capacity to produce better fineness; regular monitoring of mill fineness and corrective actions might improve combustion

Area	Issues	Suggested Interventions
		• Quantity of primary air and secondary air needs to be monitored. Primary air control should be maintained to get better combustion and flame control. Secondary air control needs to be introduced • Adopt measures to stop steam leakages
	Air preheater efficiency	• Options to increase air preheater efficiency to be assessed and implemented – which might be retrofitting extra surface area in the air preheater, retrofitting with modified design of baskets
	Auxiliary power	• Install online monitoring system with integration of sub-meters at equipment level to monitor auxiliary power consumption
Occupational Health and Safety	Safety Manual and Education	• Develop Safety Manual as per CEA Draft Regulations, 2008 • Ensure PTPS 'Quality, Environment, Health and Safety Policy' and all other safety booklets and on sign boards displayed in the local languages along with English • Introduce a comprehensive safety awareness and training programme which are recorded properly as recommended by the Safety Audit report
	Standard Operating Procedures	• Division heads to develop division-specific documents, based on the Safety Manual, containing procedures for: o obtaining permission for operations and maintenance of equipment, and o safety in operation and maintenance of various electro-mechanical equipments

Area	Issues	Suggested Interventions
		as per recommendations of manufacturers
	Onsite Emergency Management Plan	• Revise and update the existing onsite EMP and ensure the EMP addresses all requirements stipulated within the CEA Draft Regulations, 2008 • Conduct mock drills of the EMP every six months • Maintain record of mock drills • Prepare an offsite EMP and submit details to District Emergency Authority
	Accident Reporting, Investigation and Analysis	• Include detailed description of accidents recorded within the accidents' register • PTPS to carry out an analysis of the accidents recorded to gain an understanding on causes, frequency rate, severity rate, incidence rate and man days worked / lost
	Rotation of Work and Minimisation of Exposure	• Classify work areas based on exposure type and intensity • Devise mechanism for identification of thresholds in each work area • Monitor exposure levels and develop programme for rotation of work
	Safety Officer	• PTPS to train and depute three Safety Officers to support the CSO and ensure qualifications of CSO and Safety Officers are as per Section 40-B of the Factories Act, 1948 and rules made there under
	Safety Committee	• PTPS to increase the number of employees to equal the number management members on the Safety Committee • Ensure a proper record of the Safety Committee

Area	Issues	Suggested Interventions
		meetings is maintained • Ensure meeting minutes record action points, which are to be reviewed regularly to assess whether decisions and recommendations of the Committee are implemented
	Personal Protective Equipment	• Develop a detailed manual / procedure on PPE as per rules stated in the Factories Act • CE / SE officers of each division develop division-specific list of appropriate PPE (as prescribed by BIS) required and a manual on its usage, maintenance and storage. • PTPS should carry out a study with the aim of understanding and implementing measures against non-adherence to use of PPE
	Medical Facilities	• PTPS to consider strengthening the team of Medical Officers and ensure all Medical Officers are appropriately trained and certified in Industrial Health as required by the CEA Draft Regulations, 2008 • Develop a comprehensive programme for regular medical check-ups and tests for employees as per CEA Draft Regulations, 2008 • Maintain record of all medical tests and camps held for employees
	Fire Fighting System	• Conduct an in-depth audit of the existing system against the regulations as well as BIS standards for equipment • Conduct regular inspection and maintain a record of equipment quality, availability and maintenance

Area	Issues	Suggested Interventions
		• Conduct comprehensive and regular training sessions that raise awareness of employees regarding fire fighting and emergency situations
Community Health and Environmental Impacts	Health Problems and Infrastructure	• Continue working closely with the communities on health issues through camps and other awareness raising activities • Consider improving the conviviality of PTPS Colony by providing civic amenities such as play ground and parks, improving the cleanliness and increasing greenery in the area
	Ambient Air Quality	• Conduct comprehensive analysis of emissions associated with PTPS operations, meteorology and other sources to changes in AAQ levels; and • Adopt air quality monitoring system for measuring ambient levels outside plant boundary where maximum concentrations are expected.
	Water Quality and Water Logging	• Reassess current mechanism of reducing water logging in Khukhrana • Reduce water consumption by adopting dry ash management system
	Green Belt	• Develop green belt around CHP and ash pond areas to curb fugitive emissions
Institutional Capacity	Monitoring	• Advanced training and background enhancement of existing staff on environmental monitoring, process safety aspects, environmental management • Train and depute staff for managing environmental, occupational and safety issues and ensure health and safety staffs are qualified as per regulatory requirements

Area	Issues	Suggested Interventions
	Data Analysis	• EHS team to understand base data, interrelationship and reporting requirements, based on which comprehensive data management solution could be prepared
	Reporting	• Training staff on regulatory reporting needs, data analysis for decisions

9 Investment and Implementation Action Plan

The interventions identified were presented and discussed with HPGCL and PTPS officials. Detailed discussion with the Top Management of HPGCL was held on 3rd September 2010 based on which investment and implementation action plan was prepared. The following table discusses investment and implementation action plan. The status of implementation and time frame is also included as per the HPGCL memo No. Ch27/CE/SE/Plg-II/A-10/Vol-II dated 15.12.2010.

Area	Sl	Intervention	Investment	Benefits	Priority	Timeframe	Action plan	Implementation time frame/ status
Pollution Prevention and Control	1	Third party lab has set up continuous meteorological station at field hostel for this financial year – PTPS can either continue hiring services of external labs or set up automated micrometeorological station. Train Senior Analyst on air quality and met-data analysis and interpretation.	Investment may not be required if present engagement of third party lab to be continued.	Meet regulatory and PPAH requirement, use met-data for air quality interpretation, wind direction information for emergency preparedness,	Medium	Long term	Present system may be continued with Third Party Laboratory.	Third party lab is already maintaining a meteorological station at field hostel **Already complied with**
	2	Review present monitoring schedule to meet the new NAAQ requirements, setup monitoring stations where AQ likely to be impacted such as Khukharana and train staff on AQM & data management & analysis.	Investment may not be required if present engagement of third party lab to be continued.	Meet regulatory and PPAH requirement	High	Immediate	Third party lab approved by HSPCB has already been engaged to monitor air quality including locations such as Khukharana.	Third party lab approved by HSPCB is already monitoring air quality including village Khukhrana **Already complied with**
	3	Provide sampling ports at ESPs of Unit 1 to 6 according to CPCB requirements and specifications provide safe access to all stack monitoring points and train staff on comprehensive data analysis.	Cleaning and gas leak control along with elevator maintenance at stacks of Unit 5-8 to be taken up as part of Regular O &M, Stack of Unit 5 &6 external elevators	Safe and better working conditions for monitoring team, better monitoring results	High	Immediate	Sky climbers for Unit 5-6 stack is provided, stack monitoring team to assess its efficacy	Efficacy of safe access tot he sampling points shall be ensured by stack monitoring team by Feb 2011

Area	Sl	Intervention	Investment	Benefits	Priority	Timeframe	Action plan	Implementation time frame/ status
			could be provided					
	4	Overall performance of the ESP to be continuously monitored, components of the ESP and their operation are to be periodically inspected Isolation issues needs to be addressed to maintain ESPs of running units, install energy meters to monitor energy consumption at all ESPs and other pollution control equipment. Returns to be filed to regulatory authorities.	Isolation issues and O & M practices to be taken up as part of routine O & M, Cost per energy meter is **0.1 lakhs, 16** meters are required	Gates have advantage over dampers as they are not exposed continuously to the corrosive environment. Isolation is better achieved with gates than dampers so that ESP problems in running plants could be addressed	High	Medium term	PTPS has already started addressing ESP isolation issues, ESPs at Unit 1to 5 work has already started	The procurement of isolation inlet & outlet gates for Units-3, 4 & 5 is under process and shall be installed in next O/H in 2011-12 & 2012 respectively
	5	Commission dust suppression system at CHM -I coal stock yard	Work order already issued	Reduced fugitive emissions and better air quality	Very high	Immediate	Implementation under progress	The erection work of dust suppression system at CHM-1 has been started by M/s WRC & is likely to be commissioned by 31.3.2011.
	6	Dust extraction system at CHM –I to be renovated	Investment to be worked out as part of technical assessment, this could be taken up as part of R & M of Unit 3 & 4	Reduced fugitive emissions and better air quality	Very high	Immediate	To be carried out under Technical Assessment (Design Consultancy work)	Dust extraction system will be covered under technical assessment implementation work along with R&M of Unit-3 & 4 in year 2013-14
	7	Provision of primary crusher for CHM-I, grating size to be increased to handle big coal lumps.	Investment to be worked out as part of technical assessment,	Better coal flow, reduced demurrage charges	High	Medium term	To be carried out under Technical Assessment	Primary crusher will be covered under technical

Area	Sl	Intervention	Investment	Benefits	Priority	Timeframe	Action plan	Implementation time frame/ status
			this could be taken up as part of R & M of Unit 3 & 4				(Design Consultancy work)	assessment implementation work along with R&M of Unit-3 & 4 in the year 2013-14
	8	Provide adequate ventilation at below ground operational areas at CHM	To be taken up as part of regular O & M	Reduced occupational hazards, Better working conditions	Very High	Immediate	The length of duct for ventilation to be increased; Other issues to be addressed in phased manner	Adequate ventilation will be covered and implementation work during R&M of Unit-3 & 4 in year 2013-14
	9	Green belt around CHP area to be increased, some of the space after clearing rejects and boulders to be used for green belt		Suppression for fugitive dust	High	Immediate	HPGCL has a policy on Plantation. Action to be taken internally by PTPS.	The areas for plantation in CHM areas has been identified & plantation will be carried out by July 2011
	10	Commission STP to treat colony sewage	Tender has been invited for making oxidation pond functional.	Meet regulatory requirement	Very high	Immediate	Oxidation pond to be re-commissioned.	Oxidation pond of colony has already been made functional on 15.10.2010 **Already complied with**
	11	Efforts in dissemination of technical and financial benefits of fly ash among users (Through Press, Seminars, Circulation of material, IS codes etc.).	Dissemination tools for fly ash such as advertisements, pamphlets etc.	Direct revenue from fly ash selling, reduced negative environmental impact of ash pond , meet MoEF notification timelines	Very high	Immediate and phased over next 3 years	According to MoEF guidelines, concerned department of PTPS to carryout these activities.	Technical & financial benefits of dry fly ash is disseminated through disseminated through publishing

Area	Sl	Intervention	Investment	Benefits	Priority	Timeframe	Action plan	Implementation time frame/ status
								in leading news papers. The present action of the revised guidelines of MOE&F on fly ash utilisation has been delivered at PTPS on 14.6.2010
Resource Efficiency	1	Operate coal mill at 90% of rated capacity, monitor & correct mill fineness	Part of routine operation; Technical study to suggest investment required; to be taken up as part of Unit 3 & 4 R &M	Improved combustion, present unburnt carbon in fly ash is high	High	Medium	PTPS to discuss and decide.	Due to low CV coal & having high ash content, mills have to be run on full load occasionally. The coal mills shall be upgraded in 2013-14 during R&M of Unit-3 & 4
	2	Quantity of primary air and secondary air needs to be monitored. Primary air control should be maintained to get better combustion and flame control. Secondary air control needs to be introduced.	Part of routine operation	Improved combustion control can increase the efficiency by 0.84%, maintaining the required secondary air, the exit flue gas temperature and dry gas losses can be reduced.	High	Medium	PTPS to discuss and decide.	The ratio of primary air and secondary air is being maintained to get better combustion and flame control **Already complied with**
	3	Options to increase air preheater efficiency to be assessed and implemented – which might be retrofitting extra surface area in the air preheater, retrofitting with modified design of baskets	Technical study to suggest investment required; to be taken up as part of Unit 3 & 4 R &M	Heat loss minimization	High	Medium to long term	PTPS to discuss and decide	The retrofitting of extra surface area of AHP of Unit-3 & 4 will be done in year 2013-14 during R&M of Unit-3 & 3

Area	Sl	Intervention	Investment	Benefits	Priority	Timeframe	Action plan	Implementation time frame/ status
Occupational Health and Safety	1	Develop Safety Manual as per CEA Draft Regulations, 2008 Ensure PTPS 'Quality, Environment, Health and Safety Policy' and all other safety booklets and on sign boards displayed in the local languages along with English Introduce a comprehensive safety awareness and training programme which are recorded properly as recommended by the Safety Audit report	Part of routine work, assign responsibilities	Meet regulatory requirements, minimise near misses and accidents	High	Immediate	Safety department of PTPS to prepare safety manuals.	Preparation of safety manual has been started and will be completed by 28.2.2011.
	2	Division heads to develop division-specific documents, based on the Safety Manual, containing procedures for: obtaining permission for operations and maintenance of equipment, and safety in operation and maintenance of various electro-mechanical equipments as per recommendations of manufacturers	Part of routine work, assign responsibilities	Meet regulatory requirements, minimise near misses and accidents	High	Immediate	Division heads to co-ordinate with safety team and develop comprehensive manuals	Safety department of PTPS is carrying out suggested activities. Division specific document will be completed by Feb 2011.
	3	Revise and update the existing onsite EMP and ensure the EMP addresses all requirements stipulated within the CEA Draft Regulations, 2008 Conduct mock drills of the EMP every six months Maintain record of mock drills Prepare an offsite EMP and submit details to District Emergency Authority	Safety team to take up this exercise	Meet regulatory requirements	High	Immediate	Safety department of PTPS to take up this exercise	Safety department of PTPS is already carrying out suggested activities. **Already complied with**

Area	Sl	Intervention	Investment	Benefits	Priority	Timeframe	Action plan	Implementation time frame/ status
	4	Include detailed description of accidents recorded within the accidents' register PTPS to carry out an analysis of the accidents recorded to gain an understanding on causes, frequency rate, severity rate, incidence rate and man days worked / lost	Safety team to take up this exercise	Meet regulatory requirements, minimise near misses and accidents	High	Immediate	Safety department of PTPS to take up this exercise	
	5	Classify work areas based on exposure type and intensity Devise mechanism for identification of thresholds in each work area Monitor exposure levels and develop programme for rotation of work	Division heads in association with Chief Medical Officer to take this exercise	Minimize occupational exposure, reduction in health costs, better worker productivity	High	Long term	PTPS to discuss internally and devise exposure minimization plan	Exposure minimisation plan will be devised. Workers working in dust prone area to other works will be rotated during the year 2011
	6	PTPS to appoint three Safety Officers to support the CSO Ensure qualifications of CSO and Safety Officers are as per Section 40-B of the Factories Act, 1948 and rules made there under	Investment will depend on HPGCL salary scale for Safety Officers or equivalent rank	Meet regulatory requirements	Very high	Immediate	HPGCL to provide training to the existing staff on safety at national institute and depute them for this purpose	Safety officer posted on 28.10.2010 **Already complied with**
	7	PTPS to increase the number of employees to equal the number management members in the Plant Central Safety Committee Ensure a proper record of the Safety Committee meetings is maintained Ensure meeting minutes record action points, which are to be reviewed regularly to assess whether decisions and recommendations of the	Safety team to take up this exercise	Meet regulatory requirements, better decision making on safety issues	High	Immediate	As on 25/05/2010, 21 member committee has 7 workers; HPGCL and PTPS to discuss internally decide on worker representation	Safety committee meeting comprising of officers / employees is being held on quarterly basis **Already complied with**

Area	Sl	Intervention	Investment	Benefits	Priority	Timeframe	Action plan	Implementation time frame/ status
		Committee are implemented						
	8	Develop a detailed manual / procedure on PPE as per rules stated in the Factories Act CE / SE officers of each division develop division-specific list of appropriate PPE (as prescribed by BIS) required and a manual on its usage, maintenance and storage. PTPS should carry out a study with the aim of understanding and implementing measures against non-adherence to use of PPE	Safety team to take up this exercise along with division heads	Meet regulatory requirements, minimise near misses and accidents	High	Immediate	Safety department of PTPS to take up this exercise	Detailed manual / procedure of PPE have been developed. PTPS has also implemented the measured against non-adherence to use PPE. **Already complied with**
	9	PTPS to ensure all Medical Officers are appropriately qualified and certified in Industrial Health as required by the CEA Draft Regulations, 2008. Develop a comprehensive programme for regular medical check-ups and tests for employees as per CEA Draft Regulations, 2008. Maintain record of all medical tests and camps held for employees		Meet regulatory requirements	Very high	Immediate	HPGCL and PTPS to discuss internally decide on medical check ups, CMO to maintain records	Regular medical check ups for employees are being held on annual basis and record of all tests / check ups of employees are also maintained. Next medical check up will be completed by March 2011.
	10	Conduct an in-depth audit of the existing system against the regulations as well as BIS standards for equipment. Conduct regular inspection and maintain a record of equipment quality, availability and	Safety team to take up this exercise along with division heads	Meet regulatory requirements, minimise near misses and accidents	High	Immediate	Safety department of PTPS to take up this exercise	Record of equipment quality, availability & maintenance is maintained. Regular training sessions

Area	Sl	Intervention	Investment	Benefits	Priority	Timeframe	Action plan	Implementation time frame/ status
		maintenance. Conduct comprehensive and regular training sessions that raise awareness of employees regarding fire fighting and emergency situations.						regarding fire fighting awareness of employees is also conducted **Already complied with**
Community Health and Environmental Impacts	1	Continue working closely with the communities on health issues through camps and other awareness raising activities. Consider improving the conviviality of PTPS Colony by providing civic amenities such as play ground and parks, improving the cleanliness and increasing greenery in the area	Allocate funds for CSR which may range from 5 lakhs – 20 lakhs per annum depending on type of initiatives	Better/ improved community relationship	Medium	Long term	HPGCL to organise frequent medical camps in adjoining villages; other activities to be part of the CSR policy.	Medical check up camps for villagers of Khukhrana, Assan Khurd, Assan Kalan, Untla, and Sutana were conducted in Oct-Nov/2010 and free medicine were giving to villagers.
	2	Conduct comprehensive analysis of emissions associated with PTPS operations, meteorology and other sources to changes in AAQ levels; and Adopt air quality monitoring system for measuring ambient levels outside plant boundary where maximum concentrations are expected.	Part of routine environmental quality monitoring	Better/ improved community relationship	High	Long term	Third party lab has already been engaged for this purpose by PTPS. PTPS to continue with this set up.	Third party lab is already monitoring ambient air quality outside the plant also, i.e. Village Khukharana.
Institutional Capacity	1	Advanced training and background enhancement of existing staff on environmental monitoring, process safety aspects, environmental management Depute new staff for managing environmental, occupational and safety issues – for environmental; typical qualified staff recruited in other plants include post graduation	To be part of HPGCL routine training programme		High	Immediate	HPGCL, as per their training policy provide regular training to the officers at NPTI, PMI, and NTPC. HSE training to be integrated as part of this	As per the training policy of HPGCL, new engineers are under induction training at NPTI and other employees are also sent for need based training/ refresher course.

Area	Sl	Intervention	Investment	Benefits	Priority	Timeframe	Action plan	Implementation time frame/ status
		in engineering/ technology with specialization in environmental engineering/ industrial pollution control					training programme.	
	2	Data modelling exercise is suggested to understand base data, interrelationship and reporting requirements, based on which comprehensive data management solution could be prepared		Better decision making	Low	Long term	Existing EPCD and Safety divisions of PTPS to maintain comprehensive data on environment and safety respectively.	Existing EPCD and Safety divisions of PTPS is maintaining comprehensive data on environment and safety.
	3	Training staff on regulatory reporting needs, data analysis for decisions	To be part of HPGCL routine training programme					Training needs are assessed for routine training programme for officials. Training calendar from Nov 2010 to June 2010 has been finalised.

It is suggested that the following interventions to be assessed by Technical Consultant as part of the Technical Study proposed under this programme.

Area	Interventions
Pollution Prevention and Control	Feasibility of Dust extraction system at CHM –I for renovation
	Detailed technical assessment of ESPs of Unit 3 & 4 for performance improvement
	Feasibility of providing primary crusher for CHM-I to handle big coal lumps and ensuring better coal flow

Area	Interventions
	Reduction of noise form Stage-I compressors
Resource Efficiency	Feasibility of operation of coal mill at 90% of rated capacity
	Options to increase air preheater and boiler efficiency to be assessed

10 Addendum to the Report

The addendum to the EADD report is additional information based on the HPGCL memo No. Ch27/CE/SE/Plg-II/A-10/Vol-II dated 15.12.2010.

1. Fly ash utilization

The update progress report regarding fly ash utilization is shown in Tables below. It will be endeavour of project authorities to ensure utilization of fly ash as per MOEF notification S.O.2804 (E). But cement companies take quantity of fly ash as per their requirement. Frequent problems in dry fly ash handling systems of Units-1 to 6 are also impediment in dry fly ash utilization. These problems are being addressed; thereafter utilization of ash will increase.

Year wise Dry Fly Ash utilisation status for PTPS I & II

Sl.No.	Unit No.	Year	Ash Dry Generated	Dry Ash utilised (lifted)	% Utilisation
1	Unit 1 & 2	2008 – 09	321102	7361	2.29
		2009 – 10	448928	130102	28.98
		2010 – 11 (Up to Nov.2010)	182622	88221	48.31
2	Unit 3 & 4	2008 – 09	402178	0	0
		2009 – 10	367061	0	0
		2010 – 11 (Up to Nov.2010)	253411	57646	18.67
3	Unit 5	2008 – 09	436415	0	0
		2009 – 10	373247	2388	0.64
		2010 – 11 (Up to Nov.2010)	297756	41048	13.79
4	Unit 6	2008 – 09	423537	148250	35.00
		2009 – 10	460887	183291	39.77
		2010 – 11 (Up to Nov.2010)	301593	86336	28.63
5	Unit 7 & 8	2008 – 09	923375	411485	44.56
		2009 – 10	1021922	515024	50.40
		2010 – 11 (Up to Nov.2010)	727359	296384	40.75

Note:

Unit 1 & 2: System partially commissioned on 13.1.2009 and fully commissioned by July, 2009

Unit 3 & 4: Unit 3 system commissioned in the month of June 2010 and Unit 4 in the month of August 2010

Unit 5 : The Dry Fly Ash evacuation system for Unit 5 commissioned by M/s Jaypee Associates Ltd. On 31.3.2010

Unit 6 : Lifting of Dry Ash started from September 2007

Utilisation of Ash in Unit 7 & 8 of PTPS

Sl.No	Month	Unit 7 & 8		Quantity in MT				Ash utilised in %	
		Coal consumed	Ash content (%)	Ash generation			Dry Ash utilised (lifted)	Of total Ash generated	Of Dry Ash evaluated
				Total Ash generated	Bottom Ash	Dry Fly Ash evacuated			
1	Nov. 2009	2425.8	38.85	942.42	282.73	659.70	0.438	0.05	0.07
2	Dec. 2009	247272	37.23	92059.37	27617.81	64441.56	0.463	0.00	0.00
3	Jan. 2010	248189	36.44	90440.07	27132.02	63308.05	0.444	0.00	0.00
4	Feb. 2010	228760	38.47	88003.97	26401.19	61602.78	0.354	0.00	0.00
5	March 2010	253070.38	37.95	96040.21	28812.06	67228.15	0.461	0.00	0.00
6	April 2010	166305.00	39.84	66255.91	19876.77	46379.14	25761.1	38.88	55.54
7	May 2010	194838.00	40.72	79338.03	23801.41	55536.62	33761.8	42.55	60.79
8	June 2010	233860.00	41.01	95905.99	28771.80	67134.19	36395.2	37.95	54.21
9	July 2010	217446.00	39.85	86652.23	25995.67	60656.56	25845.9	29.83	42.61
10	Aug. 2010	245747.00	40.13	99340.61	29802.18	69538.43	38046.9	38.30	54.71
11	Sept. 2010	213197.00	40.33	85982.35	25794.71	60187.65	47607.5	55.37	79.10
12	Oct. 2010	266792.00	41.98	111999.28	33599.78	78399.50	62333.7	55.66	79.51

2. Ash management

The monthly average value of ash in coal fed to various units at PTPS is shown below. The percentage of ash in raw coal received from different collieries varies from time to time. That is why generation of ash is based on assumption of 40% ash (average ash % age value).

Monthly average value of Ash percentage in coal during the year 2010

Sl.No.	Month	Average of CHP – I, II, III	CHP - III
		Unit 1 to 8 (%)	Unit 7 & 8 (%)
1	Jan. 2010	35.80	36.44
2	Feb. 2010	38.04	38.47
3	March 2010	37.65	37.95
4	April 2010	39.43	39.84
5	May 2010	40.47	40.72
6	June 2010	40.83	41.01
7	July 2010	39.78	39.85
8	Aug. 2010	40.13	40.13
9	Sept. 2010	40.60	40.33
10	Oct. 2010	42.12	41.98
11	Nov. 2010	42.24	42.93

3. Ash pond management

Ash Dyke Area for Unit-1 to 6 and Unit-7 & 8 is having 2 phases. One phase is used for ash disposal and in the meantime raising of ash dyke of another phase is done to create additional capacity. Thus both the phases are alternately used for ash disposal. Stability is tested and confirmed by engaging the consultant. Moreover, the matter regarding lifting/use of pond ash is

being taken up with construction departments like PWD (B&R), National Highway Authority of India (NHAI), etc. In addition to utilization of dry fly ash in Unit-6 and Unit-7 & 8, utilization of dry fly ash from Unit-1, 2, 3, 4 & 5 has also been started recently, which is as under: -

Unit-1 & 2 July, 2009
Unit-3 05 August 2010
Unit-4 12 June 2010
Unit-5 April 2010

Hence disposal of ash to ash dyke area will reduce significantly.

4. Wastewater treatment

ETP of Unit-7 & 8 is operational and discharges volume in line with the consent. Oxidation pond to treat colony sewage has also been made functional on 15 Oct. 2010. Water consent for the year 2010-11 has been accorded by State Pollution Control Board on 02 Nov. 2010. Furthermore, new ETP's for remaining units will also be installed as per recommendations of Design Consultant.

5. Water balance

Plant water is discharged in 2 drains. No discharge point has been missed. In order to control wastage of water, Ash Water Recovery System of Unit-1 to 6 and Unit-7 & 8 are already in operation to reuse the water in ash handling plants. Water leakages/ unnecessary drains are also plugged.

6. Dry fly ash utilization

Generation and utilization of ash from all Units is detailed in Sr. No. 1 of this addendum. The ash generation for the project Unit-3 & 4 will be critically monitored. The dry fly ash lifting has been started by M/s JP cement for Unit-4 w.e.f. 12 June 2010. The ash lifting in Unit-3 has also been started w.e.f. 05 Aug. 2010. Total ash lifted in current financial year (upto Oct, 2010) is 57646 MT for Unit-3 & 4. The ash utilization will further improve after addressing of system problems.

7. Solid waste management

Regarding solid waste management in coal handling plant, details are provided below along with statement showing sale of coal mill reject.

Coal Rejects:

1. Approximately 4000-5000 tons per month of rejects generated from the coal of Unit I to V. The rejection is mainly due to receipt of poor quality of ROM coal from different coal companies having huge quantity of stone boulders. PTPS is getting very less quantity of washed coal from BCCL. (Approx. 10 % of the total coal supplies)
2. Mill Reject coal from Unit 1 to 4 transferred through tractor trolleys loading with manuel labour and transferred to Reject Coal Stock Yard – A of CHP-I. Similarly Mill reject Coal of Init-V is collected in the reject Coal hopper through Con. Belt system and then transfer to Reject Coal Stock Yard-A of CHP-I by means of tractor trolleys.
3. Reject coal is selling through competitive bidding. The detail of the reject coal sold from Stock Yard – A 7 B is attached.
4. Current Stock of Mill Reject Coal in CHP-I stock Yard "A" is approx. 1.10 lacs MT & in CHP-ii STOCK Yard "B" is approx. 0.70 lacs MT
5. Quality of mill reject coal of Stock Yard "B" is very poor and no firm is coming forward to purchase the same. The case for disposal of mill reject coal of Stock Yard – "B" of CHP-II is under consideration and it will likely to be spreading in between the Railways Lines in the PTPS Marshalling Yard.

Stone Boulders:

1. Coal Supplies from the different coal companies is having huge quantity of stone boulders (about 2%).
2. The stone boulders (+250 mm size) are being assessed by a team of Coal India Limited, New Delhi in the presence of PTPS representatives on monthly basis and disposed off to the dumping yard.
3. The stone boulders (-250 mm size) are being regularly disposed of by PTPS in the dumping yard.

Statement showing the details of sale of mill reject coal stock yard – A

Sl.No	Name of the Firm	Period of contract	Contractual quantity (MT)	Rate / MT (in Rs.)	Actual quantity lifted (MT)	Remarks
1	M/s Maha lakshmi Traders, New Delhi	1991 – 92	15000	512/-	6782.56	Security forfeited
2	M/s Maha lakshmi Traders, New Delhi	1992 – 93	15000	512/-	1011.495	Security forfeited
	M/s IFRC, Hissar			311/-	8153.060	
	M/s R K Bhatia, Panipat			512/-	187.610	
	Open sale			512/-	1523.280	
3	M/s IFRC, Hissar	1993 – 94	20000	311/-	16994.320	Security forfeited
4	M/s IFRC, Hissar	1994 – 95	20000	311/-	5033.195	Security forfeited
5	M/s Trade Associates, New Delhi	1995 – 96	30000	265/-	29803.305	
6	M/s Trade Associates, New Delhi	1996 – 97	40000	265/-	5828.315	Security forfeited
	M/s Garg Trading Co., Panipat			410/-	2046.630	
7	M/s Garg Trading Co., Panipat	1997 – 98	30000	410/-	10178.560	Security forfeited
	M/s R K Garg & Co., Panipat	26.3.98 – 25.3.99		441/-	59.840	
8	M/s R K Garg & Co., Panipat	1998 – 99	30000	441/-	13744.215	Security forfeited
9	M/s R K Garg & Co., Panipat	199–2000	30000	505/-	10285.305	Security forfeited
10	M/s R K Garg & Co., Panipat	2000-01		505/-	5105.225	Security forfeited
11	M/s Swastik Coal Corp. Pvt. Ltd., Indore	182/fuel dtd 15.7.2008	50000	505/-	49946.260	
12	M/s Swastik Coal Corp. Pvt. Ltd., Indore	272/ fuel dated 4.6.2009	100000	505/-	81516.560 up to 20.11.2010	

Statement showing the details of sale of mill reject coal stock yard – B

Sl.No	Name of the Firm	Period of contract	Contractual quantity (MT)	Rate / MT (in Rs.)	Actual quantity lifted (MT)	Remarks
1	M/s IFRC, Hissar	10.2.97 – 9.2.98	30000	315/-	2436	Sale order cancelled and Security forfeited
2	M/s Trade Associates, New Delhi	26.8.97 – 25.2.98	15000	315/-	6001	Security forfeited
3	M/s Vishal Enterprises,	30.4.98 –	30000	393/-	0	Sale order cancelled and

	Jalandhar	29.4.99				earnest money forfeited
4	M/s Anand Lime & Chemical, Yamuna Nagar	26.6.98 – 25.6.99	30000	322/-	2010	Security forfeited
5	M/s IFRC, Hissar	26.8.99 – 25.8.2000	20000	297/-	227	Security forfeited
6	M/s Trade Associates, New Delhi	15.1.01 – 14.1.02	15000	325/-	13500	Security forfeited
7	M/s R K Garg & Co., Panipat	27.7.02 – 26.7.03	20000	361.50	4739.86	Security forfeited
8	M/s Trade Associates, New Delhi	21.1.04 – 18.1.05	15000	250/-	7999.14	Security forfeited
9	M/s Trade Associates, New Delhi	26.8.06 – 25.6.07	15000	340/-	3950.76	Security forfeited
10	M/s Swastik Coal Corp. Pvt. Ltd., Indore	July 08 till date	15000	215/-	1194.955	Security forfeited

8. Investment and implementation action plan

Regarding investment and implementation action plan, tentative time frame for activities has been mentioned against each recommendation in the main report pages 72-80 in the last column – Implementation status/ time frame.

Annexure