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Full Length Article

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

Ms. K. Uma Rani[1],G. Soumya[2],K. Manasa[3] ,B.Salomi[4]
[1]Assistant Professor, Department of Electrical and Electronics Engineering, Bhoj Reddy Engineering College for Women, Hyderabad, India.

[2,3,4]B.Tech Students, Department of Electrical and Electronics Engineering, Bhoj Reddy Engineering College for Women, Hyderabad, India.

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ABSTRACT

Coal mining plays a crucial role in meeting the energy demands of industrial and economic development. This project presents a detailed study of operational methodologies adopted in the SRP OC-II Expansion Project, focusing on open cast mining practices and coal extraction processes. The study aims to understand the sequence of mining operations and the methods used to achieve safe, efficient, and cost-effective production.

The project explains various stages of mining operations including site preparation, drilling, blasting, loading, and transportation of coal. It highlights the use of mechanized equipment such as dumpers, excavators, drilling machines, and conveyor systems, which improve productivity and reduce manual effort. The functioning of the Coal Handling Plant (CHP) is also discussed, including coal crushing, conveying, storage, and dispatch systems.

In addition, the study emphasizes the importance of electrical systems, particularly the 33kV/3.3kV substation, which plays a key role in stepping down voltage and supplying power to heavy mining equipment. Components such as transformers, circuit breakers, current transformers, potential transformers, insulators and lightning arresters are essential for safe and reliable operation of the electrical network. The project also addresses environmental and safety aspects including dust suppression, water management, waste handling, and the implementation of safety precautions to protect workers and equipment.

Overall, this study provides a comprehensive understanding of open cast mining operations and demonstrates how systematic planning, mechanization, and a strong electrical infrastructure contribute to efficient and safe coal extraction.

Keywords:
Open Cast Mining, Coal Extraction, SRP OC-II Expansion Project, Coal Handling Plant (CHP), Mining Operations, Drilling and Blasting, Heavy Earth Moving Machinery (HEMM), Dumpers and Excavators, Conveyor Systems, 33kV/3.3kV Substation, Power Distribution in Mining, Electrical Protection Systems, Transformers and Circuit Breakers, Lightning Arresters, Industrial Power Systems, Mining Safety, Environmental Management, Dust Suppression, Sustainable Mining Practices, Energy Production

INTRODUCTION

MINE HISTORY:

The Mining lease of Srirampur Opencast project block is located in the Southern Part of the Somagudem-Indaram coal belt between Srirampur Incline block and Indaram Incline block in the South Godavari valley coal field. This Srirampur open cast block is covering an area of 5.33 Sq Km, lies between the North latitude 18° 49' 04" - 18° 51' 12" and East longitude 79° 29' 17" - 79° 32' 02" and falls in the Survey of India topo sheet No. 56 N/5, 56 N/6, 56 N/9, 56 N/10. It is covered under North Godavari Mining Lease, Indaram Mining Lease, Srirampur Mining Lease and Srirampur Additional Mining Lease held of SCCL.

The block is connected to Chennur / Mancherial National Highway by 1.5 km black top road State Highway road passes to the south-eastern end of the block Srirampur / Coal Chemical Complex Township and Mancherial township area at 1.5 Km and 7.5 Km, due West respectively. The nearest Railway station is Mancherial Railway station which is at a distance of about 7.5 Km. This Railway station is situated in Kazipet-Balharsha section of South Central Railway.

GEOLOGY:

It lies in Southern part of Somagudem-Indaram coal belt between Srirampur-1 Incline block and Indaram Khani-1 incline block in the south Godavari valley coal field. A total of 9 co-relatable coal seams are occurring in this block, these seams IA, I, II, IIIB, IIIA and III Seams attained workable thickness throughout the property. All these seams are extensively developed by underground. Average dip of the seams is 1 in .

METHOD OF WORKING:

The The underground mines of SRP-2&2A were converted into open pit method working in the year of 2007. Initially, the opencast mine was started as SRP OC, later it was called as SRP OC-II, and it is a relay project of SRP 2&2A geological bloom. After annexing the dip side property, which includes part of SRP 3&3A inclination property to the SRP OCP-II up to a depth of 350 m of III seam and by increasing rated capacity from 3.10 MTPA to 3.50 MTPA, it is named as SRP OC-II Expansion Project. This mine property consists of virgin patches and developed pillars of abandoned SRP-2&2A Inclines and SRP-3&3A Inclines.

The property of the project is highly disturbed with numerous faults; about 42 faults are present in the entire deposit, due to which the continuity of coal exploration of the seams is not possible in this project. The project is designed purely to excavate OB by off-loading method, and coal being excavated departmentally. There are two dump yards namely, External Dump Yard and Internal Dump yard.

LITERATURE SURVEY

Tiwary (2001), in the Environmental Geology Journal, studied the environmental impact of coal mining on air and water quality. The study concluded that mining operations significantly affect surrounding ecosystems, and strict environmental regulations are necessary for sustainable development .Chaulya and Chakraborty (2002), in the Environmental Monitoring and Assessment Journal, analyzed environmental impacts of coal mining. Their study highlighted major issues such as air pollution, dust generation, land degradation, and water contamination, and suggested mitigation measures like dust suppression systems and proper waste management .Research by Ghose (2004) in the Journal of Mines, Metals and Fuels focused on sustainable mining practices in India. The author emphasized the need for land reclamation, environmental monitoring, and eco-friendly mining technologies to minimize the adverse effects of open cast mining .Singh and Dhar (1997), in their study published in the International Journal of Rock Mechanics and Mining Sciences, emphasized the importance of proper mine planning and slope stability analysis in opencast mines. Their research shows that improper bench design and slope angles can lead to failures, affecting both safety and productivity .Hartman and Mutmansky (2002) in their book "Introductory Mining Engineering", open cast mining is one of the most efficient methods for extracting near-surface mineral deposits. The authors highlight that this method provides higher recovery rates, better working conditions, and greater scope for mechanization compared to underground mining .A study by Kumar et al. (2015) in the Journal of The Institution of Engineers (India): Mining Engineering Division discussed the role of mechanization in Indian coal mines. The authors observed that the use of heavy earth moving machinery (HEMM) such as dumpers, draglines, and shovels significantly improves production efficiency and reduces manual labor .

According to Peng (2006) in "Longwall Mining", modern mining operations are increasingly adopting automation technologies such as SCADA systems and PLC-based controls for improving safety and operational efficiency .

INTRODUCTION TO OPEN CAST MINING

Definition and fundamental concepts:

Open cast mining is a surface mining technique used to extract minerals and ores that lie close to the earth's surface. Unlike underground mining, which involves creating tunnels and shafts to reach deep deposits, open cast mining removes the overburden (soil, rock, and other materials covering the mineral deposit) to access the ore directly. The method is economically viable when deposits are shallow enough that the cost of removing overburden is justified by the value of the extracted minerals. This technique is widely employed for extracting coal, iron ore, copper, bauxite, phosphate, and limestone.

HISTORICAL DEVELOPMENT:

The origins of open cast mining trace back to ancient civilizations that quarried stone for construction. However, the modern industrial application began during the Industrial Revolution when coal extraction intensified in Europe and North America. The mechanization of mining in the early 20th century, with the introduction of steam-powered shovels and locomotives, transformed open cast operations from labor-intensive endeavors to highly productive industrial processes. Post-World War II technological advancements, including diesel-powered equipment, improved explosives, and advanced drilling technologies, further revolutionized the industry. Today, open cast mining incorporates cutting-edge technologies such as GPS-guided machinery, autonomous haulage systems, and sophisticated mine planning software.

ADVANTAGES AND LIMITATIONS

Advantages:

Higher productivity and extraction rates compared to underground mining,Lower operational costs per ton of ore extracted,Enhanced worker safety with natural ventilation and daylight operations,Greater mechanization potential enabling economies of scale

Limitations:

Significant environmental impact including landscape alteration and habitat,Limited to shallow deposits where stripping ratio remains economical, Large surface footprint requiring substantial land acquisition

TYPES OF OPEN CAST MINING METHODS

Strip mining

Strip mining is employed when mineral deposits extend horizontally over large areas with relatively thin overburden. The process involves stripping overburden in long, parallel cuts called "strips" and depositing it into the previously mined-out area. This creates a continuous cycle of excavation and backfilling.

Ideal Conditions:

Flat or gently rolling topography, Thin to moderate overburden thickness (typically less than 60 meters),Extensive horizontal deposits such as coal seams, Stripping ratio generally below 8:1,

The method is particularly prevalent in coal mining regions, including India's Gare Palma mine and various coalfields in the United States, Australia, and China.

COAL HANDLING PLANT

Figure Coal handling plant

The Coal Handling Plant (CHP) at SRP OC-II is an integrated system designed to handle and prepare coal extracted from the opencast mine for transportation to consumers. It involves a

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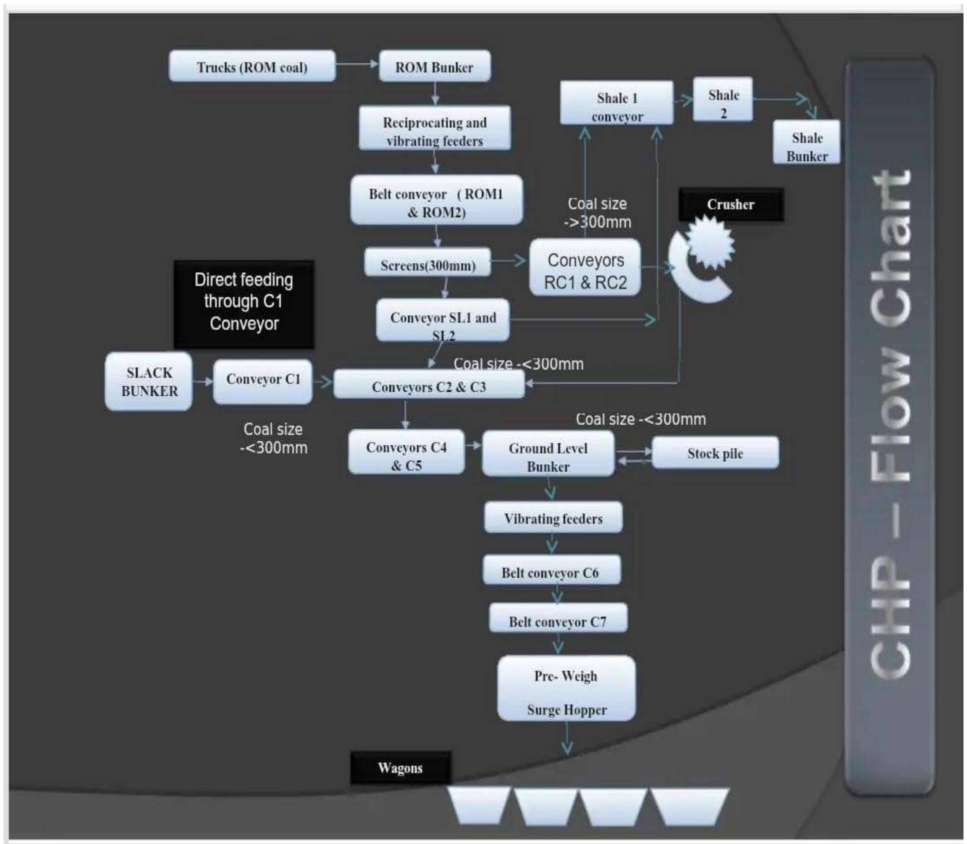
combination of mechanical, electrical, and control systems to ensure efficient, safe, and continuous operations.

SRP OC-II is one of the significant projects under Singareni Collieries Company Limited (SCCL), located in Mancherial district, Telangana. The CHP is critical in managing the 2.5 to 3.5 million tonnes per annum (MTPA) coal production.

CHP Flow Chart

Figure 3.2: Coal handling plant flow chart



Objectives of Coal Handling Plant

The coal handling plant plays a vital role in ensuring the smooth and efficient processing, storage, and transportation of coal in mining and power generation industries. One of its primary objectives is the efficient handling of Run-of-Mine (ROM) coal, which is extracted directly from the mine and often contains large lumps and impurities. To make the coal suitable for further use or transportation, the plant performs size reduction, ensuring that the coal is processed into a standard and manageable size for dispatch. Another important objective is the removal of impurities such as tramp iron and other unwanted materials, which could damage equipment and reduce the quality of coal.

In addition to processing, the coal handling plant provides temporary storage facilities to manage fluctuations in demand, ensuring a continuous and uninterrupted supply of coal. This storage capability is essential for handling surge requirements and maintaining operational stability. The plant also facilitates efficient loading of processed coal into trucks or railway wagons for transportation to various destinations. Furthermore, modern coal handling plants are designed to ensure environmental compliance by minimizing dust generation, controlling noise levels, and preventing material spillage. These measures not only improve operational efficiency but also help in adhering to environmental regulations and maintaining workplace safety.

Equipment Maintenance Management

Effective equipment maintenance management is essential for ensuring the reliability, efficiency, and longevity of machinery used in coal handling and mining operations. To achieve this, organizations adopt systematic preventive and predictive maintenance strategies that help in identifying potential issues before they lead to equipment failure. Preventive maintenance involves performing regular inspections and servicing of equipment based on predefined schedules, such as operating hours or usage cycles. This approach helps in reducing unexpected breakdowns and extending the lifespan of critical components.

In addition to preventive measures, condition monitoring techniques such as oil analysis, vibration analysis, and thermography are used to assess the real-time health of equipment. These techniques enable early detection of faults and allow timely corrective actions. Another important aspect of maintenance management is component life tracking, which helps in planning replacements before components reach the end of their service life. Centralized workshop facilities equipped with specialized technicians further support efficient repair and maintenance activities.

Proper spare parts inventory management is also crucial, as it ensures the availability of necessary components when needed, minimizing downtime. By implementing these structured maintenance practices, modern mining operations are able to achieve equipment availability levels exceeding 90 percent. This high level of reliability directly contributes to improved productivity, reduced operational costs, and overall efficiency of the system.

EQUIPMENT USED IN SUBSTATION

LIGHTING ARRESTER:

Figure : Lighting Arrester

A DETAILED STUDY ON SRIRAMPUR OPEN CAST-II EXPANSION PROJECT MINE REVIEW

Lightning Protection in 33kV/3.3kV Substation

In the Srirampur Open Cast-II (SRP OC-II) mining project, the 33kV/3.3kV substation plays a crucial role in ensuring uninterrupted and safe power supply to mining operations. Lightning arresters are strategically installed at various points within the substation to protect electrical equipment from high-voltage surges caused by lightning strikes or switching operations. These arresters are typically installed at the incoming 33kV feeder to safeguard transformers and other high-voltage components from external surges. Additionally, they are placed on the 3.3kV side of the transformer to protect against backflow surges that may originate within the system. In some cases, lightning arresters are also installed near generator terminals, motor feeders, and control panels to provide localized protection for sensitive equipment.

Modern substations primarily use Metal Oxide Varistor (MOV) type lightning arresters, commonly made of zinc oxide, due to their high efficiency, fast response time, and superior energy absorption capability. These arresters operate without spark

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gaps and provide continuous protection against transient overvoltages. Gapless arresters are also widely preferred in modern installations because of their simple design, improved reliability, and minimal maintenance requirements. The use of these advanced protection devices ensures the longevity of electrical equipment and enhances the overall reliability of the power system in mining operations.

Conclusion

The Srirampur Open Cast-II (SRP OC-II) project stands as a significant and integral part of the coal mining operations of Singareni Collieries Company Limited. The opencast mining activities in the Srirampur Division demonstrate efficient and large-scale coal extraction using modern mining techniques and advanced equipment. Heavy machinery such as dumpers, excavators, and dozers plays a vital role in improving productivity while minimizing manual labor and operational time.

The integration of advanced safety technologies, including monitoring systems and automated controls, ensures a safer working environment for personnel. Furthermore, the 33kV/3.3kV substation provides a stable and reliable power supply, which is essential for the continuous operation of heavy machinery and auxiliary systems within the mine. The combination of efficient mining equipment, strong electrical infrastructure, and effective safety measures significantly enhances operational efficiency and reliability. Overall, the project reflects the growing importance of technological advancements in achieving sustainable, safe, and productive mining operations.

Future Scope

The future scope of the SRP OC-II expansion project focuses on increasing coal production capacity to meet the rising energy demands of the region. This will be achieved by adopting improved mining techniques and optimizing extraction methods to maximize resource utilization. The introduction of modern machinery, automation systems, and digital monitoring tools will further enhance operational efficiency, reduce human intervention, and improve overall safety standards. These advancements will also contribute to cost-effective mining operations by minimizing downtime and increasing productivity.

In addition to technological improvements, the project emphasizes the implementation of environmentally sustainable practices. Afforestation initiatives will be undertaken to restore ecological balance and rehabilitate mined-out areas. Dust suppression systems will be installed to control air pollution and maintain air quality in and around the mining site. Efficient water management systems and proper waste disposal methods will be adopted to reduce environmental impact and ensure compliance with regulatory standards. These measures highlight the commitment of the project towards sustainable development while maintaining high levels of productivity and operational excellence.

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