**DEPARTMENT OF BUILDING**

**UNIVERSITI TEKNOLOGI MARA**

**(PERAK)**

# CONSTRUCTION PROCESS OF TNB COMPACT SUBSTATION

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**AUGUST 2021 - JANUARY 2022**

It is recommended that the report of this practical training provided

**By**

**Muhammad Aiman Zikri Bin Md Jizat**

**2019210574**

**Entitled**

# CONSTRUCTION PROCESS OF TNB COMPACT SUBSTATION

Be accepted in partial fulfillment of requirement has for obtaining Diploma in Building.

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## STUDENT'S DECLARATION

I hereby declare that this report is my own work, except for extract and summaries for which the original references stated herein, prepared during a practical training session that I underwent at Gniu Groupe Sdn.Bhd for duration of 20 weeks starting from 23 August 2021 and ended on 7 January 2022. It is submitted as one of the prerequisite requirements of BGN310 and accept as a partial fulfillment of the requirement for obtaining the Diploma in Building.

…….

Name: Muhammad Aiman Zikri Bin Md Jizat

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Date: 10 January 2022

## ACKNOWLEDGEMENT

First of all, writer would like to thank to Encik Mohd Shah Nizan bin Abu to give him an opportunity to undergo the industrial training at this company. Writer would like to express his gratitude to the experienced supervisors, Encik Mohd Suhaimi bin Selamat for his endless supports and guide during the twenty weeks of industrial training period from 23 August 2021 until 7 January 2022. Writer also grateful to be attached to this company which is Gniu Groupe Sdn. Bhd.

Writer would also like to express his appreciation to all the staffs at Gniu Groupe Sdn. Bhd. Their endless supports and knowledge given during industrial training period really helps him. Furthermore, it helps writer to understand more about the job scopes.

Apart of that, all of these would not be possible without writer family members and friends, direct and indirectly who have been supporting him throughout this internship program. All their efforts in ensuring the success and completion of this program are really appreciated.

Lastly, thanks to Gniu Groupe Sdn. Bhd for their willingness and giving writer an opportunity to share their working experience. Writer would also like to express the gratitude for their generosity in providing him all the facilities and technical expertise in making this program successful.

## ABSTRACT

Compact substations are used for energy transformation in secondary distribution network from MV to LV or LV to MV. This report is briefly explained about construction process of TNB Compact substations. From the observation, writer gets to know how the basic of construction is done for becoming a building TNB compact substation and it is also the basic to make the building. In construction, the differences of another construction are based on plan architectural. The objective of this study is to identify the construction process of TNB compact substation. The method of this study is by using observation, interview and document review. For the conclusion, this report can explain with clearly how the process built up for TNB substation done starting from site to completion.

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# CHAPTER 1.0

# INTRODUCTION

## 1.1 Background of Study

In building construction, Compact substations are used for energy transformation in secondary distribution network from MV to LV or LV to MV.

Compact substations is a type tested and arc tested assembly comprising an enclosure containing medium voltage (MV) switchgear, distribution transformers, low voltage (LV) switchboards, connections and auxiliary equipment to supply low voltage energy from medium voltage systems.(ABB,2021) These substations are typically installed in locations accessible to the public and ensure protection for all people according to specified service conditions. (ABB,2021)

Substations may be owned and operated by an electrical utility, or may be owned bya large industrial or commercial customer. (JSTOR,May 2021). The word substation comes from the days before the distribution system became a grid. (JSTOR,May 2021) As central generation stations became larger, smaller generating plants were converted to distribution stations, receiving their energy supply from a larger plant instead of using their own generators. (JSTOR,May 2021) The first substations were connected to only one power station, where the generators were housed, and were subsidiaries of that power station.(JSTOR,May 2021)

## 1.2 Objectives

There are several objectives have been developed from this constructionas follow;

i. To identify the documentation process
ii. To determine the machineries and equipment
iii. To identify the construction method of TNB compact substation

### 1.3 Scope of Study

The scope of the industrial training including the project management, site management, design management and product testing and quality. These scopes are made to be as a guideline to the student to be succeed in the industrial training achieved the objective for this course program.

### 1.4 Methods of study

1.Observation

Observation is a method of gathering facts through observation. The observation is about how the compact substation construction process works, from piling to completion. The average length of time for this observation is around 3-4 weeks. This means that the entire compact substation construction procedure will take 3 to 4 weeks. Smartphones and notes were used to record observations of the construction process over the duration of 20 weeks internship.

2.Interview

The structured or semistructured interview with a project's trusted person is one of the ways for collecting construction data. They were completed while observing and working on the site. The interview was done with the company manager, who is the contractor in charge of overseeing the project on the job site. This interview was also conducted with the workers who were on-site at the time of the project. Every week in the office, semi-structured interviews with the project's contractor were performed, which lasted about 10 – 15 minutes on average. Short notes were taken during the semistructured interview.

3.Document Review

Company profile, construction drawing, standard operating procedures (SOP), progress report, and images taken by other personnel are among the documents reviewed to collect all of the data for the construction. The drawing design will be utilised as a reference at the project's monitoring location. During document evaluations, photos that belong to others are also the finest reference. In most cases, document evaluations will take 30 minutes per drawing plan per week. This material has been submitted in the office for evaluation.

# CHAPTER 2.0

# COMPANY BACKGROUND

## 2.1 Introduction of Company

GNIU Groupé Sdn. Bhd was build established on 1 January 2020 and conducted by three directors. GNIU Groupé Sdn. Bhd have many sub company which are 2 companies with grade G3, 9 companies with grade G2 and 5 companies with grade G1.In 2018, another 4 companies joined venture and established a group of company that called GTU Resources with five directors. For the first year of GTU Resources, the company gained a huge profit but second year, the company do not gain profit or loss. Because of that, two directors from GTU Resources willingly to resign in 2019 and they build another group of company with GNIU Groupé Sdn. Bhd. This company have three directors as another company joined the group. Day by day, the GNIU Groupé Sdn. Bhd achieves more success and become more active in construction field and supplier field..The table shows companies' name based on the grade and registration number.

Table 2.1: Companies' name for G3 with registration number

| **Companys' name** | **Registration number** |
|---|---|
| 1. MSBS Global Resources | MA0176767-V |
| 2. Ammarbena Global | 002865464-A |

Table 2.2: Companies' name for G2 with registration number

| **Companys' name** | **Registration number** |
|---|---|
| 1. E Jump Enterprise | MA0054327-U |
| 2. Syahrizamir Bayu Enterprise | MA0114775-M |
| 3. Pelangi ASA Resources | MA0215659-K |
| 4. One Zerra Resources | 002923429-M |
| 5. Raiyan Resources | 002880731-H |
| 6. Khatib Resources | UT0034527-X |
| 7. AG Kiosk Enterprise | MA0245535-K |
| 8. Msm Resources | MA0115290-V |
| 9. Zul95 Enterprise | MA0247033-A |

Table 2.3: Companies' name G1 with registration number

| **Companys' name** | **Registration number** |
|---|---|
| 1. Raza Resources | MA0155191-V |
| 2. Marhab Maju Enterprise | UT0013950-M |
| 3. Roslynn Enterprise | 003202073-M |
| 4. Mega Muda Enterprise | MA0050218-P |
| 5. S&A Energy Services | MA0223176-D |

## 2.2 Company Profile


Company Profile

| Companys' Detail | |
|---|---|
| Company's Name | GNIU Groupé Sdn. Bhd |
| Company's Registered Number | 1392541-T |
| Company's Address | MD1-09 Jalan SB Utama, Taman Seri Bayan, 76100 Melaka |
| Principal Business Address | A-0-14 Pangsapuri Sri Siantan, 75150 Bukit Baru, Melaka |
| Email Address | gniugroupe@gmail.com |
| Date of Incorporation | 01 January 2020 |

This company is located at Taman Seri Bayan, Durian Tunggal which near to Melaka airport. Dealing hours are between 8.30 am to 5.30 pm every Monday to Friday.


Figure 2.1: Location for GNIU Groupé Sdn. Bhd

## 2.3 Organization Chart

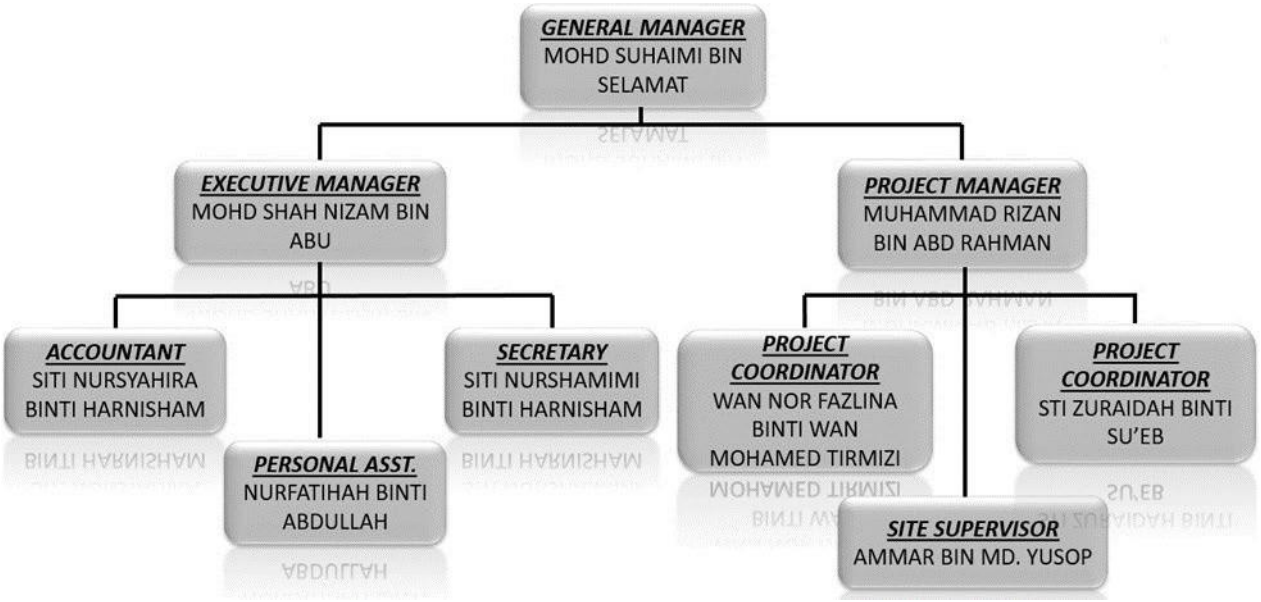


Figure 2.2: Organization Chart

## 2.4 List of Projects

### 2.4.1 Completed Project

| No. | Project Title | Project Value | Start Date | Completion Date | Project Duration | Client |
|---|---|---|---|---|---|---|
| 1 | Kerja-kerja pembinaan satu unit pencawang padat bagi punca bekalan elektrik tnb 100A dan lain-lain kerja yang berkaitan di rumah pam setulang daeng,Daerah Melaka Tengah, Melaka | RM197,500 | 19 FEBRUARY 2021 | 19 AUGUST 2021 | 6 Months | Department of Irrigation and Drainage |
| 2 | Kerja-kerja menaik taraf longkang dan lain-lain kerja berkaitan di kampung sungai putat dun ayer keroh daerah melaka tengah,melaka. | RM21,000 | 12 JULY 2021 | 4 OCTOBER 2021 | 3 Months | Department of Irrigation and Drainage |

### 2.4.2Project in Progress

| No. | Project Title | Project Value | Start Date | Completion Date | Project Duration | Client |
|---|---|---|---|---|---|---|
| 1 | Kerja-kerja membina Dewan Serbaguna (Terbuka) Di Sekolah Kebangsaan Othman Shawal daerah Alor Gajah,melaka. | RM485,000 | 7 AUGUST 2021 | 12 DECEMBER 2021 | 4 Months | Melaka Public Works Department (Alor Gajah) |
| 2 | Kerja Senggaraan Bangunan RKAT No. 3 Dan 5 Jalan Sentosa Serta Lain-Lain Kerja Berkaitan Di Kem Terendak, Melaka. | RM263,000 | 4 AUGUST 2021 | 21 DECEMBER 2021 | 20 Week | Melaka Public Works Department |
| 3 | Kerja-kerja pemasangan pam selam elektrik & lain-lain kerja berkaitan bagi tujuan pengairan di rumah pam No.1,Stulang Daeng,Daerah Melaka Tengah,Melaka | RM800,000 | 19 APRIL 2021 | 18 DECEMBER 2021 | 8 Months | Department of Irrigation and Drainage |
| 4 | Kerja - kerja pembinaan 1 unit pencawang padat bekalan elektrik TNB & lain-lain kerja berkaitan di rumah pam kandang daerah melaka, Melaka | RM240,000 | 17 SEPTEMBER 2021 | 10 DECEMBER 2021 | 3 Months | Department of Irrigation and Drainage |

# CHAPTER 3.0

# CASE STUDY

## 3.1 Introduction of Case study

The compact substation was proposed by the Department of Irrigation and Drainage, Melaka at Stulang Daeng, Melaka. The project under construction started 19 April 2021 and finished on 18 December 2021.the period of the structure must be done within 8 months and cost of this project is RM800,000.00. The title of this project is “Kerja-kerja pemasangan pam selam elektrik & lain- lain kerja berkaitan bagi tujuan pengairan di rumah pam No.1, Stulang Daeng,Daerah Melaka Tengah,Melaka”. The Contract Number of this project is JPS/M/M&E/02/2021.The company that responsible to construct this project is S&A Energy Services which is one of sub company in GNIU Groupé Sdn. Bhd.


Figure 3.1: The location of the project

### 3.2 To identify the documentation process

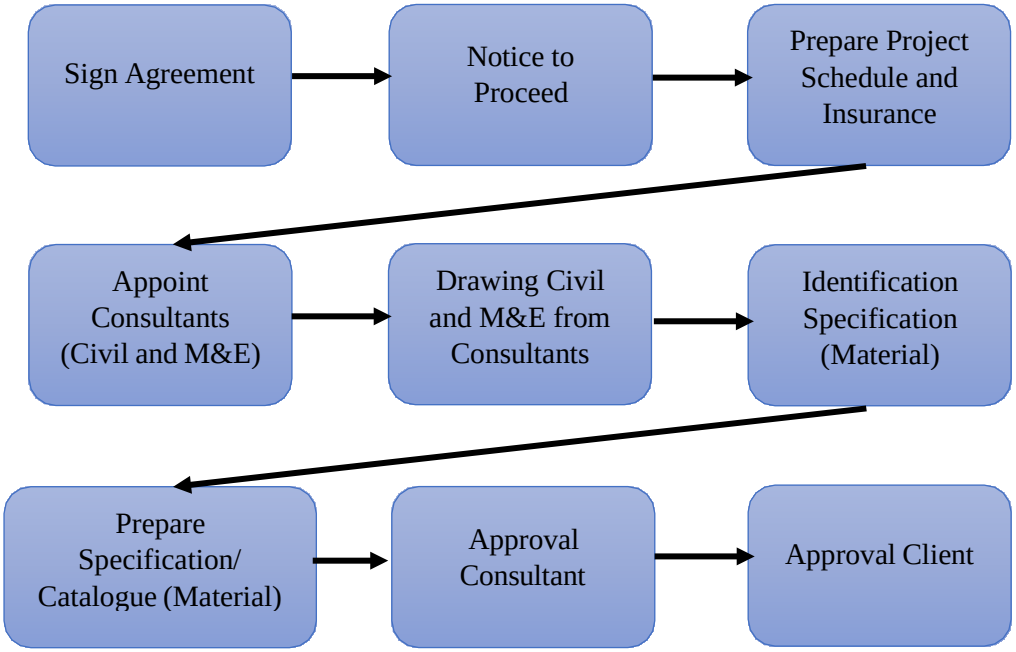


Figure 3.2: Documentation process

After sign agreement, client with give notice to proceed for the project. Then, contractor need to prepare project schedule based on original bill of quantity that stated in tender and contractor also need prepare insurance for this project as initial step after get notice to proceed from client. After prepare project schedule and insurance, contractor need to submit this document to our client.

Contractor need to appoint two consultants which are KEZO CONSULT Sdn. Bhd for civil works and SAGA JURUTERA Sdn. Bhd for mechanical and electrical works. Contractor have selected two consultant and responsible in preparing drawing for civil work and mechanical and electric work. Contractor need to prepare official letter on assignation consultants to our client. If client agree with our consultant, we can proceed preparing documentation.

Consultants will prepare the drawing for this works and give to contractor. Then, contractor need to analyses the drawing and identify the material and specification that use. After that, contractor need to prepare material approval form for each item that stated in drawing and bill of quantity and need sign from consultant as an evidence that consultant agree with contractor to use certain item on

construction site Material approval form need to be attached with catalogue or specification or certificate as references to consultant and material approval form that have been sign by consultant also must get approval from client.

Based on drawing that provided by consultants, we list out material that use in site and need approval from consultant.

Table 3.1: List of material for this project

| Material for Civil work | Material for Mechanical and Electrical work |
|---|---|
| • PVC Pipe | • Construction Drawing |
| • Cat Epoxy | • Drawing TNB Meter Kiosk |
| • Piling | • Cable –XLPE/SWA/PVC (4C) |
| • Soil Investigation | • Copper Tape |
| • Construction Drawing | • Earth Rod |
| • Trial Mix Design | • Concrete Inspection Earth Chamber |
| • Brick | • Isolator |
| • Steel | • Commando Plug |
| • Pile Driving Analysis Test | |
| • Crusher Run | |
| • GI Pipe | |

Based on table above, we need to prepare material approval form with their catalogue or specification or certificate and ask for approval from consultant. Consultant will analyse and give some comment either the material suitable or not for this project. We also need to contact with supplier to get document such as catalogue and certificate. Besides that, we must make appointment supplier concrete because we need to attend to batching plant and observe they preparing concrete cube based on grade that mentioned in drawing. After test, concrete cube do compressive strength and compressive result need to be submit and get approval from consultant.

### 3.3 To determine the machineries and equipment

- Concrete vibrator machine

Figure 3.3: Concrete vibrator machine

Concrete vibrator machine used to remove air avoid present between the concrete ingredients and prevent from concrete forming honeycomb. Using vibration to assist concrete during its settling period has proven a worthwhile method that aids in long-term durability. As wet concrete is poured, air bubbles become trapped within the mixture creating cavities or honeycomb-like spaces.

- Concrete mixer

Figure 3.4: Concrete mixer

Concrete mixer trucks transport concrete from the batch plant where they load. aggregate, cement, and water to the jobsite. Concrete mixer trucks are often erroneously called cement mixers or cement trucks, but the final product is concrete. The concrete can either be ready mixed at the plant, or the materials can be loaded into the truck, which then mixes the concrete as it travels to the jobsite.

- JCB

Figure 3.5: JCB

JCB are ideal for exploitation, excavation, digging, dozing, and demolition, and both work well even on hard soil.

- Hammer for piling

Figure 3.6: Hammer for piling

Pile driving is used to drive piles into the soil, to provide foundation support for buildings and structures. Piles can be fabricated from concrete, timber, or steel. The piles act as a structural member to transfer the load of the structure to a required depth in deep foundations.

- Loader

Figure 3.7: Loader

Loader is used to bring materials to the site.

### 3.4 To identify the construction method of TNB compact substation

PREPARATION WORK

For preparation work, the site was setting out by taking all the data and measurements during survey. Later, the site must be clean from the bushes, vegetation and anything that prevent the construction work to proceed. All the machines, materials and the equipment must be arrived before the undergone construction such bar bender, formwork, and reinforcement steels. All the equipment and the materials must be stored at the safe place to prevent any loss or incidents, the plywood become warp and rusting on the reinforcement steels.

Figure 3.8: The workers setup the level machine at site

PILING WORK

Before start piling work, contractor must remark (tagging) the place that need insert the span pile. Tagging process must base on drawing that provided by our consultants. In this project, we use 4 span pile to construct compact substation.

Figure 3.9: Marking piling point

Piling work started after the all the preparation work settled. The concrete pile must be straight 90◦ before driven into the ground by using water level. The concrete piles with size 150mm x 150mm were hit by the hammer with weight 1.2 tons near the pond. The hammer was lift at the height of 900mm before hit the concrete piles. Each of the concrete pile was driven into the soil with depth 12.5 m. The average of the depth for each blow are 14mm according to the piling records. All the piling records will be attached to the appendix

Figure 3.10: The span pile was driving with hammer help.

EXCAVATION

The excavation process use JCB. The size of excavation 4m x 7m x 1.5m, according to the drawing provided by shovels. The waste of soils was dumped into the contractor landfill.

Figure 3.11: Excavate the area of compact sub after finish piling work

FOUNDATION

The lean concrete was laid at the bottom of the ground before other works such as installing formwork for conc trench, installing rebar and pouring concrete start. Lean concrete is a mix where the amount of the cement is lower than the amount of liquid present in the mix. The higher the aggregate or cement ratio, the leaner the concrete. The main function of the lean concrete is to provide the uniform surface to the foundation concrete and to prevent the direct contact of the foundation concrete to the soil. It also gives protection to the foundation from soil below as moisture or other chemical such as sulphates attack the foundation and lead to lower strength of the concrete of the foundation. For this project, the thickness of the lean concrete is 50mm.

Figure 3.12: The condition of lean concrete at the evening.

After the lean concrete harden, the general workers installed the formworks and rebar. The formworks and the rebar were cut and bend during the preparation works and excavation works to save time. The installing process almost took three days to complete both installing works. The rebar used for the foundation is T10 with 200mm gaps according to the drawing. After installation reinforcement for foundation, we need send request for inspection form (RFI) to inspect the rebar either installation of rebar fulfil the requirement or not. If there is no problem with the installation, contractor can proceed by pouring concrete for foundation. Request for inspection will be attach in appendix.


Figure 3.13: Installation rebar for foundation and conc trench process was completed

The mixer truck transported the G25 concrete to the site and poured on the lean concrete with the formworks and the rebar ready. Concrete G25 was used to increase the compressive strength of the concrete and the durability of the concrete. The piles were driven near watery area that is why the higher concrete grade recommended and this concrete stated in drawing that provided by our consultant. Next, the bubbles in the fresh concrete eliminated to reduce air void in the concrete by using the vibrator electric to avoid the future problem such as honeycomb.


Figure 3.14: vibrator electric is use in pouring concrete to avoid honeycomb

After concreting work was done, the foundation was left for seven days to give time the concrete to undergo hydration process and harden slowly. Hydration process occurs when the water and the calcium oxide react and produce calcium silicate hydrate gel and heat.


Figure 3.15: Concrete fully dried for foundation of compact substation

CONC TRENCH

After foundation for compact substation dried, we need install formwork for conc trench and pour the concrete with G25 based on drawing provided. Then removed the formwork.


Figure 3.16: Formwork for conc trench

Figure 3.17: Concrete totally dried and removed formwork

COMPACT SUBSTATION

After concrete for wall of conc trench dried, contractor need to build brick wall for under ground level wall. After finish, we need to do process plastering the brickwall.


Figure 3.18: Construct brickwall


Figure 3.19: Plastering the brickwall

After finish construct brickwall, we need to plaster the wall and let it dried for one day. Then, we need to install formwork and rebar for upper slab beam. After installation reinforcement for foundation, we also need send request for inspection form (RFI) to inspect the rebar. At the same time, we need to prepare formwork for cover slab compact substation. The szie for cover slab referring the drawing. The mixer truck transported the G25 concrete to the site and poured on the lean concrete with the formworks and the rebar and formwork for cover slab ready and one day need for concrete to complete dry. Then, removed the formwork for upper beam.


Figure 3.20: Formwork for upper beam and slab


Figure 3.21: Formwork for upper beam and slab poured with concrete grade 25


Figure 3.22: Poured concrete on formwork of cover slab and let it dried


Figure 3.23: After the formwork for upper beam and slab were removed

Figure 3.24: The cover installed to compact substation

After the process poured concrete to upper beam, we need to remove the formwork for upper beam and install the concrete cover for compact substation.

EARTHING SYSTEM

After complete build structure compact substation, contractor focus on installation the earthing system in compact substation. The material that use in earthing process are c/w copper rod, earth chamber, copper bar/earth cable and any other related accessories or works as per shown in drawing and specification. Earthing system process must comply with TNB requirements.


Figure 3.25: Complete installation earthing system in compact substation

Figure 3.26: Complete install the copper road outside compact substation

After that we need test the earthing system after we completed install earthing system. TNB have their standard to determine the earthing system fulfil the requirement which is reading must not exceeding than 0.003 ohm. In this process, we need to prepare testing and commissioning for earthing system. The form will be attach in appecndic.

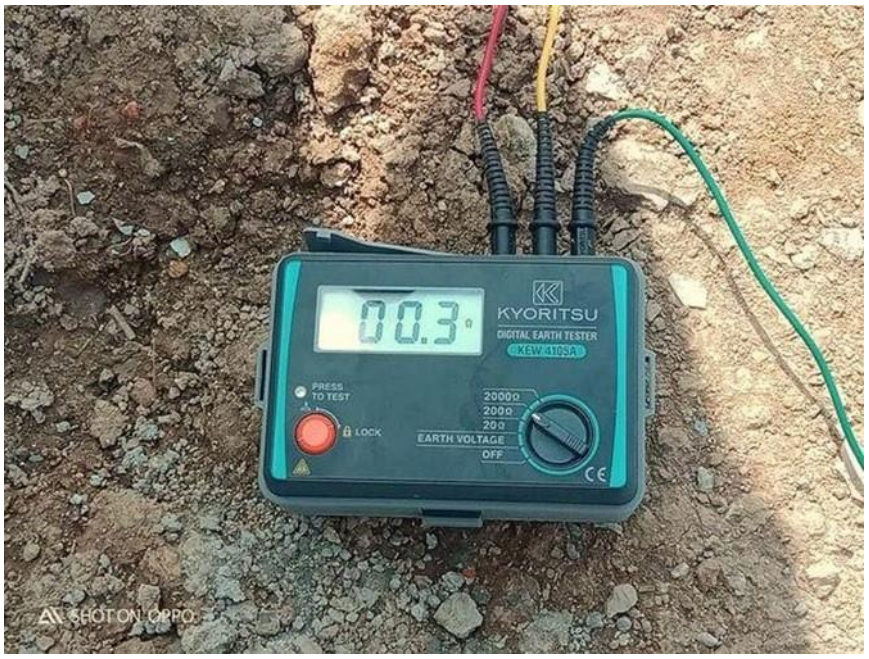


Figure 3.27: Third reading (R3) for every point

CABLING SYSTEM

The piping system actually as cable protection from existing pump to compact substation. The size of pipe that used in this project is 150mm and the type that used is HDPE pipe. This project used 4. Contractor have two material for pipe which are PVC pipe or HDPE pipe but TNB choose to used HDPE pipe for material protection cable. Before laying the pipe, we need to do some excavation because the pipe must install underground between existing pump and compact substation.


Figure 3.28: Excavation process before laying HDPE pipe


Figure 3.29: Installation the pipe as cable protection complete

APRON AND BOLLARD

After settle on build compact substation, we need to continue with apron process. Firstly we must install reinforcement (rebar) to support apron. The size of the apron is 7000mm x 4000mm based on drawing mechanical and electrical that provided by our consultant.


Figure 3.30: Installation rebar for apron

Bollard made from PVC pipe as the mould that located around the compact substation. Bollard act as gate for compact substation. We get request from TNB to use bollard. To prepare bollard very simple which we need PVC pipe, rebar and concrete only. PVC pipe must be in vertical position and in side PVC pipe must have rebar to make sure bollard more stable and not easy to broken. Then, poured the concrete inside of PVC pipe and the upper of bollard must have semi-circle. Semi-circle must follow specification from TNB. After the concrete dried, removed PVC pipe.


Figure 3.31: Process preparing apron and bollard were completed

PLASTERING AND PAINTING

Finally, after complete all process build up compact substation, outside compact substation need to plastering again to make sure the surface of the product smooth and easy to apply the paint letter on. The paint that use based on specific code from TNB which are green for compact substation and yellow for bollard.

Figure 3.32: Progress of plastering work


Figure 3.33: Plastering work complete


Figure 3.34: Compact substation finished

Finally, the project complete within the estimation time and handover to our client which is Department of Irrigation and Drainage Melaka.

# CHAPTER 4.0

# CONCLUSION

As a result of writer observations at the project site, conclusion that writer has made from TNB Substation is the building built for cable routing. The project site TNB building cannot be built together with other buildings because TNB compact substation is a restricted area because of high voltage. The process took around 6-7 weeks starting from 26 August until 14 October 2021. The compact substation construction delayed a few days because of the weather and also the movement control order during the pandemic Covid-19. Therefore, it takes more time than the estimated. The method for compact substation process in the construction are common method and it similar to the theory. In conclusion, this construction is simple to built and follow the safety in construction.

## REFERENCES


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