Analysis of Distribution Network Planning and Load Development at Rorinata Housing Phase 11 Development

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ABSTRACT

Planning in study this aiming for get a flexibility optimal service so that capable anticipate with fast growth energy electricity and how much congested the burden that must be served. So that in planning system network distribution power electricity must notice condition load in the field, this thing intended for the system network planned distribution still can work with good until a number of year forward. Method data collection used in the form of observation the field of purpose know condition field and obtain future load data planned. Results research conducted in housing Rorinata Stage 11 Development in the Village Sukamaju Subdistrict the Deli Serdang River show that there are 68 housing units that will be built on housing area this. A total of 68 housing units the will shared into 3 blocks A, B, C and planned with Power beginning each housing unit of 2200 VA. With notice condition field , then used cable land as system network distribution that includes Channel Channel Cable Voltage Intermediate (SKTM) and Channel Cable Voltage Low (SKTR). From the calculation so total power obtained amounting to 149,600 VA served by 1 transformer unit distribution with use substation transformer pole with 200 kVA power. on planning this is not yet addition burden or housing units on area the Because is stage end from development housing, then for overcome existence development housing area that is with determine transformer with addition by 20% which is useful for Power backup as form anticipation if happen development burden on housing area

Keywords: *Distribution network planning, Load development, Electric power distribution*

Introduction

Rorinata Housing Phase 11 Development is a new housing development located in Suka Maju Village, Sunggal District, Deli Serdang Regency. Because it is a new housing development, the availability of electricity resources to meet the load needs in Rorinata Housing Phase 11 Development is not yet available, so planning of an electricity distribution network system is needed to meet this.

In addition, the current trend is that the increase in electricity is not in line with the increase in the supply of electricity, where the installed power capacity remains the same, while the needs of the community continue to increase along with the increasing population and population activities. The imbalance in demand and availability of electrical energy sources has led to frequent power outages, especially during peak hours, which is due to the use of electricity exceeding the available power. This condition requires the development of electricity supply in the coming years.

Therefore, planning is needed that aims to obtain flexibility in the growth of electrical energy and how dense the load must be served.

Literature Review

System Electric Power Distribution

System network power electricity is distribution power electricity from center power station to to consumers (users) on level required voltage. This System power electricity consists of from the generating unit, transmission unit, and distribution unit.

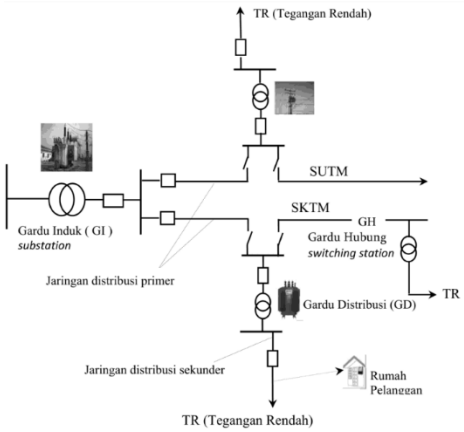

Figure 1. Single System Chart Network Distribution

Substation Distribution

Distribution substation is one of the components of the distribution system that functions to connect the network to consumers or distribute electricity to loads (medium voltage consumers and low voltage consumers) either through overhead lines or underground lines. Distribution transformers function to lower the voltage of electricity from the distribution network. high to the voltage used in low voltage distribution networks.

Transformer

Transformer distribution used for lower voltage electricity from network distribution voltage tall to voltage used on network distribution voltage low (step down transformer), for example voltage 20 KV becomes voltage of 380 Volts or 220 Volts. While transformer used for raise voltage electricity (step up transformer) only used on centers generator electricity so that the voltage is distributed on long channel no experience decline significant stress, namely no exceed decline allowable stress that is by 5% of voltage again.

For determine capacity transformer so need known total power installed and notice factor development of transformers can charge 100% of burden maximum. Then total power multiplied by 120% where 20% is Power purposeful reserve for handle if happen development burden so that no need replace transformer new.

$$\textbf{Capacity Power installed} = S_{Total} \times 120\% \quad (1)$$

Where :

S_{Total} = Power total installed load

120% = Reserve power percentage

Distribution Panel (PHB)

A device for distributing electrical power and/or controlling and protecting circuits and electricity users including circuit breakers, low voltage electrical panels and the like. Where the whole is completely assembled with cables and mechanical systems on the supporting parts.

Channel Cable Underground

Ground cable is one/several wires that are insulated, so that they are resistant to a certain voltage between one conductor and another or the conductor with the ground is wrapped in a protective layer, so that it is protected from other chemical influences in the ground, therefore components that include cables must be able to operate in the ground, therefore components that include cables must be able to operate continuously because they have special insulation requirements to protect them from all forms of moisture and other influences in the ground. To determine the conductor, namely by first knowing the nominal current in the following way:

$$In = \frac{S}{\sqrt{3}\,xV} \quad \text{.....} \quad (2)$$

After know nominal current, determine I_{KHA} that is with method as following:

$$I_{KHA}\,x\,In\,x125\% \quad \text{.....} \quad (3)$$

Where :

In = Nominal Current

S = Power Installed

V = Voltage

I_{KHA} = Current Conducting Capacity

Fall Voltage (*Voltage Drop*)

Voltage drop is the amount of voltage lost in a conductor. Voltage drop in power lines is generally directly proportional to the length of the line and the load and inversely proportional to the cross-sectional area of the conductor. The amount of Voltage Drop is expressed in units of % or Volts.

Electrical Load Forecasting

The electricity needs in an area depend on the location of the area, population, standard of living, development plans or development of the area in the future. Inaccurate electricity demand forecasting can cause the capacity provided to be insufficient to serve consumers and vice versa, if the forecast is too large from demand, there will be excess power capacity which is wasteful. Therefore, errors in forecasting must be as minimal as possible.

Research

Method Time and Place of Research

This research was conducted in the Rorinata housing complex Phase 11 of Sukamaju Village Development, Sunggal District, Deli Serdang Regency, which is still under construction so that there is no electricity network distribution in the housing complex. The research implementation period starts in February-September 2024.

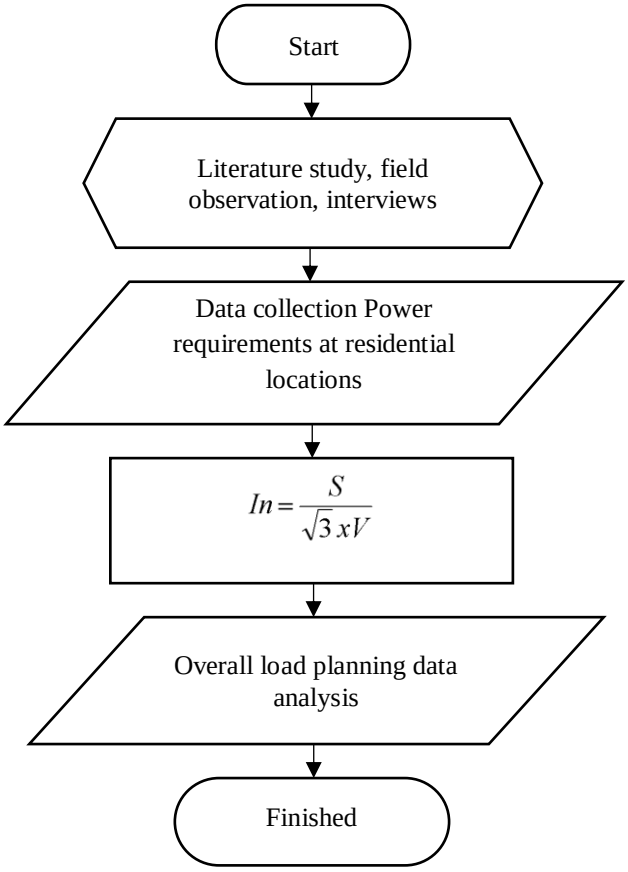

Figure 2. Research Flow Diagram

Data collection

To design a distribution network that uses underground cables, it is necessary to collect data obtained by conducting observations at the location where the project is implemented. The data obtained is in the form of a plan where the housing area is 120,000 m2 and 68 housing units will be planned with different types in each house. Each house will be planned with an initial power of 2200 VA so that the total planned power is 149,600 VA.

Results and Analysis

Rorinata Housing Phase 11 This development will be divided into several blocks, starting from block A to block C. The electrical power of each housing unit is planned to use 2200 VA of power. For the electrical system in this housing, it is planned to use a ground cable channel with a Pole Transformer Substation. While residential roads are generally two-way, in this planning the type of lamp post that will be used is a single-arm lamp post, the position of the lamp post will be placed in the road media.

Phase Division

Table 1 . Phase Division

Distribution Phase	Housing Block	Amount House	Power / Home	Total Power (Watts)
R	A	23	2200	50,600
S	B	23	2200	50,600
T	C	22	2200	48,400
Total		**68**		**149,600**

Selection Transformer on Housing area

Capacity Power installed = Total power (Total) + 20% Reserve

Capacity Power installed = S_{Max} x 120% ..... (4)

Capacity Power installed on Substation Transformer Pole

= 149,600 VA x 120%

= 179,520 VA

Total load to be supplied that is of 179,520 VA then the transformer that will installed with capacity of 200 kVA.

Election Deliveryman on PHB-TR

Determination located PHB-TR conductor on Substation Transformer Pole

It is known :

$S3\varphi = 200.000V$

$V = 380V$

$$I_n = \frac{S}{\sqrt{3}.V} \quad \text{..... (5)}$$

$$I_n = \frac{200.000}{\sqrt{3}.380}$$

$I_n = 304,22$

$I_{KHA} = 304,22\, x 125\%$

$I_{KHA} = 380,275A$

From the calculation so chosen cable with NYY type with wide cross section as much as 4 x 300 mm^2 .

Table 2. Size Deliveryman on PHB-TR On Substation Pole Transformer

Unit	**Housing Block**	**Total Power (W)**	**Size Cable (mm^2)**	**Cable Type**
PHB.TR Substation Transformer Pole	A	50,600	300	NYFGBY
	B	50,600	300	NYFGBY
	C	48,400	300	NYFGBY

Table 3. Size Cable from PHB-TR to Group PHB on Each Housing Block

BLOCK A				
Unit	Amount House	Power (W)	Size Cable (mm^2)	Cable Type
Main PHB	8	17,600	4 x 50	NYY
Main PHB	8	17,600	4 x 50	NYY
Main PHB	7	15,400	4 x 50	NYY
BLOCK B				
Main PHB	8	17,600	4 x 50	NYY
Main PHB	8	17,600	4 x 50	NYY
Main PHB	7	15,400	4 x 50	NYY
BLOCK C				
Main PHB	8	17,600	4 x 50	NYY
Main PHB	7	15,400	4 x 50	NYY
Main PHB	7	15,400	4 x 50	NYY

Election Security on PHB-TR

Determining MCCB PHB-TR On Substation Transformer Pole

It is known :

$S = 200.000V$

$V = 380V$

$$I = \frac{S}{V.\sqrt{3}} \quad \text{.....} \quad (6)$$

$$I = \frac{200.000}{380.\sqrt{3}}$$

$I = 304,22A$

MCCB Rating = Inominal x 125% ..... (7)

MCCB Rating = 304.55 x 1.25

MCCB Rating = 380.275 A

Calculation on the MCCB rating obtained that is of 380.275 A, then the MCCB rating used namely MCCB with current rating of 450A - 500 A.

Determining the NH Fuse PHB-TR

$I_{Nominal} = 304.22A$

$$Arus\,Tiap\,Jalur = \frac{I_n(Ampere)}{Total\,Jalur\,Di\,PHB-TR} \quad \text{.....} \quad (8)$$

$$Arus\,Tiap\,Jalur = \frac{304,22}{3}$$

$Arus\,Tiap\,Jalur = 101,40\,A$

KHA Fuse = Current each major x 0.9 ..... (9)

KHA Fuse = 101.40 x 0.9

KHA Fuse = 91.26 A
Calculation The fuse KHA was obtained as 96.26 A so that NH Fuse was selected with a rating of 100 A.

Determine PHB-TR busbar

$I_{nominal}$ = 304.22 A
Ibusbar = 125% x $I_{nominal}$ ..... (10)
Ibusbar = 1.25 x 304.22 A
Ibusbar = 380,275 A
I busbar result got of 304.22 A, then chosen bus bar size 40 x 3 mm with loading continuously amounting to 380,275 A.

Election Load Protection On Every House
Election safety for housing units
S = 2200 VA
V = 220 V

$$I_{No\,minal} = \frac{S}{V} \quad (11)$$

$$I_{No\,minal} = \frac{2200}{220} = 10A$$

From the results calculation obtained a nominal I of 10 A. Then the MCB as security used For each housing unit that is with a rating of 10 A.

Overcome Load Development on Housing area

There are several requirements after the planning is done so that the planned electricity distribution can supply housing well for the next few years. It should also be noted that this housing planning is the 11th stage of the development planning which includes 68 housing units divided from block A to block C. This housing is planned to use its own pole transformer substation. Based on the reference of the planning section, especially at PT. PLN (Persero) Customer Service Unit (ULP) East Binjai, the estimated maximum power for 1 housing unit which is used as a benchmark for initial planning is 2200 VA.

Rorinata Housing Phase 11 This development is the final stage of development and it is almost certain that there will be no more additional housing units, so the Transformer is planned to add a reserve of 20% for an estimate of around 7 years in the future which aims to be able to cope with the development of the load that occurs in this housing or in other words as a form of anticipation if there is a development of the load in the housing, then the electricity distribution is planned to be able to distribute electricity properly. With a reserve of 20%, the total transformer power is chosen with a power capacity of 200 kVA

CLOSING
Conclusion

From the results of the research and calculations that have been carried out, several conclusions can be drawn, namely as follows: Based on the data obtained, the load of each house that will be installed in Perumah Rorinata Phase 11 of Sukamaju Village Development,

Deli Serdang Regency uses an initial power of 2200 VA for each house unit, where the total units to be built are 68 houses. By using the analysis method in this planning, the distribution network used uses ground cables which include Medium Voltage Cable Channels (SKTM) and Low Voltage Cable Channels (SKTR). The substations used are in the form of pole transformer substations and transformers that will be used with a power of 200 kVA

Based on the results of the discussion, in this planning there is no additional load or housing units in the area because it is the final stage of housing development, so to overcome the development of housing, namely by determining the transformer with an additional 20% which is useful for backup power as a form of anticipation if there is a development of the load in the housing so that the planned electricity distribution can supply electricity well in the next few years.

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