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Full Length Article

A Detailed Study On Srirampur Open Cast-II Expansion Project Mine Review

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Abstract
Coal mining remains a cornerstone in fulfilling the growing energy requirements essential for industrial and economic progress. This study presents an in-depth analysis of operational practices implemented in the SRP OC-II Expansion Project, focusing on open-cast mining techniques and coal extraction processes. The research aims to elucidate the sequence of mining operations and evaluate the methods employed to achieve safe, efficient, and cost-effective production.The study outlines the key stages of mining activities, including site preparation, drilling, blasting, loading, and coal transportation. The application of mechanized equipment—such as excavators, dumpers, drilling rigs, and conveyor systems—is emphasized for enhancing productivity and minimizing manual labor. The functioning of the Coal Handling Plant (CHP) is examined, highlighting processes such as coal crushing, conveying, storage, and dispatch.Furthermore, the study underscores the critical role of electrical infrastructure, particularly the 33 kV/3.3 kV substation, which supplies power to heavy mining machinery. Essential components including transformers, circuit breakers, current and potential transformers, insulators, and lightning arresters are discussed in the context of maintaining a safe and reliable electrical network. Environmental and safety considerations are also addressed, encompassing dust suppression, water management, waste handling, and protective measures for personnel and equipment.Overall, this study provides a comprehensive overview of open-cast mining operations, demonstrating how strategic planning, mechanization, and robust electrical systems collectively contribute to efficient and safe coal extraction.

Keywords— *Open-Cast Mining, Coal Extraction, Drilling and Blasting, Coal Handling Plant (CHP), Mining Equipment, Electrical Substation.*

Introduction

The Srirampur Opencast Project (SRP OCP-II) is situated in the southern section of the Somagudem-Indaram coal belt, positioned between the Srirampur Incline and Indaram Incline blocks within the South Godavari Valley Coalfield. Covering an area of 5.33 km², the block lies between latitudes 18°49′04″–18°51′12″ N and longitudes 79°29′17″–79°32′02″ E, and falls under Survey of India topo sheets No. 56 N/5, 56 N/6, 56 N/9, and 56 N/10. The project is encompassed by the North Godavari Mining Lease, Indaram Mining Lease, Srirampur Mining Lease, and Srirampur Additional Mining Lease managed by SCCL.The block has convenient connectivity, located 1.5 km from the Chennur–Mancherial National Highway and State Highway, and approximately 7.5 km west of Mancherial township. The nearest railway access is Mancherial Railway Station, situated on the Kazipet–Balharshah section of South Central Railway, approximately 7.5 km away.

Method of Working

Originally an underground mine (SRP-2 & 2A), the area was converted to open-cast mining in 2007, subsequently renamed SRP OC-II. The expansion project annexed adjacent dip-side properties, incorporating portions of SRP-3 & 3A inclines, and increased the rated capacity from 3.10 MTPA to 3.50 MTPA. The deposit features numerous faults (~42), which interrupt coal seam continuity, necessitating careful excavation planning. Overburden is removed via offloading methods, with coal extraction conducted departmentally. The project includes both internal and external dump yards for OB disposal.Special attention is given to mining near major faults, particularly a 220 m downthrow fault at the southern quarry boundary, with benches formed parallel to fault lines. Coal production currently reaches 3.50 MTPA and is dispatched via in-pit and surface feeder breakers, supported by a 3 km in-pit and 0.6 km surface conveyor network. Coal is delivered through the Pre-Weigh Wagon Loading System (PWWLS) and rail mode to power plants and other customers, ensuring uninterrupted supply.

Literature Survey

Tiwary (2001) studied the environmental effects of coal mining on air and water quality, concluding that mining operations significantly impact local ecosystems and require strict environmental management for sustainability. Chaulya and Chakraborty (2002) analyzed dust, air pollution, land degradation, and water contamination in coal mines, emphasizing mitigation strategies such as dust suppression and proper waste handling.Ghose (2004) highlighted sustainable mining practices, including land reclamation and eco-friendly technologies to minimize open-cast mining impacts. Singh and Dhar (1997) emphasized the importance of proper mine planning and slope stability analysis, noting that inadequate bench design can compromise both safety and productivity.

Hartman and Mutmansky (2002) noted that open-cast mining provides higher recovery rates, safer working conditions, and better mechanization potential than underground methods. Kumar et al. (2015) demonstrated that the use of heavy earth-moving machinery (HEMM), including dumpers and shovels, significantly enhances productivity and reduces labor requirements. Peng (2006) observed that automation technologies, such as SCADA and PLC-based control systems, improve operational safety and efficiency in modern mining operations.

Objectives

1. To study operational methodologies implemented at SRP OC-II, including open-cast mining processes and electrical system integration.
2. To understand the functioning of the power supply system, coal handling plant, conveyor system, and associated infrastructure.
3. To evaluate how mechanization, electrical equipment, and automation systems enhance safety, productivity, and efficiency.
4. To analyze environmental protection, safety measures, and maintenance practices implemented within the mine.

Coal Handling Plant (CHP) – SRP OC-II

Figure 1: Coal handling plant

The Coal Handling Plant (CHP) at SRP OC-II is a fully integrated system designed to manage, process, and prepare coal extracted from the opencast mine for transportation to end consumers. It combines mechanical, electrical, and control systems to ensure continuous, safe, and efficient operation.

Process Flow and Conveyor Layout

Situated in Mancherial district, Telangana, the SRP OC-II project under Singareni Collieries Company Limited (SCCL) produces between 2.5 and 3.5 million tonnes of coal annually, making the CHP a critical component in the supply chain.

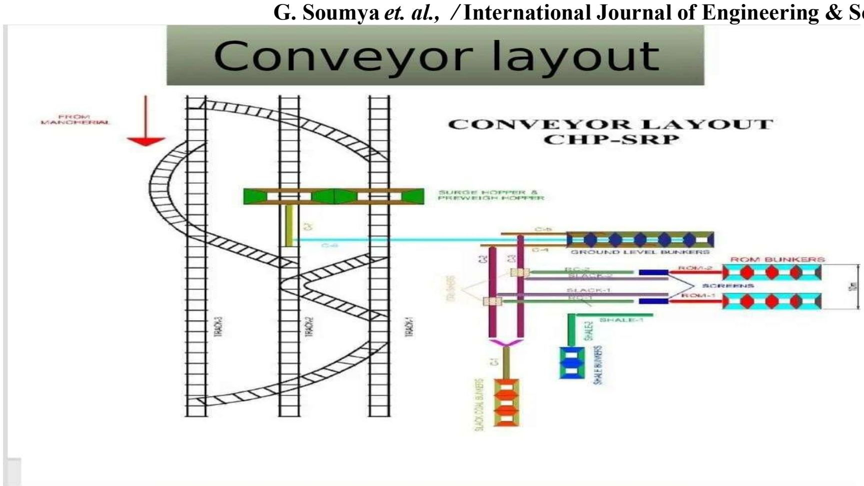

Figure 2: Conveyor layout

Step-by-Step Process:

1. **Dumping & Initial Feeding:** Large dumpers unload ROM coal into the receiving hopper. Vibrating feeders regulate flow and separate oversized boulders.
2. **Crushing:** ROM coal is reduced to 1–200 mm using a primary crusher. A secondary crusher may further reduce size to 1–100 mm as needed.
3. **Magnetic Separation:** Magnetic separators remove metallic particles to prevent equipment damage.
4. **Conveying & Stacking:** Crushed coal is transported via belt conveyors to a stacker, forming uniform stockpiles in the storage yard.
5. **Storage & Reclaim:** Stockpiles act as buffer storage. Reclaimers retrieve coal and transfer it back onto conveyors for dispatch.

Vehicles and Equipment in SRP OC-II

Off-Highway Dump Trucks (BEML, CAT, Komatsu)

Figure 3: Dumpers

Off-highway dump trucks, such as those manufactured by BEML, CAT, and Komatsu, are extensively used for transporting overburden and coal within the mine. These diesel-powered trucks feature heavy-duty axles and either powershift or hydrostatic transmissions that drive the rear wheels, ensuring stability on steep and unpaved haul roads.The dump body is lifted hydraulically from the front, allowing gravity-assisted discharge through the rear gates. Specialized braking and steering systems maintain control even under fully loaded conditions, ensuring safe and efficient material transport.

Wheel Loaders (Volvo, Komatsu)

Figure 4: Volvo Loader

Wheel loaders, including Volvo and Komatsu models, are articulated-frame front-end loaders used for loading, hauling, and short-distance material transfer. Diesel engines power the axles through a robust transmission system, enabling quick maneuverability between stockpiles and trucks.

Water Tankers (BEML)

BEML WATER TANKERS

Hydraulic cylinders on the loader arms control lifting and lowering of the bucket, while additional cylinders regulate bucket tilt, enabling operators to "curl" material for better load distribution and stability during transport.

Figure 5: Water Tanker

BEML water tankers are specialized vehicles designed for dust suppression and road maintenance. They consist of a water tank, pump, and spray system. A diesel engine powers both the vehicle and an auxiliary pump, pressurizing water for distribution through spray nozzles mounted at the rear and sides.

Operators can selectively control spray zones, applying water to haul roads, stockyards, or other dusty areas to reduce airborne particles and improve operational visibility.

Motor Graders

MOTOR GRADERS

Figure 6: Motor Graders

Motor graders are precision machines used for constructing and maintaining haul roads and leveling mine surfaces. Equipped with a long front blade controlled by hydraulic cylinders, graders can adjust the blade's height, angle, and offset to achieve accurate slope and crossfall. The operator performs multiple passes over the surface, each removing a small layer, gradually bringing the road or site to the required grade and smoothness.

Drill Machines (Rotary Blasthole Rigs)

DRILL MACHINE

Figure 7: Drill Machine

Drill machines, such as rotary blasthole rigs, are used for creating deep, precise holes for explosive placement. The rig consists of a mast or derrick holding a rotating drill string with a cutting bit at the end. Flushing air or water removes rock cuttings from the hole during drilling. Hydraulic motors provide rotational and downward force, while operators control drilling speed, thrust, and angle from the cab, ensuring uniform hole patterns for controlled blasting operations.

Equipment Maintenance, Environmental, and Safety Management in SRP OC-II

Equipment Maintenance Management

Ensuring operational reliability of mining equipment requires systematic preventive and predictive maintenance programs. Efficient maintenance directly affects equipment availability, productivity, and operational cost control.

Maintenance Strategies:

1. Scheduled preventive maintenance based on machine operating hours.
2. Condition monitoring using oil analysis, vibration analysis, and thermography.
3. Tracking component life for planned replacements.
4. Centralized workshops staffed with specialized technicians.
5. Maintaining spare parts inventory to avoid downtime.

Through disciplined maintenance practices, modern open cast operations achieve equipment availability exceeding 90%, thereby enhancing production efficiency and reducing operational costs.

Environmental Impacts and Management

Land Disturbance and Habitat Loss

Open cast mining significantly alters the natural landscape by removing vegetation, topsoil, and geological formations. For a medium-sized coal mine producing 40 million tonnes annually, the operational area may be disturbed over 25–30 km².

Primary Impacts:

- Complete vegetation clearance and habitat fragmentation.
- Topographical changes creating artificial landforms.
- Soil profile disruption affecting fertility and structure.
- Wildlife displacement and biodiversity loss.
- Sedimentation and altered drainage patterns affecting downstream users.

33/3.3 kV Substation at SRP OC-II

A **33 kV/3.3 kV step-down substation** plays a critical role in industrial and mining operations by converting high-voltage power from the grid into medium-voltage suitable for heavy electrical equipment. In the SRP OC-II mining project under Singareni Collieries Company Limited (SCCL), this substation supports continuous operation of draglines, shovels, crushers, conveyor belts, and pumps by providing reliable and protected power supply.

Substation Layout

LAYOUT OF 33/3.3KV SUBSTATION

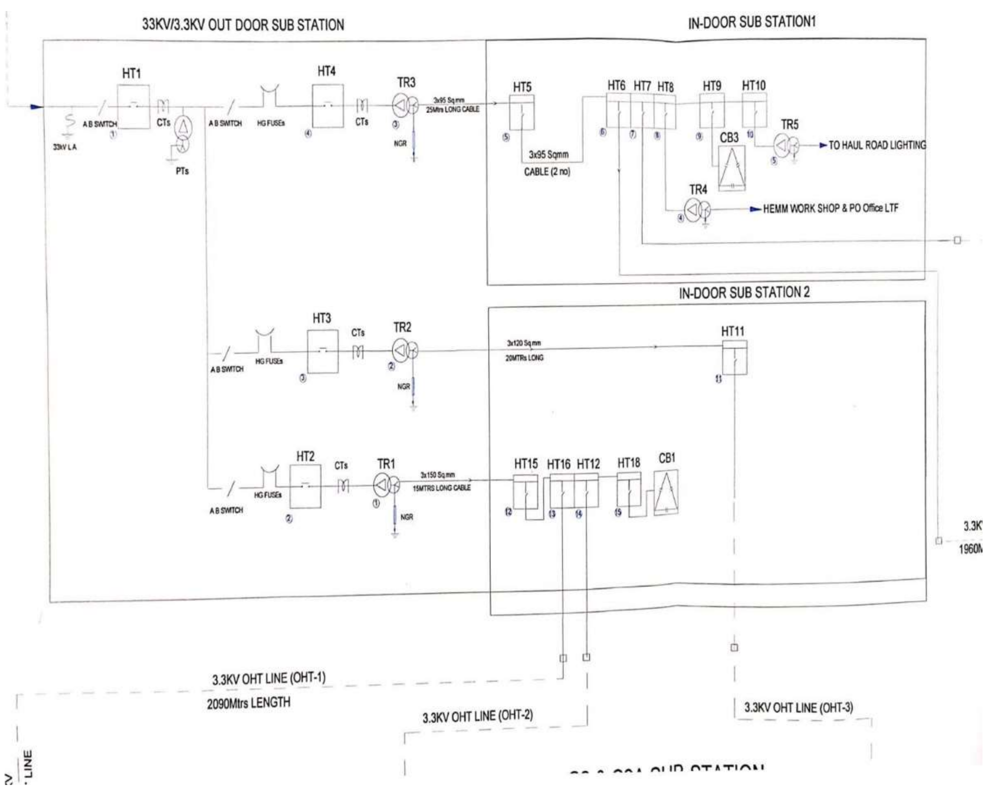

Figure 8: Layout of 33/3.3kv substation

The 33/3.3 kV substation is organized to separate incoming high-voltage feeders, transformer bays, switchgear, and outgoing medium-voltage feeders while providing safe operational access for maintenance and monitoring.

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Key Electrical Equipment

LIGHTING ARRESTER:

Figure 9: Lighting Arrester

Installed at the 33 kV incoming line, transformer terminals, and 3.3 kV feeders to prevent damage from voltage surges. Common types include:

- **Metal Oxide Varistor (MOV) Arresters** – fast response and high efficiency.
- **Gapless Arresters** – simple, reliable design suitable for modern substations.

Insulators

Provide mechanical support while electrically isolating live components. Materials include porcelain, glass, polymer, or epoxy resin depending on voltage levels and environmental conditions.

Potential Transformers (PTs)

Figure 10: Potential Transformer

Step down high voltages to standardized levels (typically 110 V or 63.5 V) for safe metering and relay inputs. Installed at:

- 33 kV incomer panels
- Transformer panels (33/3.3 kV)
- 3.3 kV feeder panels
- Control & relay panels
- Energy metering boards

Power Transformer

Figure 11: POWER TRANSFORMER

A static device transferring energy via electromagnetic induction, stepping down 33 kV to 3.3 kV to power mining equipment. Example parameters in SRP OC-II:

- Rating: 5–20 MVA
- Cooling: ONAN / ONAF
- Location: Outdoor substation
- Applications: Draglines, shovels, conveyors, crushers, and lighting systems

Conclusion

The **SRP OC-II opencast project** represents a significant operational asset within the Singareni Collieries Company Limited (SCCL) mining portfolio. The division demonstrates effective large-scale coal extraction by employing modern mining methods and equipment.High-capacity machinery, including dumpers, excavators, dozers, and wheel loaders, enhances productivity while minimizing manual labor. The incorporation of safety technologies, such as automated monitoring systems and operational controls, ensures a safer working environment for personnel.Additionally, the **33 kV/3.3 kV substation** provides stable and reliable electrical power, supporting the continuous operation of heavy mining equipment, conveyors, pumps, and auxiliary systems.

In summary, the synergy of advanced equipment, robust safety measures, and reliable electrical infrastructure significantly improves operational efficiency, reduces hazards, and promotes sustainable practices in coal mining. This highlights the critical role of modern technology in optimizing large-scale mining operations.

Future Scope

To meet increasing energy demands, SRP OC-II plans to **expand coal production capacity** through the adoption of enhanced mining techniques and optimized extraction strategies. Future initiatives will focus on:

- **Modernization of machinery and automation**: Introducing digital monitoring tools and automated systems to improve operational efficiency, minimize human error, and enhance safety standards.
- **Environmental sustainability**: Implementing afforestation programs to restore ecosystems, advanced dust suppression techniques to improve air quality, and efficient water management and waste disposal systems to reduce environmental impact.
- **Cost optimization**: Leveraging predictive maintenance and data-driven operations to minimize downtime, reduce operational costs, and maximize equipment lifespan.

These initiatives aim to establish SRP OC-II as a benchmark for **safe, efficient, and environmentally responsible coal mining**, integrating technological innovation with sustainable operational practices.

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