POWER DELIVERY ENGINEERING

EIT Training Review:

Progress Report

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1. Introduction

This document outlines the various Engineer in Training (EiT) activities completed through the first six months. The training is administered through a rotational training within the Eskom Power Delivery Engineering (PDE) department. This training program consists of two stages. The first stages of the training program rotational training which takes 63 weeks. The aim of this rotational training is to gain an understanding of what PDE departments and the activities done within those departments. The last stage consists of 41 week. In this stage a department of interest from the rotational training is elected where more practical training is provided to develop a skill in that environment. This training also aims to empower young engineers with the necessary skill and requirements to register as Professional Engineers with the Engineering Council of South Africa.

The purpose of this document is to provide feedback on activities attended through the past six months of the training. These various activities are listed and elaborated in the following sections.

2. Training Activities

2.1. Geographical Information Systems (GIS)

Geographic Information System (GIS) is primarily concerned with providing geographical expertise to facilitate the process of infrastructure planning and management, as well as network planning. There are numerous other applications of GIS such as electrification planning, site and route selection, strategic environmental assessments, information sharing, reporting system, servitude vegetation management and decision making tools.

Table 1: GIS

Level of Responsibility:	Observing and Training
Standards/SOG/Procedures:	
Previous Training Used	
Pro-activity:	
Duration:	2 weeks

During the two weeks spent at GIS, the main task assigned to me was to familiarize myself with the ArcGIS software. ArcGIS is a comprehensive geographical information system software package which allows one to capture, edit, manage and analyse GIS data. The software investigation enabled me to perform the following functions:

- Create and interact with maps
- View, edit and analyse data
- Acquire data from a Geo-database
- Site and route planning
- Investigate land-use change

Figure 1 shows how land survey is conducted in GIS and the same method is also used by the lines Line Engineering Service surveyors.

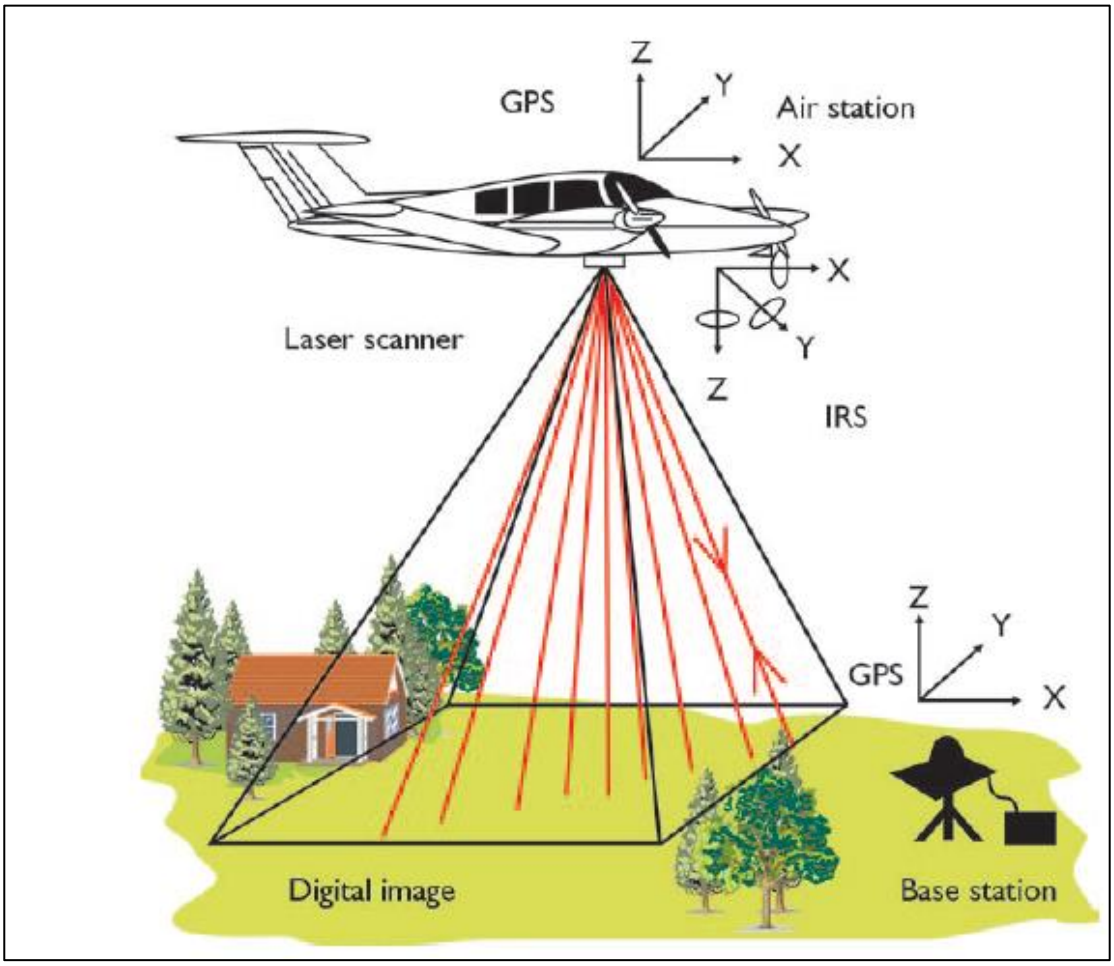

Figure 1: GIS land survey

2.2. Design Base Operating Unit and Support (DBOUS)

This department is accountable for the integrity of the design base and provides operational support. The design base and operational support done through implementation of Steering Comity of Technology (SCOT) standards and design assurance by offering first line Operating Units (OU) support and by defining, interpreting and maintaining the design base.

Table 2: DBOUS

Level of Responsibility:	• Reviewing the DC Maintenance Engineering Standard for batteries and chargers. • Transformers inspection at Rosherville warehouse
Standards/SOG/Procedures:	240-45395762 240-61182045 batteries and chargers
Previous Training Used	None
Pro-activity:	
Duration:	4 weeks

During training at this depart I was assigned two major task of reviewing and implementing standards. The first task was to review the Maintenance Engineering Standard (MES) and task manual for batteries and chargers. In this task I had to identify the gabs between the standard and the task manual. The gabs which were identified are not clearly discussing the environmental condition and the health condition of the area of operation of the equipment . The aim of this task was to update the standard and the task manual while gaining more understanding of their implementation. The standard used is the 240-61182045 batteries and chargers

The second task was of standard implementation for periodical material inspection at the Rosherville Warehouse. My task specifically was to conduct a visual inspection to assess the condition of various MV/LV transformers of up to 33KV and 1MVA at the Warehouse. This was to check if the transformers condition and the storage condition meet the Eskom standard. For this inspection, pole and ground mounted transformers from various manufacturers were assessed. Thereafter I compiled a report about the condition of the transformers, which explained if the defects found could be from manufacturer or due to the warehouse storage condition. The standard used to complete this task is 240-45395762: Specific Requirements for distribution pole and ground-mounted transformers up to 33kV and 1MVA.

Figure 2 shows some of the pictures of the defects found on the transformers.

Figure 2: Transformers condition

2.3. Integration

The Integration structure is said to the interface between project management and design. The following are the some of the Integration Project Phases which we were introduced to through presentations, with the explanation of what I have learned about them.

Table 3: Integration

Level of Responsibility:	Observing and Training
Standards/SOG/Procedures:	
Previous Training Used	None
Pro-activity:	
Duration:	1 Weeks

Integration Project Phases

Whenever a project is introduced to the Integration department, it has to go through three phases which standardises execution of all projects. These phases are:

- Concept Design Process in order to achieve Definition Release Approval
- Detailed Design Process in order to achieve Execution Release Approval
- Execution Process in order to achieve Construction of assets

These phases are mapped in a process flow diagram to indicate the inputs to Integration, as well as project management activities, engineering design processes, technical interfaces and lastly Integration outputs.

2.4. Lines Engineering Services (LES)

LES is a department within Power Delivery Engineering (PDE), which is responsible for the design of transmission line. The projects in this department are initiated grid and the grid receives projects from planning department. One of the most important aspects of the line planning is the load forecast. The line design entails aspects such as land servitude, type of tower and tower spotting, conductor type and weather forecast studies. These aspects are all influenced by the desired load capacity of the line.

Table 4: Lines Engineering Service

Level of Responsibility:	Observing and Training
Standards/SOG/Procedures:	
Previous Training Used	None
Pro-activity:	
Duration:	4 Weeks

The training at Lines Engineering Services outlined the following sections known as the Huts. This training was provided through presentation training. The aim of the training was to gain an understanding of what the LES huts are and what their responsibilities are when designing a transmission line.

Towers: A tower is a structure which is used for suspending, tensioning and directing a conductor. The Eskom towers are categorised into two categories, namely strain and suspension towers. The strain tower is mainly used for tensioning, redirecting and suspension of the conductor whereas the suspension tower is mainly used just for suspending the conductor. There are various types of towers which may be used as strain or suspension towers, the following are their examples and are shown in figure 3:

- Self-supporting tower
- Guyed tower/ Cross-rope tower
- Guyed V tower
- Monopole tower
- Sugarcane tower

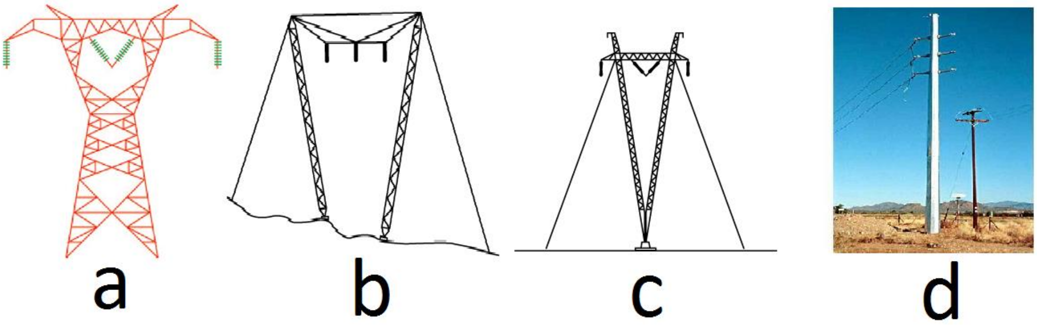

Figure 3: (a) Self Supporting Tower, (b) Guyed/Cross-rope tower, (c) Guyed V Tower and (d) Monopole tower

In the design of these towers, the designer must consider the forces which are going to be exerted on the tower, including the wind span and the weight span. The wind span design caters for the sagging of the conductor between two towers and each tower must handle half of the span. Regarding the weight span design, the tower has to be able to handle the weight of the conductor and this depends on the spotting of the tower; for example if the tower is on hill, the weight distribution will not be the same as when it is on a flat surface.

Conductor Optimization: The most important aspects in conductor selection are the electrical and mechanical requirements. When selecting a conductor for a line, the conditions which the line is to be exposed to must be considered. These conditions include load forecast, conductor temperature profiling, located area of the servitude (settlement, farm, open space, e.t.c) and weather forecast of that area. The line also has restrictions which states that a transmission line should have at least 8.1m ground clearance, the noise and the magnetic field should be less than 53dB and 200T respectively when measure at 1.8m from ground and the electric field should be less than 5m out of the servitude. These restrictions influence the choice of the conductor since they are influenced by the amount of voltage and current to be transmitted on the line. These conditions are considered so that a conductor that will have optimum operation may be chosen to avoid corona, line overheating and other faults that may occur due to the conductor choice.

According to the Planning, Design and Construction of Overhead Power Lines article which was written by the LES editorial committee it is explained that ACSR is the most popular option for bare overhead power line conductors because it combines the advantages of mechanical strength (steel core) and high conductivity (aluminium outer layers). There are several different sizes, and ratios of aluminium to steel and stranding as shown in Figure 4. The choice of these depends on specific electrical and mechanical requirements

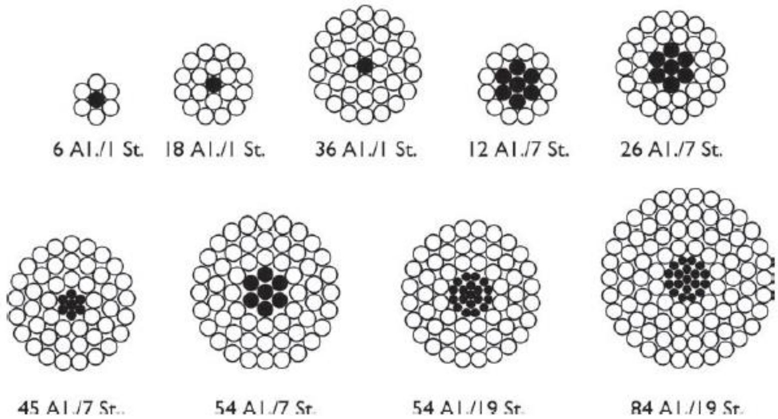

Figure 4: Examples of ACSR conductor

Earthing: Every line and tower requires earthing for protection reasons. Surge arresters are used for line and tower protection against lighting and other surges. The settings of the surge arrestor should be less than the basic insulation level (BIL) of the line and tower. If the BIL is less the current injected by surge, it may lead to insulation failure (e.g. bushing).

In the tower earthing design, the tower footing resistance is very important and it may be calculated as:

$$R = \frac{\rho L}{A}$$

Where: ρ – resistivity of the soil, $L -$ Length of the rot and $A -$ Correctional area of the electrode. The tower footing design also caters for the touch potential and the step potential. Touch potential is the voltage difference between the energised tower and the person or object in conduct with tower. Whereas the step potential is the voltage difference between the feet of a person or object standing next to an energized tower. Tower footing resistance is influenced by the type of soil where the tower is sported; therefor in this case soil sampling is also important. Figure 5 illustrates the tower footing, the touch and step potential.

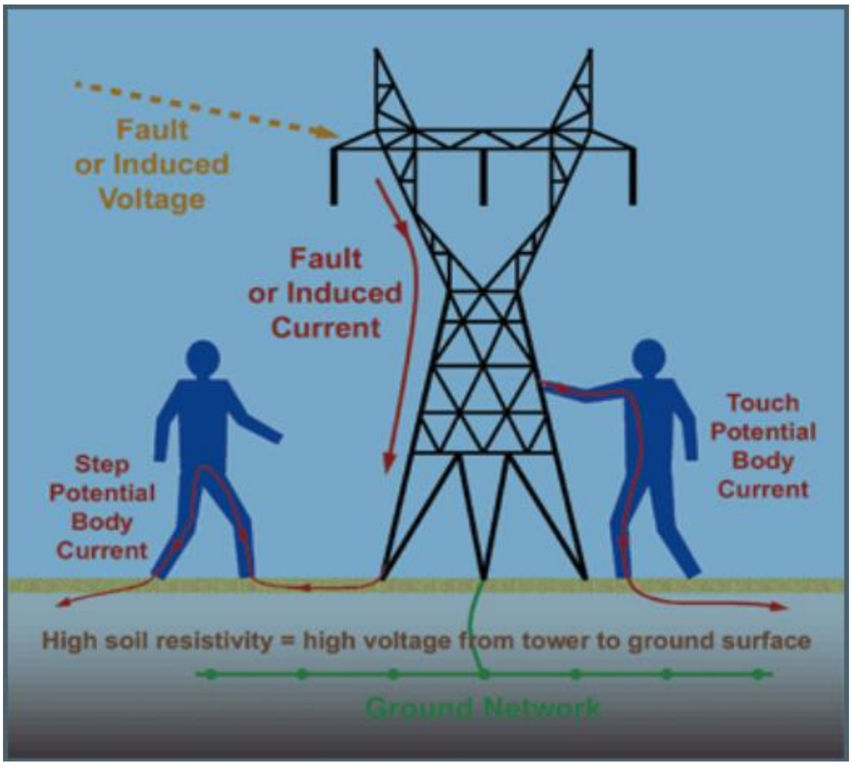

Figure 5: Tower footing

Every line has capacitance with reference to ground; therefore the longer the line, the more susceptible it becomes to Ferranti effect. Due to this effect, Ferranti studies are conducted for very line going over 200km and to mitigate this effect, reactors are implemented on such lines. In addition, during transmission, there may occur phase unbalancing due to varying load demand on the line phases and this can be resolved through the transposing process shown in figure 6:

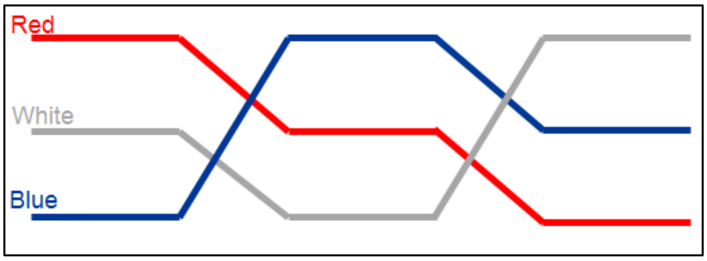

Figure 6: Transposing process

Foundation: The tower foundation is one of the most important aspects is the line design. When designing a line, the foundation is expected to be the strongest and have the longest lifespan since failure of the foundation has a lot of damage implications on the line. In the design of the foundation, the most important aspects to look into are the forces to be experienced by the foundation and the soil type of the foundation location.

The common forces experienced by a foundation include uplifting, compression, transverse and longitudinal forces. When designing for the uplifting force, the uplifting resistance angle (θ) is also considered. Figure 7 shows examples of foundations for self-supporting and guyed wire towers.

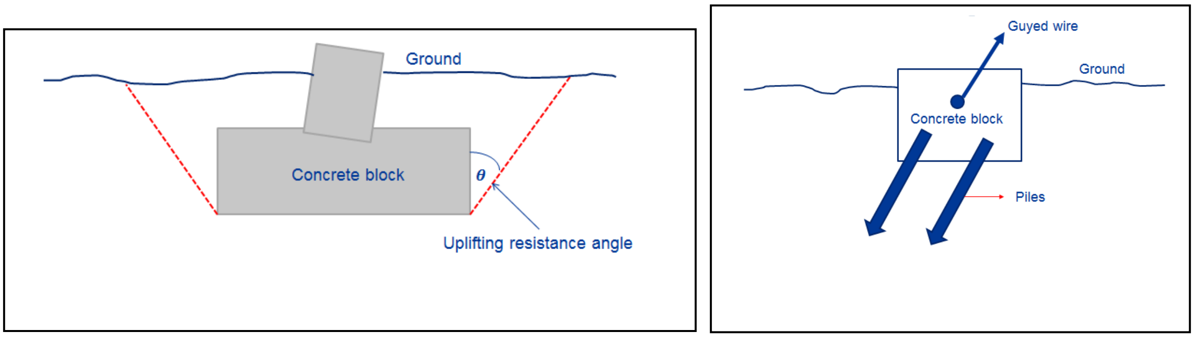

Figure 7: Examples of tower foundations.

2.5. Substation Engineering

A substation can be referred to as a nodal point that joins two transmission circuits or a transmission and the distribution circuits. In general there are three types of substations; namely the Gas Insulated Substation (GIS), the Conventional Air Insulated Substation (AIS) and the Hybrid Switchgear.

Table 5: Substation Engineering

Level of Responsibility:	• Observing and Training • Reviewing the Electric Diagram
Standards/SOG/Procedures:	
Previous Training Used	Lines Engineering
Pro-activity:	• Checking correspondence between Station Electric Diagram the actual substation.
Duration:	4 Weeks

The training at Substation Engineering entailed the following activities:

- Reviewing equipment naming on the Station Electric Diagram of Luckhoff Substation.
- Reviewing the naming correspondence of the equipment at Zeus substation with reference to the Station Electric Diagram.

The aim of training in this department was to get an overview of what a substation is, the purpose of a substation and what types of equipment found in a substation.

Station Electric Diagram (SED): Every substation has a station electric diagram which is drafted upon design. Before commissioning a substation, evaluations are conducted to verify the correspondence of the SED and the equipment at the substation. These verifications are also conducted periodically after the commissioning and are also conducted after every refurbishment or maintenance at the substation. This is done to keep the SED up to data so that if a certain equipment requires attention, it may be easily located and identified.

During training there were SED naming verifications which were required and I specifically was assigned a task of verifying the naming of the components at Luckhoff substation. This was done to verify the correspondence of the equipment naming on site to the SED and update the Station Electric Diagram if necessary. The aim of this task was to update the SED.

The other task was on site at Zeus substation. In this task I had to check if all the equipment at the substation is noted on the SED and to also verify if the equipment naming corresponds to the naming on the SED. The aim of these verification tasks was to update the SED and the naming of the components on site. Figure 8 shows a sample of a station electric diagram

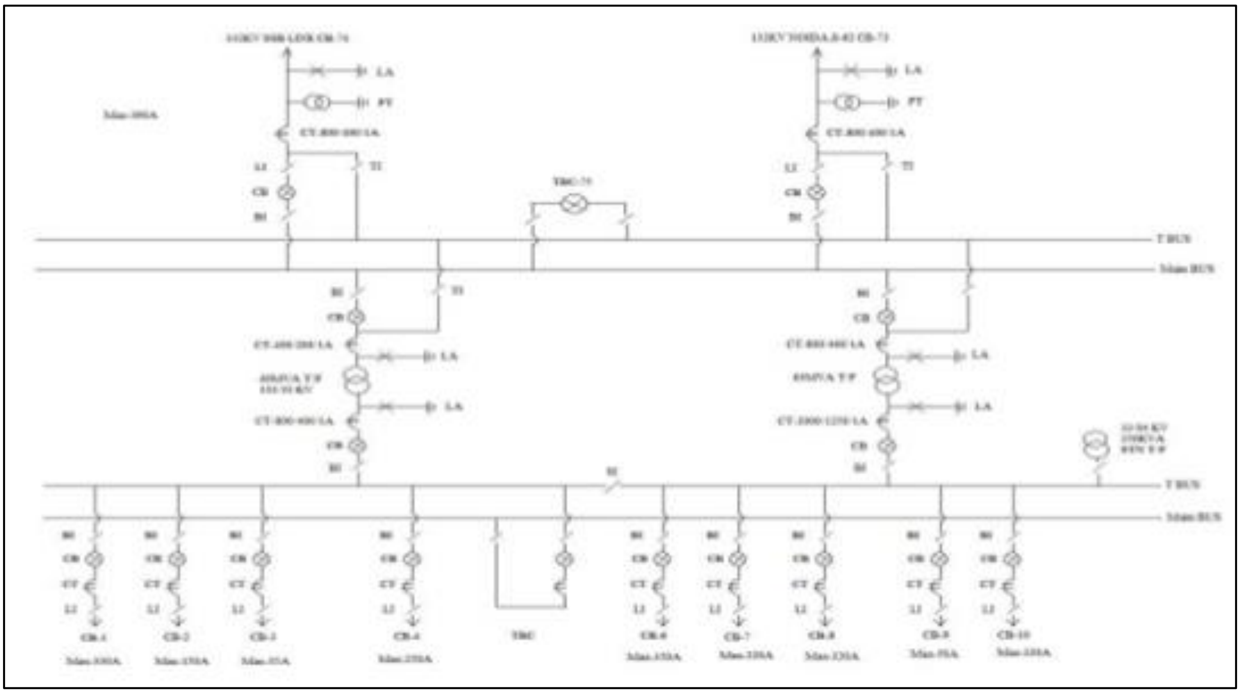

Figure 8: Station Electric Diagram

2.6. Protection Telecommunication Metering and Control (PTM&C)

The training at PTM&C involved visiting various sections within this department for short periods of time in order to have an overview of these sections. The overview entailed understanding the work scope of this department and how it connects with the other PDE departments.

Table 6: PTM&C

Level of Responsibility:	Observing and Training
Standards/SOG/Procedures:	
Previous Training Used	Substation Engineering
Pro-activity:	
Duration:	9 Weeks

2.6.1. Control/Automation Technology

The Control/Automation Technology department is responsible for researching on new technologies for SCADA and making informed recommendation on new software and hardware required. SCADA (Supervisory Control and Data Acquisition) is a system that is used to supervise and acquires data from the primary plants and the lines. Whenever new technology which can be beneficial to the SCADA is developed, this department is the one responsible for conducting investigations and compile designs and recommendation on how to incorporate it with the Eskom SCADA. After compiling the designs and making recommendation, they are then forwarded to Control Applications department for implementation.

Table 7: Control/Automation Technology

Level of Responsibility:	Observing and Training
Standards/SOG/Procedures:	
Previous Training Used	Substation Engineering
Pro-activity:	
Duration:	2 Weeks

During training at Control/Automation Technology, I was given the overview of the operation of the SCADA. This training was provided through explanation of the current SCADA network architectures for distribution and transmission; the architecture of the upcoming technology was also explained. Figures 9 and 10 are the SCADA Transmission and Distribution network architectures respectively, which were presented during training and the stages on the architectures are explained below.

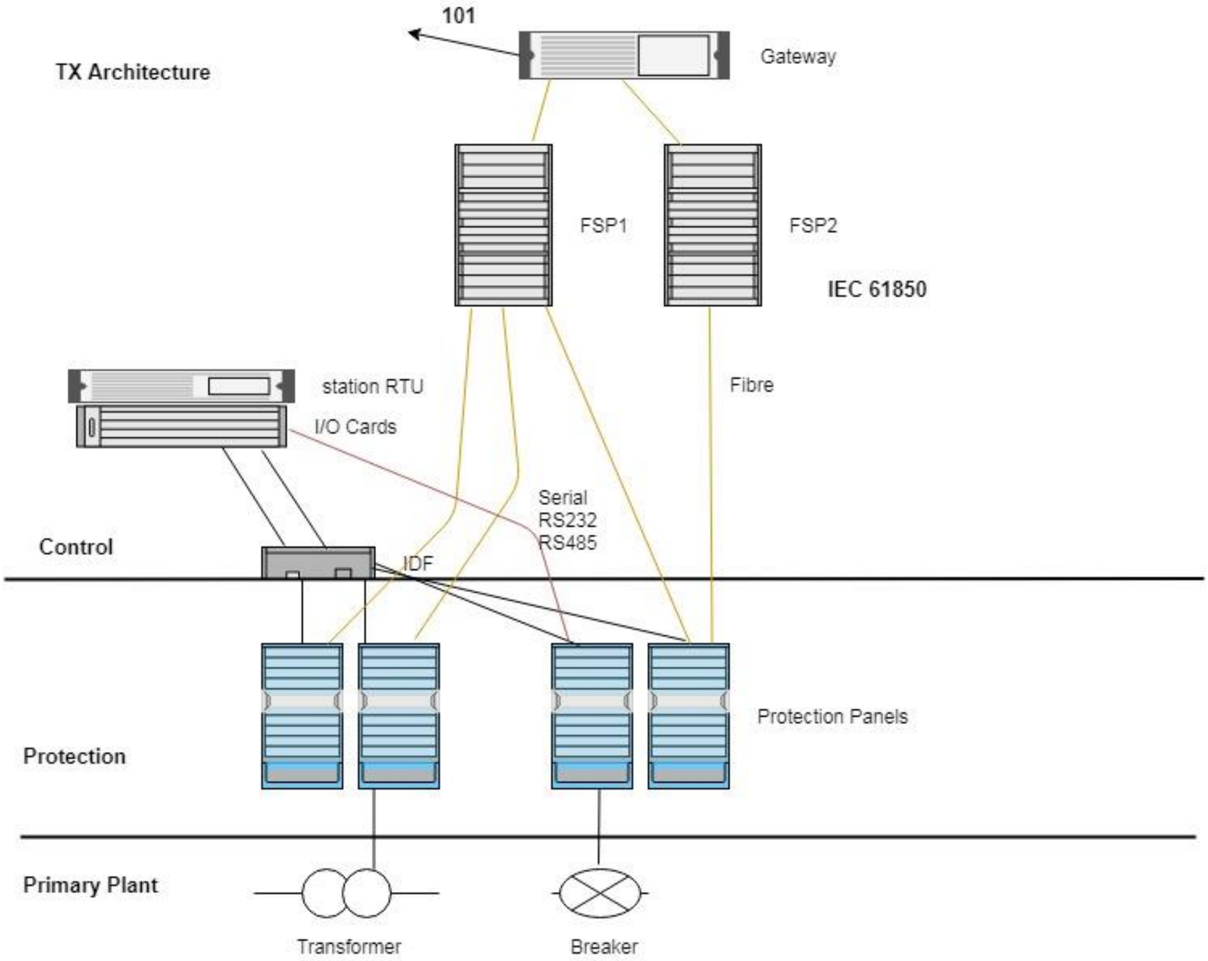

Figure 9: Transmission SCADA Architecture

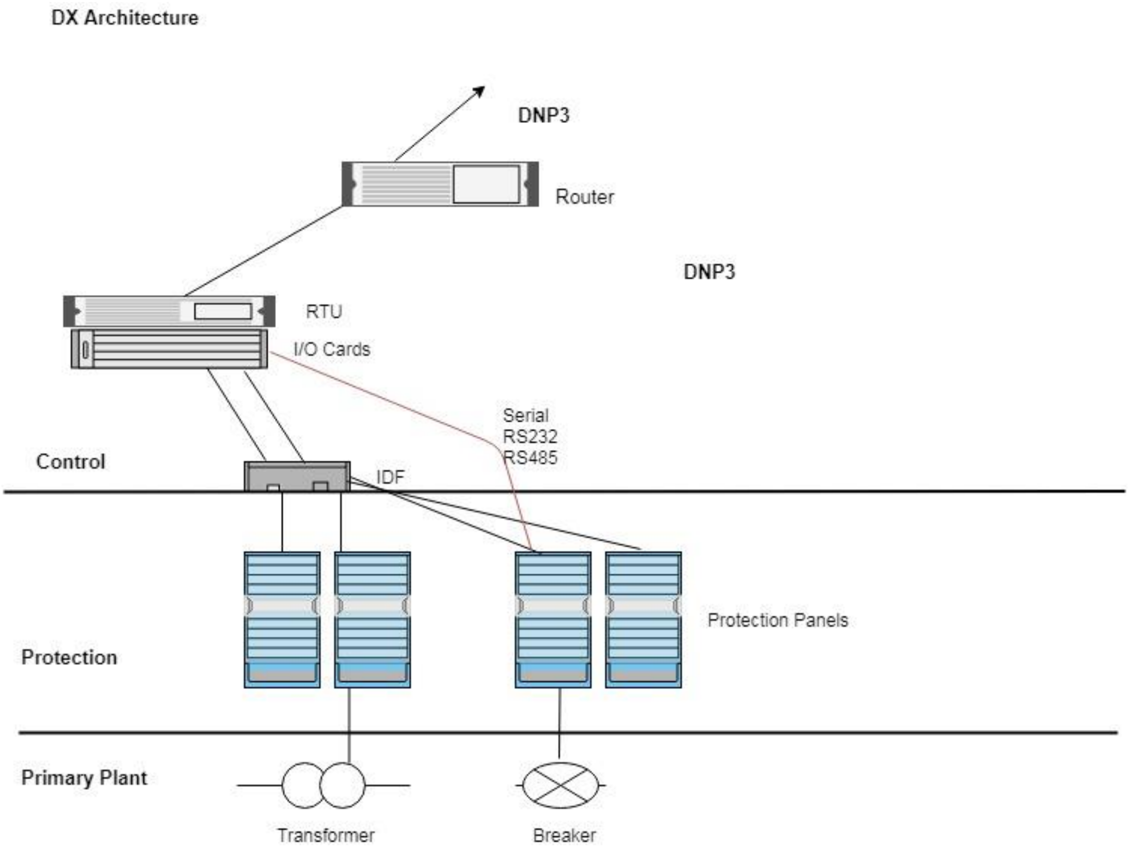

Figure 10: Distribution SCADA Architecture

Protection: When reading the network architectures from the bottom, it can be seen that firstly data and alarms are send from the primary plant to the protection panels in the secondary plant. In the secondary plant on the protection area we find the bay processor and the protection relays M1 and M2. The bay processor converts the signals from the primary plant to an understandable language or the signal from the control centre to a language understood by the primary plant equipment. The function of the relay panels M1 and M2 is to perform the protection protocols for the primary plant.

Control: The data and signals from the protection area are then forwarded to the station Remote Terminal Unit (RTU) through copper wires which are connected by the Intermediate Distribution Frame (IDF). Commonly, the RTU used is the D20. The station RTU contains I/O cords which can be used to convert signals either from analogue to digital (AD) or from digital to analogue (DA).

From the station RTU, the data or signal are sent to the Gateway through fibre wires which are connected by Fibre Switch Panels (FSP). These FSP panels are used to mitigate the necessity of having to replace the whole fibre wire in case of a fault. The commonly used gateway is the D400.

The D400 gateway is only used for transmission stations, in case of Distribution, the station RTU is used as the gateway. At the gateway is where all the signals or data are grouped and send to Reginal

Control Centre (RCC) and National Control Centre (NCC) through the telecom cloud. This communication is bidirectional, meaning that signals or data can be send from the Substation to the NCC/RCC and can also be send from the NCC/RCC to the Substation.

Furthermore, at the gate way we find the GPS, Human Machine Interfacing (HMI), Gateway Switch, and Station Router. The GPS is used for time synchronisation of the equipment at the Substation and the NCC and RCC. The HMI is used by the substation operator to monitor the substation operating signal and the router is sued for communication between the substation and the control centres.

New SCADA Architecture: In the new SCADA architecture, more dual redundancy is introduced. In the protection area, new panels with separate M1 and M2 relays are introduced. The station RTU is eliminated and two gateways are introduced. Most of the copper wired connections are replaced with fibre wire in this new technology. The aim of this new technology is to provide a more effective and secured SCADA system.

Site visit: During training at this department we went to Jupiter Substation where I got to see the equipment which was discussed in the architecture. It was also explained as to how they physically connect to each other.

2.6.2. Protection Technology

Protection technology is a system that continuously monitors conditions on electrical plant to detect abnormal conditions and when such an abnormal condition occurs it will automatically open breakers in order to remove these abnormal conditions from the plant and the power system. The aim of protection is to protect human lives and the equipment.

During training at Protection Technology department, I was introduced to the two protection schemes namely the Impendence and Differential. The aim of this training was to gain an overview understanding of how the protection of a line works.

Table 8: Protection Technology

Level of Responsibility:	Observing and Training
Standards/SOG/Procedures:	
Previous Training Used	Control/Automation Technology and Lines Engineering
Pro-activity:	
Duration:	1 Week

When choosing a protection scheme for a line, power transmitted or distributed on line and the distance of the line are the most important aspects which need to be considered. It is advisable to use differential protection when the line is less than 30km since it uses fibre communication and is expensive and sensitive but it can be used on longer distances when accuracy is very essential. It is cost effective to use the impedance protection when the line is very long.

The impendence protection uses the Ohm's law to monitor the impedance of the conductor. In the case of a fault, the current will increase consequentially decreasing the impedance and then the line will trip. This protection scheme use zonal protection as explained below and illustrated in figure 11:

- Zone 1 - Forward, 80% of the line , instantaneous
- Zone 2 - Forward , 120% of the line, TD = 400msec
- Zone 3 - Forward, 150% of the line, 2.5sec
- Zone 4 – Reverse, 50 – 80% of the line, instantaneous

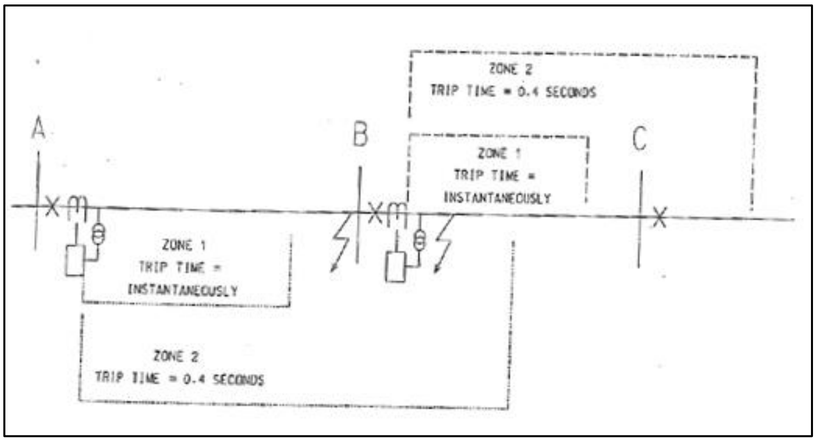

Figure 11: Impedance protection

The differential protection scheme uses Current Transformers (CT) to monitor the current flow and a Current Differential Relay (CDF) to check the current difference between two transmission or distribution points. Under normal state, the current difference should be zero and if not then the relay will see it as a fault and trip. Figure 12 illustrates an example of differential protection.

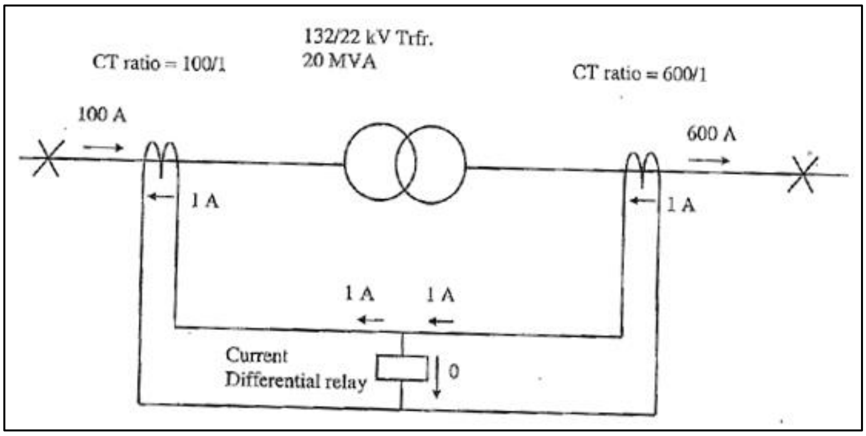

Figure 12: Differential protection

The most important aspects which requires attention when protecting a line are Over Current (OC), Over Voltage (OV) and Earth Fault (EF). These aspects can be detected using the Current Transformers (CT) and Voltage transformers (VT). Whenever a fault occurs, it needs to be recorded for investigation purposes and must also be located so that it can be quicker to attend to. Therefore in this case a Disturbance Fault Recorder and a Traveling Wave System (TWS) are used to record and locate the fault

2.6.3. Project Engineering and Support

This department entails planning the scope of a project in terms of the equipment required and the time needed to complete the project. These aspects are achieved through the use of proformas and task schedules. Basically a proforma is an equipment ordering schedule which is used to create a purchase order list; it specifies the types of equipment required and their quantities. A task schedule is a document which notes all the activities of a project and drafts an estimated period and costs for each activity.

Table 9: Project Engineering and Support

Level of Responsibility:	Observing and Training
Standards/SOG/Procedures:	
Previous Training Used	Control/Automation Technology
Pro-activity:	
Duration:	2 Weeks

The training in this department entailed compiling refurbishment proformas and Project Task Schedule for Glockner Substation. The aim of this training exercise was to familiarize myself with how proformas and task schedules are compiled.

Site visit: During training we had a site visit to Glockner Substation to observe a progress meeting about an ongoing project at the substation. Here we met with the contractors, clients and project supervisors to get feedback about the progress of the project. In that meeting I learned that when a project is in progress, communication, commitment and following time schedule as per the agreement is of much essence. If there are changes incurred, they have to be clearly communicated with the right people and when committing to something, you must produce results while keeping the time as per the agreement, unless communicated otherwise.

3. Additional Training Activities

The additional training activity I had was to one of the specialists from HV pant with a report on distribution transformer failures incidents. My task was collecting a list of all 2017-2018 distribution transformers failure incident reports from all Operating Units (OUs). After collecting the data, I had to graphically compile with Microsoft Excel a summary of the failures. This summary was done by categorizing the failure incidents into various categories.

In this process I was assisted by the specialist who is responsible for this report to categories these failures incidents. After categorising the failures, a graph of date of failure versus age of a failure was plotted. The aim of this graph was to visualise the causes of failure and the age at which the transformer failed. This was to help conclude on what the common cause of failure is and the age at which the transformers fail; then write a recommendation. Unfortunately I cannot disclose much information about this activity since it is confidential and not closed yet.

During this process I was also accompanying this specialist to Rotek during investigation. Through these the attended investigations I learn about parts of a transformer and some causes of transformer failures.

4. Upcoming Activities

- Complete Training at PTM&C
- System Operations
- Dx Operations
- Telecommunication Field Services
- Transmission Grids or Distribution Field
- Generation

- HV Plant

5. Summary

This section summarizes each of the training activities, both theoretical and practical, that were covered over the course of the training period being reviewed.

5.1. Extent of Training Activities

In this section, summery of broad issues covered during the program i.e. theoretical/ practical is compiled.

Table 10: Theoretical training activities

Theoretical	
Department	**Description**
GIS	
Design Base Operating Unit and Support (DBOUS)	• Developed an understanding of the role of the department and where it falls into the process. • Learned about standards and what they are used for.
Integration	• Developed an understanding of the role of the department and where it falls into the process. • Learned about the Integration project phases
Lines Engineering	• Developed an understanding of the role of the department and where it falls into the process. • Got an overview of the LES Huts and their purpose.
Substation Engineering	• Developed an understanding of the role of the department and where it falls into the process. • Conducted a study on types of substations and busbars schemes
PTM&C	• Developed an understanding of various sub-departments within PTM&C, the roles of those departments and how they inter-connect.

Table 11: Practical training activities

Practical	
Department	**Description**
Design Base Operating Unit and Support (DBOUS)	• Reviewing the DC Maintenance Engineering Standard for batteries and chargers. • Transformers inspection at Rosherville warehouse
Substation Engineering	• Reviewing station electric diagram for Luckhoff and Zeus substations.
PTM&C	• Compiling proformas and project tsk manuals for refurbishment of Glockner substation.

5.2. Value Added During Training

Value added to the Business:

Although the training throughout the six months was focused much on learning and observing, there are practical tasks completed which added value to the business. The first task was to review the DC Maintenance Engineering Standard (MES) for batteries and chargers, where I discovered gabs between the task manual the MES. The second task was a visual transformers inspection at Rosherville warehouse. In this task I had to check the condition of the transformers and their storage condition if they comply with the 240-45395762 standard. During this inspection I discovered defects on the transformers which could be from the manufacturer or the storage condition.

Value Added to ME:

Throughout the six months training, I gained vast amount of experience in the Power Delivery Engineering. The following are the lessons learned from the activities completed:

- **Geographical Information Systems (GIS)**

During training at the GIS department I have learned that whenever a line, substation or a power station is designed, there a various geographical aspect which needs to be considered. The aspects include settlements, grave yards, agricultural sectors, endangered species and other geographical aspects which will be affected. I also learned that GIS also helps discover other aspects which may affect the line, substation or power station during operation.

- **Design Base Operating Units and Support (DBOUS)**

The training at DBOUS taught me more about the importance of a standard in every field when performing a task. In this department I learn what a standard and task manual are. I also learned that for a business to have tasks performed procedurally, regulated and produce quality products, there has to be standards which are adopted or develop and implemented in every task.

- **Lines Engineering**

During training at lines engineering I learned about designing a transmission line. I learned that when designing a transmission line, you need to consider load forecast of the line for you to select the conduct that is going to be required. In addition, you must negotiate for servitude, choose towers require for the line, conduct tower sporting, consider protection of the line, conduct geographical studies in the weather condition and soil type within the line servitude and cater for all possible aspects which may affect the line

- **Substation Engineering**

At substation engineering I learned about what a substation is and its purpose with in the Power Delivery Engineering department. The main lesson I learned is that the station electric diagram of a substation must be kept up to date in order to mitigate human error when a task is performed at the substation. For example, if the naming of equipment of the station electric diagram does not match, it me results in attending to the wrong equipment when there is a fault, maintenance or refurbishment on site.

- **Protection Telecoms Metering and Control (PTM&C)**

In this department I learned about Supervisory Control and Data Acquisition (SCADA) system and its purpose on the Eskom operating and operation system. I learned that SACADA is the supervisory system which Eskom uses to monitor and control the protection systems on the lines and at the substation. The communication between the control centres on the SCADA and the protection equipment on site is achieved through the telecommunication cloud. This also taught me that during operation on the line and substations, faults may and occur therefore protection is important to protect human life and the equipment. Since the protection time is very crucial automation of the protection is required and that is achieved through control systems.

5.3. Awareness and Application of Work Related Standards

A standard is a regulation document with a set of rules and procedures required to perform a certain task. Commonly the standards used in Eskom are adopted from ICE, IEEE and some are in-house standards which are approved by Eskom committees. The standards which I have used to complete my pro-activities are Eskom in-house standards, namely:

- 240-61182045 : DC Maintenance Engineering Standard for batteries and chargers.
- 240-45395762: Specific Requirements for distribution pole and ground-mounted transformers up to 33kV and 1MVA

5.4. OHS Act

The OHS Act is of key importance within Eskom and is highly emphasised. In the beginning of my training, I was invited to a safety induction where I learned about the safety precaution at the office and the operational field. To enforce the OHS Act, Eskom has adopted initiatives such as Zero Harm Policy and life-saving rules to ensure that employees conduct all of their jobs and task in a safe manner and according to standards and regulations.

The following are the five Cardinal Rules which I have learned about during the safety induction:

- Open, Isolate, Test, Earth, Bond and/or Isolate before touch
- Hook up at heights
- Buckle up
- Be sober
- Ensure you have a permit to work

5.5. Leadership Opportunities and Networking Achieved

During this six months training, I have not yet got any leadership opportunities since my training was based much on learning, observing and assisting my supervisors with tasks where possible. In terms of networking, I was able to meet various experienced engineers and others from various disciplines whom I believe they are of much importance in my process of growing as a young engineer.

5.6. Pro-Activity and Innovation

During my training I had site visits at Rotek for HV transformers failure investigations where I got to learn more about transformers and the faults which can cause fatal transformer damage. During this period, I also assisted my supervisor with collecting data of the 2017-2018 transformer failure incidents and compiling a report. I was also given a task to inspect the condition of transformers at the Rosherville warehouse and compile a report for feedback. The other activity was to review a standard at DBOUS to ensure that the standard and its task manual complement each other.

5.7. Highest Level of Responsibility

The following are my highest levels of responsibilities within the listed departments:

Design Base Operating Unit and Support (DBOUS)

- In this department under maintenance section, I had to review the DC Maintenance Engineering Standard for batteries and chargers.

- I also had to conduct an inspection at the Rosherville Warehouse on specific requirements for distribution pole and ground-mounted transformers up to 33kV and 1MVA

HV Plant

In this department I had to collect data of the 2017-2018 HV/MV distribution transformer failure incidents from all Operating Units (OUs). After collecting the data, I had to organize and plot the data with excel to display the graph of transformer Date of Failure versus Age at Failure. This was then used to analyse the transformer failure incidents within the distribution OUs.

5.8. Awareness of Professionalism

As a trainee, there are various professional conducts which I learned in Eskom. These conducts include regulations through standards as to how various activities have to be carried out. The standards also regulate and also highlight ethical ways of self-conduct during every activity. Therefore in general I have learned that in every activity, there is always a procedure which has to be followed

6. Conclusion

Throughout this six months training, I have been through various departments within Power Delivery Engineering (PDE). These departments include Geographical Information Systems (GIS), Design Base Operating Units and Support (DBOUS), Integration, Lines Engineering Substation Engineering and PTM&C. My training through these departments was mostly about learning, observing and assisting with tasks where possible.

This training also equipped me with an overview understanding of how these various PDE departments connect to each one. The following figure shows a summarised interconnection of these departments:

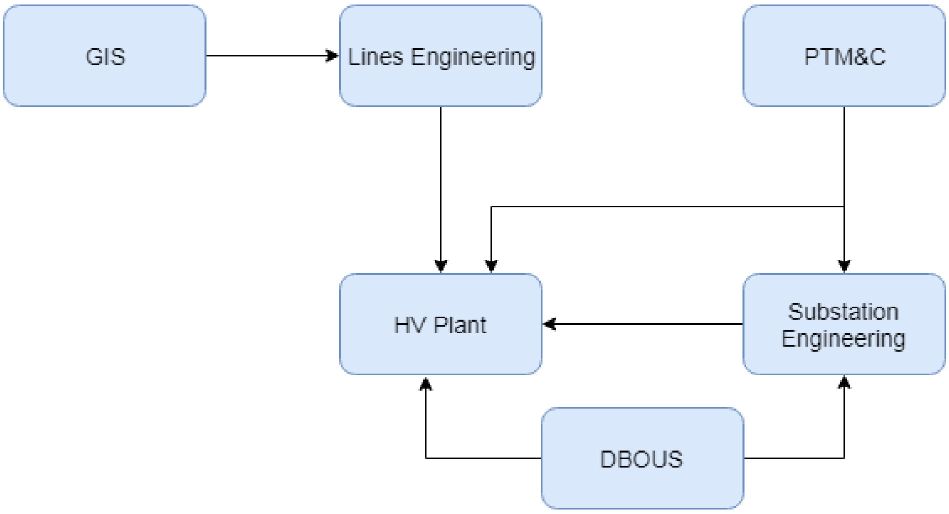

Figure 13: Inter connection op the PDE departments

In conclusion, I may say that throughout this six months training I have accumulated a lot of information about these various PDE departments. I am now familiar the responsibilities of each department and how these departments connect to complete a project.