



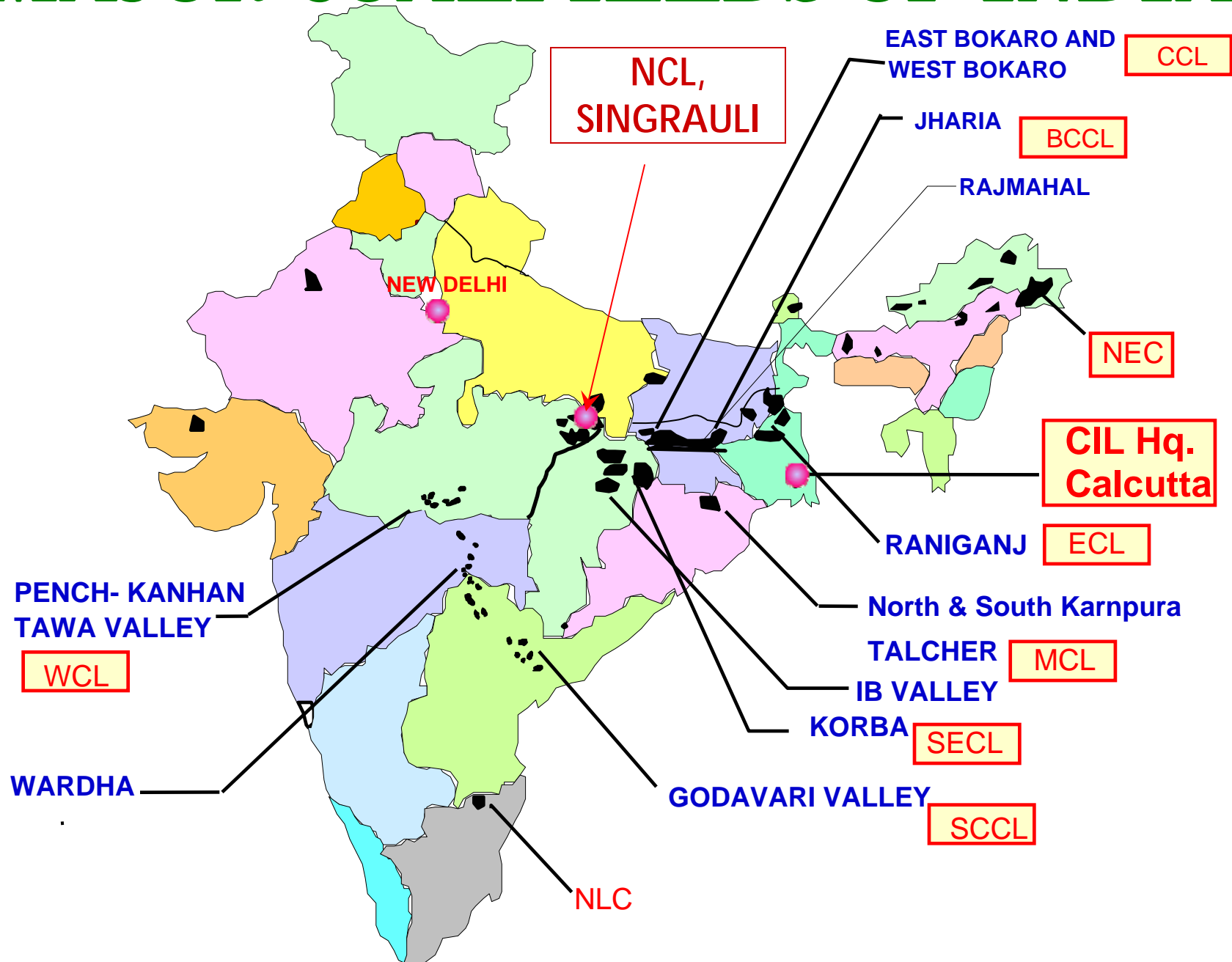
Northern Coalfields Limited

(AN ISO 14001 COMPANY)
(A Subsidiary of Coal India Limited)

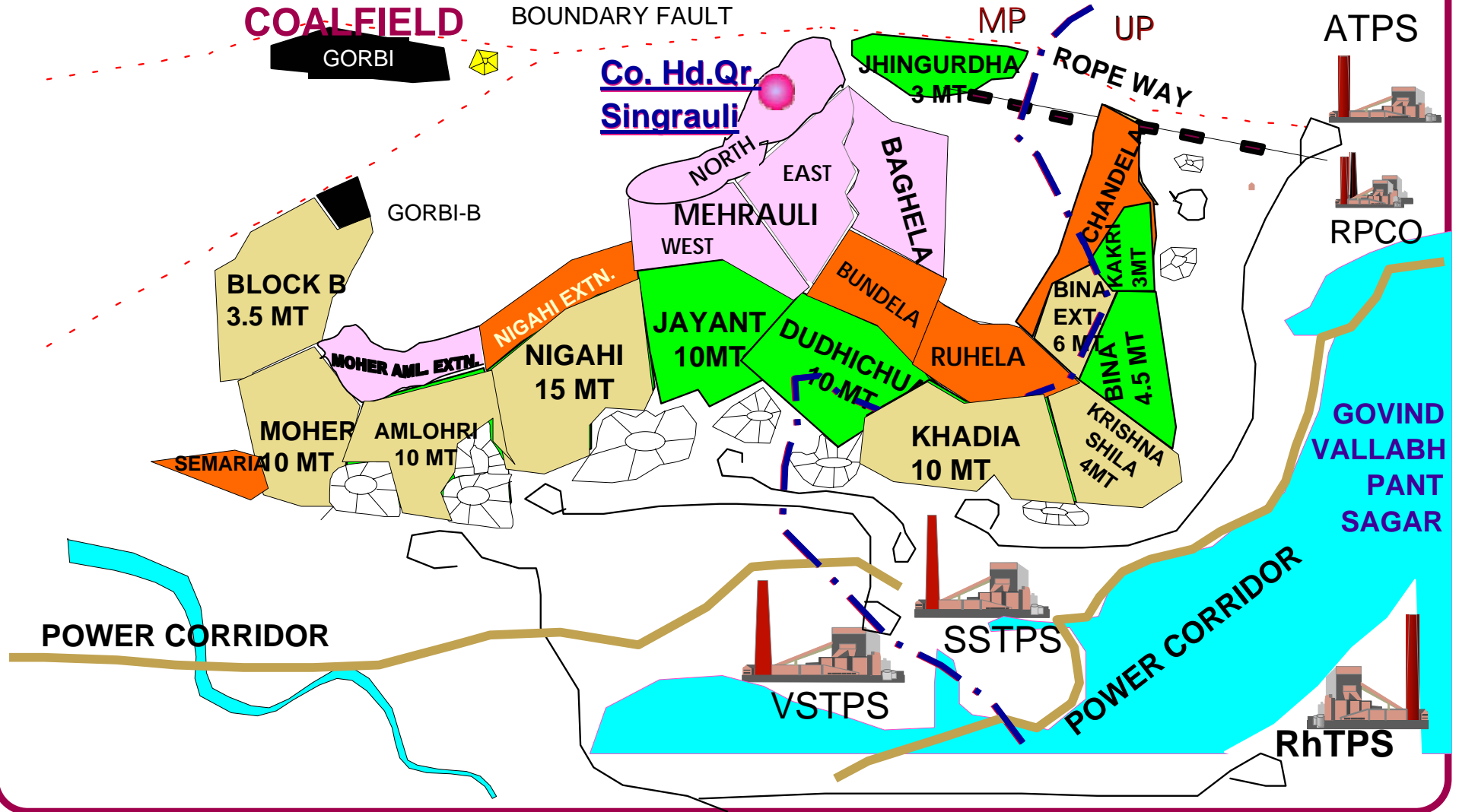


Overburden Dump Stability

MAJOR COALFIELDS OF INDIA



MASTER PLAN FOR MOHER BASIN - SINGRAULI COALFIELD



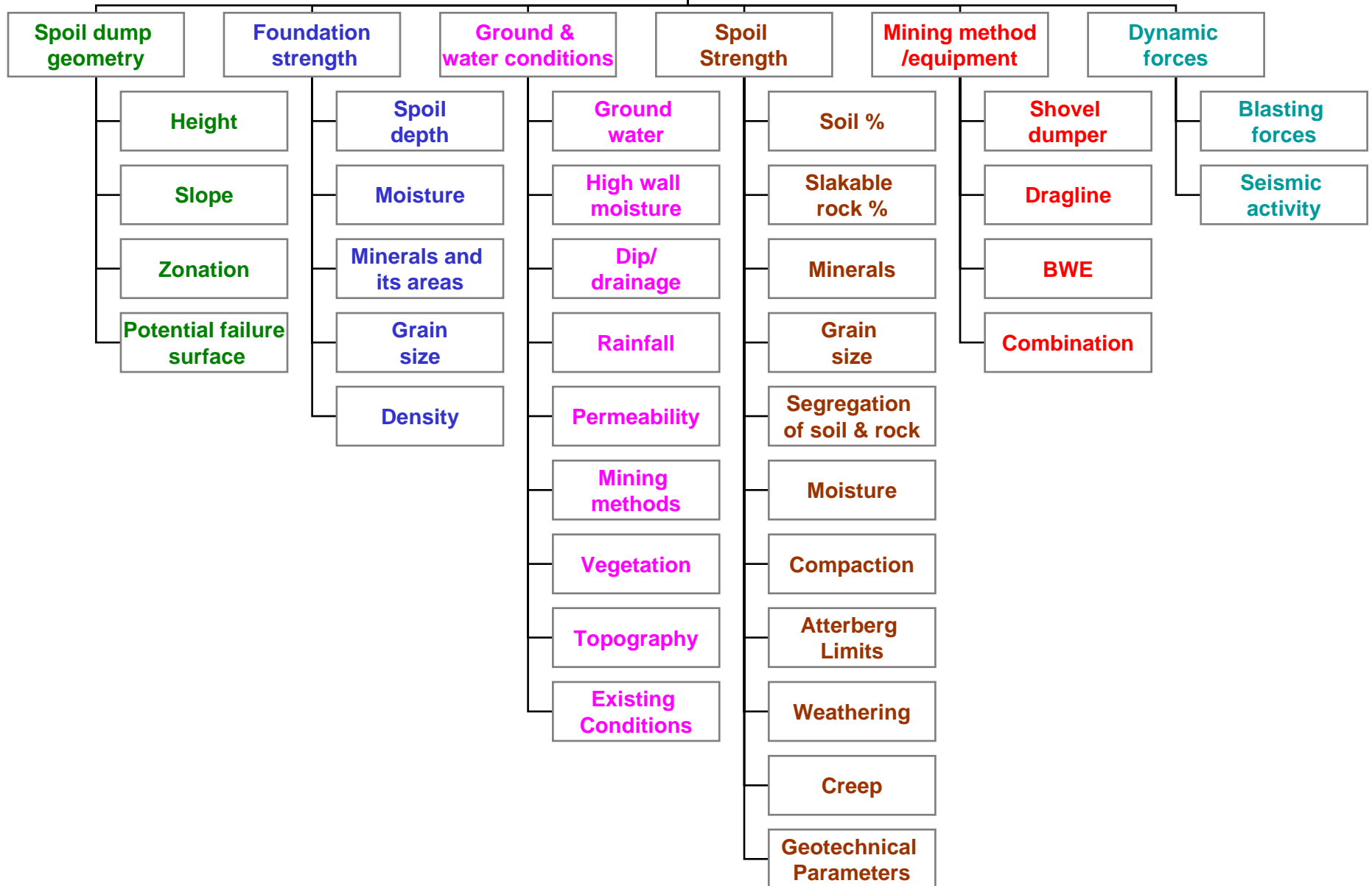
- COMPLETED PROJECTS
- EXHAUSTED MINES
- EXPLORATION COMPLETED

- NEW MINES UNDER FORMULATION
- PARTLY EXPLORED

INTRODUCTION

- *In opencast mining part of overburden removed above the economic mineral has to be dumped outside.*
- *A judicious dumping of the same ensures saving in ground and chances of any slide back or dangerous incidents / accidents in future.*
- *While very low height and flat dumps could be ideal from the points of stability, these would not only occupy lot of ground space but also prove very expensive.*
- *Hence, a balance has to be struck, maximum slope with minimum possible ground space to be occupied while ensuring that dumps do not slide and causes any untoward incident/ accidents.*

Parameters affecting the Overburden Dump stability



Overburden Dump Stability in the Context of NCL

- *NCL produces only power grade coal through 8 nos. mechanised opencast mines.*
- *NCL has produced about 770 Million Tonnes of Coal and removed about 2228 Million CuM of Overburden since 1964-65 with an average stripping ratio of 2.89 MCuM/Te.*
- *NCL has produced 51.52 Million Tonnes and 133.86 M.CuM. of Overburden removed during 2005-06.*
- *It is evident that huge amount of OB is removed in NCL. In the coming years OB Removal will further be increased to a great extent, more than 250 Million CuM by 2011-12 with an average stripping ratio of 3.64 for producing 70 MT of coal.*

Overburden Dump Stability in the Context of NCL

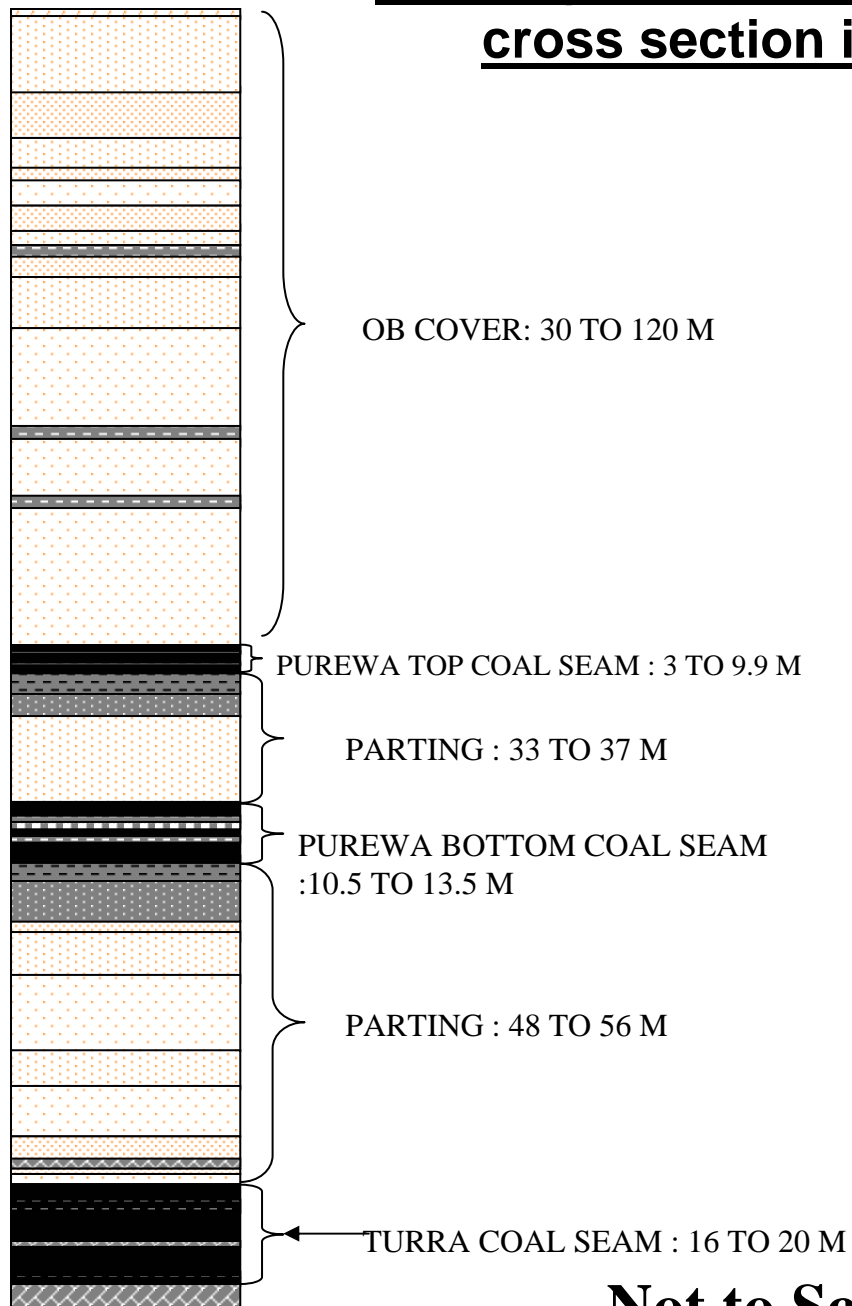
- *In Most (6) of the mines Overburden cover/parting between surface to Purewa Bottom seam (60m) is removed with shovel dumper combination.*
- *The parting between Turra and Purewa bottom is decapped first (15m) with shovel dumper combination and rest of the parting (about 35-45 m) is removed with draglines.*
- *External OB dump is kept to the bare minimum.*
- *Maximum possible OB is back filled in mined out area.*
- *Hence Overburden Dump Stability is very important aspect.*
- *There are few instances of Internal Dump failure in NCL Mines.*

Major Incidences of Dump Slides and Failures in NCL between 1994-2000

Date	10/09/94 & 03/10/94	10/0297, 28/05/97 & 12/01/2000	19/09/98 & 09/04/99	22/09/2000, 15/10/2000 & 14/11/2000
Season	Rainy	Winter, Summer & Winter	Rainy & Summer	Rainy, Winter & Winter
Location	400 m & 60 m from Mid Entry	400 m from Mid Entry, 120 m from Central entry & 20 from Mid Entry	400 m & 120 m from Mid Entry	150 m, 400 m & 400 from Central entry
Probable factor	Water accumulation behind coal rib	Dump Height up to 83.7, 82.5 & 88 M (and high dump slope angle)	Rib Fire	Large Accumulation water behind dragline dump , No corridor and no reverse grading

- *Hence, NCL has conducted scientific studies for stability of Overburden dumps through renowned institutes :*
 - *CMRI – Dhanbad*
 - *ISM - Dhanbad*
 - *CBRI - Roorkee*
 - *IIT- Kanpur*
 - *BHU –Varanasi*
 - *Giproshokt & State Research and development institute of Mine Geomechanics and Surveying(VNIMI) - Russia*
 - *CMPDI – Ranchi*
- *As per the recommendations of these studies dump parameters and stability provisions are made with the permission from DGMS for stability of dumps.*
- *Accordingly dumps are designed and managed in NCL.*

Litholog of a typical borehole cross section in NCL



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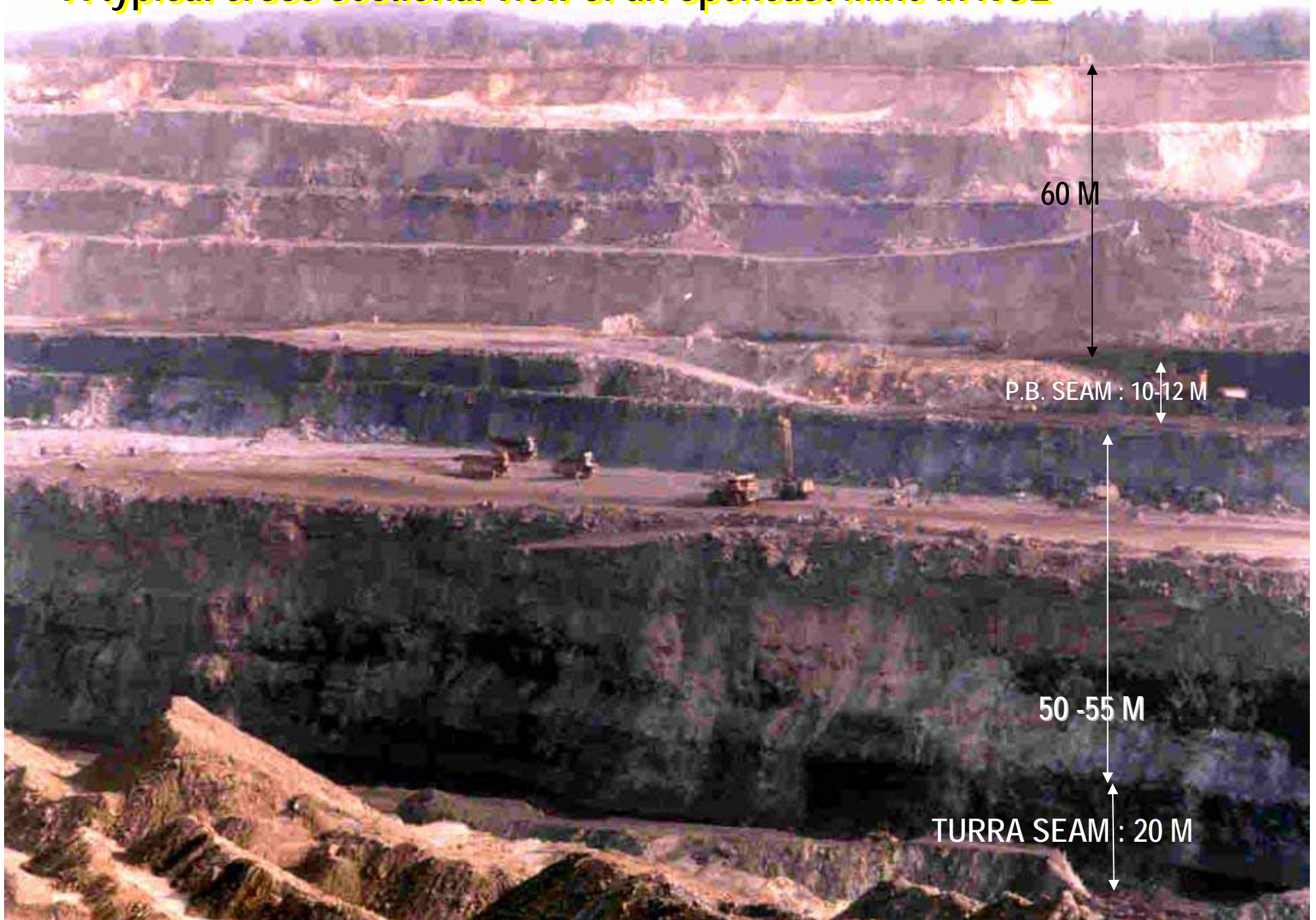
Soil / Sub Soil	
Coarse Grained Sandstone	
Medium Grained Sandstone	
Fine Grained Sandstone	
Coal	
Shale	
Carbonaceous Shale	
Sansy Shale	
Shaly Sandstone	

Not to Scale

Thickness & Uniaxial Compressive strength for different Litho-facies for a typical borehole cross section

Litho-facies	Thickness (m)	Percentage of Total Thickness(%)	Uniaxial Compressive Strength (Kg/Cm2)
Fine Grained Sandstone	60	25	55 to 227
Medium Grained Sandstone	36	15	18 to 132
Coarse Grained Sandstone	80	33	14 to 127
Shale	6	3	52 to 157
Carbonaceous Shale	5	2	63 to 347
Sandy Shale	10	4	234 to 298
Shaly Sandstone	5	2	72 to 273
Coal	38	16	50 to 216
Total	240		

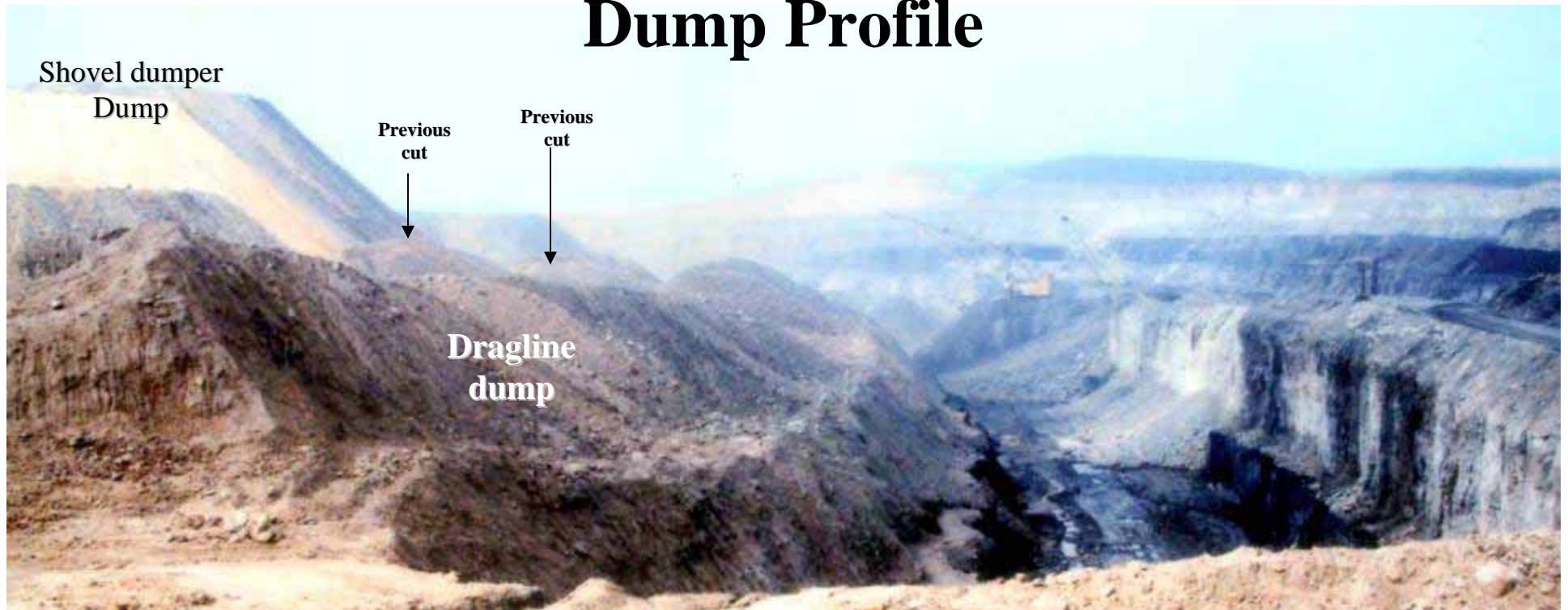
A typical cross sectional view of an opencast Mine in NCL



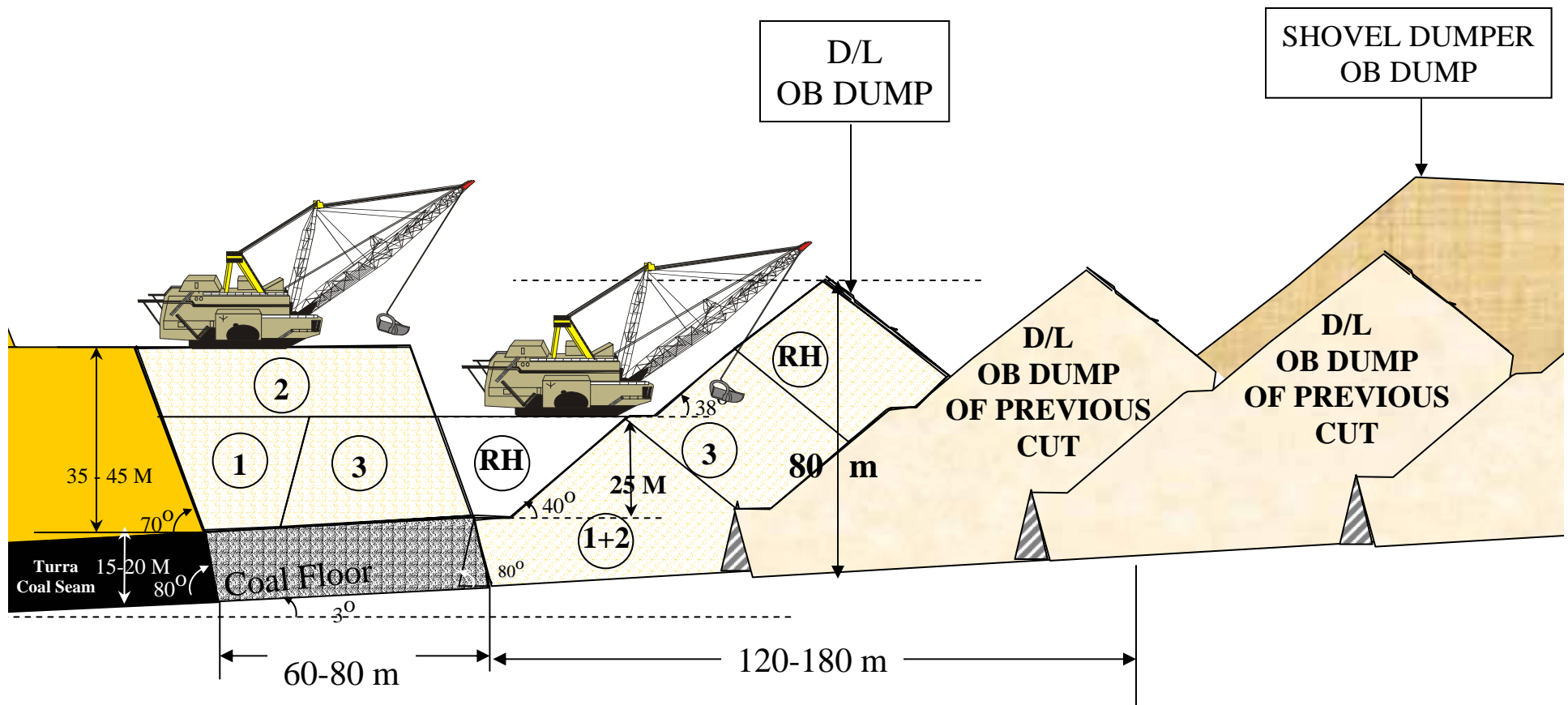
Internal Dumps

On the basis of the recommendations by CMPDI, Giprosokt & State Research and development institute of Mine Geomechanics and Surveying(VNIMI) the dump profile of internal dump for a maximum height of 80-90 m is designed and due permissions are sought from DGMS.

Dump Profile



Dump Profile for 80 m Height Internal Dump



STEPS TAKEN BY THE NCL TO AVOID DUMP SLIDES

- 1)For reliable dump stability two corridors of 8-10 m are formed, one at the level of rib top and one at the dragline sitting level.*
- 2)Dumping by Shovel dumper is not done on or near the currently created dragline dump to avoid the dead loading of the partially consolidated dragline dump. In most cases dumping by shovel dumper is done at least two cuts away.*
- 3)Dumping of topsoil is avoided at the bottom of the cut as it leads to instability. Dumping of soil and clayey material is done away from the working area, that is on the farther end of the dump so that formation of weak planes is avoided.*
- 4)While extracting coal ribs holes are not drilled right up to the floor but 4 to 5 metres is left against the floor. This in turn avoids formation of weak zone between the coal rib and floor of the seam.*

STEPS TAKEN BY THE NCL TO AVOID DUMP SLIDES

- 5) Sufficient time is allowed before deployment of HEMM after blasting in the coal rib for safety.*
- 6) Final regrading of internal dumps is done in such a way that rain water is drained outside the mine through drains and culverts.*
- 7) Retaining walls have been made in the mid entry roads to provide safety.*
- 8) Constant vigil is kept on the condition of the dumps by experienced competent officials and if any signs of movement are observed (like development of Cracks etc.). precautions are taken to ensure safety of persons and machines.*
- 9) Afforestation by planting trees has helped a lot in improving stability of dumps by preventing erosion.*
- 10) Height of the dragline bench is judiciously selected by decapping about 15 m parting just below the Purewa Bottom seam by shovel dumper combination system.*

A view of Draglines in tandem operations for exposing Turra Coal seam



TECHNICAL AND BIOLOGICAL RECLAMATION OF OB DUMPS

- *Stabilisation of OB dumps*
- *Construction of gabion retaining wall*
- *Construction of drain for drainage*
- *Provision of jute mesh for facilitating grass growth on slopes*
- *Provision of good soil mixed with manure and subsequent irrigation for growth of grass for anchorage on slopes*
- *Plantation*



**WALLS & DRAIN AT THE TOE OF THE DUMP FOR
ARRESTING THE SILT**



**GABION WALLS AT THE TOE OF THE DUMP FOR
ARRESTING THE SILT**

External Dumps

- 1. Study of Stability of External Dumps is conducted through :*
 - a) By Indian School of Mines, Dhanbad*
 - b) By CMRI*
 - c) By Indian Institute of Technology, Kanpur*
- 2. On the basis of the above studies 9 nos. of external dumps have been technically and biologically reclaimed in NCL under ESMP at Jayant, Nigahi, Dudhichua, Bina and Jhingurdah*

Study of the External dumps of NCL by ISM, Dhanbad

Project	Dump No.	Maximum Height (m)	Maximum slope (°)	Factor of Safety (FOS)		Max.slope for a min. FOS of 1.3 (°)	Remarks
				At existing slope	At 28°slope		
BINA	1	65.00	45.00	1.29	2.16	44.50	++
	2	33.00	43.00	1.60	2.41	*	
	3	28.00	43.00	1.68	2.49	*	
	4	19.00	44.00	1.86	2.74	*	
	5	18.00	38.00	2.14	2.78	*	
	6	30.00	45.00	1.57	2.46	*	
	7	40.00	45.00	1.45	2.33	*	
DUDHICHUA	1	81.50	37.01	1.23	1.78	35.50	++
	2	62.50	36.33	1.28	1.79	35.50	++
	3	74.00	36.54	1.26	1.78	35.50	++
JAYANT	1	98.00	38.00	1.21	1.74	35.50	++
	2	98.00	38.00	1.21	1.74	35.50	++
JHINGURDA	1	46.00	40.00	1.27	2.05	39.00	++
	2	18.00	32.00	1.80	2.11	*	
	3	29.00	35.00	1.57	2.07	*	
	4	26.00	35.00	1.57	2.08	*	
	5	25.00	36.00	1.52	2.08	*	
	6	66.00	42.00	1.17	2.04	39.00	++
	7	65.00	41.00	1.21	2.04	39.00	++
	8	42.00	40.00	1.28	2.05	39.50	++
NIGAHI	1	80.00	39.15	1.25	1.86	38.00	++
	2	57.00	38.89	1.34	1.91	*	
	3	22.00	39.15	1.56	2.16	*	
	4	87.00	39.15	1.24	1.86	37.50	++

* Factor of safety from the dump is more than 1.30 for the existing height and slope

++ The dump is required to be re-sloped to the angle as indicated in the table for having a factor of safety value of at least 1.30

A case study of External OB Dump No.2 of Jayant Project

Jayant Open Cast Mine Project.

The Dump of Over Burden consisting of soil and stones, is formed outside the open cast mine. It alters the surface topography and causes severe environmental degradation. It is prone to slide endangering lives and adjacent properties, if the slopes are not stable and maintenance is poor from safety point of view. The following steps were adopted to reclaim the O.B. Dump No. 2 of Jayant OCP, near Madwani reservoir, with the aid of World Bank.

External OB Dump No.2 of Jayant Project

Technical Reclamation

(Construction of OB Dump with stable slopes)

- 1.1 *Earthwork in cutting and filling had been done for construction of the Dump, formation of safe and stable slopes, preparation of benches including compacting, dressing, sealing of fissures, gullies and cracks, etc.*

The dump accommodates huge volume of bulk OB nearer the mine occupying area within the limit.

<u>Location</u>	<u>Bench length</u>	<u>Dump slope range</u>
Top	565 m	28° 00' to 37° 00'
Middle	528 m	34° 00' to 39° 00'

- 1.2 *Gabion retaining walls had been made of GI wire net cages filled with stone boulders and anchored with bamboo/ wooden bellies/ angle iron as per specification.*

Gabions provide vertical support to the bottom of the slope and help against sliding. Those also protect the toe of the reshaped OB dump.

<u>Location</u>	<u>Height of walls</u>	<u>Total length</u>
At Toe	5 m	/
At benches	4 m	/ 4,860 m

1.3 *Drains on tip surface, periphery and along benches, slopes have been provided at 50 m interval. Thermally bonded non-woven geo-textiles have been wrapped under drain system laid in trenches of cross section 500 mm X 500 mm. filled with stone aggregate. Slit perforated PVC pipes of dia. 150 mm have been laid in middle of the trench with 100 mm thick sand cushion at the top to prevent clogging from surface soil. Drains protect the slope surface against rain-cuts and seepage in rainy season. Those make safe way to discharge top and surface water to bottom of the dump. Earthen bunds had been provided at the end of each bench to guard against spilling of water from benches to side slopes. Total length of drains = 3,490 m*

External OB Dump No.2 of Jayant Project

Biological Reclamation

(Operation and maintenance of the Dump by vegetation)

- 2.1 *Saplings have been planted at each bench as well as at top of dump protecting against animals, pests, weather, diseases, etc. with replacement in case of casualties.*

Plant roots grip the dump materials up to sufficient depth and increase binding among them. Total plants = 900 nos. (approx.)

- 2.2 *Jute mat/ coir netting of about 25 mm X 25 mm mesh size had been laid on slopes and anchored by pins on dressed and leveled surfaces and in trenches to prevent displacement and to have intimate contact. The mat/ net had been covered with 80 mm thick good agricultural soil mixed with fertilizer, pesticides and saw dust/ hay as base for vegetation.*

Grasses like Stilohamata and Doob with Baugenvillia had been sowed over total slope surfaces including routine maintenance and upkeep. The grown grasses were anchored with the mat/ net by pins afterwards.

The grasses stop erosion of soil by wind or rain and help to maintain uniform moisture content of the soil underneath.

Total slope surface area = 44,550 sqm

2.3 An irrigation system has been installed for watering the plants and vegetation areas in benches and slopes. It consists of brass/ glass/nylon nozzle sprinklers with spray angle 65° and range 5 m, fitted on 25 mm dia distribution HDPE pipeline. Headers of 50 dia at 100 m interval have been provided.

Irrigation system is a vital infrastructure for survival and development of the vegetation.

2.4 One pump House with GI sheeting on structural sections had been constructed. Two pumps had been installed. Each is having 100 m delivery head and 100 lit/min discharge capacity. One open RCC ground water reservoir had been constructed adjacent to the pump house. It is of size (10 m X 3 m) and having capacity of 300 cum.

Pumps are important tools and basic need for artificial watering on the vast area of vegetation on the dump surface specially during summer and draught period.

Salient features of OB Dump No.2, Jayant OCP

1. Name of the work : Technical and Biological reclamation of OB Dump No.2, Jayant OCP
2. Date of completion : 30.01.2002
3. Construction cost : Rs. 2.19 lakhs
4. Total length : Middle Bench = 460 m (av)
5. Total height : = 44 m
6. Bench height : Top = 20 m (av)
Bottom = 24 m (av)
7. Bench width : Top = 4 m
Bottom = 4 m
8. Gabion height : Top = 4 m
Bottom = 5 m

- 9. Irrigation system :**
- a) Ground Reservoir capacity = 300 cum**
 - b) Pump = 2 sets**
- 10. Drainage system :**
- Cross section : 500 mm X 500 mm**
(consists of geo-textiles, stone aggregate, PVC pipes and sand layer on top)
- 11. Grass : Stilohamata and Doob with Baugenvillia.**
- 12. Slope surface area : 44,500 sqm.**

TECHNICAL RECLAMATION OF DUMP No.2 JAYANT PROJECT



BIOLOGICAL RECLAMATION DUMP No.2 JAYANT PROJECT



BIOLOGICAL RECLAMATION DUMP No.2 JAYANT PROJECT



External OB DUMP No.2 JAYANT PROJECT Reclaimed





O.B. Plantation Nigahi-2000

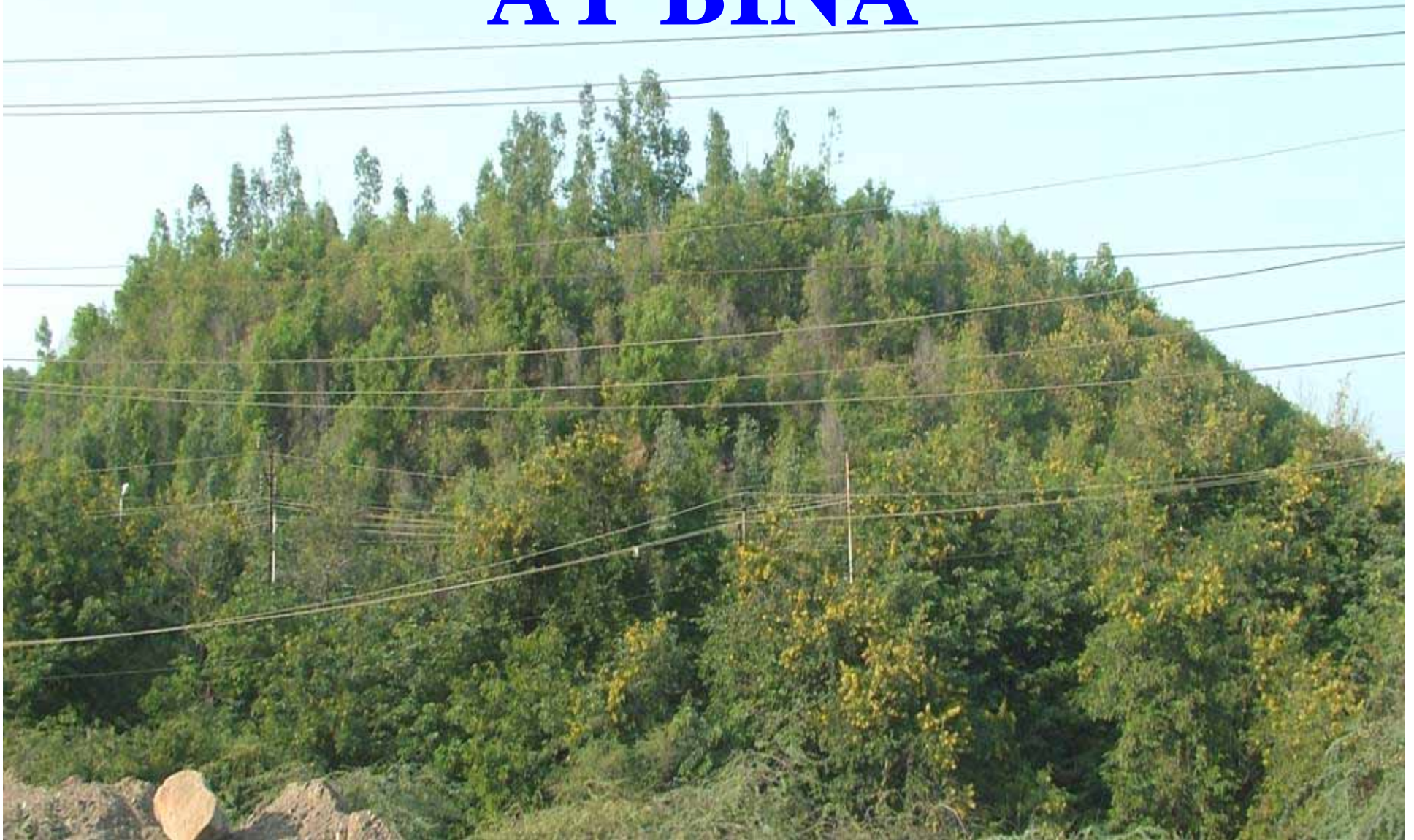


O.B.Plantation Nigahi-2000

OB DUMP PLANTATION AT GORBI “B” - 2000



OB DUMP PLANTATION AT BINA



Thank You !