2 X 10 MVA, 33 KV / 6.6 KV
Electrical Sub Station
Outdoor Yard
(Highly Mechanized Underground Coal Mine)
33 KV Incoming Low Bus to Yard High Bus

Power Supply Co. to Consumer yard
33 KV Low Bus Isolator, CTs, MOCBs, Isolator

Consumer end 33 KV yard
Detail view of Low Bus Zone Feeding Power Transformer

Low Bus Isolator, CTs, MOCBs, Isolator, Soak Pit
33KV Low Bus connecting Out Door Type Power Transformer

By Hollow Tubular Conductor in Primary (33 KV) side &
Galvanized Cu Flat in Secondary (6.6 KV side)
7.5 MVA, 33 KV / 6.6 KV ONAN Power Transformer under installation along with Earth Pits to enhance Electrical Power demand of the Mechanized Mine to introduce Modern Rapid Bulk Production Machinery
Single Line Electrical Layout Diagram of 6.6 KV Power Distribution from Surface Main Sub-Station to different sections of the Mine

Single Line Electrical Layout Diagram with numbering of Switchgear and Outgoing addresses is being kept at Control Room of Sub-Station for Ready Reckoner of Sub-Station Attendants
33 KV MOCB Control Panel

Control Panel with Annunciator
6.6 KV MOCB

Indoor Sub-Station Building
6.6 KV MOCB as Incomer
Battery Bank

Emergency back up Supply
Automatic Power factor correction Device

Automatically add and reduce Capacitor Banks from the Circuit as per requirement to keep Power factor to desired value
India has emerged as the third largest coal producer in the world after China and USA. With global total coal production of 6.2 Billion Tonne, the share of China, USA & India is about 51%, 15% and 9% (8.7%), respectively. About 76% of global hard coal production is from these 3 countries. Other major contributors with coal production of more than 100Mt are Australia (6%), South Africa & Russia (about 4% each) Indonesia (3%) and Kazakhstan (around 2%). Most of global coal production is consumed locally, i.e. within domestic market. Only about 15% of this coal production is destined for international coal market

Coal mining is carried by

Surface or ‘opencast’ mining;

Underground or ‘deep’ mining

Around 60% of this world coal production is from underground mines while 40% from surface mines. However, the proportion of coal production from underground coal mines varies widely in various countries. China accounts for about 95% of its production from underground mines, while corresponding figures for USA and India stands at about 33% & 10%, respectively. In South Africa, production underground mines is about 50% while in Australia, it is 20%.

While the choice of mining method is largely determined by the geology of the coal deposit.

**Board / Room & Pillar Mining:**

In room-and-pillar mining, coal deposits are mined by cutting/driving a network of 'rooms/boards' into the coal seam and leaving behind 'pillars' of coal to support the roof of the mine. These pillars can be up to 40% of the total coal in the seam - although this coal can sometimes be recovered at a later stage.

**Longwall Mining:**

Longwall mining involves the full extraction of coal from a section of the seam, or 'face' using mechanical shearsers. A longwall face requires careful planning to ensure favourable geology exists throughout the section before development work begins. The coal 'face' can vary in length from 100-350m. Self-advancing, hydraulically-powered supports temporarily hold up the roof while coal is extracted. When coal has been extracted from the area, the roof is allowed to collapse. Over 75% -85% of the coal in the deposit can be extracted from panels of coal that can extend in km through the coal seam.

The mining methods with associated technologies in vogue in UG mines of CIL are as under :

(i) Conventional Bord & Pillar (B&P) system with manual loading of coal onto tubs.

(ii) Semi-mechanised B&P system with loading by Side Discharge Loaders (SDLs) or Load Haul Dumpers (LHDs) or mechanised drilling by Universal Drilling Machines (UDMs).

(iii) Mechanised Bord & Pillar/ Room & Pillar system with Continuous Miners (CMs).

(iv) Mechanised Powered Support Longwall (PSLW) mining system.

With the increase in coal demand and growing awareness towards sustainable development, the coal industry has drawn a consensus over the need for increased production from underground coal mines. From the current share of about 10 per cent, the industry aims to reach a total coal production of 30 per cent from underground mines by 2030.

This is more relevant considering the likely exhaustion of shallow depth coal reserves and hurdles in surface land acquisition in future.
Underground Coal Mine
Underground Mine Plan
Single Line Circuit Diagram Surface to Underground
Mine Ventilation Fan
Mine Ventilation Fan Evase

**Horizontal Evase**  **Vertical Evase**
Winder Head Gear Structure
Winding Engine
Overhead Power Lines are drawn from Main Sub-Station upto Bore Hole site
Electrical Power is Transmitted Underground by Cable lowered through Bore Hole
Single Line diagram showing Power Cable to transmit Electric Power Underground may be lowered via Winder Shaft, Incline, Bore Hole etc. upto Main Sub-Station Underground.
Transwitch Unit
Underground Mine Gallery well illuminated & Power Cables have been laid by Cable hangers in Side wall
Underground Mine Gallery for carry Coal & material which is well illuminated, Power cable drawn by hanging in Side wall and Signal & communication Cables drawn by hanging from Roof Hanger.
Bulk Head FLP Lamp Shed
to illuminate pathway Underground

Bulk Head may be fitted with CFL Lamps

Lamp shed may be fitted with CFL Tube
Drill Panel

Drill Panel is basically a three phase Transformer 1.5 KVA, 550 Volt / 110 volt, 3-ph, 50 Hz, enclosed in a FLP chamber and it is having Outgoing Plug suitable for Flexible Trailing Cable which can be fitted to Hand held FLP Drill machine.
Hand held Electric Coal Drill is being used for Board & Pillar Development
Gate End Box by which Machine is started by Pilot operation from remote i.e. from machine end
Side Discharge Loader (SDL)
replaced manual Coal loading on Tub
Load Haul Dump (LHD) machine has made production faster by hauling Coal from Face to Loading point and discharge at Conveyor.
Universal Drilling Machine is being used for Roof Support, Side wall Support as well as Floor Bolting
Communication System by which every moment communication is possible between different sections of the Underground Mine as well as between Surface & Underground
Auxiliary fan is used to force fresh Air to working place / Blind heading
Chair Lift Man riding System to minimize travelling time and to restore fore boarding spirit
Single Line Circuit diagram for Continuous Miner Section
Underground Electrical Sub-Station
CONTINUOUS MINER (MAIN PARTS)

- Chain Conveyor
- Cutting Peaks
- Cutter Drum
- Traction
- Boom
- Hydraulic Shear Cylinder
- Gathering Arm
Shuttle Car driven by Electric Power / Diesel depending upon condition of Underground Mine
Quad Bolter it can operate bolting
4 Nos at a time at 4 different places
Load Center is the source of Power for Continuous Miner Section which can be shifted as per progress of the section since it is mounted on skid.
Single line diagram of Longwall Face
Longwall Face set up

Source: Energy Information Administration
Longwall Mining

The gap between production and demand of coal in future can not be totally met by the depleting Opencast mines. Hence immediate and urgent attention is required to plan and execute large underground coal mining projects.

For bulk production of coal at a faster rate from underground mining, particularly at depth, the proven technology world over is Longwall.

World Longwall mining is moving towards increased face dimensions, least cost per tonne, higher productivity and lesser face transfer periods producing 1 to 4 MT of coal per annum, per face.

In early nineties, higher capacity of Longwall powered supports were introduced. These faces were mostly successful except the collapse of Churcha and Kotadih. With the perspective of history of Longwall of China, US etc and the need of understanding the technology these should be treated as experiences rather than failures.

Long walls were introduced mostly in the blocks left over by working Bord and pillar method. Clean and extensive blocks have not been identified. Even the smaller blocks, which were identified, were of inferior grade coal.

Long wall had to co exist with the conventional mining in most of the mines, which caused management problems.

There were some deficiencies in the imported spares management and the supplies were not reaching in time.

The sequence of operations in longwall mining is basically simple. The rectangular longwall panel, averaging nearly 150 mtr. wide, 900 mtr. feet long, and 4.5 mtr. high, is “blocked out” by excavating passageways around its perimeter. Room-and-pillar mining is used to block out the panel. Excavation of the coal in the panel is an almost continuous operation. Working under the steel canopies of hydraulic, movable roof supports, a coal cutting machine runs back and forth along the 120 mtr. face, taking a cut ranging anywhere from a few cm to 0.8 mtr. deep during each pass. The cut coal spills into an armored chain conveyor running along the entire length of the face. This face conveyor dumps the coal onto belt conveyors for transport out of the mine. As the cutting machine passes each roof support, the support is moved closer to the newly cut face to prop up the exposed roof. The roof is allowed to collapse behind the supports as they are advanced towards the face. Mining continues in this manner until the entire panel of coal is removed.

Because longwall mining is essentially a continuous, highly mechanized operation, longwall productivity is potentially higher than room-and-pillar productivity.

Longwall mining also offers improved safety through better roof control, more predictable surface subsidence, and better opportunity for full automation. On the other hand, capital costs for longwall equipment are much higher than for room-and-pillar equipment, productivity during development (“blocking out”) of the longwall panels is typically low, and large amounts of dust and methane are generated during the mining process.
Shearer Machine
Shearer machine in a Longwall Face
Belt Conveyor carrying Coal from Face to Surface CHP in stages
Gate End Boxes in Bank on skid
Mining is potentially one of the most hazardous occupations. This has been recognized in India since at least 1901, when the first legislation was passed. Awareness of environmental issues has come later. There is now a large body of law dealing with safety health and the environment in mines. The problem remains however, that implementation of the law and policies is not consistent.

The ILO approach to these issues is in keeping with the fundamental philosophy of the organization.

Lasting improvements in safety and health—as opposed to "safety weeks"—can only come about through genuine tripartite and bi-partite activity. A number of ILO projects have been implemented with the Directorate General of Mines Safety (DGMS).

It was recognized that there should also be cooperation with workers' organizations.

The Worker's Education Branch of the ILO therefore made mining one of the priority sectors in the workers' education project "Workers' Education Assistance on Occupational Safety, Health and Environmental Issues to Workers' Organizations in Selected South Asian Countries"
Checklists make inspections easier. It is not practicable to walk around a mine with copies of Acts, Rules, Regulations, DGMS circulars, etc.

A well-drafted checklists should put into question form the DGMS statutory requirements/ILO guidance/Company instructions. It serves as an aid in inspecting all potential hazards.

- **CHECKING OF EQUIPMENT**
  - 1. All bolts and nuts are of correct size. Yes/No
  - 2. All bolts and nuts are properly tightened. Yes/No
  - 3. No missing bolts and nuts found.
  - 4. No alteration done in the equipment
    - (fitting fabricated cable sealing box
    - or fitting any mild steel : blank flame
    - fitting of wrong size bolt and nut
    - fitting of non-standard spare etc.)
  - 5. Enclosure free from cracks, damage, corrosion, pitting, broken bolts inside stud hole.
  - 6. Air gap between flange joints as per statute.
  - 7. Properly earthed.
  - 10. Properly compounded.
  - 11. Shrouds, guarding, bolt heads free from dust and dirt.
- **TRAILING CABLE**
  - 1. Plug and socket coupling properly fitted both ends.
  - 2. No bad joints.
  - 3. Vulcanizing done (for joint in trailing cable).
  - 4. Proper insulation resistance of power/trailing cable and the system of the circuits regularly recorded. Yes/No