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# Protection Of Electrical Equipment In Coal Handling Plant

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***ABSTRACT***

*To Analyze the Different types of protective Equipment in CHP Mine. The Goleti Coal Handling Plant (CHP) mine, located in the Singareni coal belt, is a critical site for coal processing and transportation. Electrical hazards in coal handling plants pose significant risks to personnel due to the presence of high-voltage equipment, complex control systems, and continuous operations. The Goleti Coal Handling Plant (CHP), a part of Singareni Collieries Company Limited (SCCL), relies heavily on electrical systems for the operation of conveyors, crushers, and auxiliary machinery. This project focuses on the study and evaluation of electrical protective equipment (EPE) used to safeguard workers from electrical shocks, arc flashes, and other associated risks in the Goleti CHP mine.*

*Environmental considerations include dust suppression techniques and wastewater management systems. The integration of these protective measures ensures operational efficiency, regulatory compliance, and workplace safety. This study highlights best practices for optimizing coal handling plant safety while minimizing risks and enhancing system reliability. In addition, system-based protection devices such as lockout/tagout (LOTO) kits, grounding rods, insulating mats, voltage testers, and circuit protection mechanisms are also examined. Field visits, maintenance logs, and interviews with electrical staff were used to assess the current safety practices and equipment standards*

*The analysis underscores the Electrical safeguards, such as earth fault protection and surge arresters, enhance operational safety. Furthermore, personnel protection is reinforced through the use of personal protective equipment (PPE), emergency response protocols, and hazard awareness training.*

## 1-INTRODUCTION

The Goleti Coal Handling Plant (CHP), located in Rebbena district, Telangana, is a vital infrastructure component of the Singareni Collieries Company Limited (SCCL). This facility plays a crucial role in the downstream processing and dispatch of coal extracted from nearby mines, primarily catering to thermal power plants and industrial customers.

The Goleti Coal Handling Plant (CHP) is a key facility under the administration of **Singareni Collieries Company Limited (SCCL)**, a public sector coal mining company jointly owned by the Government of Telangana and the Government of India. SCCL has a rich legacy dating back to 1889 when coal mining operations began in the Yellandu region of Telangana. Over the decades, the company has expanded its operations across multiple districts in Telangana, playing a crucial role in meeting the region's energy and industrial demands.

With growing mechanization and increased reliance on electrical machinery, the Goleti CHP has evolved into a technologically advanced facility, incorporating high-voltage switchgear, conveyor motors, control panels, and lighting systems. However, this advancement has also brought heightened electrical risks to the workforce. To mitigate these risks, the use of electrical protective equipment (EPE) has become an integral part of the mine’s safety management system.

The primary objective of the Goleti CHP is to facilitate the efficient handling, processing, and transportation of raw coal through a series of mechanized systems. The plant is designed with a focus on automation, safety, and environmental sustainability.

At Goleti Coal Handling Plant (CHP), coal is first brought from nearby mines to the plant using dumpers and unloaded into receiving hoppers. From there, the coal goes through primary screening and crushing to reduce its size. The crushed coal is then carried by conveyor belts, which are equipped with metal detectors, magnetic separators, and dust suppression systems, to maintain quality and safety.

Thermal power plant starting from fundamentals leading in depth to technical treatment. The book is aimed at providing new dimension to the subject and thrust of the book is focused on technology and design aspect with special treatment on plant operating practices and troubleshooting. To Utility Operators and Design Engineers this book would be of immense help as reference book and to execute day-to-day activities .

Mohammed Elamin discusses the different aspects of thermal power generation including plant components engine types and the fundamental of thermodynamics with respect to power generation. The main components of thermal power plants and their role in the operation of the power plant are discussed. Understanding the main concepts of Rankine cycle, After this, the coal is either directly sent for loading or stored temporarily in stockyards using stackers. When needed, the coal is reclaimed using reclaimers and sent to the Rapid Loading System (RLS), where it is quickly and efficiently loaded into railway wagons. These wagons then transport the coal to thermal power stations or other customers. The entire process is mostly automated and monitored to ensure smooth and continuous operation.

## 2-LITERATURE SURVEY

Leigang Miaoa, and Yuanyuan Niub highlighted the critical impact of coal dust on electrical systems in coal handling plants. Their study revealed that coal dust, being conductive and abrasive, can infiltrate electrical panels and motors, leading to short circuits, insulation degradation, and increased risk of fire. They recommended the use of dust-tight enclosures (IP65 and above) and regular cleaning schedules to mitigate these risks.Their research emphasized that coal dust, due to its conductive and abrasive nature, poses significant risks to electrical equipment. The infiltration of coal dust into electrical panels and motors can result in short circuits, insulation degradation, and an elevated risk of fire. To address these hazards, the authors recommended the implementation of dust-tight enclosures with protection ratings of IP65 or higher. In addition to these recommendations, the study emphasizes the importance of integrating advanced technologies for proactive safety management. Specifically, the authors propose the use of neural network technology and signal processing to monitor and analyze electrical equipment in coal mines. By simulating animal neural networks, these technologies can process large-scale node information, enabling the detection of abnormal signals and prediction of potential electrical accidents. The implementation of such systems can effectively reduce the probability of electrical safety accidents and improve the efficiency of electrical safety management in coal mines..[1]

E. J. Gleim's examination of thermal protection strategies for induction motors in coal handling plants (CHPs) emphasizes the importance of safeguarding motors against overheating and electrical faults to ensure operational reliability.

While specific details of Gleim's study are not readily available, the protective measures he recommends—thermal overload relays, earth protection relays, and real-time thermal modeling—are widely recognized in the industry. Here's an overview of these methods:

Thermal overload relays are designed to protect motors from excessive current that can cause overheating. They typically use bimetallic strips that bend when heated by over current, triggering a trip mechanism to disconnect the motor. This prevents damage due to prolonged overload conditions.

Earth protection relays, also known as ground fault relays, detect leakage currents that may occur due to insulation failures or faults within the motor winding. By identifying these faults early, the relays can disconnect the power supply, preventing potential hazards such as electric shocks or fires.

Real-time thermal modeling involves continuously estimating the motor's internal temperature using mathematical models and real-time data. This approach accounts for factors like ambient temperature, load variations, and cooling efficiency. Advanced models, such as those employing lumped-parameter thermal networks (LPTN) or machine learning algorithms, provide accurate temperature predictions, enabling timely interventions before critical thresholds are reached .

Implementing these protective measures enhances the reliability and lifespan of induction motors in coal handling plants, ensuring safe and efficient operations

## 3-COAL HANDLING PLANT

A **Coal Handling Plant (CHP)** is a facility in thermal power plants where coal is received, stored, and processed before being fed into the boiler for combustion. The primary purpose of a CHP is to ensure a continuous and regulated supply of coal of the desired quality and size. Key operations include **coal receipt (by rail, road, or ship)**, **unloading (wagon tippler or track hopper)**, **crushing** to reduce size, **magnetic separation** to remove metal contaminants, and **stacking/reclaiming** through stackers and reclaimers. Processed coal is then transported via **conveyor belts** to the boiler bunkers. Efficient coal handling is crucial for uninterrupted power generation and helps in reducing losses due to spillage, dust, and unburnt carbon. CHPs are designed with automation, safety, and environmental compliance in mind.

The Goleti Coal Handling Plant (CHP), operated by Singareni Collieries Company Limited (SCCL), is a pivotal facility in Telangana's coal logistics network. Strategically located near the Mancherial–Chandrapur National Highway, it serves as a crucial hub for coal processing and dispatch in the northern region of the state.

Key Features and Operations Capacity and Throughput: Designed to handle 5 million tonnes per annum (MTPA) of coal, the Goleti CHP achieved a significant milestone by dispatching 3.611 million tons in the financial year 2024–25.

Infrastructure: The facility includes a 6,000-tonne bunker and a pre-weigh bin system, enabling efficient and precise loading of coal into railway wagons. Coal is transported via belt conveyors, ensuring streamlined operations.

## 4-PROTECTIVE ELECTRICAL EQUIPMENT

### 3.1.1 PULL CHORD SWITCH

A pull chord switch is a type of safety device used in coal handling plants to Control conveyor belts, allowing operators to quickly stop or start them as needed.

Pull Chord: A rope or cord that can be pulled to activate the switch.

Reliable Operation: Designed to function reliably in harsh environments, such as coal handling plant.

**EMERGENCY STOP SWITCH**

Emergency stop switches are critical safety devices in coal handling plants, enabling quick shutdowns in emergency situations.

a. Easy Access: Strategically located for easy access by operators.
b. Reliable Operation: Designed to function reliably in harsh environments.
**c.** Multiple Locations: Often installed at multiple points along conveyor belts.

**TRAVEL LIMIT SWITCH**

In a coal handling plant, a **travel limit switch** is a crucial safety and control device used primarily in conveyor systems to monitor and control the movement of equipment such as stackers, reclaimers, and conveyor belts. It functions by detecting the position or movement liInmit of a mechanical component and triggering an electrical signal to either stop or reverse the motion to prevent over-travel or mechanical damage. Typically installed at the ends of a machine's travel path, travel limit switches ensure that machinery operates within predefined safe limits.

**TYPES OF ELECTRICAL EQUIPMENT USED IN CHP**

**CIRCUIT BREAKER**

A circuit breaker is an electrical safety device designed to protect a circuit from damage caused by overload or short circuit. Its basic function is to interrupt the flow of electricity when a fault is detected.

There different types of circuit breakers are used as mainly Air Circuit Breaker, Vaccum Circuit Breaker.

**VACCUM CIRCUIT BREAKER**

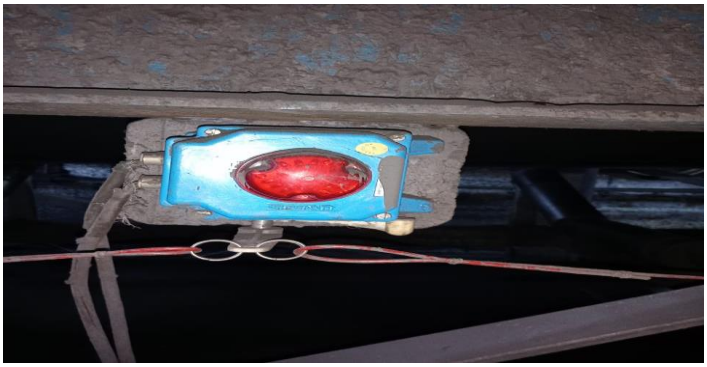

Fig 1: Pull chord switch

Fig 2: Emergency stop switch

Fig 3: Travel limit switch

Fig 4: Coal handling plant

In CHPs, VCBs are used for:

- Protection of motors for conveyor belts, crushers, feeders
- Isolation and control of HT (high-tension) panels
- Switching of substation feeders and transformer incomers
- High-reliability systems exposed to coal dust and high ambient temperatures

A Vacuum Circuit Breaker uses a vacuum as the medium for arc extinction. When a fault is detected, the breaker opens its contacts inside a sealed vacuum interrupter. As the contacts part, an arc is formed, but it is quickly extinguished because the vacuum offers high dielectric strength and prevents arc reformation. The absence of gas or oil makes the arc extinguishing process very fast and efficient. VCBs are ideal for medium-voltage applications and are known for their reliability, long life, minimal maintenance, and ability to interrupt high-frequency current without damage.

Common Ratings of Vaccum Circuit Breaker

**AIR CIRCUIT BREAKER**

An Air Circuit Breaker operates using air as the arc extinguishing medium. When a fault occurs, the breaker detects the overcurrent or short circuit through a protective relay and opens the contacts. As the contacts separate, an arc is formed between them, which is cooled and extinguished by air blast or natural convection. The arc is stretched and broken by specially designed arc chutes that divide it into smaller arcs, increasing resistance and cooling them

more effectively. ACBs are commonly used for low voltage applications and provide protection against overload, short circuit, and ground faults.

**RELAYS**

In electrical circuits, a relay is an automatic switch that uses a small electrical signal to control a larger electrical load.

## 5-HUMAN SAFETY AND PROBLEMS FACED IN CHP

**Personal Protective Equipment (Ppe)**

Workers should always wear appropriate PPE to protect themselves from various hazards in the plant.

- **Dust Masks/Respirators:** To prevent inhalation of coal dust, which can lead to respiratory issues like pneumoconiosis (black lung disease).
- **Ear Protection (Earmuffs/Earplugs):** Coal handling areas can be noisy, so ear protection should be used to prevent hearing damage.
- **Safety Helmets:** To protect from falling objects.
- **Safety Goggles/Face Shields:** To protect the eyes from flying debris, dust, or chemicals.
  - **Conveyor Belt Safety:** Conveyors should have emergency stop buttons, and workers should be trained on the dangers of working near conveyor systems.
  - **Regular Inspections:** Carry out regular inspections and maintenance of machinery to prevent malfunctions that could lead to accidents.

**5.2 Electrical Safety**

Electrical hazards are prevalent in coal handling plants due to the presence of large equipment, control systems, and power lines.

1. **Grounding and Bonding:** Ensure proper grounding of electrical equipment to avoid electrical shocks and static buildup, especially in areas where coal dust can create explosive atmosphere.
2. **Electrical Isolation:** Ensure that workers are trained in isolating electrical circuits during maintenance and repair activities.

**5.3 Precautions For Persons Working On Electrical Equipment**

1. At each mine where electricity is used underground there shall be in charge of the electrical equipment a man fitted for his position by ability, training, and experience. The character of the equipment will determine the qualifications of the mine electrician, and he shall be thoroughly familiar with the operation and maintenance of the equipment under his charge.

## 6-ADVANTAGES AND DISADVANTAGES

**Advantages Prevents Equipment Damage**

Overloads, short circuits and electrical faults can cause irreversible damage to electrical components like motors, transformers and switchgear. Protection systems (like circuit breakers, fuses and relays) help detect abnormal conditions and disconnect faulty equipment before damage occurs, thus extending the life of the equipment.

**Improves System Reliability**

By protecting electrical equipment from faults and malfunctions, the system can operate more reliably. This reduces downtime and ensures the plant runs smoothly without unexpected shutdowns, which are crucial for continuous coal processing and handling.

**Enhances Safety**

Protection systems like earth fault relays, overcurrent protection, and arc flash detection prevent electric shocks and fires by detecting and isolating faulty equipment. This increases the safety of plant personnel and protects them from potential harm.

**Prevents Fire Hazards**

Coal handling areas are highly prone to dust explosions and fires especially with electrical sparks. Protection mechanisms such as overload relays and earth fault detection can quickly identify fault that

may lead to overheating, sparking, or electrical fires, thus minimizing the risk of fire.

**Reduces Operational Costs**

Early fault detection helps in minimizing repairs and extending the lifetime of expensive electrical equipment. The cost of replacing electrical components can be high, but regular protection systems can help avoid those costs and prevent major breakdowns that would disrupt the plant's operation.

**Prevents Coal Spillage and Loss of Material**

If electrical equipment, such as conveyor belts or crushers, fails due to a lack of protection, it can result in coal spillage or loss of material, which is a significant operational setback. Ensuring protection helps keep the equipment running without major interruptions, thus minimizing material loss.

**Compliance with Regulatory Standards**

Coal handling plants are subject to regulations and standards set by safety and environmental authorities. Protection of electrical equipment ensures compliance with these standards, which may include specific electrical safety norms like IEC 60079 for hazardous areas, thus avoiding legal penalties and ensuring operational integrity.

## 7-CONCLUSION

Coal handling plants are essential to the functioning of coal-based power stations. They ensure a steady flow of coal to the boilers through a network of conveyors, crushers, and bunkers. However, the efficient operation of a coal handling plant depends on several protective systems such as pull cord switches, belt sway switches, and zero speed switches. Interlocks and defined operating sequences help streamline coal movement and prevent blockages or damage to the system. Despite these safeguards, CHPs encounter a variety of challenges, particularly related to the quality of coal, environmental conditions, and mechanical failures. Effective maintenance and adaptability in dealing with these issues are key to ensuring continuous and efficient operation.

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