

Geophysical Surveying, Mining Methods, Research and Development in Kothagudem Region Coal Mines

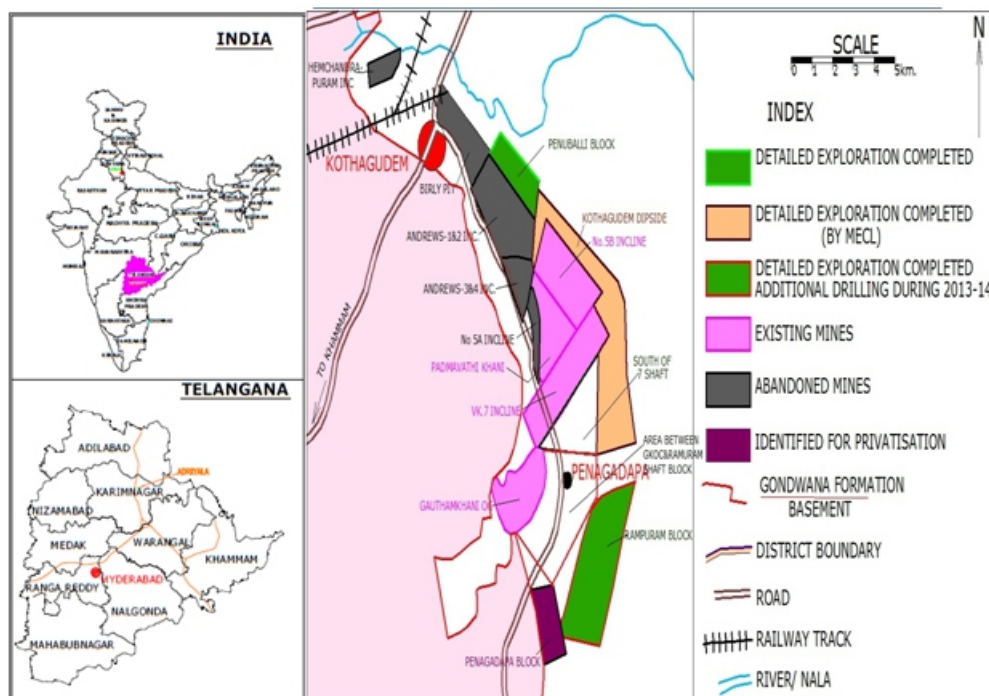


T. Satish Babu
 Geologist
 Cyient Ltd.

Abstract:

Geology Of Kothagudem Area described as This coal belt extending over a strike length of 20 Km. from Hemachandrapuram in the North to Penagadapa in the South, is located in the southern part of Godavari valley coal field. It situated in the Khammam District of Telangana(erstwhile Andhra Pradesh).

The belt falls in Survey of India Toposheet No. 65C/11 bounded by N.Lat. 17° 25'.00" - 17° 32'.30" and E.Long 80° 37'.30" - 80° 42'.00". It is one of the oldest mining areas of SCCL where coal is raised by shafts since 1937. Incidentally Kothagudem has the Headquarters of SCCL. The annual coal production from 3 mines. Underground 2 (VK-7 and PVK-5) and Open cast 42.42 Lacs Tons.



Introduction:

GEOMORPHOLOGY OF KOTHAGUDEM:The 10km buffer area of the block is a plain terrain with relief vary from 100 m above MSL to 180 m above MSL with a slope of 10.5 m per Km. towards north northwest. The central part of the plain area consists of fragments of pediment due to active erosion. In the eastern side

the plains are undulatory dotted with hillocks and sandy patches, which are imperfectly drained. The north-south trending hill ranges forming the drainage divide between Murreru and Pamuluru sub-basins are of beveled cuesta type, while the adjoining hill ranges are of 328m above MSL to 431m MSL (Balusu Gutta 328 m, Kanigiri Gutta 431 m etc.,).

Drainage:

The area is mainly drained by Edulavagu and Tellavagu in the buffer area. The north and central portion of the area is drained by Tellavagu and the western and southern area is drained by Yedula vagu - tributaries of Murreru River which in turn is the tributary of Kinnerasani River. The eastern part of the area is drained by Pamuleru river which in turn tributary of Godavari river. All these streams are of ephemeral nature. The drainage pattern is dendritic to sub parallel type.

SOILS:

The soil in the area is clayey loam to sandy loam. Its colour varies from reddish brown to dark greyish brown. The soil analytical data furnished below indicates that the available organic carbon is 0.20% to 0.40%, Phosphorus content is ranging from 85 to 130 kg/ha, Potash content is ranging from 6 to 53 kg/ha and the Nitrogen content is varying from 42 to 85 kg/ha.

GEOPHYSICAL METHODS:

Geophysics is one of the discipline in the exploration division working for coal exploration. Geophysical surveys are of two types:

- 1.Surface survey
- 2.Subsurface survey

1.Surface Survey Methods:

Surface survey methods are Magnetic, Gravity, Electrical and Seismic surveys etc. The magnetic and gravity surveys are conducted for studying basin structure mapping and electrical methods comprising of different electrode configurations, Werner and Schlumberger (Vertical Electrical Sounding) methods are popularly employed in the coal exploration. Earlier days Werner and Schlumberger methods are widely used in the Exploration division of Singareni collieries company Ltd.

2.Subsurface Survey Methods(Well Logging):

In Singareni Collieries Company Ltd. They are using the following well logging methods. Working of all these methods depends on media (water+mud) between probe and borehole wall.

- a)Density Probe
- b)Resistivity Probe (SPRN)
- c)Sonic Probe
- d)Echostic Televiwer Probe

Density Probe:

This probe length is 3.08m. The bottom of the probe contains Cs137 radioactive source. In this method we can measure five parameters

1. Density, 2.Long spaced density, (LSD), 3.High resolution density (HRD), 4.Natural gamma, 5. Caliper.

Resistivity Probe (SPRN):

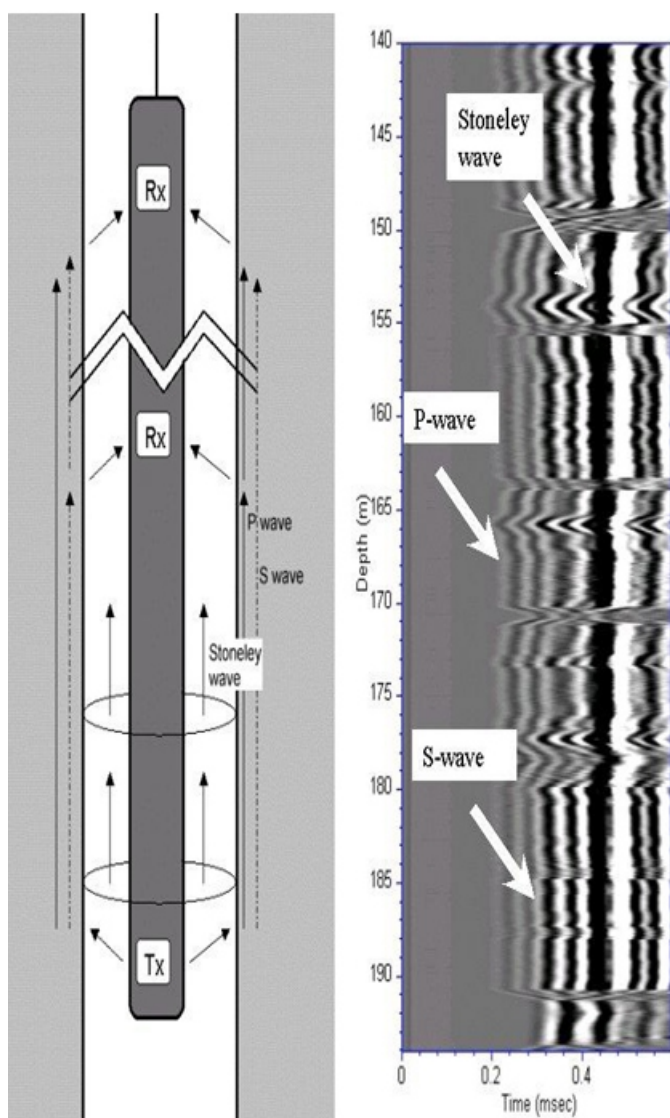
This probe length is 3m. This is called as Single Point Resistivity with Neutron, this is only electrical probe. This Probe used for correlation of coal seams. In this method we can measure four parameters. i.e.,

- 1.Single Point Resistivity (SPR),
- 2.Short Normal Resistivity (SNR),
- 3.Self Potential (SP).

Sonic Probe:

This is velocity analyzing log. This probe length is 2.96m. In India this probe used first time in SCCL. In this method we can measure three parameters. i.e.,

- 1.P-waves
- 2.S-waves
- 3.Stoneley waves



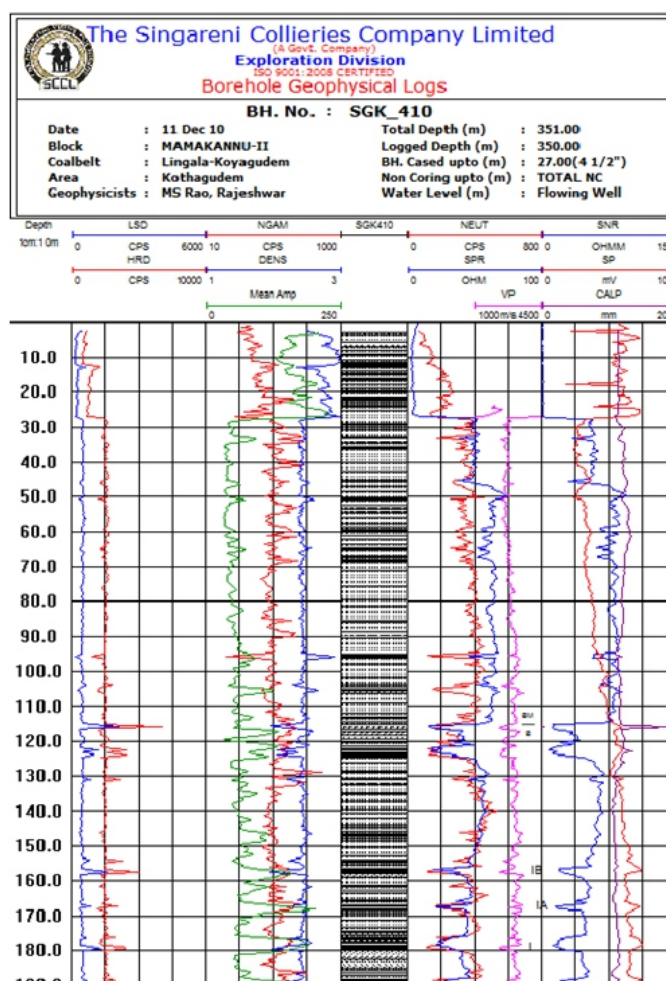
After completion of the drilling of the borehole the concerned geologist will request for geophysical logging of the borehole. The geophysical logger comprising of Winch, probes, radioactive source, etc are mounted on the logger vehicle. The geophysicist will reach to the site along with laptop and logger vehicle to log the borehole. The each geophysical probe head is attached to winch head before lowering the probe into the borehole via tripod arranged on the borehole. The log data is acquired in the field, through the software called Winlog installed on the Laptop. After completion of the data acquisition in the field, it is processed and interpreted.

Echostic Televiewer Probe: This is sound wave analyzer. This is used to detect the deviation of borehole. In this method we can measure three parameters. i.e.,

- 1.Travel time
- 2.Amplitude
- 3.Deviation of the borehole

All the above parameters can be done by the following software's

- Micro Winlogger- Acquisition of data
- Well CAD- Interpretation of data
- RGL Dip- Detect the Borehole deviation HiRAT-Azimuth parameter using WellCad software in the office.



GEOPHYSICAL LOGGING INSTRUMENT:

This has been conducted at borehole drilled by SCCL and GSI at Kothagudem by Exploration Geo-physical wing, using EG & G Mount SO Pris Instruments Ltd., USA Series-III – Geo-physical logging system.

Now a days the SCCL is used by Exploration Geo-physical wing, using M/s Robertson Geologging Instrument.,UK. The boreholes logged for Spontaneous Polarization (SP), Resistivity and Natural gamma of the strata. Entire borehole converted by Geophysical logging to the interpreted depths and thickness of coal seams and dirt bands along with some log exposures. The interpreted depths and thickness of coal seams are fairly agreement with core logs and from the temperature logging data the geothermal gradient calculated.

Neutron logs of boreholes clearly show the areal rock types. According to geo-physical logging of strata lying above the roof of seam i.e., overburden comprises sandstone, shales, clays, carbonaceous clays and thin coal bands constitutes the thickness varies from/greater than 5 to 135 m. The Geo-physical method of exploration is very much useful to detect the coal seam horizons and various faults, not only in Kothagudem area, but also in the whole of the Godavari Valley Coal Field because the whole area was a highly disturbed region due to various tectonic evolutions.



VENKATESH KHANI 7 INCLINE:

The Venkatesh Khani is part of Kothagudem area. This Mine is started in 1954 with conventional operation system. Now it is converted as semi mechanized Under Ground mine.

GEOMORPHOLOGY:

Surface Features:

The surface area of this mine covered with Thella Vagu, and various types of plantation and red type of soil and sand.

Location:

The mine is situated between North latitude 17° 27' 07" to 17° 30' 24" and East longitude 80° 40' 00" to 80° 41' 30" as covered in survey of India Topo sheet No.:65C/10 & 11 of Khammam District in Andhra Pradesh. It is at a distance of 297 kms from Hyderabad. The nearest railway station, Bhadrachalam Road, a branch line from Dornakal in Kazipet-Vijayawada section of the South Central railway, is about 10 kms from the line.

Topography:

The terrain is gently sloping towards east. The average ground level is about 138m above MSL. The minimum and maximum MSL is about 119m and 157m respectively. The mine is very extensive with an area of 6.5 Sq.km. and developed to maximum depth of 425m. The mine was opened in the year 1954 and the mine progressed to a distance of 2.6km from inclines, a shaft (6.00m diameter and 266m depth) was sunk from surface and was commissioned in the year 1974.

The shaft is being used as Man-winding shaft. Two major faults of 40 to 80m up thrown on the north side and 90 to 168m down throw on the South side are limiting the mine. The proved workable coal reserves are 65Mt in-situ. The mine has contributed a total output of 23.31 MT up to Mar-2013. At present, there is no development activity. Extraction is done by depillaring using various technologies. At present rate of extraction, the mine will last for 07 Yrs (considering the reserve which are at more than 250m depth i.e below shaft level). Presently the mine employs 991 persons (Mar'13),

THE METHOD OF MINING:

A)Top seam:

Some skeleton development by conventional method was done in the year 1967-68. But due to inferior quality of coal and difficult roof conditions the development was suspended. Subsequently, when there was demand for power grade coal, the exploitation of Top seam was re-started in the year 1980 by Board and pillar system. With a view to increase the production and to liquidate Top seam at a faster rate Long wall technology was introduced in the year 1985 and it is worked upto the year 2005-06. Totally 19 Long wall panels were worked with in this technology.

The dip side property of Top seam(below 96L) is proved to be inferior quality and the same is declared as “Non-Vendible”. Thus no further development is done by the seam.As further development was not possible in top seam, depillaring with caving was started.

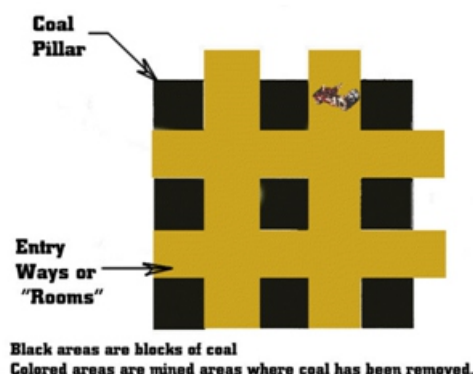
Till now 04 depillaring caving panels were extracted using SDLs & LHDs. At present in the Top seam, depillaring Panel No.19 is under extraction by caving method with LHDs. The dip side developed pillars between 85L to 88L & 2D to 6D which served as trunk roadways for Long wall panels are being extracted.

B)Index seam:

Index seam is worked from Ananda Khani. This seam is worked only in this section. Due to inferior quality of coal and thinning down seam, this could not be worked further and was sectionalized. Seals are being monitored periodically.

C)King seam (V.K section):

The King seam in VK section has been extensively developed along Top section by Board & Pillar system. Totally 21 conventional depillaring panels were extracted. A few panels have been extracted by BG method in which both the sections are extracted (Reds & Blues). In the year 2006 Continuous Miner Technology was introduced.



Board & Pillar Method:

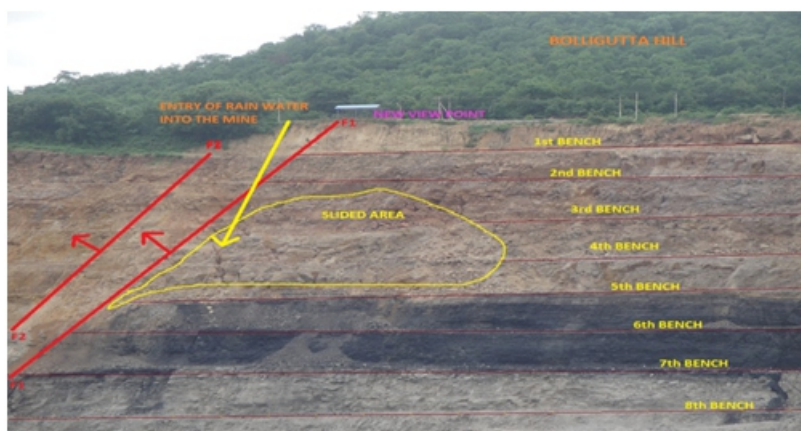
Installation of Air Cooling system plant in King seam (56LN/10D) is completed. With this introduction, the face temperature is maintained at 26-27°C thereby creating congenial workings atmosphere in the district which has improved production, productivity and safety.

CONTINUOUS MINER (Caving and Non-caving method):

To extract King seam dip most property Continuous Miner technology was introduced in the year 2006. Extraction in CMP-1 started by caving method on 04-09-06. Unfortunately during the extraction, a fatal accident occurred on 12-11-06 due to roof fall. Later permission was withdrawn by DMS.Again Continuous Miner was reintroduced in the year 2009. Extraction was done by Non-caving method.

With this method 4 panels were extracted. While extraction of panels CMP-3A & 3B, there were incidents of unpredictable side spalling with floor heaving endangering safety of the persons, equipment and loss of about 12 pillars of coal. Permission for extraction of subsequent panels was obtained to work by caving method. The next panels CMP-5A & 5B were extracted successfully on trial basis by caving method.

Keeping the experience in view, it was proposed to work the next panels, CMP-6A(1),(2) & 6B by the same caving method. Accordingly CMP-6A(1)panel was extracted successfully and at present, extraction is being done by slicing in CMP-6A(2) panel.



VENTILATION:

Mainly ventilation design in all underground mines. Because depth increases automatically temperature will be increasing. But it shouldn't exceed 30.50C in working areas. And also the main cause of spontaneous heating property of coal. In this mine area the mine is ventilated by two 300 HP axial flow fans, one fan located at shallow air shaft and the other fan located at main incline. The existing fans are presently exhausting about 85m³/s and 130m³/s of air 800 and 1150 pa respectively.

SAFETY:

No person is allow to go underground without having helmet, cap lamp of battery light and footwear. The safety officer from time to time checks the roof conditions and advises preventive methods. Every foreman and sardhar is supplied with a safety lamp to detect the traces of Carbon monoxide, Methane, CO₂ gases. The walls in the mine are dusted so that the coal may not be subjected to shouldering. They are using recently Self rescuer.

PADMAVATHI KHANI-5 INCLINE:

LOCATION:

PVKNo.5 Incline is located approximately between North latitude 170 29' 13" to 170 30' 35" and East longitude 800 39' 28" to 800 41' 00" and is covered under survey of India Top sheet No.65-C/11. It falls in Kothagudem Mandal of Khammam district, Andhra Pradesh. It is situated about 8kms. South east of Bhadrachalam Road Railway Station of South Central Railway.

By road is 90kms from the district head quarters khammam and 295km from Hyderabad , the state capital.

About The Mine

Main started in: 1952

Mine Area : 9.25 Sq. Km.

The working of the Mine are spread over a distance of 3.20kms up to maximum depth of 420mts covering an area of 9.25 Sq.km. another shaft of 6.50m dia was sunk in the year 2006 to connect the top seam and king seam workings. At present the same is being used as a downcast shaft. Within the mine boundary, from the middle of the property on dip side No.5B Incline mine was worked, which has worked top most section No. 1 seam and abandoned on 13-1-2010. On south side of the mine and North side of the boundary abandoned no. 5A Incline and No.3& 4 Incline mines are situated respectively. Two major faults of 40-45mts down thrown in the North side and 35mts to 70mt down thrown of the south side limbs the workings of the mine. Presently, the mine providing employment of 1064 persons.

The proved extracted reserves of the mine are 43.38 million tones as on Feb-1988. It was proposed to extract only king seam coal and to stop extraction from the top seam in view of poor quality of coal. As such the mine lasts another 15 years by taking account of extract reserves of king seam (single section) as 7.5 MT, as per the annual target i.e 5.0 LT. Surface premises of Rudrampur CHP (RCHP), Central Workshop and Central stores have been brought the control o mine manager, PVK No.5 Incline during recent past. Direction and average dip of the seam : N68o 15' E, 1in 8.9.

GEOLOGY:

Padmavathi Khani No.5 Incline block lies in Kothagudem coalfields, which is the southern part of Godavari Valley coalfields. The Kothagudem Coal fields extends over a strike length of 20 Km. Currently, the coal is being exploited from three underground mines and one opencast mine.

According to reports of SCCL Engineering Department Labs. The physico- mechanical properties of King Seam and Bottom Seam indicates that the roof is weak/moderately weak/strong. The roof and floor strata of coal seams present in pvk – 5shaft are given the below table.

Name of the coal seam	Roof strata	Floor strata
No. I Seam	Sandstone & few shale, clay bands.	Sandstone with few shale and thin coal bands.
Queen (Top) Seam	Carbonaceous clays and sandy shale	Grey Sandstone
Index I & II Seams	Sandstone (Grey white)	Sandstone (Grey white)
King Seam	Grey Sandstone	Grey Sandstone
Bottom Seam	Sandstone	Sandstone

The roof and floor strata of coal seams present in PVK – 5shaf



Due to the step faults (F1-F1, F2-F2) and heavy surface rain water flow immediate above the slided benches caused the entire strata become weak and slided towards quarry

DETAILS OF THE ENTRIES

The mine has 3 sections, namely 5 Incline section, PVK section and shaft section.

The mine has 6 inclines and 4 shafts. The details are given below: (A) Shafts

Sl. No	No/ Name of the shaft	Diameter (mts)	Working depth (mts)	Working of diff. seams connected with the shaft	Purpose
1.	5-shaft	6.0m	212m	Top & King seam	man winding(intake)
2	PVK shaft	6.5m	292m	Top & King seam	Ventilation shaft(intake) Works are under progress For man winding installation
3	Incline shaft	4.3m	77.6m	King Seam	Ventilation shaft(Return)
4	PVK Air shaft	5.5m	38m	Top seam	Ventilation shaft(Return)

Table of Shafts

Top seam:

The seam is having 9-12m thickness. It is developed in middle section leaving 3 m coal and shale in roof and 3 m shale in floor. When there is demand for poor grade coal, PVK project was initiated with a view to increase the production and to liquidated top seam at a faster rate by introducing Long wall technology in the year 1995. The development of the long wall gate road ways done by LH-100's. AM-50's. total 12 No.s of Long wall panels were extracted by 2 Long wall units. The seam was developed upto 120 level (350m depth) and further development of the seam was stopped from July 2008 due to inferior quality of coal.

King seam:

King seam is of high quality coal and has been extensively developed in two sections up to 64 level along floor and roof with an intervening parting of 4m coal by board and pillar technology. Majority panel of this seam above shaft level have been extracted in 2 sections: i.e bottom section by stowing and Top section by Caving. Below 64L the seam thickness is 5-7m only, the development was done up to 124 L in one section either along stone roof or stone floor.

Due to water body in No.1 seam of 5 B Incline above King seam working and Long travel distance the development activity was stopped towards North and also Dip directions. 5 LHDs of 912 model are on rool under working in S-22 Panel Sand stowing depillaring district and prepration N-58 panel is to be taken up for accomodating LHDs to meet targeted production. Necessary notice for sliptting of pillar between 5 D and 7D in 86L to lay belt conveyor for coal evacuation of N-58 panel as been submitted to Director of Mines Safety.

Bottom seam:

Bottom seam, which is C-grade coal, has been developed up to 43L. further development was stopped due to thinning of seam thickness. Few panels have been extracted by Board and Pillar system with hydraulic stowing. Presently there is no activity in this seam in Incline section in air lock doors to fulfill statute.

VENTILATION:

The mine working are being ventilated with 2 Main Mechanical Ventilators i.e. one 300HP Voltas Fan is running with 300HP Andrew Yule as Stand by and second Main Mechanical 200HP is also running with 100HP Stand Bye.

To resolves ventilation issues, after ventilation pressure and quality survey by pro. D. C Panigrahi, a decession has been taken by Higher Management to Re-organize ventilation of Mine by Isolating the King seam workings above 60L and entire bottom Seam & Top seam with explosion proof Stoppings. Approval has been obtained from Directorate of Mines & Safety Under regulation146 (5) of CMR 1957, wide Lr. No.H1/010072/ PERM/2010/1478, Dated 31.12.2010. The total activity has been organizing in two phases.

I-phase:

a)Isolation o King seam working above 60L with EP Stopping and Isolating 5 Incline out lets and up cast shaft

b)Shifting of winder from 5 shaft to new shaft i.e. 5B Incline premises

c)Installation of 300HP Main Mechanical Ventilator at 5 shaft, presently man winding shaft

II- phase:

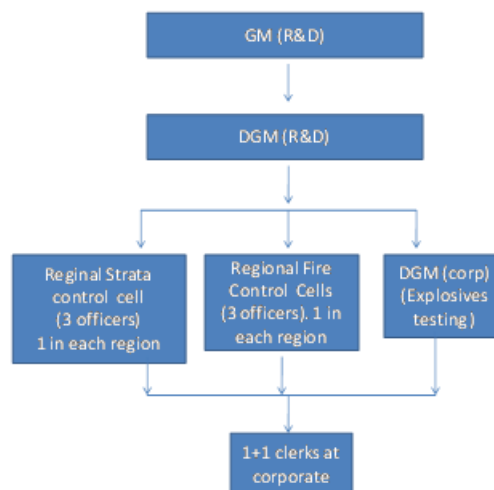
a)Drivage of 1km length tunnel from surface to King seam workings i.e. 5B Incline premises to 73L/8D in King seam.

b)Isolation of entire Top seam by construction EP stoppings and isolation of surface outlets of PVK section.
RESEARCH & DEVELOPMENT (R & D) DEPARTMENT

SCCL MISSION:

- SCCL has established R & D Department in 1980.
- To retain our Strategic role of a premier Coal Producing Company in the country and excel in a competitive business Environment.
- To strive for Self-reliance by optimum utilization of existing resources and earn adequate returns on capital employed.
- To exploit the available mining blocks with maximum conservation and utmost safety by adopting suitable technologies and practices and constantly upgrading them against international benchmarks.

ORGANISATION CHART OF R&D DEPARTMENT IN SCCL



•To supply reliable and qualitative coal in adequate quantities and strive to satisfy customers needs by constantly sharing their experience and customizing our product.

•To emerge as a model employer and maintain harmonious industrial relations within the legal and social framework of the State.

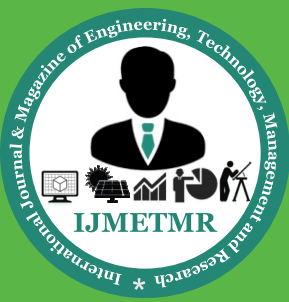
•To emerge as a responsible Company through good Corporate Governance, by laying emphasis on protection of environment & ecology and with due regard for corporate social obligations.

QUALITY POLICY OF R&D DEPARTMENT:

- To Implement and coordinate consultancy and Science & Technology Projects to modify, Upgrade and optimise the existing Mining related technologies, envisaging improvement in Production, Productivity, Safety and Quality.
- Disseminate knowledge of innovative mining concepts, to achieve continual improvement in performance of mining related activities.

References:

- 1)SCCL scientific studies centre,khammam
- 2)Acharyya, S.K. and Basu, P.K., (1993): Toba ash on the Indian subcontinent and its implications for correlation of late Pleistocene alluvium. Quart. Res., V. 39, pp. 1-10.



3)Bhattacharya, S., Sen, S.K. and Acharya, A., (1993): Structural evidence supporting aremnant origin of patchy charnockitesin the Chilka Lake area, India. Geol. Mag., V.130, pp. 363-368.

4)Dobmeier, C., (2000): Structural evidence for a syn-kinematic arrested charnockitization

5)in the Chilka Lake area, Eastern Ghats belt, India. Spl. Publ. Geol. Surv. Ind., V. 57, pp. 290-295.

6)Dobmeier, C. and Raith, M., (2000): On the origin of 'arrested' charnockitization in the Chilka Lake area, Eastern Ghats belt, India-a reappraisal. Geol. Mag., V.137, pp. 27-37.

7)Goswami, A.B., (1993): Review of Quaternary geological mapping and standardization of scheme of classification for interbasin regional correlation of Quaternary landform.