INDUSTRIAL VISIT TO

OIL INDIA LIMITED MORAN

Submitted by:

3rd Year Girl-Students (BATCH 1 OF VISIT)

Mechanical Engineering Department

Jorhat Engineering College, Jorhat

Assam Science And Technology University: GUWAHATI (2025)

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ACKNOWLEDGEMENT

The Department of Mechanical Engineering at Jorhat Engineering College sincerely appreciates Oil India Limited for making the one-day industrial visit to their operational sites possible. The opportunity to explore the Drilling Rig, Oil Collecting Station (OCS) and Gas Compressor Station (GCS) offered valuable practical insights and improved the department's understanding of real-world industrial operations.

We are grateful to the officials and engineers at OIL for their helpful guidance and support throughout the visit. We also thank the JEC Alumni Association, OIL Duliajan Chapter, for organizing and ensuring the smooth execution of this program.

We further express our gratitude to Dr. Deva Kanta Rabha Sir, Dr. Mafidur Rahman Sir, and Mr. Uttaran Sonowal Sir for joining the team and providing ongoing academic support during the visit.

Department of Mechanical Engineering

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INTRODUCTION

Oil India Limited (OIL) is one of the premier National Oil Companies of India, engaged in the exploration, production, and transportation of crude oil and natural gas. With decades of experience and a strong presence across the energy sector, OIL plays a crucial role in meeting the nation's energy requirements. The company operates extensive oilfields, drilling units, processing facilities, and pipeline networks, combining advanced technology with skilled manpower to ensure efficient and sustainable energy production. The story of OIL traces and symbolizes the growth and development of the Indian petroleum Industry. From the discovery of the crude oil in the far east of India at Digboi, Assam in 1889 to its present status as a fully integrated National Exploration and Production company with footprints across entire E&P value chain. The company is India's second largest National E&P Company. Oil India Private Limited was incorporated on 18th February 1959, to expand and develop the newly discovered oil fields of Naharkatiya and Moran in the North-Eastern region of India. In 1961, it became a joint venture company of Government of India and Burmah Oil Company Limited, UK. In 1981, OIL became a wholly owned Government of India enterprise. As part of our academic curriculum, we had the opportunity to visit Oil India Limited, Moran, to gain practical exposure and a deeper understanding of the industrial processes involved in oil and gas operations. The Moran oilfield is one of OIL's significant operational areas, known for its long-standing contribution to crude oil production in Assam. The visit aimed to bridge the gap between theoretical learning and its real-life industrial application. During the visit, we were introduced to various stages of exploration, drilling, processing, maintenance, and safety protocols followed at the Moran installation. The interaction with industry professionals offered valuable insights into the technologies, machinery, and operational practices adopted by Moran Oil India Limited. This exposure not only enhanced our understanding of industrial procedures but also highlighted the importance of efficiency, environmental responsibility, and workplace safety in the petroleum industry. Overall, the industrial visit served as an enriching learning experience, enabling students to gain practical knowledge, develop technical awareness, and understand the industrial standards followed in the oil and energy sector.

Overview of The Visiting rig

- **Objective of the Visit:**

An industrial visit to Oil India Limited provides Mechanical Engineering students with a practical understanding of how large-scale mechanical systems operates in real field conditions. It allows us to see firsthand how engines, pumps, hoisting equipment, rotary systems, and power-transmission units work together to drive the drilling process. It also helps us to understand the importance of maintenance, safety procedures, and system reliability in an industry where equipment operates under high loads, harsh weather, and continuous duty cycles. By observing these systems in action, we can connect theoretical concepts learned in class- such as thermodynamics, fluid mechanics, material strength, and Machine design- to our real-world applications in one of the most demanding engineering environments.

- **Rig Details:**

The **S-6 (E-1400 HP AC SCR)** drilling rig, manufactured by **BHEL**, is a long-serving and reliable land rig that has been a key asset in Oil India Limited's drilling operations. Commissioned on **26 February 1988**, it has accumulated decades of operational experience and continues to be deployed for challenging wells. Over its service life, the rig has successfully completed 97 development wells and 1 production well, reflecting its consistent performance and ability to operate across varied geological settings. The total meterage drilled—**347,747 meters**—highlights the extensive workload the rig has handled and its durability in long-term field conditions.

The rig is powered by **four CAT** power packs, providing the energy required for hoisting, rotary systems, fluid circulation, and auxiliary equipment. Its pumping capability is established through two high-capacity rig pumps rated at **1600 HP** each, enabling efficient drilling fluid circulation to cool the bit, maintain wellbore stability, and carry cuttings to the surface.

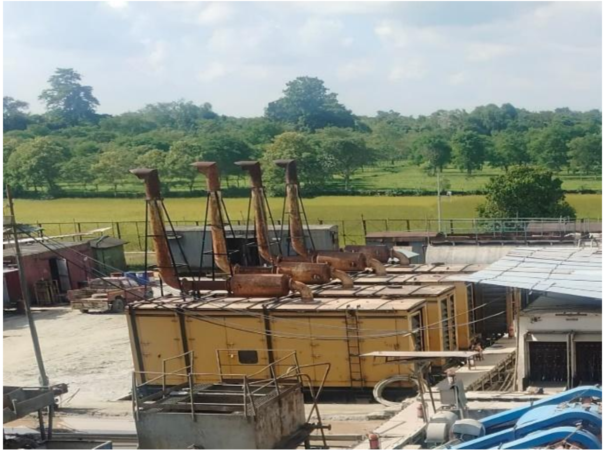


Fig: four CAT power pack

These features collectively make the S-6 a robust and dependable rig suitable for deep and directional drilling operations.

Even after years of service, its configuration and performance continue to meet the demands of modern drilling programs, demonstrating the strength of its engineering and maintenance standards.

- **Visit to Workover Rig:**

A workover rig in the oil industry is a specialized unit designed to service, repair, or optimize an existing well so it can continue producing safely and efficiently. Unlike a drilling rig, which focuses on creating a new wellbore, a workover rig returns to an already-drilled well to solve problems such as declining production, equipment failure, or reservoir access issues. Its role is essential in extending the life of a well, restoring flow, and ensuring that the well continues to perform as expected. In many ways, it acts like a doctor for the well—diagnosing issues, performing corrective procedures, and helping the well regain its productivity.

Structurally, a workover rig resembles a lighter and more compact version of a drilling rig, with a mast, substructure, power unit, hoisting system, and circulation equipment. It includes components such as the drawworks for lifting tubing and tools, blowout preventers for safety, and pumps for circulating fluids. Around the rig, various auxiliary systems support the operation, including hydraulic power units, wireline tools, storage tanks, and handling equipment. Together, these elements create a nimble and efficient setup capable of reaching deep into the wellbore and manipulating downhole components with precision.

A typical workover operation may involve pulling out old tubing, replacing worn-out downhole pumps, cleaning the wellbore, stimulating the formation, or installing new completion equipment. Throughout the process, the crew works in a coordinated rhythm—lifting pipe, circulating fluids, running specialized tools, and monitoring pressures—to ensure the well is restored safely. The entire operation reflects both engineering skill and human teamwork, as every member of the crew contributes to bringing an aging or troubled well back to life, allowing it to continue supporting energy production for years to come.

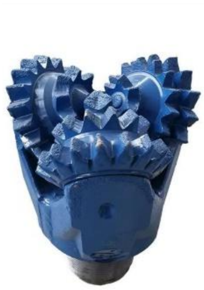
The Process of Drilling:

- **What is drilling**

Drilling is the process of cutting holes in a solid material using a cutting tool called drill bit. It is one of most common machining and construction operations. In an oil rig, drilling operation refers to the entire process of creating a blowhole (well) in the soft surface (earth subsurface) to reach oil or gas reservoir (hard surface). It involves specialised equipment, fluids, and procedures to safely and efficiently penetrate rock layers.

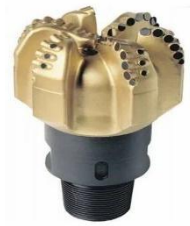
- **Some Types of Drill Bit used in Drilling Operation of Oil Rig:**

i) Milled Tooth Tricone Drill Bit: A milled tooth tricone bit is a drilling tool with three rotating cones, each having steel teeth that are milled directly from the cone body. As the bit rotes, the cones roll and crush the rock.



ii) Insert Bit: An insert bit is a type of tricone drill bit where the cutting teeth are tungsten carbide inserts that are pressed into the cones instead of being milled from steel.

iii) PDC Bit: A PDC bit is a diamond-cutting drill bit used on oil rigs to drill rock quickly and efficiently. It has no moving parts and is ideal for long reach, horizontal, and high speed drilling.



- **Types of drilling**

The main types of drilling performed in an oil rig are-

i) Straight drilling: it is the simplest and cheapest type of well which uses minimal directional control tools. In straight hole drilling the well is drilled vertically downward with little or no deviation to reach the reservoir directly below the rig

ii) Directional drilling: It is a type of drilling that intentionally changes direction to reach targets not directly below the rig. It is further classified into two types i.e., J-bend and S-bend. In J-bend drilling the well is drilled vertically at first, then gradually curved into a J-shaped trajectory. Similarly in S-bend drilling the path forms an S shape.

iii) Horizontal drilling: It is type of drilling that starts with a vertical well then deviates to drill sideways through the reservoir. In this drilling, at a specific point (kick off point) the wellbore is gradually curved (1.2 degree per 30 metre of length) to achieve a near horizontal angle into the target formation.

- **Different Phases of Drilling Activity**

i) Rig up: It is the stage where all the equipment, structure, and systems needed for drilling are assembled, installed, and prepared at drilling site.

ii) Drilling: In this phase the boreholl(well) is created according to the type of required.

Fig: RIG

iii) Rig down: Rig down means taking apart the drilling rig piece by piece, after the well has been drilled, cased, or cemented, or completed.

iv) Rig move: It is the phase where all drilling equipment, machinery, and support systems are transported from one site to the next drilling location.

- **Spudding-In Process**

Spudding means starting the drilling of a well by driving the initial bit into the surface formations. It is the moment when the drill bit first begins cutting into the ground to start the wellbour. It happens after the rig up and before deeper drilling begins. It provides a strong foundation for the rest of the well.

- **Different stages of Drilling in Oil Rig**

i) Conductor: The conductor stage refers to installing the conductor pipe, which is the first and largest diameter casing placed on top section of the well. It is installed before spudding deeper section. This stage comes first because it creates the structural foundation on which the surface casing will be installed.it prevents the soft formation from collapse and the conductor pipes hold them in place.

ii) Isolation: Stage isolation means creating barriers inside the well to isolate each formation layer so that fluids do not mix between zones and the wellbore remains stable. This stage prevents problems like formation collapse, crossflow, water and gas inflow, blowouts and many more. It is achieved by installing casing strings of different diameter above and below it. Also cement is pumped around the casing to create solid barrier. Isolation stage occurs in the drilling sequence after each major section is drilled.

iii) Oil string: it is the final string of steel pipe set into the wellbore to prepare the well for the extraction of oil and gas. The phase involving its installation and completion is called the well completion phase, which occurs after drilling to the target depth has finished.

- **Perforation and production:**

Perforation is the process of making holes (360 degree) in the lowermost casing of the wellbore to allow oil and gas to flow it from the surrounding reservoir. The main purpose of perforation is to create a pathway for hydrocarbons to flow from reservoir into the wellbore. After the well is drilled and cemented, a perforating gun with explosives charges is lowered into the wellbore. The charges are detonated, creating channels through the casing and cement into the productive formation. This allows the hydrocarbons to be brought to the surface through a process called production

- **Drilling Mud: A Multipurpose fluid**

Drilling mud (blood of oil drilling) is a specially engineered fluid circulated through the well during drilling. It performs multiple critical functions that keep the well safe, stable and efficient.

When the drill bit cuts the rock, it generates cuttings. If these cuttings are not removed from the bottom of the hole the bit will not cut effectively and the pipe may stuck. So drilling mud pump down the drill pipe returns through the annulus (space between pipe and holes), cleaning the bottom and carrying the cuttings upward.

During well drill the open hole has no structure to hold the rock layers in place. The drilling mud provides hydrostatic pressure and forms a thin filter cake on the borehole wall. This is what supports and stabilize the wellbore.

Again in drilling the formation pressure pushed towards the open borehole, which can lead to blowouts without proper control of it. Drilling mud has weight(density) which creates hydrostatic pressure inside the wellbore (which magnitude is equal or slightly higher than formation pressure) and balances the natural pressure.

When the drill bits cuts the rock at high speed, a huge amount of heat is generated because of friction between bit teeth and rock. Drilling mud is also used in cooling the bit. During drilling, mud is pumped at high pressure down the drill string. This high pressure flow delivers hydraulic power to the drill bit, which increases the bit efficiency and rate of penetration.

Sometimes the drilling mud becomes communication medium that carries signals from downhole tools to the surface. Measurement while drilling (MWD) is a system that sends real-time downhole data from the drilling tool to the surface using pressure pulses in mud.

Drilling mud is also useful reducing friction arises due to the continuous rubbing of drill pipe and collars against borehole wall. The drilling mud consists of additives and properties that protect metal surface. Due to which it can also prevents the drilling pipe and other material components from corrosion.

Due to this major part played by drilling mud, it is called as blood of oil drilling.

- **Role of Seismic Testing and Geological Study in an Oil Drilling Rig:**

Seismic testing and geological performance assessment are crucial preliminary steps in oil and gas exploration, serving to identify potential hydrocarbon reservoir, assess the probability of drilling success, reduce risks, and optimize the drilling process.

Seismic survey are the most important and widely applied geophysical method for oil and gas exploration. They function by creating detailed images of subsurface rock layers using sound waves. It is the first major steps in exploration which helps engineers to understand the requirements and criteria that would be applicable in drilling.

On the other hand, geological performance assessment involves a comprehensive evaluation of the potential drill sites geology, integrating data from various sources to ensure the feasibility and safety of drilling operation. Apart from this it confirms the presence of hydrocarbon by studying rock samples, surface geology and regional pattern.

Overview and Operational Framework of an Oil Collecting Station (OCS):

An Oil Collecting Station (OCS) represents a fundamental installation within the upstream segment of the petroleum industry. Its primary role is to receive multiphase crude from surrounding production wells and perform essential preliminary processing prior to transportation or refining. The incoming crude typically comprises a heterogeneous mixture of hydrocarbons, formation water, associated gases, and suspended impurities. To ensure safe handling and optimized processing, the OCS employs a combination of controlled heating, pressure-based routing, multi-stage separation, dehydration, and stabilization techniques.

This section provides an academically oriented overview of the operational sequence followed at the Moran OCS.

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1. Inflow Management and Preliminary Conditioning

Crude oil is delivered to the station through two distinct pressure regimes: **High Pressure (HP)** and **Low Pressure (LP)** streams. Treating these streams independently is necessary because their flow characteristics and separation behaviours vary considerably with pressure.

- **Manifold Integration:** HP and LP inflows are directed into their respective manifolds, which function as regulatory units for combining well effluents and controlling their entry into subsequent treatment stages.
- **Thermal Conditioning of LP Stream:** The LP crude is subjected to indirect heating using steam or hot water. This thermal input reduces the viscosity of the crude, enhances flowability, and prevents hydrate formation, thereby facilitating more effective downstream separation.

After this preliminary conditioning, both HP and LP streams enter advanced separation units for further processing.

2. High-Pressure Gas Disengagement

The thermally conditioned HP crude is initially introduced into the **Group Unit (GU)**, which performs the first stage of gas–liquid disengagement.

- **Primary Gas Separation:** High-pressure gas, typically around 250 psi, is liberated and subsequently routed to the station's gas-handling and distribution network.
- **Secondary Purification:** The partially degassed crude is transferred to the **High-Pressure Master Separator (HPMS)**, which removes additional free gas and entrained water, thus preparing the stream for integration into the three-phase separation system.

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3. Three-Phase Separation (TPS)

The crude from HPMS and the LP manifold converges into a **Three-Phase Separator (TPS)**, a horizontal vessel designed to segregate gas, oil, and water based on their density contrasts under quiescent flow conditions

Fig: three phase separator

- **Gas Phase:** Low-density gases accumulate in the upper section and are withdrawn through dedicated outlets.
- **Oil Phase:** The intermediate layer consists of crude oil, which moves toward the oil outlet after sufficient residence time.
- **Aqueous Phase:** Formation water settles at the bottom due to its higher density and is discharged through a controlled water leg.

Internal flow-distribution baffles increase residence time and promote efficient gravitational separation. The TPS thus removes most easily separable water and gas prior to specialized treatment.

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4. Component-Specific Processing Pathways

a) Gas Treatment

Low-pressure gas (~30 psi) exiting the TPS is transported to the **Gas Compression Station (GCS)**. In the GCS, the gas is compressed to around 250 psi to meet operational requirements for reinjection, controlled flaring, or distribution. Compression minimizes wastage and ensures regulatory compliance.

b) Oil Dehydration

Although free water is largely removed in TPS, the crude often contains a stable emulsion of oil and fine water droplets.

- The crude enters the **Emulsion Treater (ET)**, where heating, settling, and chemical treatment are employed to break the emulsion.
- A demulsifying reagent, typically an **Oil Soluble Demulsifier (OSD)**, destabilizes the water–oil interface.
- Some ET units incorporate electrostatic coalescing grids to promote the agglomeration of water droplets.

This process reduces Basic Sediment and Water (BS&W) content, producing dehydrated oil suitable for stabilization.

c) Water Treatment

Water separated from TPS and ET still contains trace hydrocarbons. It undergoes purification processes designed to reduce residual oil content to <10 ppm. The treated water is then directed to a formation water storage system for reuse or environmentally compliant disposal.

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5. Stabilization and Final Crude Handling

Fig: stabilizer

The dehydrated crude is subsequently processed in a **Stabilizer**, where dissolved gases and light hydrocarbons are removed. Stabilization mitigates vapor losses, minimizes pressure build-up in storage, and ensures the crude attains the required level of thermal and compositional stability for transportation. Once stabilized, the crude is transferred to designated storage tanks within the OCS, concluding its initial processing cycle prior to export or further refining.

Working of a Gas Compressor Station (GCS)

A Gas Compressor Station (GCS) is a critical installation within the natural gas production and transportation network. Its principal function is to receive raw multiphase fluids from multiple wellheads and process them to obtain pipeline-grade natural gas and stabilized condensate. As the inlet stream typically contains natural gas, condensate, and produced water, the GCS performs separation, pressure enhancement, and conditioning to ensure that the processed gas meets the quality and pressure specifications required for downstream transmission.

The specific GCS examined during the visit receives multiphase inputs from approximately fifteen producing wells. After undergoing a series of separation and compression steps, the station delivers two commercially valuable outputs—dry natural gas and stabilized condensate—which are subsequently directed through dedicated export pipelines.

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1. Gas–Liquid Separation

Upon arrival, the multiphase fluid flow is directed to separation units that remove bulk liquids before the gas enters compression stages. Because the incoming stream may contain significant quantities of condensate and produced water—often in the form of large, intermittent slugs—effective separation is essential for preventing mechanical damage, erosion, or overloading of compressor systems.

The primary separators utilise gravity-driven settling and internal flow-distribution devices to separate gas from liquids, ensuring that only sufficiently dry gas proceeds to the compression phase. The separated condensate and water are routed to appropriate treatment and storage systems for further handling.

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2. Gas Compression

Following separation, the gas—typically at low to moderate pressure (around 30 psi)—is introduced into the compression system. Compression is required to elevate the gas pressure to levels suitable for long-distance pipeline transport, which in this facility typically ranges up to approximately 250 psi, depending on reservoir characteristics and downstream pipeline requirements.

a. Multistage Compression

The pressure increase is achieved through multiple compression stages. This staged configuration is essential for maintaining thermodynamic efficiency, limiting excessive temperature rise, and ensuring mechanical reliability. Between each stage, intercoolers remove heat generated during compression, thereby improving efficiency and preventing thermal stress on compressor components.

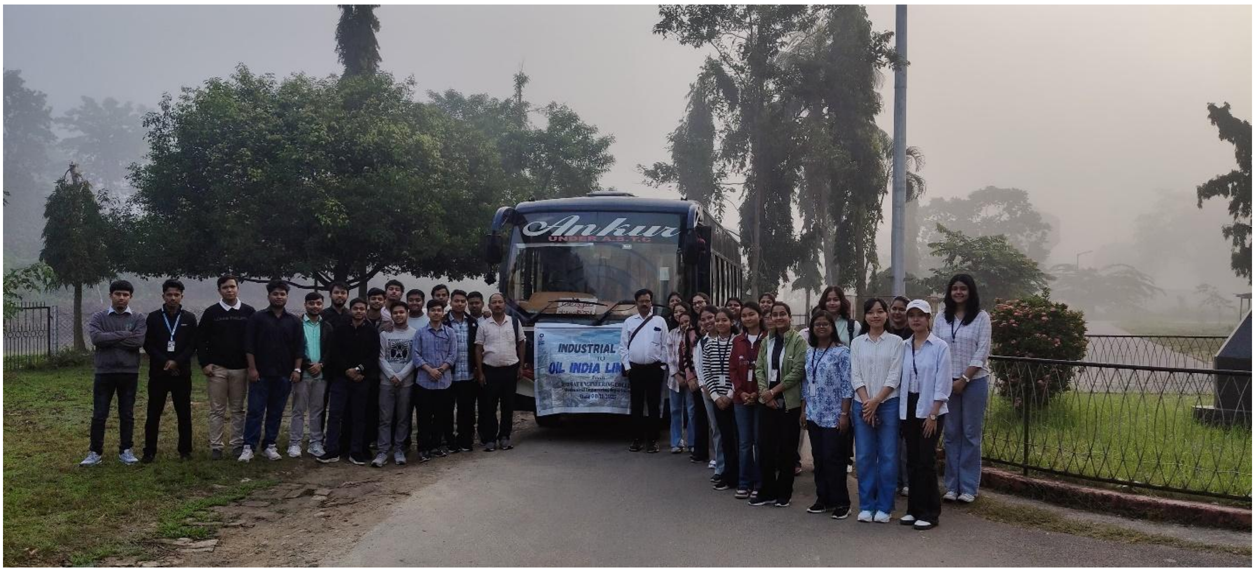
b. Compressor Drive and Control

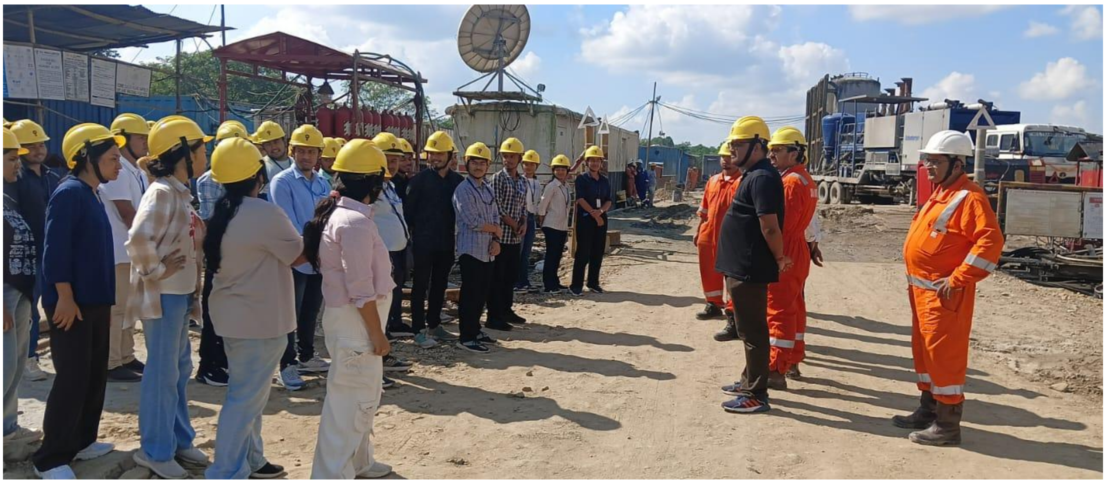
Modern compressor units at the station are driven by gas engines or electric motors, which provide stable operation under fluctuating inlet conditions. Advanced instrumentation and automated control systems continuously monitor flow rate, pressure, temperature, vibration, and compressor load. These systems ensure that the gas is compressed within the required operational limits while maintaining plant safety and reliability.

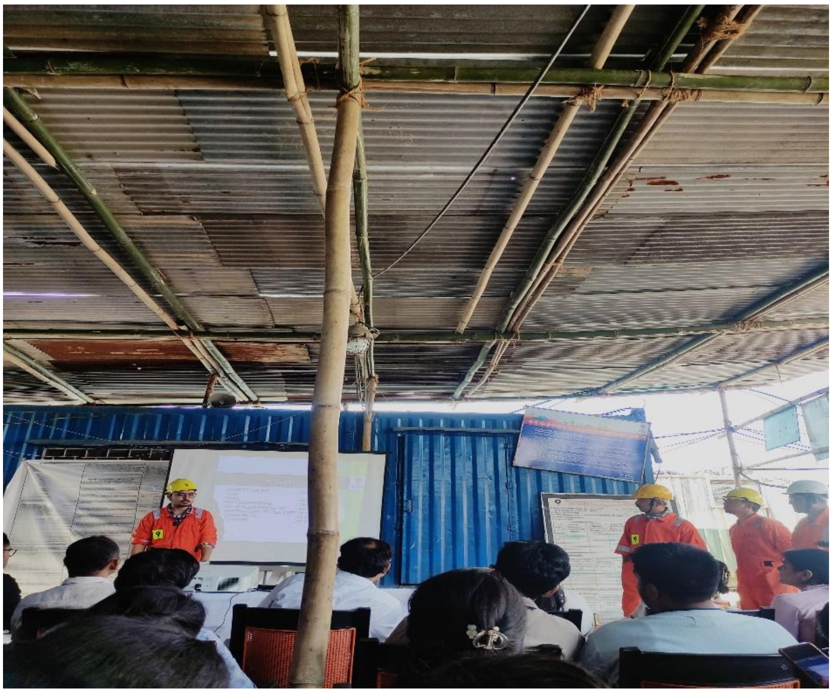
c. Functional Outcome

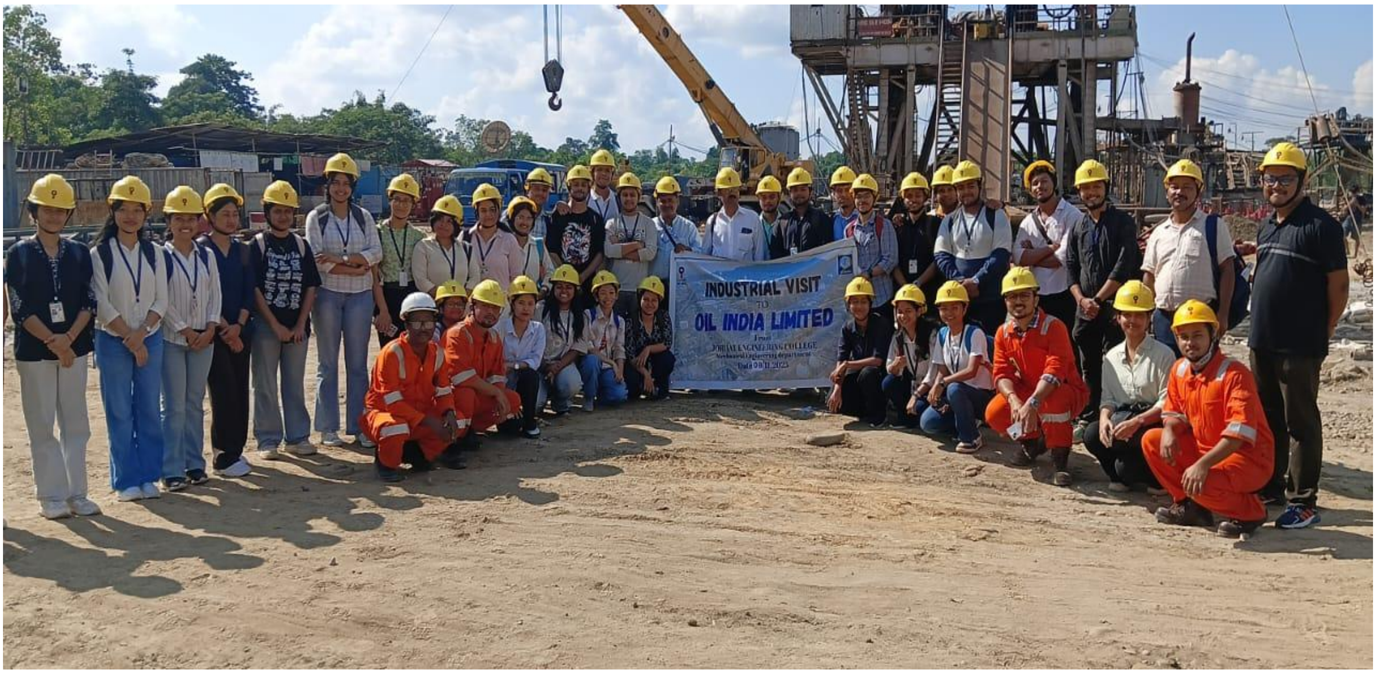
By raising the gas pressure to pipeline specifications, the GCS improves the transport efficiency, enhances gas throughput, and ensures that the processed stream can be delivered without additional boosting in the immediate downstream sections. The compression process thereby plays a central role in maintaining uninterrupted gas supply within the regional transmission network.

Photo Gallery





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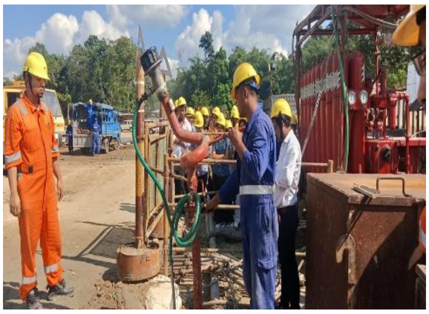

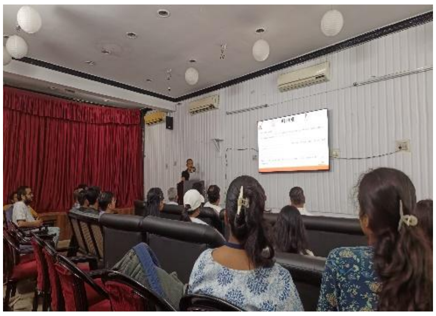

Conclusion

The industrial visit to the operational facilities of Oil India Limited (OIL) provided a practical insight into the lifecycle of hydrocarbon exploration and production. The experience serves as an invaluable platform for bridging the gap between theoretical knowledge acquired in classroom and the complex technological realities of a large-scale energy enterprise. The direct observation of the Drilling Rig was instrumental in observing a real-world perspective on modern well construction, concepts of rotary drilling mechanisms, casing, and the critical role of safety protocols for accessing hydrocarbon reservoirs. The visit to OCS (Oil Collecting Station) offered a clear understanding of the immediate post-production phase – three phase segregation, where crude oil, gas and water are efficiently segregated post drilling, prior to stabilisation and transport. Furthermore, the insights gained from GCS (Gas Compression Station) highlighted the multi-stage compression process and the logistical effort required to raise the pressure of gas for efficient long-distance transmission. The principal overall takeaway from this industrial visit is that modern hydrocarbon exploration and production is a comprehensive effort demanding the seamless integration of large-scale engineering, rigorous safety standards, and a decisive commitment to efficiency and advanced technology across the entire value chain.