

## CHAPTER – VI

### ENVIRONMENTAL CONTROL MEASURES

#### 6.0 ENVIRONMENTAL CONTROL MEASURES

#### 6.1 Socio Economic Measures:

##### 6.1.1 Resettlement/Rehabilitation

This is an underground mining project and comprises forest land and tenancy land. There will be no displacement of the people and therefore no involvement of resettlement/ rehabilitation is required for the proposed Vijay West UG mining project.

##### 6.1.2 Secondary Employment opportunities

There will be spontaneous economic stimulus in the area with the commencement of underground mines. Some traders and private enterprises will grow in the area with this economic growth. Besides, the State exchequer will derive financial revenues through levy of royalty, sales tax etc. and Central Government will also be benefited by way of Central Sales Tax, Income Tax, Cesses etc.

##### 6.1.3 Educational Facilities

There are several educational institutions of various standards managed by both public and private sectors/bodies in the area by SECL and State Govt.

It is proposed to provide primary school, dispensary, vocational training, centre and training institute for the employee and then will cater the nearby villages.

##### 6.1.4 Preventive measures:-

The SECL authorities have adopted following measures to prevent occupational diseases and health hazards.

- \* Pre-employment, pre-placement and periodic medical examination of employees.
- \* Regular monitoring of working environment and implementation of safety and control measures, to prevent hazards.
- \* Use of protective equipment, clothing, helmets, Gas mask, shoes, etc.
- \* Periodical medical examination of every worker is necessary to be done once in five years to detect preventable and curable diseases at an early stage.
- ‰ Cases suspected having Pneumoconiosis is to be examined by a Special Board constituted by the Chief Medical Officer. Established cases will be suitably compensated and their job shall be changed if required.

#### 6.1.5 Literacy Drive:

An action plan for achieving 100% literacy among workers in the SECL, was launched in the year 1992. Under the same scheme, workers of Vijay West Underground project will be covered to achieve 100% literacy level.

### 6.2 **Control measures for air pollution**

Following air pollution control measures are and will be practised within the mining area and at coal handling plants and railway siding site.

- a. Water spraying by water Sprinkler will be done regularly on approach roads within the mining area to minimise the dust generation.
- b. Water sprinkling arrangement will be provided at the transfer point of coal.
- c. Approach road from mine-face to despatch site will be suitably constructed to minimise the generation of fugitive dust.
- d. Minimising the transport of coal from the underground mine to loading system through belt conveyor will be provided.

To keep the air quality within limits, following steps will be adopted:

1. Approach road will be properly stabilised and sprinkled with water.
2. Water sprinkling on approach roads, specially, during dry weather conditions.
3. Intensive plantation of 20-30 width all along the approach road will be raised to minimise transport generated pollutants.
4. Regular monitoring of ambient air quality of project area.

### 6.3 **Water Management**

#### 6.3.1 Mine Water Discharge & Industrial Effluent

The mine water discharge needs treatment before discharge to the surface water drainage. The collected water at the floor of mine sump will be pumped to the settling tank where suspended solids will get settled. The clear water after sedimentation will be reused for water sprinkling, plantation etc. The CHP effluent will be diverted to industrial effluent treatment plant constructed for workshop effluent. The combined effluent will be treated in this plant.

### 6.3.2 Domestic Effluent Treatment

Domestic effluent is to be treated in conventional Soak-Pit system for the colony and service buildings. The capacity of the scheme will be designed to cater the need of colony and service buildings.

### 6.3.3 Water Conservation

The recycled water will be used for dust suppression, vehicle washing purposes and horticulture.

### 6.3.4 Water Quality Monitoring

For complying with the statutory provision of MOEF and Pollution Control Board, fortnightly water quality will be monitored and evaluated. The corrective measures will be taken on the basis of monitoring results.

## 6.4 **Control measures for Noise**

The present noise levels are below the prescribed limits. If the impulsive noise levels increase due to mining operation, sufficient measures will be adopted to maintain the noise level within permissible limits at working zone.

The following measures are adopted and will be followed:

1. Planting of rows of trees with thick foliage along roads and other noise generating centres to act as acoustic barriers.
2. Isolating/enclosing the noisy machines/sources by using resilient mounting/altering structures.
3. Routine maintenance of machinery to eliminate noise as far as possible.
4. Balanced and properly aligned conditioning of machines to reduce vibration.
5. Provision of ear muffs/ear plugs to workers subjected to noise level above recommended limits.
6. Regular monitoring of noise level of project area.

## 6.5 **Green Belt Development**

### 6.5.1 Green Belt Around Mine

In the directions where natural forest does not exist, there is need for creating green belt to provide an effective dust and sight curtain in the periphery of mining area. The trees planted in the green belt area shall act as buffers and shock absorber against dusts, noise and stone flying. The trees in the green belt will be tall, wind firm, broad leaved and evergreen. The planting of the green belt will be started in second year.

The first ten rows from the mine will consists of Bauhinia, Subabool, Karanj, Neem, and the rest rows will be of Eucalyptus sps., Cassia siamea, Peltaphorum, Dalbergia etc. at 2x2 meter spacing (approx.).

### **6.5.2 Approach roads**

Along the roads, 3-4 rows of evergreen and dust resistant plants as mentioned above will be planted. These may also be raised in triple storey fashion.

## **6.6 Subsidence Management**

Considering the impacts of subsidence on surface topography, forest and surface features, the following subsidence management aspects are required to be undertaken to minimise adverse effects.

- i) To limit the tensile strain within 20 mm/m in the forest area, it is suggested to restrict the thickness of extraction in most of the panels of seam III and in some of the panels of seam II (Top), which are shown in Table 5 and 6. It is also suggested that there should be a lapse of about 5 years between extractions of successive panels in superimposition. This will allow the strata to settle. Wherever, due to deployment of SDLs / Continuous miner, it is not possible to restrict the thickness of extraction, manual depillaring or partial extraction or development as a final operation may be planned.
- ii) With mitigative measures as suggested above, the maximum possible tensile strain likely to occur in the forest area is 19.98 mm/m. The maximum slope likely to occur after extraction of each seam is 39.96 mm/m, i.e. a tilt of  $2.3^{\circ}$ . Such tilts will take place in three steps and after a long interval of time of 5 years. So it is not expected to have any adverse impact on the trees. Thus, for the above amounts of slope and tensile strain the forest may not be considerably affected by subsidence. Only a limited number of trees falling on the edges of subsidence trough and surface cracks may get tilted or dislodged. This has been experienced during subsidence monitoring at Sobhapur, WCL and Jhanjra, ECL where the depth of cover were 105 and 45m respectively.
- iii) Due to subsidence, surface cracks likely to occur over the mining area, need to be filled up properly and regularly by clay and stone chips and thereafter with a 0.3m high clay heap over the cracks. It will help in achieving original drainage pattern

over the mining area, improve water retention capacity of the soil and avoid the chances of underground inundation and spontaneous heating.

- iv)** Subsidence may result into depression on the surface with accumulation of water during the rains. Such accumulation of water may be beneficial for vegetation in the forest. These water bodies may be retained wherever possible or drained out (by cutting drains) depending on safety of the underground workings.
- v)** Surface drains should be made outside of the subsidence area to prevent the surface water of adjoining area coming into active subsidence area.
- vi)** It is suggested that the mine management should form a team that will be responsible for the proper and regular filling of surface cracks formed due to subsidence. The team will also maintain record of the development and filling of surface cracks. Adequate supply of filling materials should be arranged by mine management at the site.
- vii)** To protect the surface features, like roads, villages, nallas and area proposed for infrastructures, coal pillars are to be left un-extracted vertically below and within the subsidence influence area.
- viii)** Provision has to be made for compensatory afforestation and strengthening of forest cover to take care of losses, if any.
- ix)** Tenancy/agriculture land over the mining area is likely to be affected by subsidence. Thus, crop compensation is to be paid to the tenancy land owners and subsequent reclamation by filling and consolidation of the land. Payment of crop compensation has also been recommended in the project report during the year when depillaring will be done below the tenancy land.

The impact of subsidence on different surface features and forest land along with the degree of damage are provided in Annexure I for reference, i.e. the “Subsidence Impact Matrix”. The Subsidence Impact Matrix (SIM) shown therein was developed under a Ministry of Coal funded S&T project.

**CONCLUSION:**

- i) Considering the extraction thickness as proposed in the project report, the anticipated maximum possible subsidence over the mining area is 3.567m. The estimated tensile strain values in the forest area due to extraction of seams III and II (Top) individually and after extraction of all the three seams are exceeding the limit prescribed by MOEF, i.e. 20 mm/m, for certain panels. Such amount of tensile strain is likely to develop surface cracks more than 300mm wide in the forest area.

To restrict tensile strain within the permissible limit in the forest area, some control measures have been suggested, such as restricting the thickness of extraction in the panels of seam III and seam II (Top) and there should be a lapse of about 5 years between extraction of successive panels in superimposition. This will allow the strata to settle. These mitigative measures are shown in Tables 5 and 6. Wherever, due to deployment of SDLs / continuous miner, it is not possible to restrict the thickness of extraction, manual depillaring or partial extraction or development as a final operation may be planned.

- ii) With control measures (mitigative measures), the anticipated maximum possible subsidence in the forest area is 2.978m. The estimated maximum possible tensile strain likely to occur is 19.98 mm/m, due to which the width of surface cracks likely to occur is less than 300 mm. The maximum slope likely to occur after extraction of each seam is 39.96 mm/m, i.e. a tilt of  $2.3^{\circ}$ . Such tilt will take place in three steps and after a long interval of time of 5 years. Thus, it is not expected to have any adverse impact on the trees.
- iii) It is anticipated that with mitigative measures, as suggested above, there will be no appreciable damage to the forest. Only a limited number of trees falling on the edges of subsidence trough and surface cracks may get tilted or dislodged.
- iv) Provision has to be made for compensatory afforestation and strengthening of forest cover to take care of losses, if any.

- v) Surface cracks formed due to subsidence will need to be filled up with clay and stone chips and thereafter with about 0.3m high clay heap over the cracks. It will help to achieve original drainage pattern over the mining area, improve water retention capacity of soil, minimise the top soil erosion and avoid the chances of underground inundation and spontaneous heating.
- vi) It is suggested that mine management should form a team that will be responsible for proper and regular filling of surface cracks developed due to subsidence. The team will also maintain record of the development and filling of surface cracks. Adequate supply of filling materials should be arranged by mine management at the site.
- vii) Surface drains should be made outside the subsidence area to prevent the surface water of adjoining area coming into active subsidence area.
- viii) For the safety of the underground workings it will be necessary to drain all water bodies in the subsidence area while extracting panels in the lower seams. It is also suggested that dewatering of the goaves of upper seam should be continued as long as the lower seam is worked to prevent the formation of large water bodies over the working area.
- ix) The topography of the mining area is gently undulating and the ground elevation varies from 435 to 515m, i.e. a difference of elevation of 80m. For such terrain, the maximum anticipated subsidence of 2.978m is unlikely to extensively affect the drainage pattern in the area. However, subsidence may result in the formation of depressions over the centre of the panels where water may accumulate during rains. The accumulation of water may be beneficial for vegetation in the forest, thus the desirable water bodies may be retained after all the three seams are extracted.
- x) The surface features, such as villages, PWD road and forest roads, existing over the mining area are unlikely to be affected by subsidence.
- xi) Except at three places, all the nallas flowing over the mining area are unlikely to be affected by subsidence. The above said three places where nallas are likely to be affected by subsidence need to be protected by leaving coal pillars un-extracted

vertically below and within the subsidence influence area, i.e. coal pillars to be left un-extracted in the panel M5 of seam II (Top) and in the panels T11 and T17A of seam III.

- xii)** Tenancy land / agriculture land over the mining area is likely to be affected by subsidence. Thus, crop compensation to be paid to the tenancy land owners and subsequent reclamation by filling and consolidation of the land.
- xiii)** Considering the above suggested mitigative measures and recommendations the extraction of coal seams at Vijay West Project may be done

It is recommended that while carrying out extraction in the panels of top seam III, close subsidence monitoring should be done and their impacts and effectiveness of the mitigative measures be reviewed before starting depillaring in lower seams. On the basis of observed data, necessary correction in subsidence estimation may be done, if required.

**Table 1 : Anticipated maximum possible subsidence, slope and tensile strain overmining area after extraction of seam III, without control measures**

<b>Panel No.</b>	<b>Av. Width</b>	<b>Av. Depth</b>	<b>Extraction Thickness</b>	<b>Maximum subsidence</b>	<b>Maximum slope</b>	<b>Maximum Tensile strain</b>	<b>Likely width of surface cracks</b>
	(m)	(m)	(m)	(mm)	(mm/m)	(mm/m)	(mm)
T1	82.8	30	3.2	1376	91.73	45.87	>300
T2	82.8	30	3.5	1505	100.33	50.17	>300
T3	82.8	30	3.5	1505	100.33	50.17	>300
T5	82.8	39	3.6	1548	79.38	39.69	>300
T6	82.8	40	3.6	1548	77.40	38.70	>300
T7	82.8	45	3.6	1548	68.80	34.40	>300
T8A	64.0	35	3.6	1355	77.43	38.71	>300
T8B	82.8	50	3.6	1548	61.92	30.96	>300
T9	82.8	55	3.6	1548	56.29	28.15	>300
T10	82.8	35	3.6	1548	88.46	44.23	>300
T11	82.8	45	3.6	1548	68.80	34.40	>300
T13A	88.8	35	3.6	1548	88.46	44.23	>300
T13B	88.8	70	3.6	1348	38.51	19.26	<300
T14	88.8	60	3.6	1548	51.60	25.80	>300
T15A	88.8	55	3.6	1548	56.29	28.15	>300
T15B	88.8	80	3.6	1273	31.83	15.91	<200



Panel No.	Av. Width	Av. Depth	Extraction Thickness	Maximum subsidence	Maximum slope	Maximum Tensile strain	Likely width of surface cracks
T17A	60.0	25	3.0	1290	103.20	51.60	>300
T17B	82.8	35	3.0	1290	73.71	36.86	>300
T22	88.8	78	3.6	1458	37.38	18.69	<300
T29	82.8	44	3.6	1548	70.36	35.18	>300
T30	82.8	42	3.6	1548	73.71	36.86	>300
T31	82.8	40	3.6	1548	77.40	38.70	>300
TMD1R	106.8	80	3.0	1213	30.33	15.16	<200

**Note :** To limit the tensile strain below 20 mm/m in the forest land, mitigative measures required to be undertaken are given as in table-5:

**Table 2 :** Anticipated maximum possible subsidence, slope and tensile strain over mining area after extraction of seam II (Top) only, without control measures

Panel No.	Av. Width	Av. Depth	Extraction Thickness	Maximum subsidence	Maximum slope	Maximum Tensile strain	Likely width of surface cracks
	(m)	(m)	(m)	(mm)	(mm/m)	(mm/m)	(mm)
M2	82.8	50	2.2	1122	44.88	22.44	>300
M5	82.8	42	2.2	946	45.05	22.52	>300
M6A	109.8	30	1.8	774	51.60	25.80	>300
M6B	109.8	57	2.0	1020	35.79	17.89	<200
M7	109.8	62	2.0	1020	32.90	16.45	<200
M8A	109.8	43	1.8	774	36.00	18.00	<200
M8B	109.8	68	2.0	1020	30.00	15.00	<150
M10	109.8	50	1.9	969	38.76	19.38	<300
M12	106.8	72	2.8	1428	39.67	19.83	<300
M13	106.8	80	3.0	1530	38.25	19.13	<300
M14	106.8	70	3.0	1530	43.71	21.86	>300
M21	106.8	100	2.8	1323	26.46	13.23	<150
MMD3	106.8	40	2.2	946	47.30	23.65	>300
MMD1R	106.8	100	2.8	1323	26.46	13.23	<150

**Note :** To limit the tensile strain below 20 mm/m in the forest land, mitigative measures required to be undertaken are given in Table 6.

**Table 3 : Anticipated maximum possible subsidence, slope and tensile strain over mining area after extraction of seam I only, without control measures**

<b>Panel No.</b>	<b>Av. Width</b>	<b>Av. Depth</b>	<b>Extraction Thickness</b>	<b>Maximum subsidence</b>	<b>Maximum slope</b>	<b>Maximum Tensile strain</b>	<b>Likely width of surface cracks</b>
	(m)	(m)	(m)	(mm)	(mm/m)	(mm/m)	(mm)
L2	109.8	65	1.8	918	28.25	14.12	<150
L3	109.8	72	1.8	918	25.50	12.75	<100
L4	109.8	67	2.0	1020	30.45	15.22	<200
L5A	88.8	62	2.1	1071	34.55	17.27	<200
L5B	88.8	83	2.1	972	23.42	11.71	<100
L6	88.8	86	2.3	1002	23.30	11.65	<100
L7	106.8	45	1.9	817	36.31	18.16	<300
L9A	132.3	50	1.7	867	34.68	17.34	<200
L9B	80.0	67	1.7	768	22.93	11.46	<100
L9C	132.3	93	2.0	1020	21.94	10.97	<100
L11A	106.8	95	2.3	910	19.16	9.58	<100
L12A	106.8	100	2.5	1158	23.16	11.58	<100
L12B	106.8	125	2.5	860	13.76	6.88	<50
L14	106.8	75	2.5	1012	26.99	13.49	<150
L20	106.8	122	2.5	959	15.72	7.86	<50
L31	109.8	85	2.0	1020	24.00	12.00	<100
LMD1 R	106.8	125	2.3	959	15.34	7.67	<50
LMD3	106.8	75	2.7	1372	36.58	18.29	<300

**Note :** To limit the tensile strain below 20 mm/m in the forest land, restriction in thickness of extraction is not required, only a time lag of about 5 years is required to be implemented after extraction of the panels of seam II (Top) in superimposition.

**Table 4 : Anticipated maximum possible subsidence, slope and tensile strain over mining area after extraction of seams III, II (Top) and I, without control measures.**

Panel No.	Av. Depth	Maximum subsidence	Maximum slope	Maximum Tensile strain	Likely width of surface cracks
	(m)	(mm)	(mm/m)	(mm/m)	(mm)
T1, M2	50	1791	71.64	35.82	>300
T2, M2, L2	65	3191	98.18	49.09	>300
T3, L3	72	2033	56.47	28.24	>300
T5, M5	42	2042	97.24	48.62	>300
M5, L4	67	1900	56.72	28.36	>300
M6A, L5A	62	1759	56.74	28.37	>300
T6, M6B, L5B	83	3499	84.31	42.16	>300
T7, M7, L6	86	3567	82.95	41.48	>300
T8A, M8A	43	1482	68.93	34.47	>300
T8B, T9, M8B	68	2512	73.88	36.94	>300
L7	45	817	36.31	18.16	<300
T10	35	1548	88.46	44.23	>300
T11, M10, L9C	93	3534	76.00	38.00	>300
M10, L9A, L9B	67	1891	56.45	28.22	>300
T13A, T13B, M12	72	2937	81.58	40.79	>300
T14, M12, M13, L11	95	3118	65.64	32.82	>300
T15, M13, L12	125	3429	54.86	27.43	>300
T17AB	35	1290	73.71	36.85	>300
T15A, M14, L12A	100	2096	41.92	20.96	>300
T22, M21, L20	122	3405	55.82	27.91	>300
T29	44	1548	70.36	35.18	>300
T30, L31	85	2458	57.83	28.92	>300
T31	40	1352	67.60	33.80	>300
TMD1R, MMD1R, LMD1R	125	3495	55.92	27.96	>300
MMD3, LMD3	75	2318	61.81	30.91	>300
L14	75	1012	26.99	13.49	<150

**Note : To limit the tensile strain below 20 mm/m in the forest land, mitigative measures required to be undertaken are suggested in the Tables 3, 5 and 6.**

**Table 5: Anticipated maximum possible subsidence, slope and tensile strain over mining area after extraction of seam III, with control measures as indicated in mitigative measures column**

Panel No.	Extraction Thickness	Max. subsidence	Max. slope	Max. Tensile strain	Likely width of surface cracks	Mitigative measures for panels in forest area
	(m)	(mm)	(mm/m)	(mm/m)	(mm)	<b>Extraction thickness to be reduced from :</b>
T1	1.35	585	39.00	19.50	<300	3.2 to 1.35m/partial extraction/only development/manual depillaring
T2	1.35	585	39.00	19.50	<300	3.5 to 1.35m/partial extraction/only development/manual depillaring
T3	1.35	585	39.00	19.50	<300	3.5 to 1.35m/ partial extraction/ only development/manual depillaring
T5	1.80	774	39.70	19.85	<300	3.6 to 1.8m
T6	1.85	796	39.80	19.90	<300	3.6 to 1.85m
T7	2.05	882	39.20	19.60	<300	3.6 to 2.05m
T8A	1.60	688	39.32	19.66	<300	3.6 to 1.6m
T8B	2.30	989	39.56	19.78	<300	3.6 to 2.3m
T9	2.55	1097	39.90	19.95	<300	3.6 to 2.55m
T10	1.60	688	39.32	19.66	<300	3.6 to 1.6m
T11	2.05	882	39.20	19.60	<300	3.6 to 2.05m
T13A	1.60	688	39.32	19.66	<300	3.6 to 1.6m
T13B	3.60	1348	38.52	19.26	<300	Not required
T14	2.75	1183	39.44	19.72	<300	3.6 to 2.75m
T15A	2.55	1097	39.90	19.95	<300	3.6 to 2.55m
T15B	3.60	1273	31.82	15.91	<200	Not required
T17A	1.15	495	39.60	19.80	<300	3.0 to 1.15m/partial extraction/only development
T17B	1.60	688	39.32	19.66	<300	3.0 to 1.6m
T22	3.60	1458	37.38	18.69	<300	Not required
T29	2.00	860	39.10	19.55	<300	3.6 to 2.0m
T30	1.95	839	39.96	19.98	<300	3.6 to 1.95m
T31	1.85	796	39.80	19.90	<300	3.6 to 1.85m
TMD1R	3.00	1213	30.33	15.16	<200	Not required

**Table 6: Anticipated maximum possible subsidence, slope and tensile strain over mining area after extraction of seam II (Top), with control measures as indicated in mitigative measures column**

Panel No.	Extraction Thickness	Max. subsidence	Max. slope	Max. Tensile strain	Likely width of surface cracks	Mitigative measures for panels in forest area
	(m)	(mm)	(mm/m)	(mm/m)	(mm)	<b>Extraction thickness to be reduced from :</b>
M2	1.95	995	39.80	19.90	<300	2.2 to 1.95m
M5	1.95	839	39.95	19.98	<300	2.2 to 1.95m
M6A	1.35	581	38.73	19.37	<300	1.8 to 1.35m/partial extraction/development/manual depillaring only
M6B	2.0	1020	35.79	17.89	<200	Not required
M7	2.0	1020	32.90	16.45	<200	Not required
M8A	1.8	774	36.00	18.00	<200	Not required
M8B	2.0	1020	30.00	15.00	<150	Not required
M10	1.9	969	38.76	19.38	<300	Not required
M12	2.8	1428	39.67	19.83	<300	Not required
M13	3.0	1530	38.25	19.13	<300	Not required
M14	2.7	1377	39.34	19.67	<300	3.0 to 2.7m
M21	2.8	1323	26.46	13.23	<150	Not required
MMD3	1.85	796	39.80	19.90	<300	2.2 to 1.85m
MMD1R	2.8	1323	26.46	13.23	<150	Not required

**Note: A time lag of about 5 years is required to be implemented after extraction of the panels of seam III in superimposition.**

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