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# Evaluation of the Current Setting for the Protection of Electrical Load in the Tunnel "P" Gold Underground Mining "PT. ABC"

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***ABSTRACT:*** *A lot of equipments those used at underground mining operation at PT. ABC are powered by electrical that supplied from surface power housing. And to make secure for electrical power circuit, it needs an electrical protection system. One way to obtain the reliability of an electric power system is to implement a system of protection to protect equipment from disturbances that occurred in the system. The selection of protection should not be less than the value of the Current Rate Capability (CRC) and must not exceed the value of the maximum setting protective devices. The electrical distribution panel "P" is used to the tunnel "P" of gold underground mining "PT. ABC". In this tunnel, there are 5 (five) mining areas, namely: Mining Area "P1", Mining Area "P2" Mining Area "P3", Mining Area "P4", and Mining Area "P5". The main protection that's installed in each mining area are using ACB and for each electrical equipments in each mining area are protected using MCCB. For the effectiveness of ACB and each MCCB to protect a transformer and electrical system must be recalculated to find out the appropriate value. After recalculating, current setting value obtained as follows: for the electrical equipment load that has power 15 kW needs MCCB 30A, for the electrical equipment load that has power 22 kW needs MCCB 40A, for the electrical equipment load that has power 37 kW needs MCCB 75A, for the electrical equipment load that has power 75 kW needs MCCB 150A, for the electrical equipment load that has power 110 kW needs MCCB 225A, for the electrical equipment load that has power 132 kW needs MCCB 250A.*

***Keywords:*** *current setting, electrical load, protection system, underground mining*

## I. INTRODUCTION

Gold is one type of metal with high economic value because it has a distinctive trending compared to other metals. Gold is categorized as one type of precious metal that has been used since the past until today. Utilization of gold metal is the most common as jewelry. However, along with the development of technology, the use of gold metal is now starting expanded in electronic, electrical equipment and another technologies.

In nature, gold is generally found as a native Au, rounded shape (nuggets) or plates (flakes) listed as veins breaking through a rock. Aside from being a pure metal, gold can also be found in the form of minerals "tellurides" associated with quartz and pyrite. Generally the presence of gold mineralization found in magmatic rocks (frozen plutonic, volcanic) called "plutovulkanisma", which is shown by the results of activities magmatisma be intrusive and volcanic rocks (Sunarya &Yudawinata, 1996)[1]. If the presence of gold mineralization observed pathways created by Sunarya &Yudawinata (1996), rock trap occurrence of gold mineralization is in volcanic rock (igneous and pyroclastic rocks). And to get pure gold contained in volcanic rocks do with mining and processing.

Definition of mining are extraction of deposition of minerals precious and economic value of the earth's crust, the Earth's surface, below the surface of the water, either mechanically or manually, such as : oil and gas, coal, iron ore, nickel ore, grains bauxite, copper ore, gold ore, silver, manganese ore and etc (bps, 2016)[2]. The purpose of mining is to process minerals that are in the earth that can be used to process minerals that are in the earth so that it can be used and utilized by all mankind to establish a life in order to achieve welfare and prosperity.

To get the gold or other mineral materials effectively and efficiently needs to be done appropriate mining method selection. Selection of mining method is based on the location of the deposition on the surface of the shallow or deep. According to Morrison and Russel (1973) and Boshkov and Wright (1973) in Suyono (2011)[3], the main rules of exploitation of the mine is selecting a mining method that best suits the unique characteristics (nature, geology, environment and etc) of mineral deposits mined within the bounds of safety, technology and the economy, to achieve lower costs and maximum profit. In general, mining method is divided into three parts, namely: open pit mining methods, underground mining methods and underwater mining method (hartman, 1987)[4].

PT. ABC is an Indonesian state-owned enterprise which conducts exploration and exploitation of gold. Mining is done with a system of underground mines using the "Cut and Fill" and "Shrinkage Stopping", where the main equipments are jumbo drill, load haul dump, wheel loader, back hoe, dump truck, mine truck, excavator, and etc. Beside of those equipment, there are equipments those used for supporting mining operation, for example: main fan for ventilation, pump for draining the water, and etc.

A lot of equipments those used at underground mining operation at PT. ABC are powered by electrical that supplied from surface power housing. More reliable supply of electricity it will be more safe in mining operations. And to make secure for electrical power circuit, it needs an electrical protection system. Electric power protection system is a safety system on the equipment installed on the electric power system against abnormal operating conditions of the electric power system (J. Soekarto, 1985)[5]. Because the electricity needs continuously, the electric power system should be designed to be reliable and economical. One way to obtain the reliability of an electric power system is to implement a system of protection to protect equipment from disturbances that occurred in the system. The terms of the protection system are should be reliable, selective (able to sort of protected areas), stable, and sensitive (Davis, 1984)[6]. Protection system should serve to protect the equipment against disturbances that occurred in the system so as not to damage and disruption due to localized so as not to spread in the electrical system (Ward, 2004)[7].

According Prasetyo (2009)[8], aspects of concern to the design of the protective device settings are full load current of the motor. Referring to The Indonesian National Standard SNI 0225: 2011 (2011)[9] on General Requirements for electrical installations in 2011 (PUIL 2011), that the selection of protection used should not be less than the value of the Current Rate Capability (CRC) and must not exceed the value of the maximum setting protective devices. Here are the equations to determine the value of the CRC and the maximum value of the protective device settings:

1. The equation to calculate the In (nominal current) of the electric load

$$I_n = \frac{P}{V\ x\ \sqrt{3}\ x\ cos\theta} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (1)$$

$I_n$ : Full Load Current (A)
$P$ : Power Load at The Name Plate (kW)
$V$ : Inter Phase Voltage (V)
$Cos\ \theta$ : Power Factor of The Electrical Load

2. The equation for determining the CRC flowing on the electrical load

CRC = In x 125% ………………………………………………………… (2)

3. The equation for determining the maximum setting protective devices on the power load

Protective Max = In x 115% ………………………………………………………… (3)

Protection system has the functions to secure electric power system from power failures or overload, by separating the electric power system is disrupted, so that the electrical system can continue uninterrupted work flow of electric current. In effect, the security of the power system secures the entire electric power system so that reliability is maintained. Thus mining equipment will be protected from damage. This paper describes about evaluation of the value of the current setting of the protection system in the tunnel “P” of gold underground mining “PT. ABC”.

## II. MATERIAL AND METHOD

This research was conducted at PT ABC which is one of the Indonesian state owned company in West Java in March 2016 to August 2016. The method used in this research is descriptive quantitative method. This research is to see how the implementation of the system of protection applied in tunnels "P" PT. ABC. Researcher reveal the situation concerning the implementation of the protection system based on existing implementations.

The primary data to be obtained are the equipment protection system used in tunnels "P" PT. ABC and the suitability of the electricity distribution network in tunnels "P" PT. ABC, which is obtained by direct observation to the mine. While the secondary data to be collected are single line diagram of electricity distribution circuit in tunnels "P" PT. ABC and specifications of mining equipment that used in tunnels "P" PT. ABC. Presentation of data are done by create table load of electrical equipment used in tunnels "P" PT. ABC and perform calculations with the protection system suitability table load electrical appliances being.

## III. RESULTS AND DISCUSSION

### 3.1 Results

The main source of electrical power in PT. ABC came from Indonesian Electricity Company (PLN) with a capacity of 10,400 KVA. The electricity from PLN using the air duct system transmission line (line to line) 20 KV with a current of 300 A. The electricity supply back up is from the generator set with a capacity of 6325 KVA.

The electricity of PT. ABC are supply to offices, mining area, gold processing plant, etc. In the mining area, the electricity distribute to 17 electrical distribution panel, namely: electrical distribution panel “A”, electrical distribution panel “B”, to electrical distribution panel “Q”.

The electrical distribution panel “P” is used to the tunnel “P” of gold underground mining “PT. ABC”. In this tunnel, there are 5 (five) mining areas, namely: Mining Area “P1”, Mining Area “P2” Mining Area “P3”, Mining Area “P4”, and Mining Area “P5”.In each mining area there is a transformer unit to optimize the electrical power to the load, each mining area has different capacities of transformer, depending on the electrical power required by the load.

### a. Electrical Systems Overview in the mining area "P1"

In this area using a transformer with a capacity of 500 KVA, the main protection that’s installed using ACB with capasity1250 A. In this area there are some electrical equipments which have different load capacities and each electrical equipmenis secured with the MCCB protection. These are the electrical equipments contained in the mining area "P1":

**Table 1:** The Electrical Load Equipment In Mining Area “P1”

| No | Name of Mining Equipment | Spesification | | MCCB Protection (A) |
|---|---|---|---|---|
| | | Power (kW) | *Cos θ* | |
| 1 | Junction Box for Jumbo Drill Electricity Supply | 75 | 0,85 | 250 |
| 2 | Draining Pump | 110 | 0,85 | 400 |
| 3 | Main Fan | 75 | 0,85 | 250 |
| 4 | Auxilary Fan 1 | 37 | 0,85 | 250 |
| 5 | Auxilary Fan 1 | 37 | 0,85 | 250 |
| 6 | Auxilary Fan 1 | 37 | 0,85 | 250 |

### b. Electrical Systems Overview in the mining area "P2"

In this area using a transformer with a capacity of 500 KVA, the main protection that’s installed using ACB with capasity1250 A. In this area there are some electrical equipments which have different load capacities and each electrical equipmen is secured with the MCCB protection. These are the electrical equipments contained in the mining area "P2":

**Table 2:** The Electrical Load Equipment In Mining Area “P2”

| No | Name of Mining Equipment | Spesification | | MCCB Protection (A) |
|---|---|---|---|---|
| | | Power (kW) | *Cos θ* | |
| 1 | Junction Box for Jumbo Drill Electricity Supply | 75 | 0,85 | 250 |
| 2 | Draining Pump 1 | 37 | 0,85 | 250 |
| 3 | Draining Pump 2 | 37 | 0,85 | 250 |
| 4 | Draining Pump 3 | 22 | 0,85 | 100 |
| 5 | Main Fan | 132 | 0,85 | 400 |
| 6 | Auxilary Fan 1 | 37 | 0,85 | 250 |
| 7 | Auxilary Fan 2 | 15 | 0,85 | 100 |

### c. Electrical Systems Overview in the mining area "P3"

In this area using a transformer with a capacity of 800 KVA, the main protection that’s installed using ACB with capasity 2500 A. In this area there are some electrical equipments which have different load capacities and each electrical equipmen is secured with the MCCB protection. These are the electrical equipments contained in the mining area "P3":

**Table 3:** The Electrical Load Equipment In Mining Area “P3”

| No | Name of Mining Equipment | Spesification | | MCCB Protection (A) |
|---|---|---|---|---|
| | | Power (kW) | *Cos θ* | |
| 1 | Junction Box for Jumbo Drill Electricity Supply | 75 | 0,85 | 250 |
| 2 | Draining Pump 1 | 132 | 0,85 | 400 |
| 3 | Draining Pump 2 | 132 | 0,85 | 400 |

| | | | | |
|---|---|---|---|---|
| 4 | Draining Pump 3 | 110 | 0,85 | 400 |
| 5 | Draining Pump 4 | 110 | 0,85 | 400 |
| 6 | Main Fan | 132 | 0,85 | 400 |
| 7 | Auxilary Fan 1 | 37 | 0,85 | 250 |
| 8 | Auxilary Fan 2 | 37 | 0,85 | 250 |
| 9 | Auxilary Fan 3 | 15 | 0,85 | 100 |
| 10 | Auxilary Fan 4 | 15 | 0,85 | 100 |

### d. Electrical Systems Overview in the mining area "P4"

In this area using a transformer with a capacity of 1250 KVA, the main protection that's installed using ACB with capasity 2500 A. In this area there are some electrical equipments which have different load capacities and each electrical equipmen is secured with the MCCB protection. These are the electrical equipments contained in the mining area "P4":

**Table 4:** The Electrical Load Equipment In Mining Area "P4"

| No | Name of Mining Equipment | Spesification | | MCCB Protection (A) |
|---|---|---|---|---|
| | | Power (kW) | *Cos θ* | |
| 1 | Junction Box for Jumbo Drill Electricity Supply | 75 | 0,85 | 250 |
| 2 | Draining Pump 1 | 110 | 0,85 | 400 |
| 3 | Draining Pump 2 | 110 | 0,85 | 400 |
| 4 | Draining Pump 3 | 75 | 0,85 | 250 |
| 5 | Draining Pump 4 | 37 | 0,85 | 250 |
| 6 | Draining Pump 5 | 37 | 0,85 | 250 |
| 7 | Draining Pump 6 | 37 | 0,85 | 250 |
| 8 | Draining Pump 7 | 37 | 0,85 | 250 |
| 9 | Main Fan | 132 | 0,85 | 400 |
| 10 | Auxilary Fan 1 | 75 | 0,85 | 250 |
| 11 | Auxilary Fan 2 | 37 | 0,85 | 250 |
| 12 | Auxilary Fan 3 | 37 | 0,85 | 250 |
| 13 | Auxilary Fan 4 | 22 | 0,85 | 100 |
| 14 | Auxilary Fan 5 | 22 | 0,85 | 100 |

### e. Electrical Systems Overview in the mining area "P5"

In this area using a transformer with a capacity of 1250 KVA, the main protection that's installed using ACB with capasity 2500 A. In this area there are some electrical equipments which have different load capacities and each electrical equipmen is secured with the MCCB protection. These are the electrical equipments contained in the mining area "P5":

**Table 5:** The Electrical Load Equipment In Mining Area "P5"

| No | Name of Mining Equipment | Spesification | | MCCB Protection (A) |
|---|---|---|---|---|
| | | Power (kW) | *Cos θ* | |
| 1 | Junction Box for Jumbo Drill Electricity Supply | 75 | 0,85 | 250 |
| 2 | Draining Pump 1 | 110 | 0,85 | 400 |
| 3 | Draining Pump 2 | 75 | 0,85 | 250 |
| 4 | Draining Pump 3 | 75 | 0,85 | 250 |
| 5 | Draining Pump 4 | 75 | 0,85 | 250 |
| 6 | Draining Pump 5 | 75 | 0,85 | 250 |
| 7 | Draining Pump 6 | 75 | 0,85 | 250 |
| 8 | Draining Pump 7 | 37 | 0,85 | 250 |
| 9 | Draining Pump 8 | 37 | 0,85 | 250 |
| 10 | Draining Pump 9 | 37 | 0,85 | 250 |
| 11 | Draining Pump 10 | 37 | 0,85 | 250 |
| 12 | Draining Pump 11 | 37 | 0,85 | 250 |
| 13 | Draining Pump 12 | 37 | 0,85 | 250 |
| 14 | Main Fan | 75 | 0,85 | 250 |

## 3.2 Evaluation Of The Currrent Setting for The Protection of Electrical Load

Protection system serves to secure the electrical equipment from potential damage caused by disorders such as disturbance of the natural or the result of damage to the equipment of a sudden, localized areas of the system that impaired as small as possible, and to leave as soon as possible to overcome the problems that occurred in the area, so that the stability of the system can be maintained, and also to secure the man of the dangers posed by electricity. Circuit Breaker is one important part of the security system that is used to decide if the load current is going disorders such as short circuit conditions, to prevent widespread disruption to other networks.

For the effectiveness of the protection system in an electrical system, it is necessary to evaluate the use of breaker is installed, in order to obtain reliability in protecting equipment from disturbances that occurred in the system. According to The Indonesian National Standard SNI 0225: 2011, on General Requirements for electrical installations in 2011 (PUIL 2011), that the selection of protection used should not be less than the value of the Current Rate Capability (CRC) and must not exceed the value of the maximum setting protective devices. The following are the results of the evaluationof the currrent setting for the protection of electrical load in the tunnel “P” gold underground mining “PT. ABC”.

The main protection that’s installed in each mining area are using ACB and for each electrical equipmentsin each mining area are protected using MCCB. For the effectiveness of ACB and each MCCB to protect a transformer and electrical system against disturbances that occurred in the system so as not to damage and disruption due to localized so as not to spread in the system, the current setting for the protection must be recalculated to find out the appropriate value, that the value should not be less than the value of the Current Rate Capability (CRC) and must not exceed the value of the maximum setting protective devices.

As an example of the calculation example is juction box for jumbo drill electricity supply. The spesifications of jumbo drill are: has voltage input 3 phasa 380 Volt, has power 75 kW with Cos θ 0,85. The step calculationsare as follows:

a. Calculate the nominal current of the equipment nameplate by using equation (1)

$$I_n = \frac{P}{V\ x\ \sqrt{3}\ x\ cos\theta} = I_n = \frac{75000}{380\ x\ \sqrt{3}\ x\ 0.85} = 134{,}06\ A$$

b. Calculate the value of the Current Rate Capability (CRC) by using equation (2)

CRC = In x 125%
= 134,06 x 125%
= 167,58 A

c. Calculate the value of the maximum setting protective devices by using equation (3)

Protective Max = In x 115%
= 134,06x 115%
= 154,17 A

In the same way, here are the results of calculation of electrical equipment in each area of the mine:

1. The Evaluation of The Current Setting for The Protection of Electrical Load in The Mining Area "P1"

**Table 6:** The Calculation of The Nominal Current, CRC, and Protective Max In Mining Area “P1”

| No | Name of Mining Equipment | Power (kW) | Nominal Current (A) | CRC (A) | Protective Max (A) |
|---|---|---|---|---|---|
| 1 | Junction Box for Jumbo Drill Electricity Supply | 75 | 134,06 | 167,58 | 154,17 |
| 2 | Draining Pump | 110 | 196,62 | 245,78 | 226,11 |
| 3 | Main Fan | 75 | 134,06 | 167,58 | 154,17 |
| 4 | Auxilary Fan 1 | 37 | 66,14 | 82,68 | 76,06 |
| 5 | Auxilary Fan 1 | 37 | 66,14 | 82,68 | 76,06 |
| 6 | Auxilary Fan 1 | 37 | 66,14 | 82,68 | 76,06 |
| The Total for The Main Protection Calculation (ACB) | | | | 828,98 | 762,63 |

2. The Evaluation of The Current Setting for The Protection of Electrical Load in The Mining Area "P2"

**Table 7:** The Calculation of The Nominal Current, CRC, and Protective Max In Mining Area “P2”

| No | Name of Mining Equipment | Power (kW) | Nominal Current (A) | CRC (A) | Protective Max (A) |
|---|---|---|---|---|---|
| 1 | Junction Box for Jumbo Drill Electricity Supply | 75 | 134,06 | 167,58 | 154,17 |
| 2 | Draining Pump 1 | 37 | 66,14 | 82,68 | 76,06 |
| 3 | Draining Pump 2 | 37 | 66,14 | 82,68 | 76,06 |
| 4 | Draining Pump 3 | 22 | 39,32 | 49,15 | 45,22 |
| 5 | Main Fan | 132 | 235,95 | 294,94 | 271,34 |
| 6 | Auxilary Fan 1 | 37 | 66,14 | 82,68 | 76,06 |
| 7 | Auxilary Fan 2 | 15 | 26,81 | 33,51 | 30,83 |
| The Total for The Main Protection Calculation (ACB) | | | | 793,22 | 729,74 |

3. The Evaluation of The Current Setting for The Protection of Electrical Load in The Mining Area "P3"

**Table 8:** The Calculation of The Nominal Current, CRC, and Protective Max In Mining Area "P3"

| No | Name of Mining Equipment | Power (kW) | Nominal Current (A) | CRC (A) | Protective Max (A) |
|---|---|---|---|---|---|
| 1 | Junction Box for Jumbo Drill Electricity Supply | 75 | 134,06 | 167,58 | 154,17 |
| 2 | Draining Pump 1 | 132 | 235,95 | 294,94 | 271,34 |
| 3 | Draining Pump 2 | 132 | 235,95 | 294,94 | 271,34 |
| 4 | Draining Pump 3 | 110 | 196,62 | 245,78 | 226,11 |
| 5 | Draining Pump 4 | 110 | 196,62 | 245,78 | 226,11 |
| 6 | Main Fan | 132 | 235,95 | 294,94 | 271,34 |
| 7 | Auxilary Fan 1 | 37 | 66,14 | 82,68 | 76,06 |
| 8 | Auxilary Fan 2 | 37 | 66,14 | 82,68 | 76,06 |
| 9 | Auxilary Fan 3 | 15 | 26,81 | 33,51 | 30,83 |
| 10 | Auxilary Fan 4 | 15 | 26,81 | 33,51 | 30,83 |
| The Total for The Main Protection Calculation (ACB) | | | | 1776,34 | 1634,19 |

4. The Evaluation of The Current Setting for The Protection of Electrical Load in The Mining Area "P4"

**Table 9:** The Calculation of The Nominal Current, CRC, and Protective Max In Mining Area "P4"

| No | Name of Mining Equipment | Power (kW) | Nominal Current (A) | CRC (A) | Protective Max (A) |
|---|---|---|---|---|---|
| 1 | Junction Box for Jumbo Drill Electricity Supply | 75 | 134,06 | 167,58 | 154,17 |
| 2 | Draining Pump 1 | 110 | 196,62 | 245,78 | 226,11 |
| 3 | Draining Pump 2 | 110 | 196,62 | 245,78 | 226,11 |
| 4 | Draining Pump 3 | 75 | 134,06 | 167,58 | 154,17 |
| 5 | Draining Pump 4 | 37 | 66,14 | 82,68 | 76,06 |
| 6 | Draining Pump 5 | 37 | 66,14 | 82,68 | 76,06 |
| 7 | Draining Pump 6 | 37 | 66,14 | 82,68 | 76,06 |
| 8 | Draining Pump 7 | 37 | 66,14 | 82,68 | 76,06 |
| 9 | Main Fan | 132 | 235,95 | 294,94 | 271,34 |
| 10 | Auxilary Fan 1 | 75 | 134,06 | 167,58 | 154,17 |
| 11 | Auxilary Fan 2 | 37 | 66,14 | 82,68 | 76,06 |
| 12 | Auxilary Fan 3 | 37 | 66,14 | 82,68 | 76,06 |
| 13 | Auxilary Fan 4 | 22 | 39,32 | 49,15 | 45,22 |
| 14 | Auxilary Fan 5 | 22 | 39,32 | 49,15 | 45,22 |
| The Total for The Main Protection Calculation (ACB) | | | | 1883,62 | 1732,87 |

5. The Evaluation of The Current Setting for The Protection of Electrical Load in The Mining Area "P5"

**Table 10:** The Calculation of The Nominal Current, CRC, and Protective Max In Mining Area "P5"

| No | Name of Mining Equipment | Power (kW) | Nominal Current (A) | CRC (A) | Protective Max (A) |
|---|---|---|---|---|---|
| 1 | Junction Box for Jumbo Drill Electricity Supply | 75 | 134,06 | 167,58 | 154,17 |
| 2 | Draining Pump 1 | 110 | 196,62 | 245,78 | 226,11 |
| 3 | Draining Pump 2 | 75 | 134,06 | 167,58 | 154,17 |
| 4 | Draining Pump 3 | 75 | 134,06 | 167,58 | 154,17 |
| 5 | Draining Pump 4 | 75 | 134,06 | 167,58 | 154,17 |
| 6 | Draining Pump 5 | 75 | 134,06 | 167,58 | 154,17 |
| 7 | Draining Pump 6 | 75 | 134,06 | 167,58 | 154,17 |
| 8 | Draining Pump 7 | 37 | 66,14 | 82,68 | 76,06 |
| 9 | Draining Pump 8 | 37 | 66,14 | 82,68 | 76,06 |
| 10 | Draining Pump 9 | 37 | 66,14 | 82,68 | 76,06 |
| 11 | Draining Pump 10 | 37 | 66,14 | 82,68 | 76,06 |
| 12 | Draining Pump 11 | 37 | 66,14 | 82,68 | 76,06 |
| 13 | Draining Pump 12 | 37 | 66,14 | 82,68 | 76,06 |
| 14 | Main Fan | 75 | 66,14 | 82,68 | 76,06 |
| The Total for The Main Protection Calculation (ACB) | | | | 1830,02 | 1683,55 |

### 3.3 Discussion of Results

For the effectiveness of the protection system in an electrical system, it is necessary to evaluate the use of breaker is installed, in order to obtain reliability in protecting equipment from disturbances that occurred in the system. According to The Indonesian National Standard SNI 0225: 2011, on General Requirements for electrical installations in 2011 (PUIL 2011), that the selection of protection used should not be less than the value of the Current Rate Capability (CRC) and must not exceed the value of the maximum setting protective devices.

After evaluating, current setting value obtained as follows:

a. For the electrical equipment load that has power 15 kW only needs MCCB 30A, for the electrical equipment load that has power 22 kW onlyneeds MCCB 40A, for the electrical equipment load that has power 37 kW onlyneeds MCCB 75A, for the electrical equipment load that has power 75 kW onlyneeds MCCB 150A, for the electrical equipment load that has power 110 kW onlyneeds MCCB 225A, for the electrical equipment load that has power 132 kW onlyneeds MCCB 250A.
b. For main protection on each mining area:
1) In mining area “P1”, from the calculation the value of total CRC is 828,98 A, the value of total protective max is 762,63 A, ACB 1250Athat installed is too big,ACB needed is only 750A.
2) In mining area “P2”, from the calculation the value of total CRC is 793,22 A, the value of total protective max is 729,74 A, ACB 1250Athat installed is too big, ACB needed is only 700A.
3) In mining area “P3”, from the calculation the value of total CRC is 1776,34 A, the value of total protective max is 1634,19 A, ACB 2500Athat installed is too big, ACB needed is only 1600A.
4) In mining area “P4”, from the calculation the value of total CRC is 1883,62 A, the value of total protective max is 1732,87 A, ACB 2500Athat installed is too big, ACB needed is only 1600A.
5) In mining area “P5”, from the calculation the value of total CRC is 1830,62 A, the value of total protective max is 1683,55 A, ACB 2500Athat installed is too big, ACB needed is only 1600A.

## IV. CONCLUSION

The results of this research study have showed shows the importance of the electrical protection system. The selection of protection used should not be less than the value of the Current Rate Capability (CRC) and must not exceed the value of the maximum setting protective devices. The value of current setting for the protection of electrical load at the tunnel “P” of gold underground mining “PT. ABC” are too big. For protecting equipment from disturbances that occurred in the system needs to recalculatedfor finding out the appropriate value.

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