ANNEXURE – DOCUMENT OF RISK ASSESSMENT

1.1 Risk assessment and management

Risk management is the process of analyzing the hazards or risks involved in operations and equipment, qualify them and work out preventive and corrective control measures to bring them to acceptable level. to reduce risk one has reduce either the probability of occurrences of an undesired event, its consequences (seriousness) or the duration of exposure.

The risk assessment and management is essential to guard against and mitigate the consequences of major accidents. The term, " major accident" means an unexpected and sudden occurrence of event from abnormal developments in course of one's industrial activity leading to a serious danger to public or environment, whether immediate or delayed, inside or outside the installation involving one or more hazardous substances. The risk assessment study is done by using Risk Rating Scale on Consequence, Exposure and Probability with weightage given on accident and the judgment of the work persons.

Keeping in view the three basic principles i.e. prevention, preparedness (both proactive and reactive) and mitigation of effect through rescue, recovery, relief and rehabilitation; a comprehensive blue print of Safety Management Plan (SMP) has been prepared and in operation for Jayant OCP incorporating the following:

- Identification and assessment of risks
- Recommendation of measures to prevent damage to life and property against such risks.

The work Programme is documented as Emergency Management Plan (EMP)

1.1.1 Slope failure in mine pit

The exposed ends of the coal seams and OB may fail due to slope failure and collapse of benches. A safe slope is being maintained for exposed ends of the coal seams and OB to avoid slope failure and collapse of benches. Similarly, at the end of mining operation safe terminal pit slope will be provided to avoid failure.

All the working benches are under the direct supervision of project level officials and all the necessary precautions are being taken to make the workings safe.

The following pit design parameters have been adopted.

For coal seams

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
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</thead>
<tbody>
<tr>
<td>Bench height (max)</td>
<td>15m</td>
</tr>
<tr>
<td>Width</td>
<td>45m</td>
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<tr>
<td>Slope</td>
<td>80°</td>
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</table>
For OB strata (Shovel Dumper)
Shovel bench height : 10-12m
Working bench width  : 57-63m
Bench slope          : 70°

For OB strata (Dragline)
Bench height         : 6-7 m
Working bench width  : 75m
Bench slope          : 70°

Each cycle of operation shall consist removal of overburden followed by extraction of the exposed coal. After extraction of coal no body shall be employed/no work to be done at any of the benches or bottom of quarry till benches in OB & coal are provided again from top downwards and coal is again exposed.

1.1.2 Slope failure in OB Dump and management
During the process of OB removal by draglines, 10 m wide corridor was left and maintained at Turra seam top floor and at the same time a 15 m wide corridor was also being left at the sitting level of draglines on the dump side which facilitated uniform formation of profile of draglines cast dump. Maximum dump height of dragline cast dump was less than 60m which was below the permission limit and also the slope of this dump did not exceed the angle of repose of the dump material (37 to 37 Degree). At present slope of the dump was 28to 32 degree. Rib less mining method of extraction of Turra seam was being followed with a view to release hydrostatic pressure if built any time on the dumping side. After extracting Turra seam, about 10m wide strip from the toe of the Turra seam bench was being blasted off which facilitate draining out of accumulated water and at the same time it also helped in providing good bearing surface for dumping OB of the next cut. Present depth of the mine was about 200m from ground surface. Hugh volume of OB about 1.40 to 1.50 Lakh cum was being dumped/loaded continuously on the east side and west side dumps. Dumps were being monitored by Target less Total Station survey instrument targeting at fixed pegs kept on dump slope of dragline dump.

A continuous monitoring “dump & pit slope stability radar (SSR)” with integrated visual imaging system or any other such technology giving real-time displacement of strata and dumps and warn well in advance of any impending failure of pit slope or dump slope, to ensure safe and timely withdrawal of men and machinery from such prone areas, should be installed and put into operation in a time bound manner. A protocol for such monitoring shall be developed in consultation with DGMS and scientific agencies.
A geotechnical cell should be established at the mine level as well as company level to implement, maintain, monitor and control various geotechnical activities for safe and economic exploitation of coal from the mine, and at the same time this cell would look after the dump management and monitoring. Height of both the dumps should be scientifically justified by a scientific body.

**Slope stability study:** A detailed Dragline Dump slope stability study by BIT, Mesra, Ranchi has been carried out in Dec., 2010; with the help of a site specific computerized model. The recommendation are as below:

1. Factor of safety with consideration of seismic forces : 1.10
2. Factor of safety without consideration of seismic forces : 1.20
3. Slope of dump w.r.t. horizontal plan passing through Toe of dump : 36.5°
4. Height w.r.t. mine floor : 79 m
5. Height w.r.t. horizontal : 85 m

### 1.1.3 Blasting

Deep hole drilling and blasting are being conducted using SME, Safety Fuse, NONEL, Electric detonators, Electronic detonators and chord relay. Different dia holes are drilled as per availability of drill machines. In outsourced patch only 150mm dia holes are drilled whereas 260 mm to 311mm dia holes are drilled in departmental areas. 65 kg to 95 kg explosives are being charged depending on the bench condition, hole drilling pattern. In dragline bench of 27m high and hole of 300mm, 2 tonne explosive is being charged per hole. At a time 30 to 40 deep holes were blasted off. In outsourced patches, 240 to 300 holes were blasted at a time. One Blasting officer is appointed in the mine who is given the responsibility of conducting efficient blasting operation.

For proper blasting and minimising the adverse side effects due to blasting via noise, ground vibration, air blast, fly rocks etc., the following precautions are being taken to avoid dangerous situation:

- The optimal blast design parameters are maintained
- A safety zone for blasting has been provided around the quarry.
- Suitable drilling pattern.
- Before blasting is done, warning sound is given so that people can move to safe places.
- Controlled blasting with site mixed slurry.
- Optimisation of maximum quantity of explosive in a blast hole.
- Blasting will be done in daytime at a fixed time.
- Regular vibration monitoring is carried out and necessary precautions are taken while blasting.
- Blasting is carried out in conformity of extant laws with closer control of blasting parameters including blasting results like desire fragmentation, permitted vibration, etc.

1.1.4 Explosive handling

The present day technology of blasting with Site Mixed Slurry (SMS) explosive shall be used with millisecond delay detonators that are initiated by shock tube initiation system. To avoid any accident, SMS is stored by the supplier as per GOI Notification. Further, transport and charging are also done by the supplier on the spot. Only priming will be done by the project authority the relevant statutory safety provisions as stipulated by DGMS, Chief Controller of Explosives and others are followed.

1.1.5 Mine inundation

The mine pit receives water from three sources namely, direct precipitation over excavated area, surface run-off from the surrounding areas and seepage from the strata. During heavy rainfall, there may be a situation when the mine may get flooded due to ingress of water from the higher ground through natural drainage. This may cause loss of human life, equipment etc. To guard against this eventuality, the following steps are taken:

- Calculation of sump capacity based on maximum rainfall in a day and pumping capacity for 18 hours.
- Installation and maintenance of pumps after calculating the anticipated quantity of inflow of water during a day of peak monsoon rain.
- Provision of garland drain around the mine to prevent ingress of precipitation, run off & keeping the same.
- Provision of sufficient number of pumps to pump out mine water during the critical rainfall period.
- Precaution against danger from local stream.
- Channelised rain water should not be allowed from dump top to enter into rain damaged area having undulating deep rain cut surface. Water should be coursed on toe side of dump top through kacha drain of 5m x 2m dimension.
- Berms of minimum 1.5m height should be constructed 2-3 m away from crest part.
- In order to reduce the rate of silt generation and silt flow as a long term measure, technical reclamation (dozing, filling and proper benching) should be done followed by biological reclamation for growth of plants.

The pumping system mine has been designed to dewater the inflow of water due to precipitation falling within the active pit limit during the
monsoon season and the ground water discharged from aquifers to enable the mining activity to continue round the year.

The planning of de-watering of the mine has been done in such a way that as far as possible the working faces and haul roads remain dry. The lay out of the quarry provides suitable gradient along the quarry floors and the benches to facilitate self-drainage of water to the lowest level of the quarry.

The intake of rainwater to the opencast mine is non-uniform during the year. The maximum rainwater intake will be during the period of about four months (June to September) in a year. During dry season, seepage from strata is expected to be moderate and the same can be dealt by running a few number of pumps provided for monsoon pumping. During this period, repair & overhauling of the pumps will be done by rotation.

1.1.6 Fire

Accidental fires are causes of large scale loss of property and life. Keeping this in view, adequate fire fighting arrangement has been made. Adequate number of fire extinguisher has been provided for store and other service buildings. While calculating total water demand for the project, provision for firefighting has also been made.

As per the record as maintained, there were number of occurrences of fire in the mine. Fire occurred in dumpers, shovels, dozers, graders etc. many times due to overheating and short circuiting. Thick seams are susceptible to spontaneous heating and as a result fire occurs in coal benches and also coal stock yards Limited exposure of coal benches with restriction on left over of loose blasted coals is one of the important control measures. The blasting for a limited quantity of coal which could be evacuated on the same day is also a precautionary measure against danger of fire.

Regular mock rehearsal for fire fighting in emergency situation is also practiced.

For fighting fire and to look after the firefighting organization, a Fire Officer is appointed at the mine. Under him three executives, three drivers and 4 to 6 general mazdoors are distributed in shifts. Two fire tenders and 2 water tankers are also available under the control of the Fire Office. Automatic Fire Fighting System has been provided in CHP.

- Central Fire Fighting Station

There is one Central Firefighting Station under CISF having mobile fire fighting equipment’s and trained manpower to cater to the needs of all the projects of Singrauli Coalfields has been constructed and in operation at Jayant Project.
Adequate fire fighting arrangement has been provided. Adequate number of fire extinguishers has been provided for stores and other service buildings. While calculating total water demand for the project, provision for fire fighting has also been made.

1.1.7 Haul road maintenance

To avoid road accident further haul roads have been planned in such a way that the HEMM traffic remain away from the passenger traffic. Total length of haul roads in the mine is about more than 45 km. Haul road for rear dumpers are designed with double lane and shoulders on both sides for movement of dumpers and ancillary equipment. Sharp turnings have been avoided to reduce the chance of accidents. The haul road has been designed at a gradient of 1 in 16. Sufficient arrangements for illumination of roads including haul roads have also been made. Road crossings have been properly planned and designed to prevent vehicular accidents. The dumpers are fitted with sound warning while reversing. These measures are likely to prevent road accidents. A Senior Assistant Manager is appointed for the design, construction and maintenance of haul roads. He should also be given the responsibility for effective implementation of traffic rules and at the same time he should also ensure the conduct of air born dust survey and suppression of dust by water spraying on haul roads. For this purpose, a proper organization should be in place to support the team leader.

1.1.8 Illumination and communication

Sufficient lighting as per standards has been provided at all the required places, i.e. working faces, OB dump area, haul road, coal transfer points, loading points, CHP, workshop, etc., to avoid accidents and to create efficient working conditions. Tower Mast light fittings are to be installed at junctions for further improvement of lighting. Provisions for efficient communication systems (both internal and external) to allow communication link amongst various work centers to help avoid accidents and handle emergencies have been made.

1.1.9 Training

Coal industry has set up a number of training institutes for imparting training to its employees. In project level, Vocational Training Centre and at company level C.E.T.I cater the need of the training. These trainings are meant to raise awareness amongst workers for performing their duties properly with safety.

Further, the personnel directly responsible for handling emergencies are given training for making them better equipped for discharging the responsibilities. Mock drills for checking the risk management preparedness are being carried out regularly. Env. Awareness & need base training is given to all employees under IMS.
1.1.10 Medical preparedness

For guarding against accidental hazards the following measures are being taken:

1. Emergency ambulance service is kept ready on a 24 hour basis.
2. Doctor and paramedical staffs are made available during emergency.
3. First aid medical facilities exist at work place.

The mine hospital has already been provided with requisite facilities and qualified doctors to meet the medical emergencies arising out of accidents

For guarding against occupational and community health hazards, the following measures will be taken:

- Steps to control respirable dust improve workplace environment and reduce noise nuisance.
- Periodic Medical Examination (PME) of workers.
- Rehabilitation and treatment of workers affected and suffering from early stages of occupational diseases associated with coal mining.
- Availability of improved medical facilities.

AN Occupational Health study was conducted by NIOH Ahemdabad during Nov.-Dec.’ 2014 for population in NCL area. The study includes Environmental monitoring and Health monitoring of NCL workers for all the 10 projects.

1.1.11 Other miscellaneous measures

Following facilities exist:

- Provision of workshops for maintaining HEMMs and other equipment properly for avoiding their failures as well as the risk of accidents.
- Provision of store for spare parts for quick maintenance
- Fire alarm and firefighting system has been provided at the project site

The adoption of preventive measures as enumerated above ensures that the operation of this project remains safe as well as environment friendly.

Also, a Safety Management System development of safety management plan for Jayant Project by Pabsta Engineers India Ltd., Kolkata in year 2017. The Risk Assessment Plans for various Risks & hazards developed for Jayant mine has been implemented.
1.1.12 Safety & conservation

➢ Safety

The rules & regulations made under Mine’s Act, 1952 should be observed for all kinds of mining operations and required safety measures taken.

Circulars issued from time to time regarding safety measures should be implemented. In order to ensure safety to the personnel and equipment of the mine and to improve the working conditions of the mine, the operational plan envisages following measures mainly:

- Attempts are being made to remove/dress down the loose material/overhangs from highwall side to prevent any accidental falling of the same while advancing the key cut.
- Coal winning by shovels and drilling on the roof of the coal seam under dragline reach is prohibited.
- Coal is prone to spontaneous heating and catches fire. Steps are being taken to solve fire problems at the project.
- Sufficient width of haul road is provided/recommended.
- Atleast safety berm should be left on the benches.
- Stability of bench and dump slope is taken into consideration. If there is violation in bench/dump slope then the precautions are given in the operational plan.
- Gradient of haul road is maintained be within permissible limit.
- Communication network inside the mine should be strengthened.
- There should be intensive training on safety so that the workers/operators become more conscious of this vital issue.
- Compulsory medical examination of workers, staff and executives is being carried out and a systematic record of medical examination should be maintained. This keeps the persons in fit condition and enable them to discharge their duties efficiently.
- Measures are suggested for dust control and pollution control.
- After the risks are identified, appropriate risk control measures will be taken to prevent or minimize accidents.
➢ Conservation

- Rising coal demand profile coupled with limited coal reserves warrant immediate measures for conservation of coal.
  
  ▪ The operational plan suggests following strategies to minimise coal losses and to improve conservation of coal.

  ▪ There is an additional coal loss in coal rib left by dragline and at the end of the cut. Attempts shall be made to minimise such losses of coal and coal extraction should be up to the fixed floor boundary. Attempts should also be made to take all the exposed coal from the mine floor.

- On the main dragline bench, drilling is not recommended below the roof of coal seam to avoid mixing of coal with OB due to blasting and to minimise coal loss.
  
  ▪ Action shall be taken to solve fire problems so that coal loss due to fire can be minimised.

- Care should be taken in dumper loading so that there is no loss of coal during transportation. Attention should be given to minimise carpet losses of coal from coal yards.

- Due care should be taken for seam roof cleaning.

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