# CHAPTER I
# INTRODUCTION

In this chapter will be discussed the background of the research, problem formulation, the objectives of the research, the research scope, and the outline of the research.

## 1.1 Background

All aspects of people's lives will change along with the growth of the current era of globalization. Industrial development in Indonesia has also changed the perspective and mindset of consumers in choosing the products they will buy. This makes companies in Indonesia compete to improve the quality of the products they produce in order to win the competition. Quality control in the production system is one of the most important factors for improving product quality. A company is said to be of quality if the company has a good production process with a controlled process.

Process and quality improvements to the overall production system must be carried out if the company wants to produce good quality products in a relatively short time. Improving product quality to achieve a level of product defects close to zero defects can prosper the company so that the company can maximize the available time to produce quality products and become the choice of various consumers. Product defects will be detrimental to the company, especially if there are defects in large numbers.

Sutrado Kabel (PT Sutrakabel Intimandiri) is a manufacturing company engaged in the production of cables and conductors. This company has continued to grow since it was founded in 1991. The company located at Raya Bogor Km. 49, Jl. Roda Pembangunan No. 5, Cimandala, Kec. Sukaraja, Bogor, West Java is recognized as a reliable and trusted cable industry. Some of Sutrado Kabel's

consumer is the domestic market which includes Indonesia stated-owned companies, such as PT. PLN (Electricity) and PT. Pertamina (Migas), as well as international countries such as the United States, Myanmar, Iraq, Mozambique, Timor Leste, and many others. Cable directors produce types of conductor products, low voltage power cables, overhead conductor cables, copper, medium voltage power cables, aluminum medium voltage power cables, medium voltage twisted cables and high voltage cables.

To achieve a standard of excellence in providing products and services, PT Sutrakabel Intimandiri continues to implement a quality management system and obtain certification for domestic and international standards. PT Sutrakabel Intimandiri has been certified ISO 9001: 2008 for quality excellence, ISO 14001: 2004 for the company's commitment to environmental management, and OHSAS 18001: 2007 for controlling and improving health and safety performance. All products are made using the latest technology, which is designed according to applicable standards and requirements, and developed by trained and professional people to ensure customer satisfaction. Cables produced by PT Sutrakabel Intimandiri are by SPLN LMK or SNI (Indonesian Standard), and meet the following standards:

1. IEC: International Electrotechnical Commission
2. ASTM: American Society for Testing and Materials
3. BS: British Standards
4. NEMA: National Electrical Manufacturers Association
5. JIS: Japanese Industrial Standards
6. DIN: Deutsches Institut für Normung
7. ICEA: Insulated Cable Engineers Association
8. VDE: Verband der Elektrotechnik, Elektronik und Informationstechnik
9. SABS: South African Bureau of Standards
10. NF: Norme Française

(Sutrado Cable, 2020)

Busbars are strips or rods made of copper or aluminum that are usually placed inside the panel boards and the switchgear for high current power distribution. Copper busbar is better than aluminum busbar in terms of conductivity and strength. However, copper weighs more than aluminum. Copper has a higher level of hardness and thus provides greater resistance than aluminum so that a busbar made of copper is more resistant to damage. PT Sutrakabel Intimandiri produces a busbar that made from copper. Busbar is defined as a group of conductors used to collect electric power from the incoming feeder and distribute it to to all branches of the protection circuit in an electrical installation. In other words, busbar is a type of electrical connection where all of the incoming and outgoing electric currents meet. Busbars can also connect high-voltage equipment to electrical switchyards and low-voltage equipment to battery banks. PT Sutrakabel Intimandiri produces busbars with the shape of rectangles with sizes as shown in **Figure 1.2**. This research was only conducted on busbars with sizes 10x80. It's because after discussion with the production manager, a product in this size is the product most often produced by PT Sutrakabel Intimandiri. So that products in this size are a priority that needs more attention to reduce losses. **Figure 1.1** is a busbar image produced by PT Sutrakabel Intimandiri.

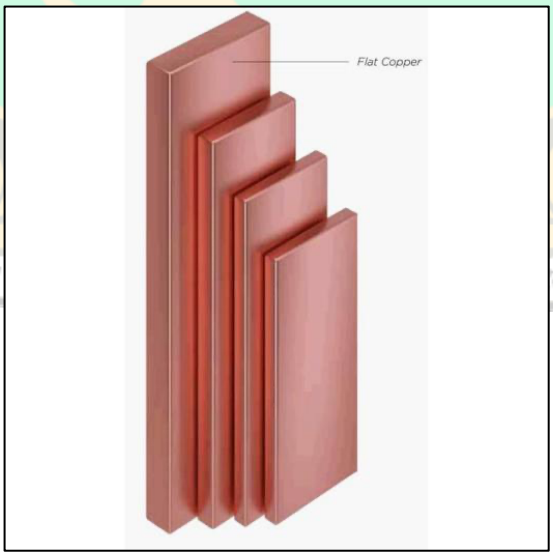


**Figure 1.1** Busbar produced by PT Sutrakabel Intimandiri
(Source: Sutrado Kabel Catalog, 2020)

| RAIL COPPER | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| PHYSICAL PROPERTIES | | | ELECTRICAL PROPERTIES | | | | | | | |
| Size | No of Packages | Approximate Weight (kg) | Current Carrying Capacity at 35°C (A) | | | | | | | |
| | | | No of Bus (AC Sistem) | | | | No of Bus (DC Sistem) | | | |
| mm x mm | pcs | 4m | I | II | III | IIII | I | II | III | IIII |
| 2x15 | 10 / 50 | 1.08 | 140 | 200 | - | - | 145 | 245 | - | - |
| 3x15 | 10 / 30 | 1.61 | 170 | 300 | - | - | 175 | 305 | - | - |
| 3x20 | 10 | 2.15 | 220 | 380 | - | - | 225 | 390 | - | - |
| 3x25 | 10 | 2.69 | 270 | 460 | 720 | 940 | 275 | 470 | 725 | 950 |
| 3x30 | 10 | 3.23 | 315 | 540 | 800 | 1,050 | 320 | 560 | 820 | 1,080 |
| 3x40 | 10 | 4.30 | 420 | 710 | 990 | 1,260 | 430 | 740 | 1,010 | 1,290 |
| 4x15 | 10 | 2.15 | 215 | 370 | 580 | 770 | 220 | 380 | 585 | 780 |
| 4x20 | 10 | 2.87 | 270 | 490 | 710 | 950 | 270 | 500 | 720 | 955 |
| 4x25 | 10 | 3.58 | 320 | 600 | 850 | 1,125 | 320 | 605 | 860 | 1,130 |
| 4x30 | 10 | 4.30 | 380 | 690 | 1,000 | 1,300 | 380 | 700 | 1,005 | 1,310 |
| 4x40 | 10 | 5.73 | 490 | 880 | 1,260 | 1,640 | 490 | 890 | 1,270 | 1,670 |
| 4x50 | 5 | 7.17 | 610 | 1,060 | 1,450 | 1,830 | 615 | 1,065 | 1,460 | 1,870 |
| 5x20 | 10 | 3.58 | 295 | 500 | 800 | 1,090 | 300 | 510 | 810 | 1,100 |
| 5x25 | 10 | 4.48 | 350 | 600 | 970 | 1,290 | 355 | 610 | 980 | 1,310 |
| 5x30 | 10 | 5.38 | 400 | 700 | 1,090 | 1,470 | 410 | 720 | 1,100 | 1,500 |
| 5x40 | 5 | 7.17 | 520 | 900 | 1,340 | 1,770 | 530 | 930 | 1,340 | 1,820 |
| 5x50 | 5 | 8.96 | 630 | 1,100 | 1,650 | 2,100 | 650 | 1,150 | 1,705 | 2,200 |
| 5x60 | 5 | 10.75 | 760 | 1,250 | 1,800 | 2,410 | 780 | 1,300 | 1,860 | 2,515 |
| 5x80 | 5 | 14.34 | 970 | 1,700 | 2,280 | 2,950 | 1,000 | 1,800 | 2,480 | 3,170 |
| 6x25 | 10 | 5.38 | 380 | 610 | 1,110 | 1,320 | 400 | 620 | 1,120 | 1,345 |
| 6x30 | 10 | 6.45 | 443 | 700 | 1,170 | 1,520 | 470 | 890 | 1,205 | 1,625 |
| 6x40 | 5 | 8.60 | 550 | 850 | 1,490 | 1,950 | 610 | 1,120 | 1,520 | 2,060 |
| 6x50 | 5 | 10.75 | 710 | 1,020 | 1,760 | 2,300 | 740 | 1,340 | 1,850 | 2,410 |
| 6x60 | 5 | 12.90 | 850 | 1,340 | 2,050 | 2,610 | 860 | 1,560 | 2,190 | 2,820 |
| 6x100 | 2 | 21.50 | 1,250 | 2,300 | 3,020 | 3,810 | 1,290 | 2,490 | 3,300 | 4,480 |
| 8x30 | 5 | 8.60 | 570 | 820 | 1,420 | 1,900 | 570 | 1,076 | 1,450 | 1,950 |
| 8x40 | 5 | 11.47 | 720 | 1,020 | 1,750 | 2,380 | 720 | 1,344 | 1,830 | 2,440 |
| 8x50 | 5 | 14.34 | 860 | 1,170 | 2,100 | 2,710 | 870 | 1,600 | 2,230 | 2,910 |
| 8x100 | 2 | 28.67 | 1,540 | 2,590 | 3,310 | 4,125 | 1,590 | 2,840 | 3,900 | 5,190 |
| 10x30 | 5 | 10.75 | 520 | 770 | 1,580 | 2,160 | 650 | 1,250 | 1,720 | 2,200 |
| 10x40 | 5 | 14.34 | 760 | 1,350 | 1,850 | 2,500 | 770 | 1,400 | 2,000 | 2,700 |
| 10x50 | 3 | 17.92 | 920 | 1,600 | 2,250 | 3,000 | 960 | 1,700 | 2,500 | 3,300 |
| 10x60 | 3 | 21.50 | 1,060 | 1,900 | 2,600 | 3,500 | 1,100 | 2,000 | 2,800 | 3,600 |
| 10x80 | 2 | 28.67 | 1,380 | 2,300 | 3,100 | 4,200 | 1,450 | 2,600 | 3,700 | 4,800 |
| 10x100 | 2 | 35.84 | 1,700 | 2,800 | 3,650 | 5,000 | 1,800 | 3,200 | 4,500 | 5,800 |
| 10x120 | 1 | 43.01 | 2,000 | 3,100 | 4,100 | 5,700 | 2,150 | 3,700 | 5,200 | 6,700 |
| 10x150 | 1 | 53.76 | 2,350 | 3,760 | 5,100 | 7,050 | 2,600 | 4,600 | 6,700 | 8,800 |
| 10x160 | 1 | 57.34 | 2,500 | 3,900 | 5,300 | 7,300 | 2,800 | 4,800 | 6,900 | 9,000 |
| 10x200 | 1 | 71.68 | 3,000 | 4,750 | 6,350 | 8,800 | 3,400 | 6,000 | 8,500 | 10,000 |

**Figure 1.2** The type of Busbar produced by PT Sutrakabel Intimandiri (Source: Sutrado Kabel Catalog, 2020)

To collaborate with customers, PT Sutrakabel Intimandiri always maintains the quality of its products. There are still busbar defects every month. The number of defects in Busbar with size 10x80 production can be seen in **Table 1.1**. Defective products produced in that month will be collected and smelted so that the defective product material can be reused and can minimize material losses. However, these defective products can also be detrimental in terms of time and money. So an improvement system is needed to improve the quality of Busbar products. The types of defects from Busbar products produced by PT Sutrakabel Intimandiri can also be seen in **Table 1.2.**

**Table 1.1** Recapitulation of total defects in the production of busbar sizes 10x80 cm

| Month | Defect Product busbar size 10 x 80 cm | | | | Passed product (pcs) | Total Production |
|---|---|---|---|---|---|---|
| | Bent busbar (pcs) | Scratched Visual (pcs) | Oxidized Visual (pcs) | Cracked Visual During Bending Test (pcs) | | |
| January | 1 | 2 | 1 | 0 | 27 | 31 |
| February | 9 | 18 | 2 | 2 | 348 | 379 |
| March | 1 | 3 | 1 | 0 | 161 | 166 |
| April | 11 | 27 | 1 | 0 | 309 | 348 |
| May | 0 | 0 | 0 | 0 | 0 | 0 |
| June | 2 | 2 | 1 | 1 | 79 | 85 |
| July | 1 | 2 | 0 | 0 | 290 | 293 |
| August | 28 | 36 | 2 | 1 | 585 | 652 |
| September | 1 | 5 | 1 | 1 | 203 | 211 |
| October | 17 | 18 | 0 | 1 | 378 | 414 |
| November | 1 | 4 | 1 | 1 | 238 | 245 |
| December | 3 | 2 | 0 | 0 | 85 | 90 |
| January | 3 | 3 | 1 | 0 | 147 | 154 |
| February | 2 | 6 | 2 | 1 | 203 | 214 |
| March | 3 | 9 | 1 | 1 | 175 | 189 |
| April | 8 | 17 | 2 | 2 | 473 | 502 |

**Table 1.2** Types of defects from Busbar products produced by PT Sutrakabel Intimandiri

| No | Defect Type |
|---|---|
| 1 | Bent Busbar |
| 2 | Scratched Visual |
| 3 | Oxidized Visual |
| 4 | Cracked Visual During Bending Test |

PT Sutrakabel Intimandiri has a predefined visual identification. Busbars that have passed quality checks are busbars that have clean, smooth, shiny, non-scratch, not bent, non-oxidizing, non-cracking, and no hollows on the busbar surface. Busbars that do not meet these criteria are included in the busbar for reject

products. The reject types found in the production of busbars can be seen in **Table 1.2.**

Defective products can cause waste. According to (Assauri, 2008) quality control is closely related to the efficiency of production costs, the effectiveness of achieving production targets, and increasing production productivity and will have a significant impact on the company's success. By undergoing quality control, it is expected that the reduction of production costs and increased productivity of the company can run smoothly.

This research is carried out by analyzing the types of busbar defects that occur and the total of busbar production defect. The most dominant type of reject is prioritized because it is the factors that causes the highest loss among other types of reject type. To research the improvement of busbar quality by knowing the causes and solutions to reduce the defects in busbar products at PT Sutrakabel Intimandiri, the researcher use six sigma method. From this method, the sigma level of the defect will be obtained. Researcher can also determine the factors causing the occurrence of defective products and formulate recommendations for quality improvement with all the types of defects. The recommendations given are expected to reduce the number of defective products that will be produced in the future

## 1.2 Problem Formulation

Based on the background above, the problem formulation in this study is how to improve the quality of busbar production process at PT Sutrakabel Intimandiri with six sigma method.

## 1.3 Research Objective

The objective of this research is to carry out quality control of busbar production, identify the factors that cause defective products in busbar production

process, and to make recommendations for improvements to minimize defective product in busbar production process.

## 1.4 Research Scope

The problems in writing this Final Project are:

1. This research was conducted with an object focus in the form of Busbar production sizes 10x80
2. Data used January 1, 2019 - September 30, 2020
3. Cost calculations are not considered
4. The stages of the six sigma concept that are carried out start from Define, Measure, Analyze and Improve without doing any control steps

## 1.5 Outline of Research

The outline of this final project consists of five chapters with the systematic as follows:

CHAPTER I INTRODUCTION

This chapter introducing the subject to be discussed that contains of background problem formulation, objectives, scope, and outline of the research.

CHAPTER II LITERATURE REVIEW

This chapter contains the theories related to the completion of the Final Project. These theories are quality, Six sigma, factors affecting quality, Six sigma implementation stages (DMAIC), Pareto diagrams, cause-and-effect diagrams (Fishbone diagrams), control charts, DPMO, and sigma levels.

CHAPTER III RESEARCH METHODOLOGY

This chapter consists of preliminary survey, literature study, selection of research methods, problem solving methodologies, closings, and a flowchart of research methodologies so that the objectives are desired.

CHAPTER IV RESULTS AND DISCUSSION

This chapter contains an evaluation of the production process that occurs at the cable factory PT Sutrakabel Intimandiri. This evaluation stage consists of defining, measuring (measuring), analyzing (analyzing)

CHAPTER V PROPOSED QUALITY IMPROVEMENT

This chapter contains an fixing (improving) the quality of products that are not following specifications.

CHAPTER VI CLOSING

This chapter contains the final project research and suggestions for further research.