Longwall- A Successful Mass Production Technology in Adriyala Project, Singareni

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Abstract:

The bulk of energy requirements in the country are being fulfilled from coal fired thermal power plants. Currently, opencast mines generate 96% of total coal production. To meet the demand, higher coal production from underground mines is the topmost priority for supplementing the opencast production. Longwall mining is one of the best options to achieve a higher coal production rate from underground especially for deep seams.

This paper mainly comprises the saga of Longwall mining at an ongoing high-capacity (2.81 MTPA) longwall project named, Adriyala Longwall Project operated by Singareni Collieries Company Limited (SCCL) in the state of Telangana, India. The various technologies adopted right from the beginning of the project to date, salient features, challenges and way forward for future are briefed in this paper.

In the Indian longwall mines, longwall face wide usually varies from 100 m to 150 m only, whereas in Adriyala, a wider face of 250 m is operating for the first time in the Indian longwall mining scenario and length of gateroads forming longwall panels are of 2500-3000m in length against earlier below 1200m. so far, at Adriyala, two longwall panels with above geometry of 250m width 2500m length are completed successfully and third longwall panel of similar geometry coal production is under progress.

Introduction:

Human existence depends on energy on a daily basis, and this requirement is more important than ever. A significant energy source besides other fossil fuels and renewable sources is coal. About 75% of the nation's power is produced in India using coal, one of the least expensive energy sources. Nearly 94% of the coal produced during the past five years has come from opencast mines (MoC, 2023). Out of 893.19 MT coal produced during 2022-23, 858.34 MT (95.0%) of India's coal output came from open-pit mines, while 34.84 MT (5.0%) came from underground mines. Mechanised longwall mines produced around 5% of the underground coal. However, opencast mining method is restricted in application to a depth of 300 m or less. In order to extract coal from deep-seated seams (depth more than 400 m) and to negotiate with high horizontal stress, one needs to deploy Longwall technology ensuring suitable seam thickness and inclinations.

In the modern longwall mining method, mine development is carried out in such a manner that large block of coal usually 100 m to 300 m wide and 1,000 m to 3000 m long, called ‘longwall panels’, are available for complete extraction.

The gateroads are driven to form chain pillars as well as longwall panels. The pillars so formed serve as natural support during retreat of longwall. During the development of gateroads, the roof is bolted

in a systematic way. However, before the retreat begins, the gateroads are additionally supported with cable bolts and one or two rows of cribs are erected to supplement the roof bolting. Each longwall panel holds a huge coal reserve of 2 to 5 Million tonnes, which can be mined out in a single year.
This paper focuses on the longwall mining that is now taking place at the Adriyala Longwall Project, a high-capacity longwall project run by Singareni Collieries Company Limited (SCCL) in the Indian state of Telangana. The paper describes the numerous steps in the project's execution, from the pre-planning stage through its implementation, the difficulties encountered, and the project's future directions for success in below seams exploitation.

SCCL at a glance:

The Government of Telangana and the Government of India jointly own The Singareni Collieries Company Limited (SCCL), a government coal mining company, on a 51:49 equity basis. The Singareni coal reserves stretch across 350 km of the Pranahita – Godavari Valley of Telangana with proven geological reserves aggregating to enormous 8791Mt. Currently, SCCL is operating 18 opencast and 24 underground mines in 6 Telangana districts with a workforce of over 42,733 and OMS 5.33T (Mar-2023). SCCL is contributing 7.5 % in the all India domestic production.
During 2022–2023, Sccl underground production produces 7.2 MT of 8.9 MT target, achieves its objective by 80%. There are 24 underground mines, of which 6 are highly mechanised and 18 are semi-mechanized. According to national data, the proportion of underground production in SCCL decreased from 36% (2004-05) to 10.7% (2022-23).
The opencast projects were designed with a stripping ratio of 1:6.5 and a depth up to 420 metres. The percentage of underground mines production must be raised because to rising stripping ratios and environmental concerns in order to offset any future losses from unprofitable opencast developments. Longwall is the globally-proven method for producing coal in bulk at a quicker pace from underground coal mining, particularly at depths.
SCCL is a pioneer in underground coal mining technology and regularly adopts new innovations like longwall, continuous, bolter, road header, diesel, LHD, SDL, man transportation systems, air chilling plants, gas monitoring, fire fighting, safety management plans, strata control organisations, etc.

History of Longwalls in SCCL:

In 1983, SCCL started using LW technology to extract coal at GDK-7 incline mine. After successfully completing two panels, the equipment was moved to GDK-9 Incline, where the Longwall face collapsed in 1986 due to insufficient support capacity. In VK-7, Second Longwall was erected in 1985. Low capacity (4×360t) supports were installed on the Longwall faces mentioned above.
Later, the technique was gradually adopted in a number of mines. Higher capacity supports like 4×450t IFS were introduced in the GDK-11A and JK-5 in the early 1990s. Later, two sets of higher rated supports in the PVK 5 Incline and one set in each of the GDK-10A, GDK-9 Inclines were introduced. With a support density of 110 to 120 t/m2, the aforementioned mines have support capacities of 4×800t and 4×760t.
Ten Longwall packages were established in seven mines prior to the introduction of Longwall Technology in Adriyala as shown in Table 1. The older generations of Longwall units are currently

being evaluated as being off or unusable. SCCL has been continuing its passion in mass production technologies and at present one longwall panel is under operation at Adriyala.

Table 1: List of Powered roof supports (PRS) deployed at Longwall faces, SCCL, India.

Mine	Initial / Shifted	Date of Commission	Make	Capacity of PRS	Rated TPD
GDK.7 Incline	Initial	02-09-1983	Gullick Dobson, UK	4 × 325t to 4 × 360t	1600
GDK-11A Incline					1600
Unit-I	Initial	01-04-1991	Gullick Dobson, UK	4 × 430t	
Unit-II	Initial	10-10-1991	MECO, UK	4 × 450t	
Unit-III	Initial	16-12-1992	Gullick Dobson, UK	4 × 450t	
VK-7 Incline					1600
Unit-I	Initial	13-06-1985	Gullick Dobson, UK	4 × 360t	
Unit-II	From GDK-11A	13-07-1994	MECO, UK	4 × 450t	
PVK					2200
Unit-I	Initial	21-08-1995	CME, China	4 × 760t	
Unit-II	Initial	22-06-1996	CME, China	4 × 760t	
JK-5 Incline	Initial	06-06-1990	Gullick Dobson, UK	4 × 450t	2000
GDK-9 Incline					
Unit-I	From GDK-7	31-01-1986	Gullick Dobson, UK	4 × 360t	1600
Unit-II	Initial	05-02-1996	MECO, UK	4 × 750t to 4 × 800t	1900
Unit-III	From PVK Unit -I	21-08-1995	CME, China	4 × 760t	2200
GDK-10A Incline	Initial	18-10-1994	MECO, UK	4 × 800t	2200
Adriyala	***Initial***	***14-10-2014***	***Bucyrus, Germany***	***2 × 1152t***	***10000***

Adriyala Longwall Project (ALP):

To meet the increasing demand from power sector and shrinking of ongoing opencast projects, SCCL envisaged the opening up of deep shaft blocks for large-scale production. At present the existing pithead of NTPC, 2600 MW thermal power station, Ramagundam is being supplied by three opencast projects of SCCL (10.20Mt) out of its total requirement of 12.50Mt. In the long run, over a period of ten years, the reserves in the above mines are depleting and opening up of 2.817Mt capacity Adriyala Longwall project along with other deep shaft projects in Ramagundam will help to fulfill the coal supply to retain the pithead nature of NTPC Ramagundam power station.

SCCL successfully commissioned a state of art High capacity automated Longwall Project at Adriyala Longwall Project (ALP) mine in 2014. The Adriyala Longwall Geological block area is more or less

free from any major faults. The project is having 132.2 Mt of extractable reserves within the depth range of 294 to 800m. The project life is about 35 years with a rated production of 2.817MTPA.

The mine has 4 workable seams namely, No.1,2,3 and 4 respectively with varying thickness. At present only, in No.1 seam longwall technology adopted. Till now, 2 longwall panels completed, 3rd longwall panel extraction and 4th longwall panel preparation is under progress. For further scope of the project, development workings for approaching No.2 seam through tunnel from No.1 seam and Punch entries for No.3 seam are under action.

The layout of longwall panels proposed in No.1 seam of Adriyala are shown in Fig.1 and the seam partitions are also marked in the figure.

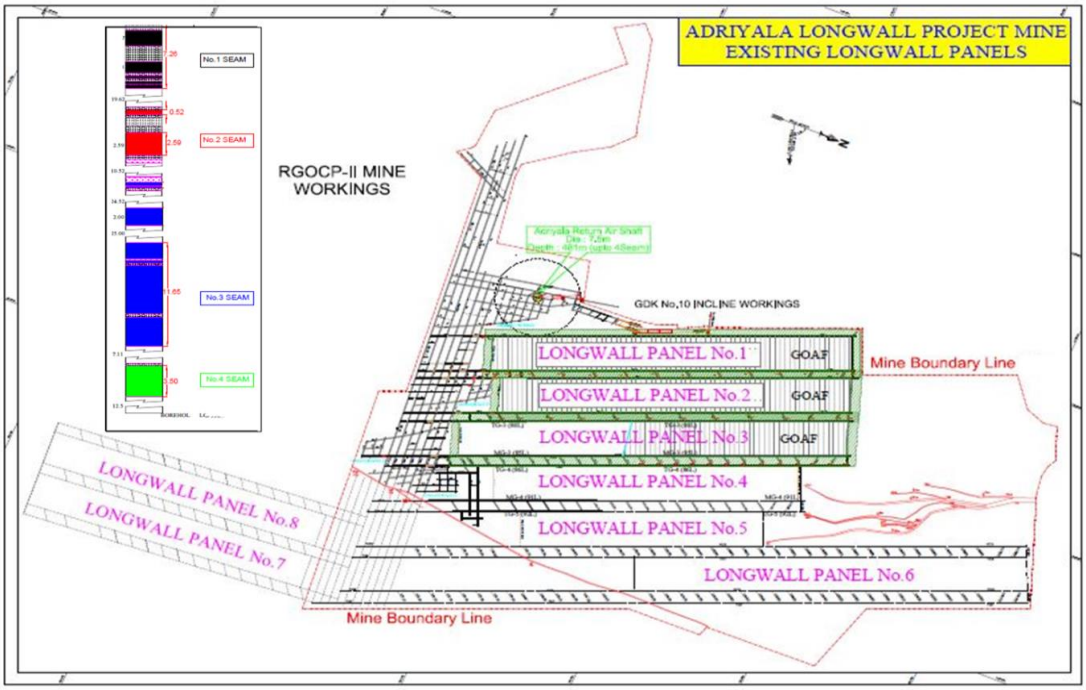

Fig.1. Layout of Adriyala Longwall Project with proposed longwall panels in No1. Seam

Initially, to finalize the mine design by eliminating earlier problems faced in longwalls, SCCL appointed the technical consultants:

- M/s CSIRO, Australia entered in to Collaborative research agreement with SCCL - for detailed geo-tech studies, Support capacity estimation and finalization of tech. specification for modern high capacity Longwalls in SCCL.
- Mr. **Andy Rutherford**, Australia for formulating Specifications, testing, drawings and commissioning of Longwall project.
- Mr. **Russell Firth**, Australia, for Geo-Technical Studies.
- Additionally, various Indian Institutes assisted in scientific studies and investigations of CIMFR, IIT-ISM, NIT-W, NIRM, etc.
- A team of senior officers of Singareni visited Australia and inspected various high productive Longwall Mines and Mines with access/operation through Punch Entries in the highwall of Opencast Mines.

There has been much difference in equipment specifications as well as gate roads and panel

dimensions between existing Adriyala Longwall Project in comparison to old Longwalls as shown in below Table.2.

Table.2. Brief Comparison between ALP and earlier Longwalls of SCCL

	Earlier Longwalls in SCCL	**Adriyala Longwall Project**
Depth Range (m)	60 to 225	400 to 650
Support Type, Capacity (tonnes), Width (m) and Life (Cycles)	4 Leg Chock Shield, 360 to 800, 1.5, and 10,000.	2 Leg Shield, 1152, 1.75, and 60,000.
Panel Length (Km)	0.2 to 1.0	2.0 to 2.5
Face Width (m)	60 to150	250
Face Automation	No Automation	Automated
Capacity (MTPA)	0.4 to 0.7	2.817
Installed Capacity :		
Shearer (kW)	750	2245
AFC (kW)	300	2565
Name plate capacity (TPH)	600-1000	3000

The unique feature of the project is that the main entries (Punch Entries) were planned through the adjacent rise side open cast mine. A platform of about 200m ×150m is prepared adjacent to highwall at No.1 Seam floor (120m depth from surface).

The drivage of Trunk road ways (5.50m × 3.60m) and Gate road ways (5.20m × 3.60m) was made using twin bolters mounted Road Headers (DOSCO, LH 1400 Model). 25Kms of drivage was made during initial five years using five Road headers. The gate roadways are driven with coal roof having two clay bands (0.3m & 0.7m thickness) in the immediate roof layers, supported with 2.4m, Ø22mm shear pin roof bolts with full column resin grout and rigid wire mesh. Secondary supporting was done in gate road ways with 6.1m long pre-tensioned bulbed cable bolts (60T capacity) to take care of Longwall abutments ahead of face. The installation face widened to 8 m with weak coal roof and could be successfully supported by adopting pre-tensioned cable bolts, for the first time without erecting vertical support.

Punch Entries (PE) was meant for specific purpose such as coal, men and material transport besides ventilation. *Chairlift System* is laid in PE-1 for men transport, *Main Belt Conveyor* is laid in PE-2 for coal transport, *and Concrete road* is laid in PE-3 for the movement of multi utility Diesel vehicles (men and material transport), *Haulage track* is laid in PE-5 for men transport using Chair car system and haulage for material transport and supplying chilled air.

The Longwall equipment consists of EL3000 Shearer with 2245kW installed capacity, Armoured Face Conveyor(AFC) with installed capacity of 2565kW, Beam Stage Loader(BSL) of 400kW, 145 shields of capacity 2×1152t and 1.75m width, 2×4.5MW of 11kV/3.3kV transwitches and 1600mm wide three kilometers long gate belt with 3x315 kW drives. The package includes SCADA (Supervisory Control and Data Acquisition System). The Longwall equipment was provided by CATERPILLAR, Germany.

Uniqueness of ALP:

Adriyala Longwall project is a unique project which introduced several technologies, machineries, plant and equipment for the first time in India.

- *Punch entry* to access coal seam directly from Opencast high wall
- *11 kV Power transmission* to belowground to reduce power interruptions due to voltage drop, A total of 7.5 km overhead lines and 19 km of 185 Sq.mm XLPE cable is laid to meet the huge power requirements. Auto power factor correction unit was installed for the first time to curtail the wasteful energy loss. The total connected load of the project was 24 MW and increased to 30 MW with the addition of Air Chilling, Nitrogen and Compressor plants.
- *Pre-tensioned Cable bolting* of 6.1m long 60Ton capacity for effective roof support and to eliminate standing supports in gate roads
- *400 kW High capacity fan* commissioned to supply 15000 Cu.m/min air with high water gauge
- ***Air chilling Plant:*** To meet the requirement of Longwall face, outsourced air chilling plant of 2424TR was installed at mouth of Punch Entry-5. 50Cu.m/sec of air quantity, chilled from ambient with 50 to 75% relative humidity to 9^0C at discharge point is being supplied, at the entry of PE-5. From there cooled air is ventilated to Longwall face through a dedicated air way via PE-5 and Longwall Main gate. After commissioning of air chilling plant and supply of cool air, the temperature has been brought down by 3 to 4^0C. Efficiency and effectiveness of men and machinery increased considerably.
- ***Floor Concreting in underground :*** To facilitate transport of Longwall equipment using diesel vehicles, one of the trunk road ways with weak floor was concreted with M-40 grade self-compacting concrete (SCC) for a length of about 2.5 Km with a gradient not more than 1 in 4. Longwall panel top gates were also concreted for about 200m length near coal floor from trunk roadway to reach of stone floor in bottom section. In gate roadways, stone floor is strong enough to take load of heavy Longwall equipment. It was proposed to do concreting in gates where stone floor disturbed due to water flow to facilitate movement of mine cruiser up to Longwall face.
- *Diesel transport vehicles* for speedy & safe transportation of heavy Longwall equipment and other mine material supplies.
- ***High capacity Belt conveyor:*** Conveyor system of 9.30 km long from Longwall gate belt discharge below ground to Coal Screening Plant (CSP) is installed and commissioned with 11 Conveyor belts with installed capacity of about 12 MW. The conveyor system consists of nine Steel cord belts (800 to 2500 ST) & two PVC belts (Type-15) of 1600mm width, 3500TPH capacity, 4.0m/s speed and Variable Frequency Drives (VFDs). The system includes one Booster belt or Tripper drive belt conveyor too, in below ground. The above entire system was provided by CODCO.
- *VFD controlled un-manned Belt conveyor* system for soft start and power conservation
- *Automation Systems* for sequence control/less manual intervention The automation of the Longwall face equipment is Shearer Initiated Roof Support Advance (SIRSA) with batch control and auto horizon control. For automation, CATERPILLAR, using PMC™ system as shown in Fig.2, which offers a tailored control unit for each of the various Longwall functions:

- PMC™-R for roof support systems
- PMC™-D as drive control (AFC)
- PMC™-V for visualization and parameter setup of the drive system
- PMC™-P node computer to act as interface between the Cat controller network, third-party systems and the mine computer. The module implements data transmission to the surface via optical fiber, modem or copper wire.
- VCU for visualization and control of all Longwall operations at the surface or with an explosion-proof computer underground

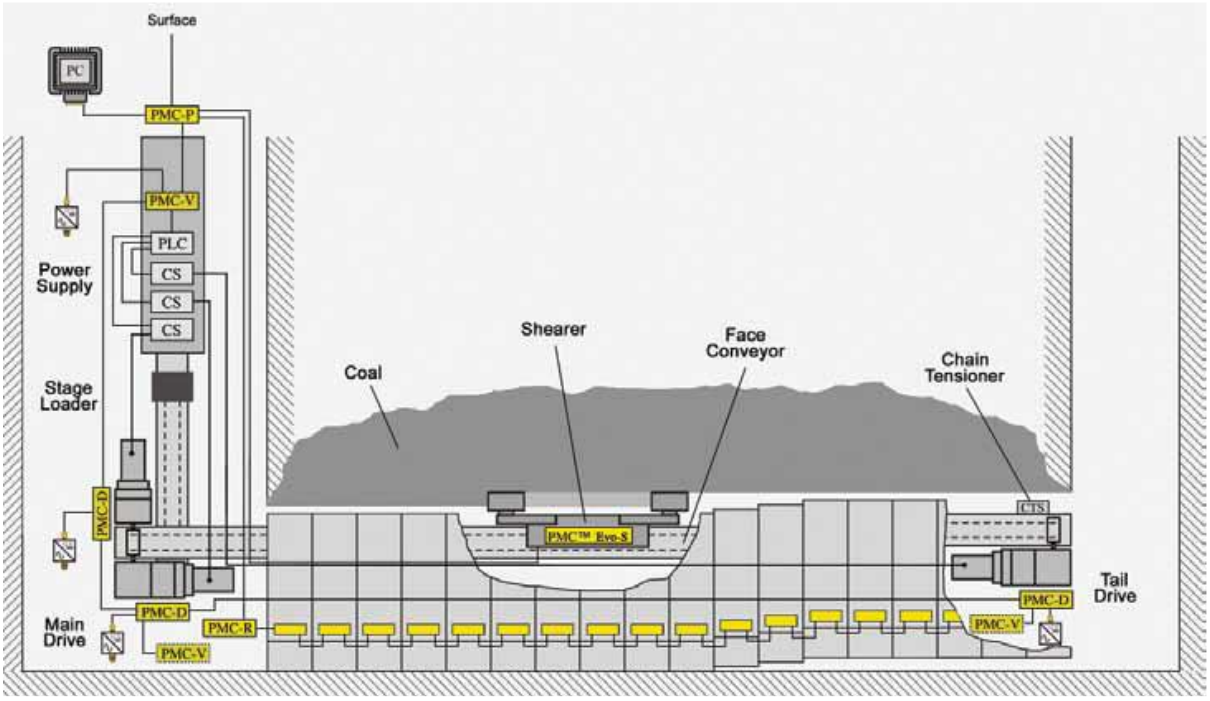

Fig.2 Longwall Automation – PMC Layout

- *Mine Cruiser* for faster transport of men
- *Pan line bolter* for speedy roof and rib bolting & use of Plastic wire mesh during salvage of Longwall panel
- *Bolter Miner* for Speedy development of Gate roads for Longwalls
- *RO plant* to supply treated water to improve powered support hydraulics
- *Chairlift man riding system* laid on overburden ramp to facilitate men transport.
- *High Capacity dewatering Pumps* (820HP, 1000GPM, and 500m head) introduced for pumping mine water directly to surface.
- *Membrane type N_2 Plant* of 1200 Cfm capacity to flush Longwall goaf with inert Nitrogen gas consisting N_2-98% and O_2-2%.
- *20 point tube bundle* system for environment monitoring.
- M/s Rod Wheel Technology (Pumping) 400m^3/Hr: Slurry water direct delivery to surface form 86AL (by stage wise pumping).
- M/s Zamep- Poland, Pumps (pumping) 315m^3/Hr water direct delivery to surface form 89L/N4 750m Head (by single pump).

Challenges faced during Construction and Operation of the Project:

- **Gate roads Drivage**

  Initially there were some apprehensions on workability of Bolter Miner (BM) at Adriyala Longwall Project due to its steep gradient and stone cutting in the floor in the gate roadways. Hence it was decided to use newly supplied Road Headers (RH) for drivage of roadways to avoid surprises with BM as RH technology is well established system for decades. For the first two Longwall panels, Gate roads were driven with road headers and cross connections between two level galleries were developed by Drilling and blasting using SDLs for coal cleaning. However, RHs progress was not meeting the project requirements due to their inherently low development rates, inability to provide a quality roadway conditions suitable for High capacity LW equipment and requirement of more man power. Hence a decision was taken to introduce BM for drivage of roadways and 12ED30 Bolter Miner was deployed for development of gate roads of Longwall panel-3, in May'17. Further Bolter miner development is supplemented with cable bolting and cable truss support system for safe management of Longwall Panel-4 gateroads.

- **Strata Control Management during Development:**

  Gate roadways: Initially roof disturbances were observed and on two occasions cavities occurred in gate road ways driven in bottom section taking middle clay in to working section. Later geological mapping and lithological study was done and working section has been changed by leaving middle clay in the overlying strata with 1m coal underneath it, which improved the stability of gate roadways.

  Cut Throughs (X-Slit): The cut throughs were driven in between two gate roadways at 200m interval. Initially cut throughs were driven across the major horizontal stress direction, in which severe strata control problems were encountered and cavities also taken place. Later the direction of cut throughs has been changed and aligned with major horizontal stress irection which eliminated major strata problems. Initially gate roadways were supported with roof bolting with linked wire mesh in the roof. Later rigid wire mesh has been introduced in place of linked wire mesh to reduce supporting cycle time and to improve the supporting efficiency of the system. The roof conditions and drivage rates have been improved with introduction of rigid wire mesh.

  Face dip widening: Strata problems were encountered while widening Longwall installation face with 8m width. As per the recommendation of Geotech consultant, Pre- tensioned cable bolting (6.1m) was introduced for the first time for better strata control and to eliminate vertical support in face dip to facilitate the movement of Diesel Vehicles. After supporting with cable bolts, the face dip was widened to 8m without any strata control problems.

- **Laying of Civil foundations on loose overburden for Conveyor belts:** For laying civil foundations for Conveyor belts, existing loose overburden soil was dug out and replaced with soil recommended by experts. The soil was compacted layer by layer for a recommended length and depth during filling to obtain the required soil strength around the foundation. Thereafter concrete foundations were made by excavating the above compacted soil for the required foundation dimensions.

- **Transport of Shearer:** Shearer body is nearly 60 tonnes weight and 11m in length. Shearer was transported using two 60 tonnes capacity Shield Haulers (SH660) provided with slew able cookie plates to its forks, on either end of shearer body. Initially binding of shearer body to SH660s was not successful with belt binders; later binding was redesigned using I- section beams and steel chains. While transporting such heavy load, naturally there was a steering control problem and much co-ordination is to be maintained between operators.

  The binding chains needs to be slackened to some extent to prevent breakage, while negotiating curves, and these need to be tightened after negotiating curves. For the first-time shearer transportation was done with the help of Expert foreign operators, later for the 2^{nd} panel it was done with mine operators.
- **Provision of Air Chilling Plant:** Adriyala Project was planned to work in the depth range of 300m to 640m. The geothermic gradient is about 69m/^{0}C. It was envisaged to introduce air chilling plant but order could not be placed due to technical reasons. Initially, when Longwall panel started wet bulb temperature was about 28^{0}C. But after working for 450m retreat, the face wet bulb temperature gradually increased to 32^{0}C due to heat generation from working machinery, large goaf area, hot strata water (35^{0}C) flowing along the bottom gate roadways and large volumes of coal cutting in the face. After the insufficiency of number of measures taken to reduce temperature in Longwall face, 1624TR air chilling plant was finally installed on surface near PE-5, to supply chilled air to Longwall face. At present 80Cu.m/sec of 2400TR capacity air chilling plant is in operation and another 40cu.m/sec 1200TR chilling plant is about to install in the mine for supplying chilled air to Longwall Panel-4 and dip most workings.
- **Dealing with Goaf Water:** In Longwall, an abnormal flow of water of about 3000 to 5000 GPM was observed several times, against the normal flow of 1000 to 1400 GPM from the goaf. Accumulation of Longwall fine cuttings and water in dip side gate, i.e., tailgate of next panel caused difficulty in movement of diesel vehicles due to nearness of sump and frequent pumping problems with sludge water. However, for the 2^{nd} panel exclusive drainage gallery is provided and sump was placed well away from Longwall panel. The trend of sudden inrush of goaf water is being observed for every 3 to 4 months, the pumping capacity is enhanced time to time to deal with sudden surges.
- **Spontaneous heating in LWP-2 salvage:** Carbon Monoxide traces were detected while withdrawing face equipment. Due to low attendance caused by COVID-19, Panel-2 was sealed off without removing powered roof supports, and CO_2 flushing and N_2 inertization continued for 60 days. Environmental monitoring behind the sealed-off area persisted during this period. When conditions became favorable, the panel was reopened, and support withdrawal resumed. After removing 50 supports, the panel was sealed off again due to the second wave of COVID-19. Subsequently, the sealed-off area was reopened, and the supports were withdrawn successfully.
- **Weighting details during retreat of longwall panels:** during retreat of longwall panels, Main weighting occurred after retreat of 55m and severe weighting observed after retreat of 83m from face start line. The average periodic local fall interval is for about every 14m distance, Every 3^{rd} or 4^{th} periodic local fall weightings, major fall was observed and its frequency was for every about

58m distance retreat. Main weighting and all periodic weightings were successfully negotiated. The local and main fall weighting zone along the face was 30th PRS to 130th PRS and tentatively 70% of total face length. The front abutment zone was confined to 25m to 30m ahead of the face. As the face retreat rate is more, periodic weighting interval is also more and vice versa, thus longwall behavior is dynamic depends on existing geo-mining conditions. The periodic weighting details during retreat of LWP No.2 are shown in the Fig 3.

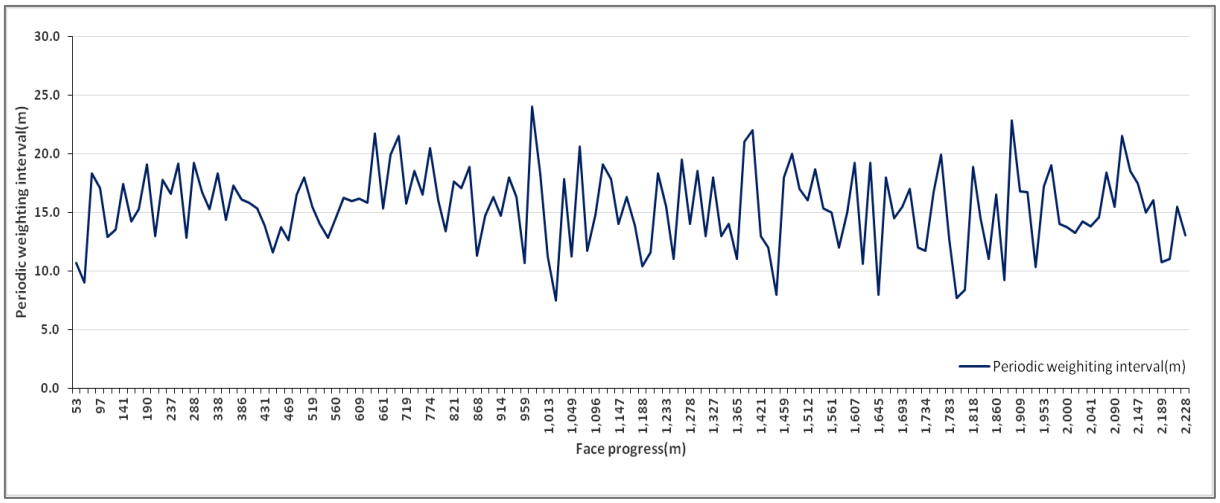

Fig.3. Periodic weighting details during retreat of Longwall Panel No.2

- **Face transfer from LWP No.1 to LWP No.2:** Due to periodic weighting cavity occurred in meshing face resulted in slow operations, and due to cavity in TG-2 for a length of about 70m the equipment is to be transported through TG-3 instead of planned transport route of TG-2 resulted in slow operation because of upward installation of equipment in new face.

  In old face first 30 supports were removed without any roof problem. As envisaged while removing 31st support (i.e., in cavity area) onwards the plastic mesh joint which is running parallel to the face and located over legs of line supports was getting opened and lot of flushing /roof fall was taking place.

  Lot of efforts have been put in to prevent the tearing/opening of the joint, but could not be succeeded. Due to this, flushing continued and removal of supports operation got delayed. the illustration of cavity in the longwall face is shown in Fig.4 (a) and cavity dealing in salvaging pictures are shown in Fig. 4(b).
- **Subsidence monitoring:** The subsidence observation is unusually high compared to the earlier prediction carried out by various institutions. This may be due to large depletion of a water bearing strata and also due to presence of clay layers in the over lying strata.The maximum subsidence recorded of about 1500mm on original ground and 1900mm over the OB dumps within the panel, which are more than the predicted values of subsidence.

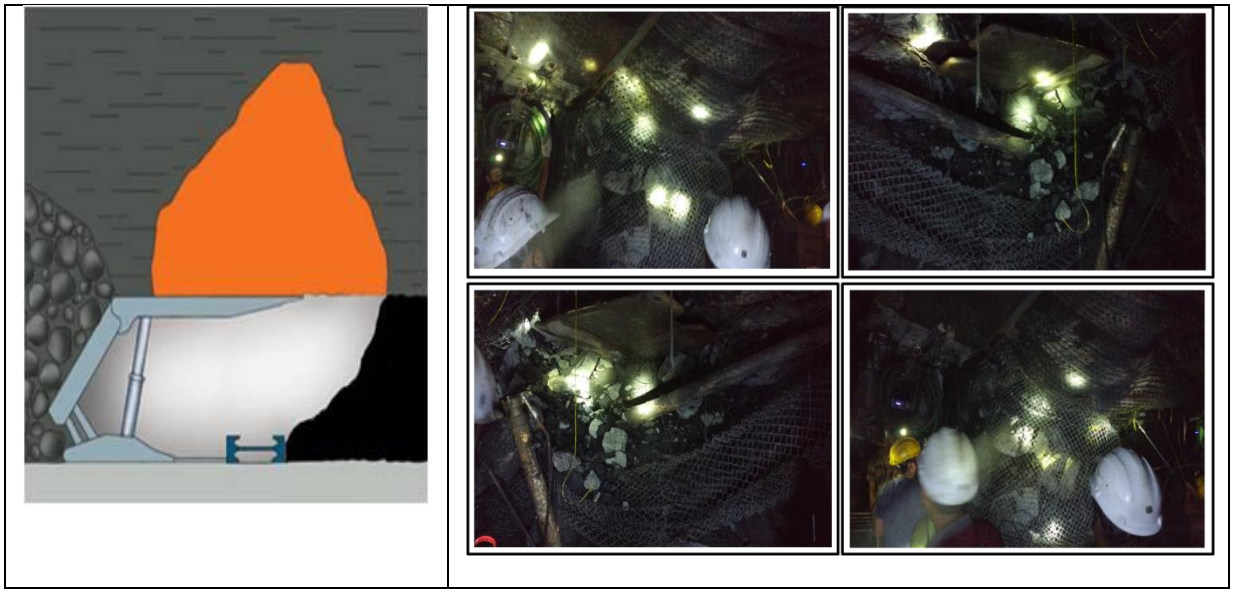

Fig.4. (a) Illustration of longwall face cavity, (b) cavities in longwall face during salvaging

- **Performance of Longwall Panels:** the details of longwall panels worked in Adriyala are summarised in Table 3.

Table.3. Details of Longwall panels worked at ALP

Description	Longwall Panel No.1	Longwall Panel No.2	Longwall Panel No.3
Dimensions of panel	2312m x 250m	2232m x 250m	2494m x 250m
Depth range	362m to 450m	409m to 506m	443m to 541m
Gate road dimension (W×H)	5.2m × 3.3m	5.2m × 3.3m	5.5m × 3.3m
Total Reserves extracted	3.37 Mt	3.25Mt	2.54Mt (till date)
Date of commissioning	15.10.2014	20.08.2017	01.04.2021
Highest daily production/Progress	13,187 t (29.2.16)	11,573 t (29.08.19)	9,580 (23.04.2022)
Highest monthly production/Progress	2.53 Lt (Apr-2016)	1.92Lt (Sep- 2016)	1.62Lt (Dec-2021)

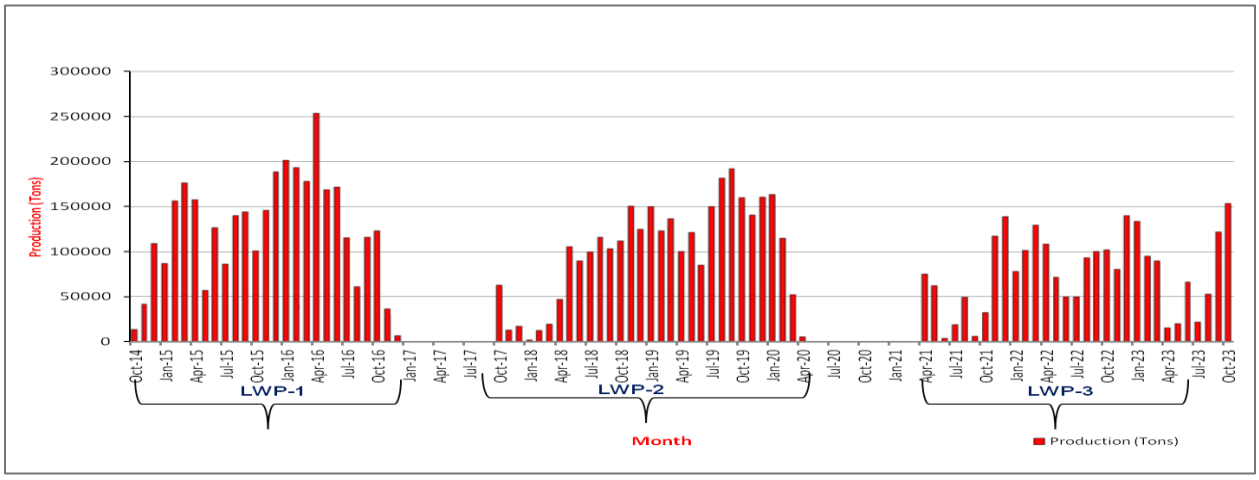

Fig.5. Production details of Longwall Panels in Adriyala

While operating LWP No.1, Initially the performance was not satisfactory due to failure of Variable Frequency Drives (VFD) and Loop-Take-up (LTU) winch hydraulic motors on gate belt and few components in face load centre electrical. Gradually the production stabilised and produced 8000 to 9000 tonnes per day and Longwall panel was successfully extracted. The cost of production for Longwall is about 1420 rupees per tonne. The OMS of Longwall and total mine are about 10 and 5 respectively.

Production details of longwall panels with respect to month are shown in the Fig.5, the longwall production as high as 2.53Lt in April-2015 during Longwall Panel-1 with highest daily production of 13,187t during retreat of Longwall panel-1. The zero production period during salvaging of longwall panels.

The V-Shield visualisation layout showing face and Shearer position, Shield pressures, Length of AFC advancing rams and flippers, of Longwall panel displayed in Computer located at Face load centre as well as at Control room on surface is as shown below Fig.4.

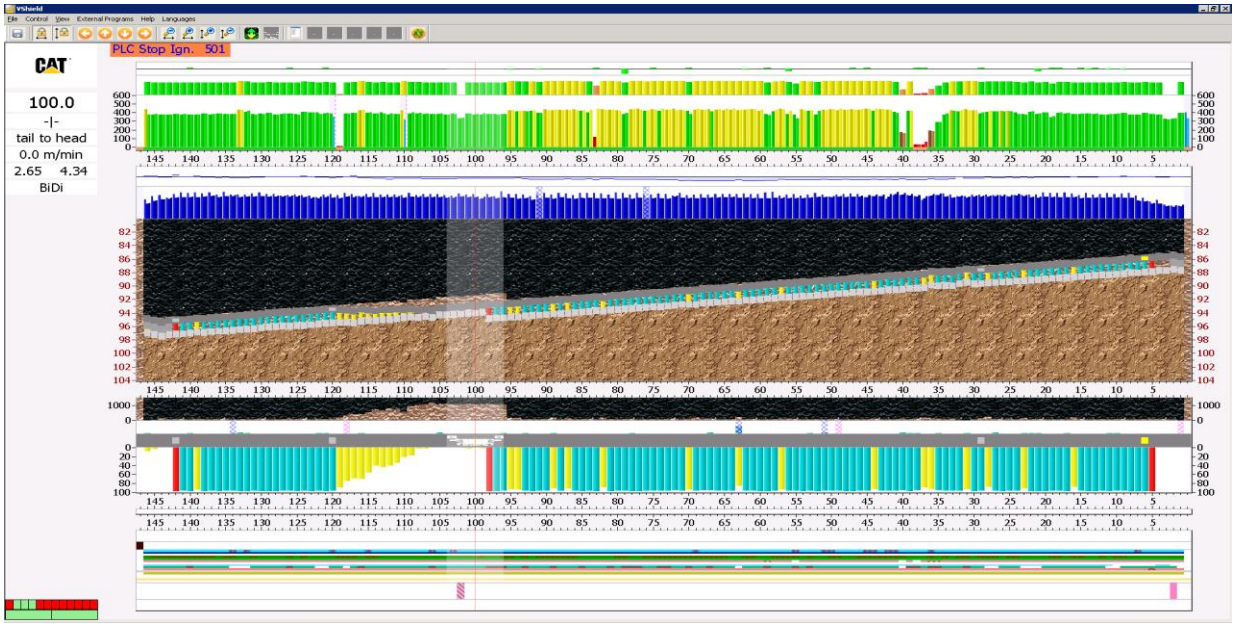

Fig.6. V-Shield Layout of Longwall Panel

Further Issues to be addressed:

The following areas to be addressed for the further improvement of production and productivity

- Longwall automation is to be fully established and utilised.
- Adequate training for further improving skills of the operating crew.
- Spares management to be improved with the indigenisation of spares.
- Motivation of Longwall Team in the form of Incentives, Special payment to encourage the team to involve heartily in the success of Longwall.
- To control release of sudden surges of water from LW face.
- To manage gate roadways roof more effectively.

Future strategies:

- 3 seam punch entries to be developed for further longwall panels in 3 seam
- South side property in No.1 seam development for longwall panels preparation beside opencast workings
- 2 seam development for sump preparation to deal mine make of water
- Man winding air shaft of 7.5m dia for safe and speedy transportation of men
- Underground bunkers for coal storage and transportation
- High capacity Pumps for dealing slurry and water to discharge at 700m height from underground to surface.
- Pre-tensioned cable truss supports for effective strata management in tailgate galleries.
- Thick seam mining with Longwall technology in No.3 seam.

Conclusion:

Longwall should be promoted as a technology mission, thrust areas are to be given due consideration to succeed Longwall technology as in other countries like Australia, USA and China. All of the main coal-producing nations have effectively used longwall mining despite challenging circumstances including extremely gassy, hard roofs, and steeply inclining seams. Longwall is a successful underground mining technique that has been shown without a shadow of a doubt to work in India, where it was first introduced. With the assistance of global operators, the appropriate underground geological blocks must be found for the widespread implementation of high capacity longwalls. When given coal blocks for underground mining, CIL, SCCL, and private operators must prepare to install as many longwalls and LTCC for thick seams as possible in the blocks that are practical for bulk production.

Acknowledgement: The authors wish to express their sincere appreciation and grateful thanks to the management of SCCL for their support and cooperation, for permitting to present this paper and also permitting to use certain data for presenting in this paper. The authors express their acknowledgements to organizers of UMANG-2023 and the views expressed in the paper are those of the authors only and should not be attributed to organization they belong.

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