INDUSTRIAL ATTACHMENT REPORT

Kenya Power & Lighting Company (KPLC)
National Control Center (NCC)
SCADA Department

SUBMITTED BY;

NAME	INSTITUTION	YEAR
Winstone Onyango	Jomo Kenyatta University of Agriculture and Technology (JKUAT)	Fourth Year
Mercy Ethel Nyakundi	Jomo Kenyatta University of Agriculture and Technology (JKUAT)	Second Year
Mark Kibe	KIST	Third Year

Supervised By;
Eng. Michael Masibo
Senior Engineer, SCADA Department

Attchment Duration: Three Months

From: 5TH May to 31ST July, 2025

Date of Submission: 20th July, 2025

DECLARATION

We, the undersigned, hereby declare that this industrial attachment report is a true and original account of the activities, experiences, and skills gained during our attachment at Kenya Power and Lighting Company PLC. The contents of this report reflect the work we individually and collectively undertook and are not copied from any other source.

Name: Winstone Onyango **RegIstration Number:** ENE221-0129/2021

Name: Mercy Ethel **Registration Number:** ENE221-114/2023

Name: Mark Kibe

ACKNOWLEDGEMENT

We would like to express our sincere gratitude to Kenya Power and Lighting Company PLC (KPLC) for granting us the opportunity to undertake our industrial attachment at the National Control Centre (NCC) – SCADA Department.

We are especially grateful to our supervisor, **Eng. Michael Masibo**, for his dedicated mentorship, guidance, and support throughout the attachment period. His patience, encouragement, and willingness to share his extensive knowledge made our learning experience both impactful and fulfilling.

We also extend our heartfelt appreciation to **Chief Engineer Kadala** for his outstanding leadership and for providing a conducive environment for learning and professional growth. Special thanks go to **Eng. Rwathe, Eng. Faith Karimi, Eng. Dennis, Eng. Alan, Irine, Titus,** and **Mike** for their invaluable teachings, technical support, and encouragement throughout our stay.

Our sincere appreciation also goes to all other KPLC staff at the NCC Station who contributed in various ways to make our attachment experience enriching and memorable. Thank you for the warm welcome, the practical exposure, and the knowledge imparted to us during this period.

EXECUTIVE SUMMARY

This report provides a detailed account of the three-months industrial attachment undertaken at Kenya Power and Lighting Company PLC (KPLC), specifically at the SCADA Department in the National Control Centre (NCC). The attachment offered us an opportunity to bridge theoretical knowledge with practical skills in the field of Electrical and Telecommunication systems, with a key focus on remote monitoring, control systems, and real-time power grid management.

We were actively involved in system observation, field work, and the fundamentals of SCADA architecture. The attachment also emphasized the importance of safety, professionalism, teamwork, and adherence to industry standards.

The knowledge and skills acquired have greatly enhanced our understanding of large-scale power management and automation, making the experience both fulfilling and instrumental to our future careers.

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CHAPTER 1 : INTRODUCTION

BACKGROUND

Industrial attachment is a critical component of technical and engineering training, designed to bridge the gap between theoretical classroom knowledge and real-world industrial practice. It provides students with a platform to gain practical experience in their respective fields of study and to understand how professional environments operate.

For engineering students, particularly in disciplines such as Electrical and Telecommunication Engineering, exposure to industrial environments such as power generation, transmission, and distribution systems is essential. These systems form the backbone of national infrastructure and are highly complex, requiring not only technical proficiency but also teamwork, discipline, and a strong understanding of safety and operational protocols.

Our attachment at Kenya Power and Lighting Company PLC (KPLC), specifically at the SCADA Department in the National Control Centre (NCC), provided us with a unique opportunity to observe and understand the functioning of a real-time grid management system. The NCC plays a vital role in monitoring and controlling electrical infrastructure across the country, making it an ideal learning environment for engineering students.

OBJECTIVES

The main objectives of our industrial attachment were as follows:

1. To gain hands-on exposure to SCADA systems and their application in real-time power system monitoring and control.
2. To understand the communication infrastructure used in remote monitoring of substations and other grid components.
3. To observe the operational procedures involved in alarm handling, fault detection, and system restoration.
4. To learn from experienced engineers and technicians through mentorship and guided observation.
5. To enhance our understanding of how theoretical concepts taught in class, such as electrical protection and automation, are applied in practice.
6. To develop soft skills including teamwork, professional communication, report writing, and adherence to industrial safety standards.

SCOPE

Our attachment was conducted at the SCADA Department, located within the National Control Centre (NCC) in Nairobi. This department is responsible for the real-time supervisory control and data acquisition of Kenya Power's transmission and distribution network.

The scope of our activities included:

- Orientation and safety briefing for access to the NCC control environment.
- Understanding the structure, components, and functionality of the SCADA system.
- Observation of real-time data flow, including voltage, current, frequency, breaker status, and transformer conditions from various substations across the country.
- Monitoring of system alarms and understanding the escalation procedures followed during grid disturbances.
- Exposure to key equipment such as Remote Terminal Units (RTUs), Human-Machine Interfaces (HMIs), alarm panels, and communication links.
- Interaction with different personnel involved in system operation, including SCADA engineers, technicians, and field support teams.
- Gaining insight into the integration of SCADA with other systems such as Energy Management Systems (EMS) and Geographic Information Systems (GIS).

Although our scope was limited to observation and guided learning due to the critical nature of operations at the NCC, the depth and complexity of the systems involved provided a robust platform for professional and technical growth.

CHAPTER 2: ORGANISATIONS PROFILE

HISTORY OF KENYA POWER & LIGHTING COMPANY (KPLC)

Kenya Power and Lighting Company PLC (KPLC) has a long and rich history dating back to the early 20th century. The company traces its origins to 1922 when two utilities — the Mombasa Electric Power and Lighting Company and the Nairobi Power and Lighting Syndicate — merged to form the East African Power and Lighting Company (EAP&L). This new entity was tasked with the generation and distribution of electricity in both Kenya and the wider East African region.

Initially, EAP&L sourced power from small hydroelectric stations and diesel generators. As demand grew, the company expanded its infrastructure and played a pivotal role in the electrification of Kenya’s major towns and rural areas.

In 1983, the company underwent restructuring, leading to the formation of the Kenya Power Company (KPC) to focus on electricity generation, while EAP&L continued with transmission and distribution. In 1986, EAP&L was renamed the Kenya Power and Lighting Company Limited (KPLC) to reflect its local mandate and ownership.

Subsequent reforms in the energy sector led to the separation of generation and distribution roles. KenGen (Kenya Electricity Generating Company) was established in 1997 as a separate entity responsible for power generation, while KPLC focused solely on transmission, distribution, and retail of electricity.

Today, Kenya Power operates the national electricity grid and serves over 8 million customers across the country. Its operations are critical to Kenya’s socio-economic development, supporting households, industries, and businesses through reliable power supply and infrastructure management.

COMPANY’S VISION

To provide world class power that delights our customers.

COMPANY’S MISSION

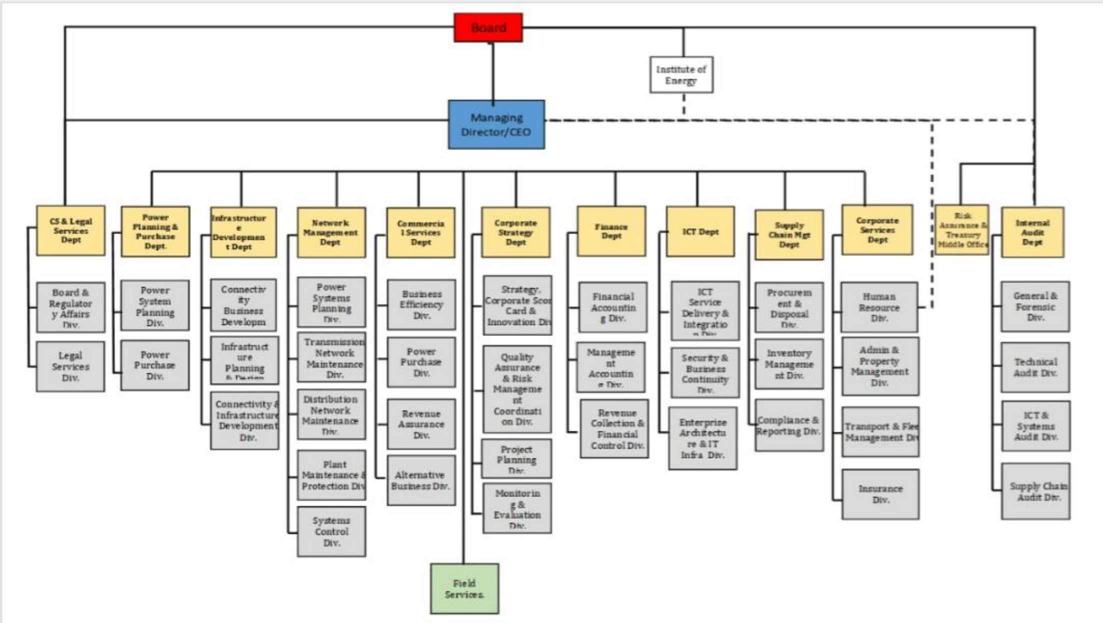
Powering people for better lives.

COMPANY’S CORE VALUES

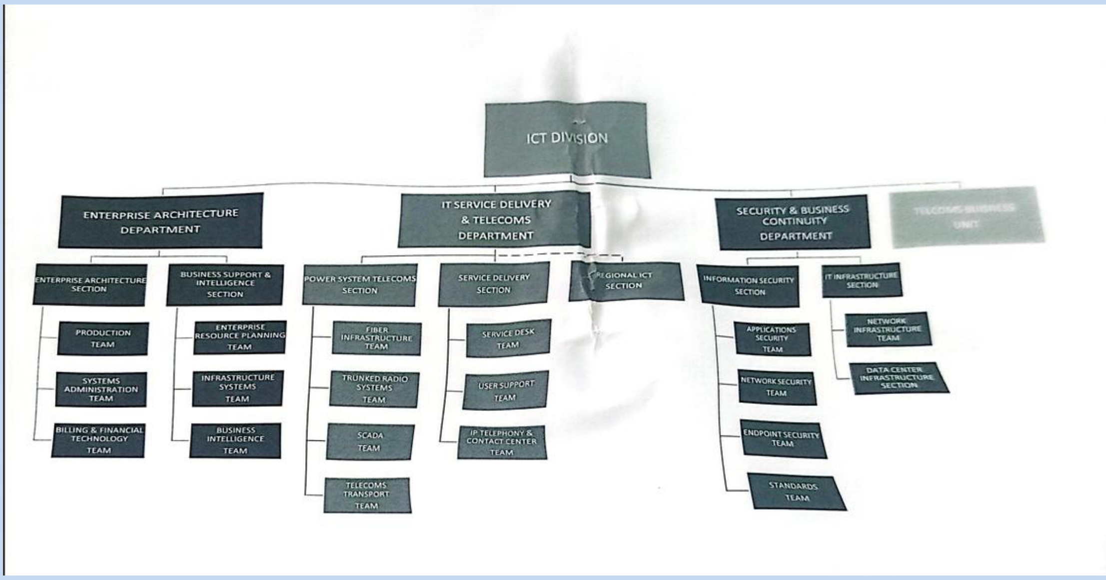
- Customer First.
- One Team.
- Passion.
- Accountability.

- Intergrity.
- Excellence.

<u>ORGANIZATION’S STRUCTURE</u>



ICT Department’s Organization Structure;



CHAPTER 3: ACTIVITIES AND RESPONSIBILITIES

OVERVIEW OF SCADA OPERATIONS AT KENYA POWER

During our attachment at the SCADA Department of the National Control Centre (NCC), we were extensively exposed to the architecture, operations, and critical functions of SCADA (Supervisory Control and Data Acquisition) systems used by Kenya Power. SCADA is a centralized system that enables engineers to remotely monitor, control, and manage electrical infrastructure such as substations, transformers, circuit breakers, and feeders across the national grid.

Kenya Power’s SCADA system forms the core of grid control operations, allowing real-time visibility and control of power flow and enabling rapid detection and response to faults or disturbances across the country. The system ensures reliability, safety, and efficiency in power delivery.

Key Components of SCADA at Kenya Power:

A) Remote Terminal Units (RTU)

RTUs are intelligent field devices deployed in substations to interface with physical electrical equipment. Their primary roles include:

- Monitoring electrical parameters (voltage, current, frequency, etc.)
- Capturing status of circuit breakers, isolators, and transformers
- Transmitting real-time data to the National Control Centre via communication channels
- Executing remote control commands issued by operators at NCC.
- RTUs operate as autonomous edge devices that continuously relay field conditions, enabling remote situational awareness.

B) Fibre Optic Multiplexers (FOX)

FOX units are installed in both substations and the NCC to manage the multiplexing and demultiplexing of data streams over the fiber optic network.

- They ensure synchronization of time-stamped data from multiple field devices.
- FOX technology supports simultaneous voice, data, and protection signals over a unified fiber network.
- The seamless operation of FOX links is pivotal for grid control integrity.

C) <u>Protection Equipments: Circuit Breakers and Isolators</u>

The SCADA system also integrates with the protection side of the electrical network, which includes:

- **Circuit Breakers:** These are critical safety devices used to interrupt fault currents and protect electrical equipment. SCADA allows circuit breakers to be operated both locally at the substation and remotely from the control center.

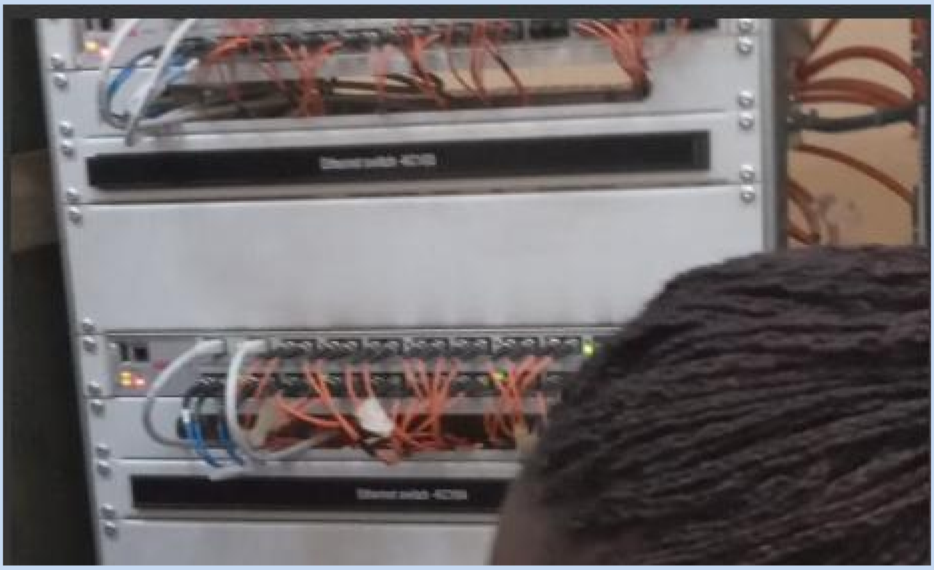
- **Isolators (Disconnect Switches):** These are used to physically isolate sections of the substation or transmission line for maintenance or in emergencies. While some isolators are manually operated, many are equipped with motorized actuators and can be controlled remotely via SCADA.

D) Fibre Optic Cables and Switches For Communication

Communication between the RTUs and the Master Station is achieved through a dedicated fiber optic infrastructure, forming the backbone of Kenya Power's SCADA data transmission network.

- Fiber Optic Cables ensure high-speed, reliable, and low-latency data exchange.
- Network Switches, particularly Layer 2 and Layer 3 industrial-grade switches, are deployed to facilitate efficient packet routing between substations and the NCC.
- The system supports redundancy and failover paths to maintain communication even during outages or link failures.

This robust communication backbone is essential for synchronization, fault response, and real-time visibility.



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E) A Uninterruptible Power Supply (UPS)

UPS is an essential backup power device used in SCADA systems and data centers to ensure continuous operation during power interruptions. It provides immediate, short-term power to critical equipment—such as servers, routers, and communication systems—allowing safe shutdown or seamless transition to generator power. In environments like Kenya Power's NCC, the UPS protects sensitive SCADA equipment from voltage fluctuations, outages, and surges, thereby ensuring system reliability and data integrity.

F) The Process Communication Unit (PCU)

The PCU (Process Communication Unit) which serves as an intermediary between the RTUs and the servers. It aggregates and preprocesses data, offloading processing tasks from servers and improving system reliability.

G) DE (Data Engineering)

Data Engineering is the backend unit responsible for data acquisition, storage, processing, and analytics of all the data collected from substations via RTUs. It plays a critical role in turning raw SCADA data into actionable intelligence that supports operational decisions, fault analysis, and long-term planning.

H) WS500

The WS500 acts as the front-end interface where SCADA engineers and operators observe the national grid and issue commands.

I) Backend Servers and System Architecture

SCADA at Kenya Power is supported by a range of powerful backend servers located at the NCC:

- **SCADA Servers:** Responsible for core data processing, historical archiving, and redundancy.

- **Application Servers:** Host specific services such as event processing, database queries, and script execution.

- **Data Engineering Servers:** Form the backbone of backend operations, ensuring storage, retrieval, and analytics of massive datasets from the field.

- **Active Directory Servers:** Manage user authentication, role-based access control, and system security.

These servers are configured in a high-availability architecture to provide fault tolerance and load balancing.

J) Alarm Management, Logging, and Historical Analysis

SCADA's alarm system is configured to alert operators in case of anomalies such as:

- Line outages.
- Equipment trips.
- Communication failures.
- Voltage/frequency violations.

Each event is logged and time-stamped, providing a valuable audit trail. Data is archived and later analyzed using the Data Engineering backend infrastructure to assess performance, identify trends, and support decision-making.

RESPONSIBILITIES AND PRACTICAL EXPOSURE

1. Field Visit to Karuri Substation For Communication Switch Repair

Our first responsibility during the attachment involved accompanying Engineer Allan and Irine to Karuri Substation to assist in the repair of a faulty communication switch. The substation had been offline for some time due to this issue, affecting real-time data transmission to the National Control Centre (NCC). Upon arrival, we collaborated with engineers from Reffhab Technologies, who were also part of the maintenance operation. Together, we assessed the issue, observed the process of replacing the switch, and ensured that communication was successfully restored between the substation's RTU and the SCADA system. This field visit gave us practical exposure to equipment handling, network fault diagnostics, and teamwork in live substation environments.

2. Troubleshooting and Restoration Of NSSF Substation

Our second responsibility involved accompanying Engineer Rwathe to the NSSF Substation for a troubleshooting exercise. The substation had remained offline for a while, prompting the need for technical intervention. Upon arrival, we initiated the recovery process by restarting the loop switch and the RTU in an effort to restore communication with the National Control Centre. We then conducted an IEC test on the router, which confirmed that the router was functional and not the source of the issue. However, despite these steps, the station still failed to come online.

Further diagnosis revealed that the existing network switch was faulty. Once the faulty switch was replaced, communication was successfully restored, and the station was brought back online. This exercise deepened our understanding of real-time diagnostics, equipment testing, and SCADA communication restoration protocols.

3. Computer Maintenance at NCC

As part of our responsibilities at the National Control Centre (NCC), we assisted Irene, Mike, and Titus in conducting a comprehensive computer maintenance and cleaning exercise. This task involved carefully opening and cleaning workstation units across the control room, removing accumulated dust from internal components such as fans, power supplies, and motherboards. The goal was to ensure proper airflow, prevent overheating, and maintain overall equipment health in the SCADA environment. This hands-on experience emphasized the importance of regular preventive maintenance in sustaining uninterrupted operations within mission-critical infrastructure.

4. Server Maintenance

We also assisted in cleaning the servers located in the data room. This task was carried out under the supervision of Engineer Michael Masibo, alongside Irene and Mike. Our role involved carefully removing dust from the surfaces and ventilation areas of various servers.

5. Guided Sessions on System Maintenance and Equipment Replacement

We also participated in guided sessions focused on system maintenance and equipment replacement. These sessions, led by experienced engineers, covered the procedures involved in handling and maintaining essential infrastructure components such as Uninterruptible Power Supplies (UPS), network switches, and loop switches. The sessions provided hands-on exposure to real-time troubleshooting and emphasized the importance of routine maintenance in ensuring system reliability and minimizing downtime in SCADA operations.

6. Continuous Learning

Throughout our attachment period at the National Control Centre (NCC), continuous learning is an integral part of our experience. Each day, we were introduced to new concepts, systems, and technologies related to SCADA operations, fiber communication, substation configurations, and fault response procedures. This daily exposure not only deepened our technical understanding but also enhanced our adaptability and practical problem-solving skills in a dynamic power system environment.

CHAPTER 4: SKILLS ACQUIRED AND CHALLENGES

SKILLS ACQUIRED

During our industrial attachment at the Kenya Power National Control Centre (NCC), we acquired a wide range of both technical and soft skills.

Technical Skills

- Understanding of SCADA system architecture and components (RTUs, FOX, PCU, etc.)
- Troubleshooting and replacement of network switches and loop switches
- Performing IEC tests to verify router functionality
- Familiarity with fiber optic cabling for data transmission
- Basic maintenance of computers and servers (dusting, cleaning)
- Exposure to backend systems such as:
  - Data Engineering servers
  - SCADA servers
  - Active Directory servers
  - Application servers
- Front-end system handling using WS500 displays
- Insight into the role of UPS in power reliability and protection
- Participation in guided sessions on system maintenance

Soft Skills

- Teamwork and collaboration with engineers and fellow interns
- Effective communication in a technical and professional setting
- Report writing and documentation of fieldwork
- Time management under tight schedules
- Adaptability in dynamic work environments
- Problem-solving and critical thinking during fault resolution
- Professional conduct and adherence to safety protocols

CHALLENGES ENCOUNTERED

Like any real-world work environment, our experience came with its share of challenges.

One major challenge was grasping complex SCADA systems and protocols within a short time, given their vastness and technical depth. However, continuous guidance from the engineers and regular engagement in field activities helped us gradually understand the systems better.

Another challenge involved the offline substations we worked on, where diagnosing and troubleshooting faults often required patience, coordination, and multiple attempts. For example, stations like NSSF had persistent connectivity issues that tested our patience and consumed a lot of time.

Working in a highly secure environment also meant adapting quickly to professional workplace conduct and complying with strict safety and procedural protocols.

PERSONAL DEVELOPMENT

This attachment experience significantly contributed to our personal and professional growth. Being exposed to real-time power system operations and participating in technical tasks has enhanced our confidence and problem-solving capabilities. We learned to appreciate the importance of detail, precision, and collaboration.

Moreover, engaging with industry experts inspired a deeper interest in various engineering fields such as system automation, influencing our future career choices. On a personal level, the experience nurtured discipline, responsibility, and resilience—qualities essential for thriving in any engineering profession.

CHAPTER 5: CONCLUSSION AND RECOMMENDATIONS

CONCLUSSION

The industrial attachment at the SCADA Department, Kenya Power's National Control Centre, was immensely beneficial to us as students and aspiring engineers. It provided a rare opportunity to bridge the gap between theoretical knowledge and practical application in a real-world, high-stakes environment. Through daily engagement with advanced power system technologies, active participation in field visits, and hands-on tasks in system maintenance and troubleshooting, we were able to deepen our understanding of SCADA operations and develop essential technical skills.

Moreover, the attachment enhanced our soft skills such as communication, teamwork, professionalism, and adaptability. Working under the guidance of experienced engineers further helped shape our career perspectives and exposed us to the expectations and standards of the energy sector. This experience has laid a solid foundation for our future roles in engineering and has been a crucial step in our academic and professional development.

RECOMMENDATIONS

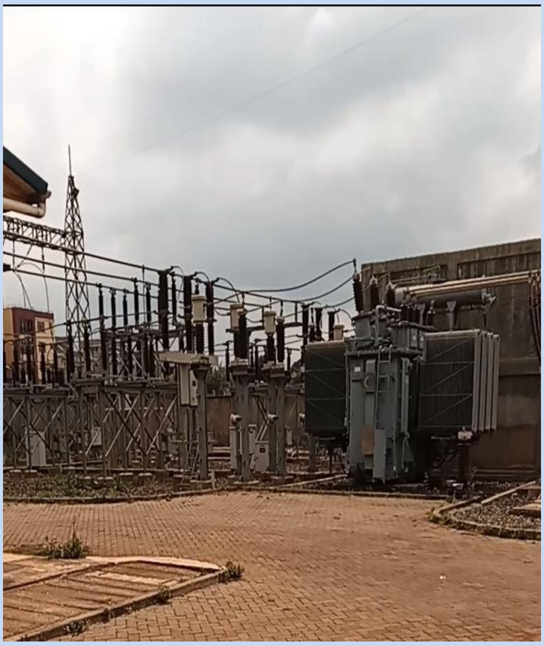
Guaranteed Internship Placement After Attachment

We recommend that Kenya Power considers introducing a policy where students who successfully complete their industrial attachment are automatically granted internship positions, without having to undergo the long and competitive application process through the KPLC portal. This would ensure continuity in practical training for dedicated students and reward those who have already proven their commitment and potential during attachment. It would also streamline talent acquisition for the company by retaining already-oriented individuals familiar with internal systems and culture.

Stipend For Attachees

We also recommend introducing a modest stipend for attachees. Providing financial support, even minimal, would go a long way in covering daily expenses such as transport and meals. It would also serve as motivation and recognition for the contribution interns make to the organization during their attachment period.

APPENDICES

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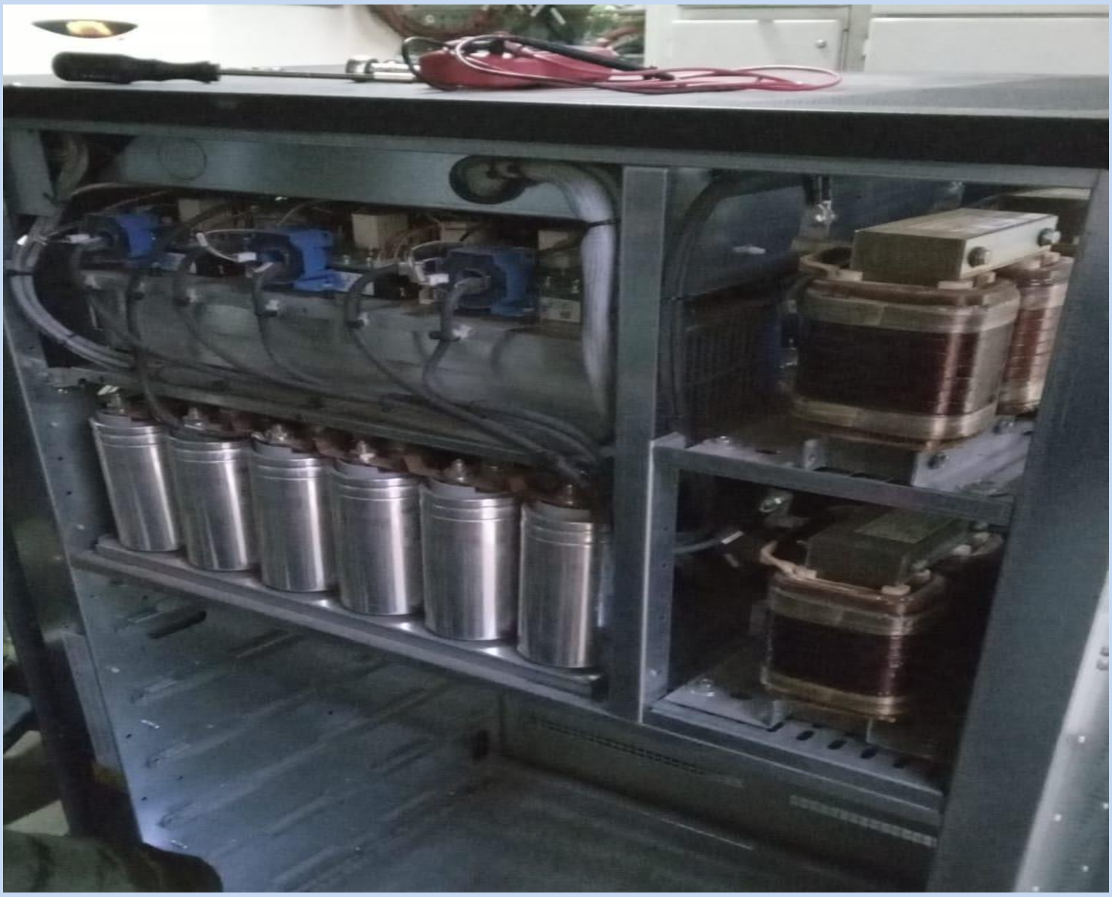

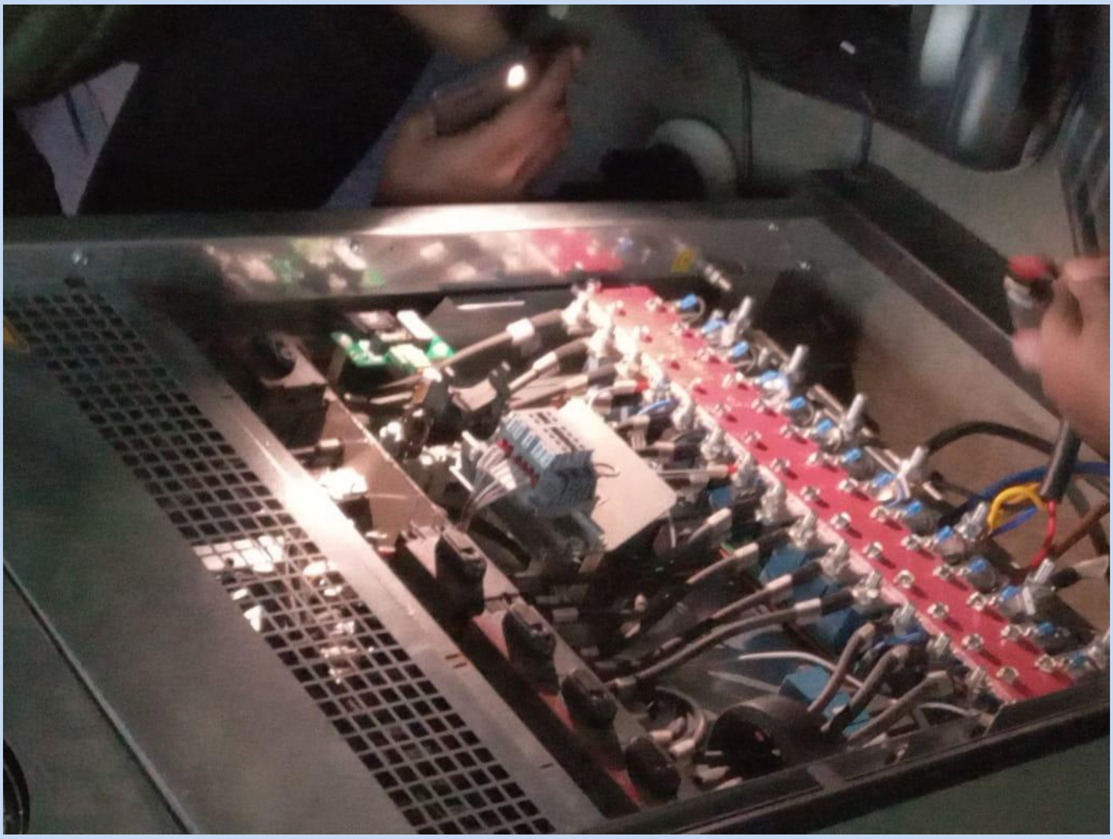

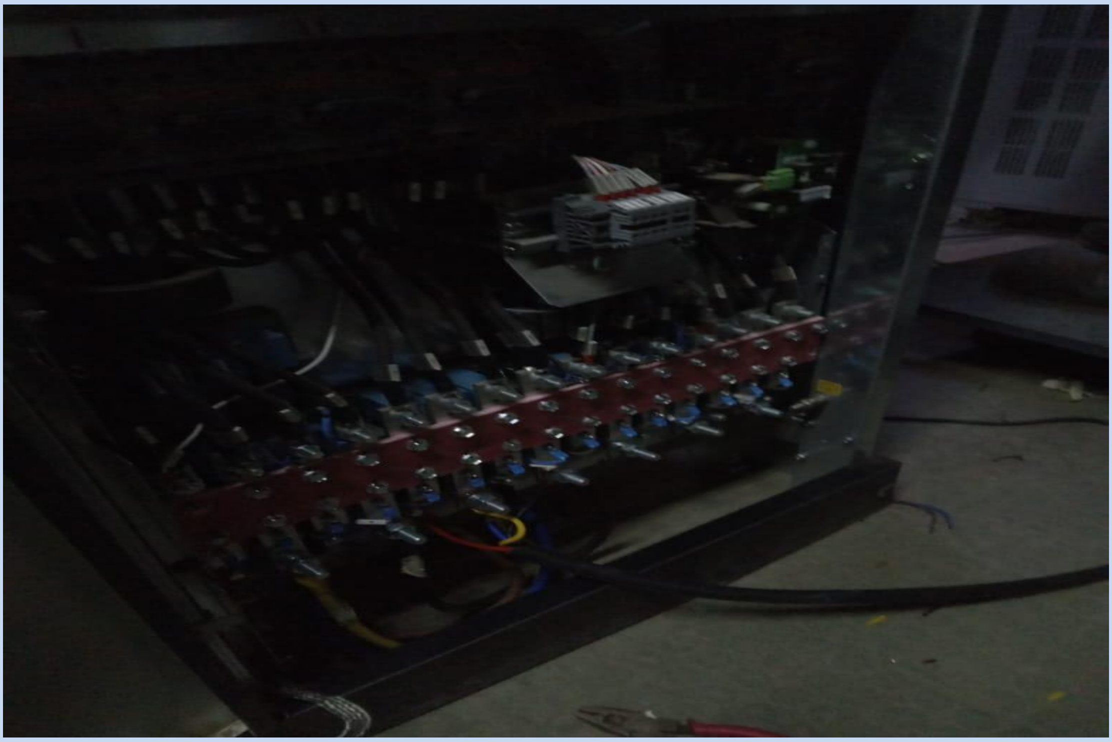

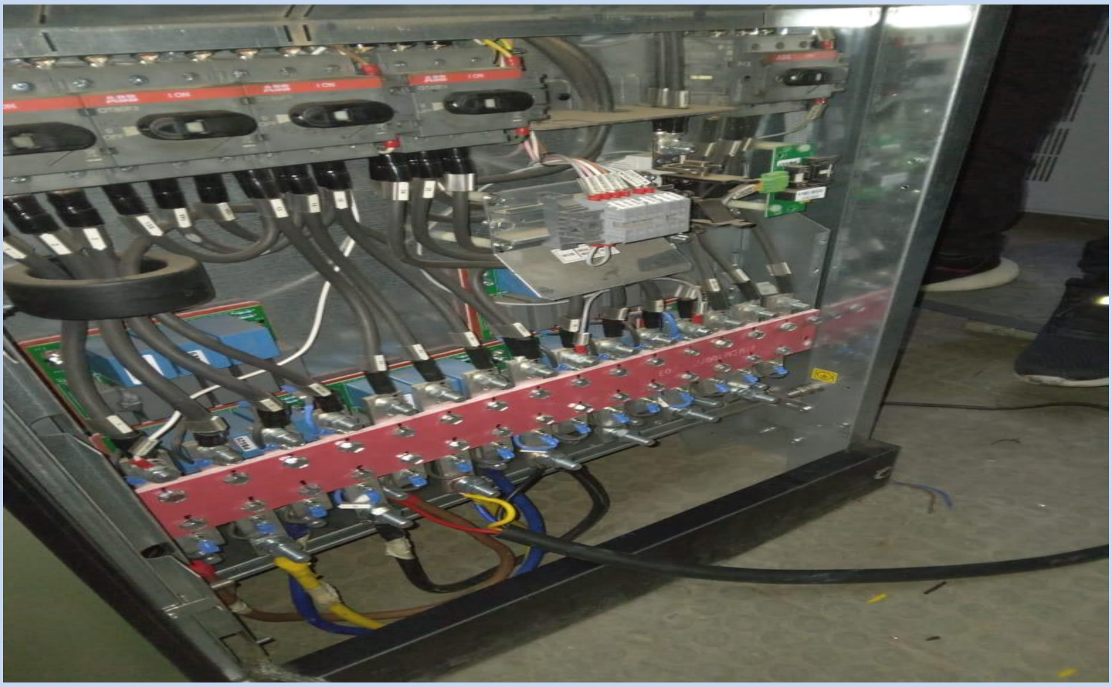

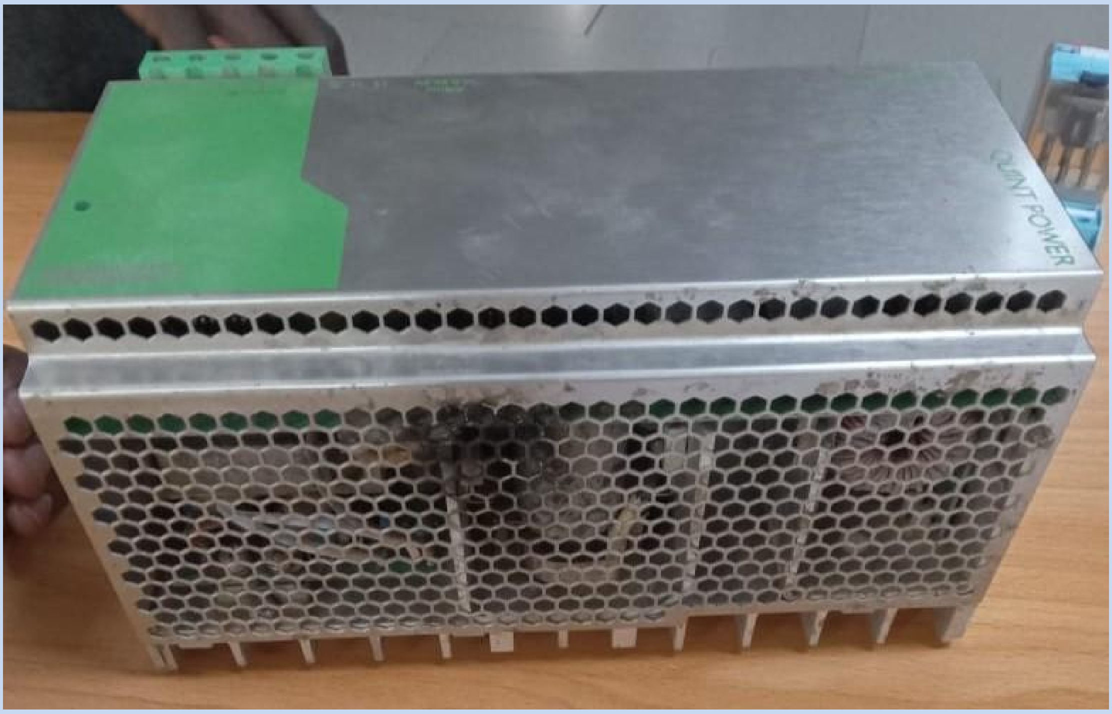
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