MEJIA THERMAL POWER STATION (M.T.P.S)

Bankura, West Bengal

of

DAMODAR VALLEY CORPORATION (D.V.C)

A Report of the Vocational Training

Under the guidance of

Rajesh Kumar Parida

Sr. Manager(M),AHMS(OPN.)(7-8),

MTPS,DVC

Submitted By

Dipendu Mondal

Department of Mechanical Engineering

Indian Institute of Engineering Science and Technology, Shibpur

Acknowledgement

I would like to express my sincere gratitude to the authorities of Mejia Thermal Power Station (MTPS), DVC, for giving me the opportunity to undertake this summer training at their esteemed plant. This training has provided me with a valuable insight into the working of a large-scale thermal power generation system and helped bridge the gap between theoretical knowledge and industrial applications.

I would especially like to thank **Rajesh Kumar Parida,** for his continuous support and guidance throughout the training period. Their in-depth knowledge and willingness to share technical expertise greatly enhanced my learning experience.

I also extend my heartfelt thanks to the engineers and staff members of the Ash Handling Plant Control Room for their patience in explaining various operational processes, and for allowing me to observe and understand practical systems and instrumentation involved in ash handling.

Thank you all,

Yours sincerely,

Dipendu Mondal

Dept.of Mechanical Engineering

IIEST Shibpur, Howrah

Date: [15/07/2025]

INDEX

1. Introduction

As part of the academic curriculum, industrial training is essential for engineering students to gain hands-on experience and understand real-world industrial practices. I had the opportunity to pursue my summer training at Mejia Thermal Power Station (MTPS), a major coal-based power plant operated by the Damodar Valley Corporation (DVC), located in Bankura district, West Bengal.

The MTPS is one of the largest thermal power stations under DVC, consisting of multiple units with a total installed capacity of 2340 MW. The power station plays a vital role in electricity generation and contributes significantly to the energy demands of the eastern region of India.

During the training, I was placed in the Ash Handling Plant Control Room, which is a critical subsystem of the thermal plant. Ash handling is essential for ensuring environmental compliance and operational efficiency of the power station. The training provided me with in-depth exposure to the operational aspects of the ash handling system, including electrostatic precipitators (ESP), dry and wet ash handling methods, control valves, pressure management, hopper systems, and the Distributed Control System (DCS).

This report documents the technical processes, key observations, system components, and my overall learning experience during the training at MTPS.

2. Overview of Damodar Valley Corporation

The Damodar Valley Corporation (DVC) is a centrally controlled public sector organization under the Ministry of Power, Government of India. It plays a key role in thermal and hydroelectric power generation, flood control, irrigation, and water supply management in the Damodar River Basin, covering large areas of **Jharkhand** and **West Bengal.**

Established on **7th July 1948**, DVC was inspired by the **Tennessee Valley Authority (TVA)** of the USA. The corporation was created following devastating floods in the region and the recommendations of a board led by the Maharaja of Burdwan and renowned scientist **Dr. Meghnad Saha.** The DVC system today spans an area of 25,000 sq. km and stands as India's first multipurpose river valley project after independence, focused on unified regional development.

3. Plant Overview – Mejia Thermal Power Station

Mejia Thermal Power Station (MTPS) is one of the largest thermal power plants under DVC, located in the Bankura district of West Bengal. It uses pulverized coal as the primary fuel for power generation through the Rankine cycle process.

Key operational processes at MTPS include:

- Coal Handling & Pulverization: Coal is transported from the stack and ground to fine powder in the Pulverized Fuel Mill using metal balls. It is then mixed with preheated air and sent to the boiler.
- Boiler Operation: The fuel-air mixture burns in the boiler, heating demineralized water that flows through tubes. The water turns into steam and moves to the boiler drum, where steam and water are separated.
- Superheating & Steam Flow: The dry steam passes through a superheater, reaching temperatures of about 540°C and 200 bar. It then flows through three turbines (high-pressure, intermediate, and low-pressure), generating mechanical power.
- Condensation & Water Recovery: Spent steam is condensed using cooling water, and the condensed water is pumped back into the system after preheating and deaeration.
- Power Generation & Transmission: Turbines are connected to three-phase generators producing 20–25 kV electricity, which is stepped up to 250–500 kV via transformers for transmission.

ESP and Emission Control: Flue gases from the boiler pass through Electrostatic Precipitators (ESP) to remove ash particles, reducing pollution before gases exit via chimneys.

4. Ash Handling Plant – Overview

In a coal-based thermal power plant like Mejia Thermal Power Station (MTPS), a significant amount of ash is generated as a by-product of coal combustion. Efficient handling and disposal of this ash are crucial for maintaining the plant's performance, minimizing environmental impact, and ensuring the longevity of equipment. The Ash Handling Plant (AHP) is dedicated to collecting, conveying, storing, and disposing of the ash produced in the boiler unit.

At MTPS, ash is mainly generated in two forms:

- Fly Ash: This is the fine particulate matter that is carried along with the flue gases and captured using Electrostatic Precipitators (ESP).
- Bottom Ash: This is the heavier portion of ash that settles at the bottom of the boiler furnace.

The ash handling system at MTPS employs both dry and wet methods of disposal. Fly ash collected by ESP hoppers is generally handled using a dry pneumatic conveying system, whereas bottom ash is usually disposed of using a wet slurry system.

Key functions of the Ash Handling Plant include:

- Collection of ash from ESP hoppers and furnace bottom
- Transportation of ash through vacuum or pressure-based systems
- Temporary storage in silos or hoppers
- Disposal to ash dykes or utilization for brick manufacturing, cement industry, etc.
- Maintaining pressure in the system (typically ~280 mmHg for dry ash and ~360 mmHg for wet ash systems)
- Monitoring and control of ash flow through the DCS (Distributed Control System)

Specialized components such as fluidizers, heater coils, and insulated hoppers are used to prevent ash clumping, maintain flowability, and manage temperature conditions.

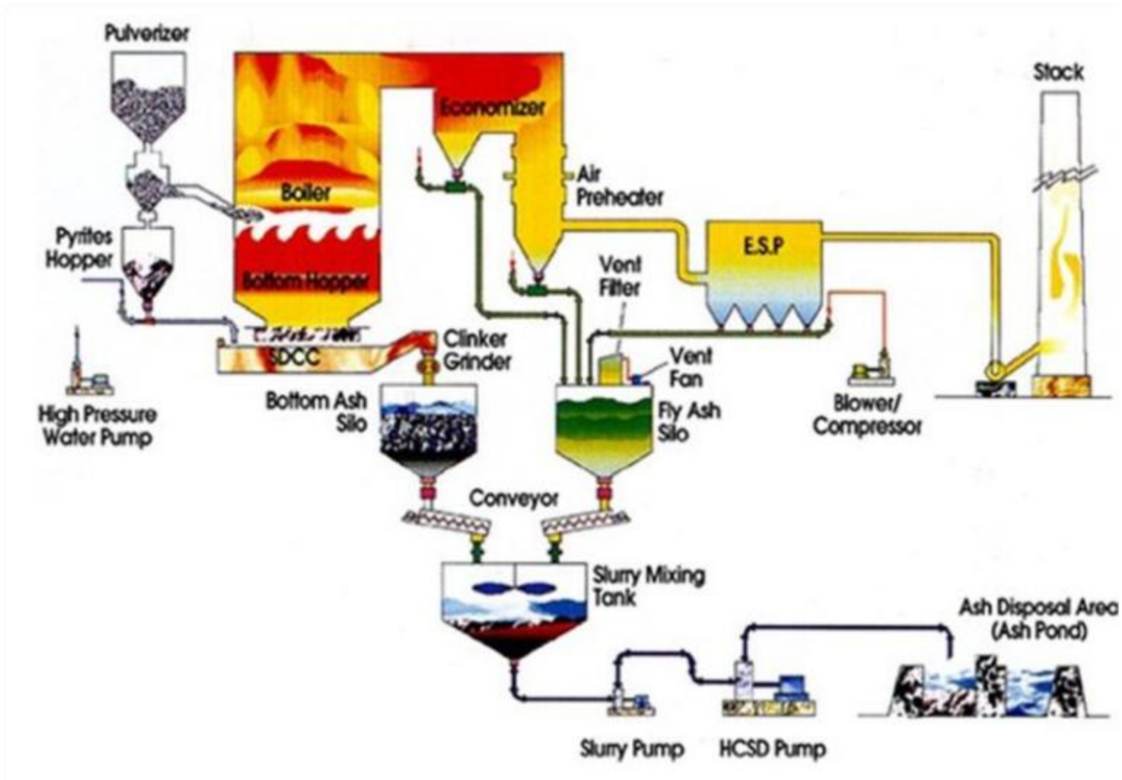


Fig.1 Ash Handling Plant Schematic Diagram

The Ash Handling Plant at MTPS is operated and monitored from a centralized control room, where operators use DCS screens to observe real-time parameters like ash levels, ESP voltages, hopper temperatures, valve status, and system pressure. This high level of automation ensures efficient operation, reduces manual intervention, and minimizes environmental hazards.

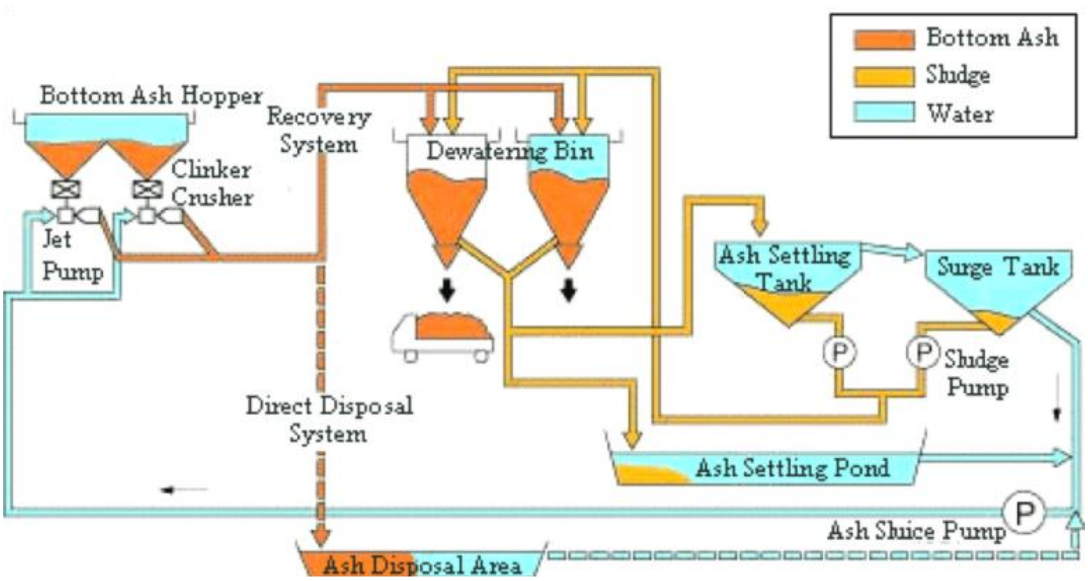


Fig.2 Ash Removal Schematic Diagram

5. Ash Handling Plant Components

Both wet and dry ash handling systems are installed in the Ash Handling Plant (AHP) at MTPS in order to gather and move ash from different boiler sections. The sequential path of ash flow below explains the main elements of the process:

A. Bottom Ash Hopper (BAH)

As pulverized coal burns in the boiler's furnace section, bottom ash—the heaviest and coarsest type of ash—is produced. Each boiler unit at MTPS has four Bottom Ash Hoppers (BAH), which are situated directly beneath the furnace. The bottom ash that falls is collected by these hoppers.

- The larger lumps of the collected ash are crushed into finer particles by passing it through Clinker Grinders.
- The wet ash handling system is then used to transport the bottom ash after it has been combined with water to create a slurry.

Fig.3 Clinker Grinder

Pipelines carry this slurry to the Ash Slurry Pump House, where it is pumped to the ash pond (dyke) for ultimate settling.

B. Economizer

As flue gas moves upward from the boiler, it carries lighter ash particles. These particles are separated in the **Economizer** zone.

- The ash collected here is finer than that in the BAH.
- This ash is also routed to the **wet handling system**, where it joins the common slurry stream.

C. Air Preheater (APH)

Next to the economizer, the **Air Preheater (APH)** section captures even finer ash particles from the flue gas.

- These particles are lighter and remain suspended in the gas stream until they are separated at the APH zone.
- The separated ash here is again directed to the **wet ash disposal system**.

D. Electrostatic Precipitator (ESP)

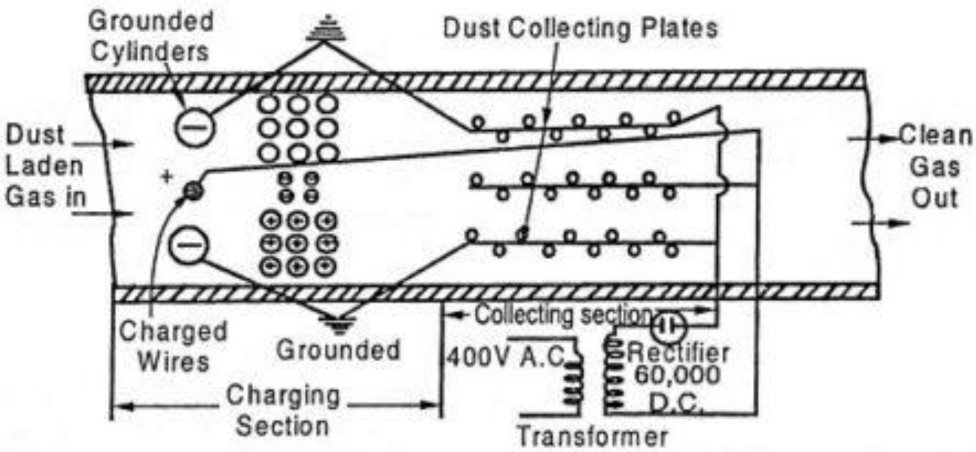
The **ESP** is a crucial unit in fly ash collection. It is responsible for removing the finest ash particles from the flue gas before it is released through the chimney. The ESP at MTPS has:

- 1 ESP for each unit (unit #7, unit #8)
- 4 passes per ESP,
- Each pass is divided into **4 sections**,
- Each section contains 9 **hoppers**,
- Total = **16 sections × 9 hoppers = 144 hoppers in both ESPs**

Fig.4 ESP

Working of ESP:

- Flue gas containing fine ash enters the ESP.
- **Emitting electrodes** ionize the gas, charging the ash particles.
- **Collecting electrodes** attract and trap the charged ash particles.
- The ash falls into ESP hoppers through rapping mechanisms.



ESP Hopper Features:

- **Insulation (Glass Wool)**: Maintains temperature by reducing heat loss.
- **Fluidizer (4 per hopper)**: Injects compressed air to maintain flowability.
- **Heater Coils**: Prevent condensation and clumping of ash by keeping it hot.

Discharge Process:

- **Dry Ash** is extracted using pneumatic systems under **280 mmHg vacuum pressure**.
- **Wet Ash** uses slurry pumps under **360 mmHg pressure** for transport.

E. Fly Ash Evacuation Tower (FAE Tower)

Collected fly ash is transported to the Fly Ash Evacuation Tower (FAE Tower) using two systems:

1. **Dry Process**:
   - Fly ash is mixed with air and passed through a **bag filter**.
   - Filters separate ash by particle size and deposit it in containers.
2. **Wet Process**:
   - High-pressure (HP) water is sprayed through nozzles onto fly ash.
   - Ash becomes heavier and forms a slurry, which is then sucked using **vacuum pumps**.
   - This slurry is pumped to the ash pond, and water is **recycled**.

Fig.5 Transporter of FAE Tower

F. Bottom Ash Silo

The Bottom Ash Silo acts as a temporary storage unit for ash collected from the boiler bottom hoppers after it passes through the primary and secondary crushers. It provides an intermediate buffer before final disposal.

Key Functions:

- Stores crushed bottom ash before it's transported.
- Equipped with level sensors for continuous monitoring.
- Transfers ash to either **dewatering bins** (for truck loading) or directly to the ash slurry system.

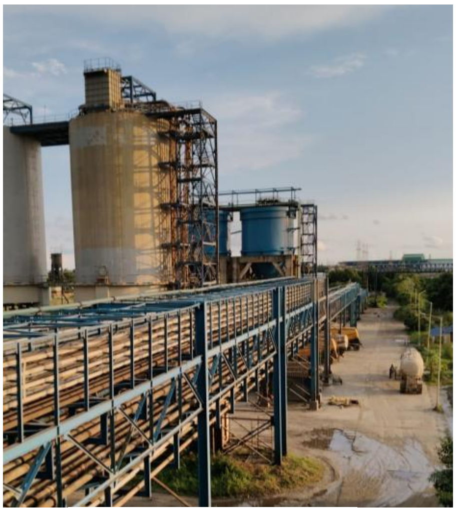


Fig.6 Silo

Technical Features:

- Constructed with **corrosion-resistant steel**.
- Ash extraction done by gravity or screw conveyor.
- Controlled by DCS for discharge scheduling.

G. Chimney (Stack)

The **chimney**, also known as the **stack**, is the **final discharge point** for flue gases after ash and particulate matter have been removed through various filtration stages. It plays a critical role in ensuring **safe and controlled emission** of treated gases into the atmosphere.

Function:

- Releases flue gases after fly ash has been captured by the **Electrostatic Precipitator (ESP)**.
- Ensures gases are emitted at a **sufficient height** to disperse pollutants and prevent ground-level contamination.
- Maintains a **natural draft** or supports **forced draft systems** for smooth gas flow through the boiler and ESP.

Fig.7 Chimney

Key Features:

- Constructed of **reinforced concrete** or **steel-lined** with insulation.
- Equipped with **Continuous Emission Monitoring Systems (CEMS)** to track SO_2, NOx, CO_2, and particulate levels.
- Complies with **CPCB/ENVIS norms** to ensure minimal environmental impact.

Although the chimney does not directly handle ash, it forms a crucial endpoint in the ash management system by ensuring that only **cleaned and treated gases** are released, post the ash removal process.

H. Ash Pond

The Ash Pond is the final disposal site for ash slurry, especially from the wet ash handling system.

Purpose:

- Settles ash particles and separates them from water.
- Recycles overflow water back to the plant for reuse.
- Prevents environmental contamination from fly and bottom ash.

Design Features:

- Large area lined with impermeable material (e.g., HDPE).
- Multiple settling compartments to allow sedimentation.
- Overflow controlled via weirs and sluice gates.

Fig.8 Ash Pond

6. Control Room and Automation System (DCS)

The **Ash Handling Plant** at MTPS is fully monitored and controlled through a centralized **Distributed Control System (DCS)** located in the **AHP Control Room**. This ensures real-time data acquisition, monitoring, and efficient operation of all ash handling components.

A. Overview of DCS in AHP

The **DCS screen** provides a visual interface showing the **live status** of:

- Bottom ash hopper levels
- Clinker grinder motor status
- Slurry pump pressure and flow
- ESP hopper temperatures
- Fluidizer and heater coil operations
- Valve positions and actuator status

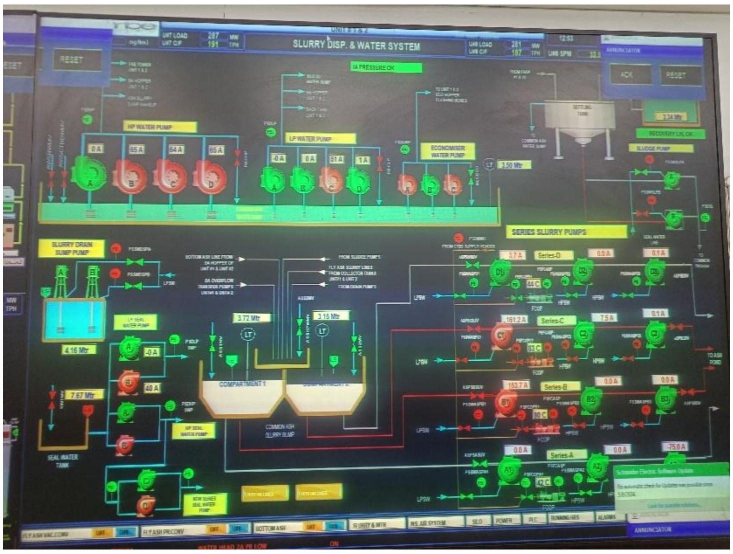


Fig.9 DCS Screen

- Vacuum pressures during ash discharge
- FAE Tower dry/wet system selection

The DCS interface enables operators to monitor and control equipment remotely, allowing for quick response to any faults.

B. Valve Operation Control

Ash discharge in both wet and dry systems involves **precise control of valves**, operated via **DCS interface**:

- **Opening/Closing Sequence**:
  - Ash Hopper Gate Valve
  - Fluidizing Valve
  - Slurry Mixing Valve / Vacuum Valve
  - Discharge Valve to Pump or Pneumatic Line

Each valve is associated with a **pressure sensor** and **limit switch**, ensuring that they operate only within **design pressure limits**.

C. Fault Detection and Alarms

The DCS system continuously monitors system parameters and triggers alarms in case of:

- Blockages in slurry lines
- Pressure drop or overload in pumps
- Overheating in ESP hopper coils
- Failures in air supply to fluidizers
- High ash levels or backup in hoppers

Immediate alarms help in preventing unsafe situations and equipment failure.

D. Operator Workstation

Operators sitting in the AHP Control Room use:

- **Touchscreen or keyboard controls**
- **Auto/Manual switch** for individual units
- **Logbooks** for daily event reporting

7. Observations and Learnings

During my industrial training at **Mejia Thermal Power Station (MTPS)**, I was assigned to the **Ash Handling Plant (AHP)** section. This hands-on exposure allowed me to gain valuable insights into the functioning, components, and real-time operations of one of the most essential systems in a coal-based power plant.

A. Key Observations

- The AHP is a highly integrated and automated system involving both **mechanical and fluid-based systems** for transporting ash.
- The entire operation is managed via a **Distributed Control System (DCS)**, which allows real-time monitoring and remote control of each component such as valves, pumps, crushers, and hoppers.
- I observed the **systematic segregation** of ash types:
    - **Bottom ash** is coarse and heavier, collected in hoppers below the boiler.
    - **Fly ash** is finer and is captured by the ESP after passing through the economizer and air preheater.
- The **ESP** setup at MTPS is very large, comprising **144 hoppers**, fluidizers, heater coils, and proper insulation to maintain ash flowability and prevent clogging.
- Both **wet and dry** methods are employed for fly ash evacuation, depending on system requirements and final use/disposal plans.
- The **slurry formation process** was impressive in its combination of **hydraulic transport and gravity flow**, ensuring efficient ash transport to the **ash pond (dyke)**.
- Safety measures, including pressure interlocks and heater coils, are actively in place to ensure smooth functioning and avoid hazards like pipeline blockage or back pressure.

B. Key Learnings

- I learned how **engineering principles** like fluid mechanics, material flow, control systems, and thermal insulation are practically applied in large-scale industrial environments.
- Gained familiarity with **industrial components** like:
    - Bottom Ash Hoppers
    - Clinker Grinders
    - ESP (with emitting/collecting electrodes)

    - Fluidizers and Heater Coils
    - Ash Slurry Pumps and Valves
- Understood the **critical role of automation** in maintaining operational continuity, fault detection, and performance optimization.
- The concept of **ash water recycling** from the ash pond helped me appreciate the plant's effort in environmental sustainability and water conservation.
- Realized how important ash handling is for meeting **pollution control norms**, especially with fly ash disposal via dry systems (bag filters) and controlled emissions.

8. Conclusion

The hands-on training at the Ash Handling Plant of Mejia Thermal Power Station (MTPS) proved to be an insightful and enriching experience. As a mechanical engineering student, observing the actual implementation of theoretical concepts such as material transport, fluid flow, thermal insulation, and process automation deepened my practical understanding of industrial systems.

The plant's ash handling system, comprising both dry and wet handling techniques, showcases the seamless integration of mechanical systems, hydraulic transport, and electronic controls (DCS) to manage one of the most critical by-products of coal-based power generation — ash. The use of ESP for fly ash collection, crushers and silos for bottom ash, and efficient slurry disposal to ash ponds reflects the complexity and scale of operations in modern thermal plants.

Moreover, the plant's focus on safety, efficiency, and environmental sustainability — through ash water recycling, emission control, and dry ash evacuation — highlighted the importance of responsible engineering in real-world applications.

This hands-on exposure not only reinforced my academic learning but also inspired me to explore further research and projects in the field of power plant operation, thermal system optimization, and fluid-particle transport mechanisms.