Journal of Airport Engineering Technology (JAET)
https://e-journal.poltekbangplg.ac.id/index.php/jaet

Volume: 3, No. 2. June 2023: pp. 89-95
E-ISSN; P-ISSN: 2774-9622; 2775-4871
DOI: 10.52989/jaet.v3i2.103
Submitted: 2023-04-08; Revised: 2023-05-16; Accepted: 2023-06-02

STUDY OF GROUND FAULT PROTECTION SYSTEM IN THE MEDIUM VOLTAGE PANEL OF THE MAIN POWERHOUSE AT THE AIRPORT

Muhammad Zaky Isdy[1], Tamal Basak[2], Fadhilla Nina[3]
[1]Politeknik Penerbangan Indonesia Curug, [2]Indian Centre for Space Physics,
[3]Politeknik Penerbangan Palembang
*Correspondence e-mail: zakyisdy1701@gmail.com

Abstract

The protection system is a system for securing electrical equipment caused by abnormal conditions such as short circuits (phase contact with the ground), human error, and others and detecting disturbances that occur and overcoming these disturbances in a short time. The ground fault protection system has not been activated at Juanda Airport Surabaya. This research aims to avoid problems that cause ground faults that spread throughout the MV. The Medium Voltage (MV) panel ground fault protection system used by the Main Power House (MPH), namely MPH M-03, for voltage distribution to Air Field Lighting (AFL) substation Airport Operation Building (AOB) substation, and Pump House 4 (PH 4) has not been activated. This study assesses the impact of activating the ground fault protection system for the MV MPH M-03 panel using the SEPAM protection relay. The research method is an exploratory study of the ground fault protection system in the M-03 main powerhouse medium voltage panel. The results showed that using a ground fault protection system for the MV MPH M-03 panel using the SEPAM protection relay is safer due to the ground fault indicator on the equipment. The Ground Fault panel helps protect electrical equipment and supplies from damage caused by ground faults. Quickly shutting off power in the event of a fault prevents excessive current flow that can damage or destroy sensitive equipment. This benefit is significant in industrial environments or areas with valuable equipment where downtime and repairs can be costly. The conclusion is that these systems should be used for safety in voltage transmission and distribution operations. Activating the ground fault protection system, operational safety at Juanda Airport Surabaya will be guaranteed, and it will be safer for the MV panel equipment and safety for the technicians working.

Keywords: *ground fault systems, medium voltage, main power house*

Introduction

The protection system is a security system for electrical equipment caused by abnormal conditions such as short circuits (phase contact with the ground), human error, etc. It detects disturbances that occur and overcomes them quickly (Maletckii & Astafyeva, 2021; Nurmalasari et al., 2021). The protection system is one of the safeguards for the electrical system to protect the electric power system from overload (Dehnert et al., 2020; Imanuddin & Achmad, 2023), so it will be safe during a short circuit. Juanda Airport Surabaya is an airport with the third level of passenger density. Juanda Airport Surabaya has 4 Uninterruptable Power Supply (UPS) locations, namely UPS terminal 1, which supports temporary operations in terminal 1. Location 2 is UPS terminal 2, which functions to back up temporarily operational in terminal 2. The third location is UPS runway 28, which temporarily backs up the Air Field Lighting (AFL) operation in the AFL 28 area. Finally, location 4 is UPS runway 10, which temporarily backs up AFL operations in the AFL 10 area.

Medium Voltage Main Distribution Panel (MVMDP) or Medium Voltage Panel (MVP) is a medium voltage switching unit that delivers medium voltage electricity to a step-down transformer for distribution to the Low Voltage Main Distribution Panel (LVMDP) (Didik Aribowo, 2021). MVMDP is an MV panel because the equipment works at medium voltage 6.6kV - 20kV. The parts of the MVMDP Panel are Busbar, Gas Circuit Breaker (GCB), Air Circuit Breaker (ACB), Disconnecting Switch (DS) or Switch (S), Earthing Switch (ES), and Current Transformer (CT). Two brands are used in distribution transmission systems, namely Schneider and Alstom. Schneider uses SEPAM Protection, while Alstom uses Micom Protection. At Juanda Airport Surabaya the Medium Voltage (MV) ground fault protection system used by the Main Power House (MPH) is MPH M-03 for voltage distribution to the sub. Airport Operation Building (AOB) and Pump House 4 (PH 4). To maintain the security of Juanda Airport Surabaya in terms of electricity, a ground fault protection system is used on the MV MPH M-03 panel, which uses the SEPAM protection relay, which is currently not activated. Previous research on the importance of using ground fault protection systems, both low- and medium-voltage systems, must be reliable. Therefore, it is essential to use various protection systems to detect and react appropriately to abnormal conditions (El-Sherif, 2017). Furthermore, according to (Sungkowo, 2014), the higher the value of the GFR setting, the greater the current will be, so the disconnection time takes longer. So, this Qualitative Research is a stand-alone field of inquiry. This research touches on various disciplines, fields, and themes. It aims to assess the impact of ground fault protection activation on MPH M-03 and the maintenance steps that must be implemented.

Methods

The method used in this paper is qualitative literature studies to observe the problems that occurred for 6 (six) months at Juanda Airport Surabaya. Juanda Airport Surabaya is an airport located in Sedati District, Sidoarjo Regency, 20 km south of Surabaya, in 1964 Juanda Airport Surabaya was inaugurated, the name of the airport was taken from the name of a national hero, namely Ir. Djuanda Kartawidjaja, the last Deputy Prime Minister of Indonesia who had suggested the construction of this airport.

Qualitative research is research that produces findings that cannot be achieved using statistical procedures or by quantitative means. Qualitative research can show people's lives, history, behavior, organizational functionalism, social movements, and kinship relationships. Some data can be measured through census data, but the analysis remains qualitative data analysis (Daniel & Harland, 2017).

Literature study is a way used to collect data or sources related to the topic raised in a study (Habsy, 2017). Meanwhile, according to the (Sibuea, 2021) literature study, it is a data collection tool to reveal various theories that are relevant to the problem being faced or researched as material for discussion of research results taken from

various books that are considered relevant to the content of the research.

Observation technique is observation which includes focusing on an object using all sensory devices. The actor and as an observer in question is the researcher as an observer not entirely as a participant, but still performs the function of an observer. In this case the researcher becomes a member of the pretend, in the sense that it does not merge in the real sense.

Results and Discussions

The ground fault protection system in the MV panel works when there is a phase touch with the ground and a human error problem occurs (Tavakoli & Nafar, 2020; Zhao et al., 2019) then the protection device will instruct the protection relay to open the opening coil, which will open the Circuit Breaker (CB), stopping the voltage distribution flows through the MV panel to the load.

Relay is an electrical component that works based on the principle of electromagnetic field induction that works automatically to regulate or include an electrical circuit (trip or alarm circuit) due to the stimulus received having reached a predetermined limit value. If a system experiences abnormal work, the relay will sense the disturbance. Then, it will send a signal to the executor (CB or alarm) to work to protect each system element from damage. (Nam et al., 2020). For MVMDP protection relays used by Juanda Airport Surabaya, the Schneider brand uses SEPAM Protection.

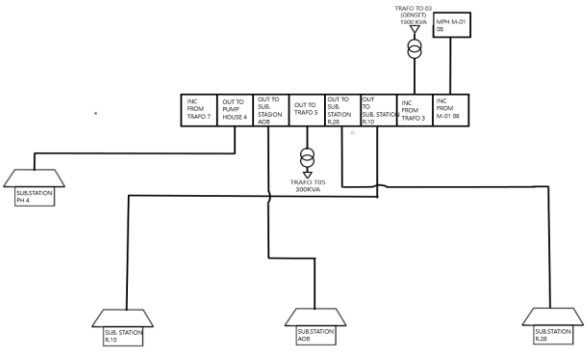

Figure 1. Voltage Distribution Line by Panel MPH M-03

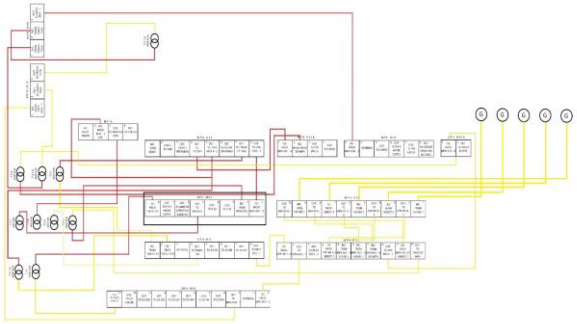

Figure 2. Location of Panel MV M-03

The ground fault protection system in the MV panel works when there is a phase touch with the ground and a human error problem occurs. Then the protection device will instruct the protection relay to open the opening coil, which will open the CB, stopping the voltage distribution flows through the MV panel to the load. This ground fault protection system also requires other tools for the protection process, where the tool is a CT and uses a Core Balance Current Transformer (CBCT). This ground fault protection system also requires other tools for the protection process where this tool, is a CT and a CBCT.

Figure 1. Current Transformer

In the use of CT can be divided into 2 things, namely Metering, the output of the Current Transformer is used as input to the measuring instrument and Protection, the output of the Current Transformer is used as input for a protective device which will later trigger a protective relay if there is a disturbance that causes a very large current as

a result of a short circuit and so on. The following is the working process of CT in protecting.

Figure 2. Core Balance Current Transformer (CBCT)

CBCT is one type of CT that has an ampere reading/monitoring function for ground faults. The function is almost the same as CT but the difference is that CBCT is more sensitive in ampere reading. The following is the protection process of a CBCT until it can open the MV panel. Each busbar in the MV panel is connected to the CT as a component that is used for metering and protection. Busbars that are currently working will have very high current values, therefore a CT is needed for measurement. After the busbar is connected to the CT, the measurement results will be sent to SEPAM as a protection system regulator to then be processed according to the settings we want. SEPAM as digital protection acts as a giver of orders if a disturbance occurs and will forward the command to the Circuit Breaker component.

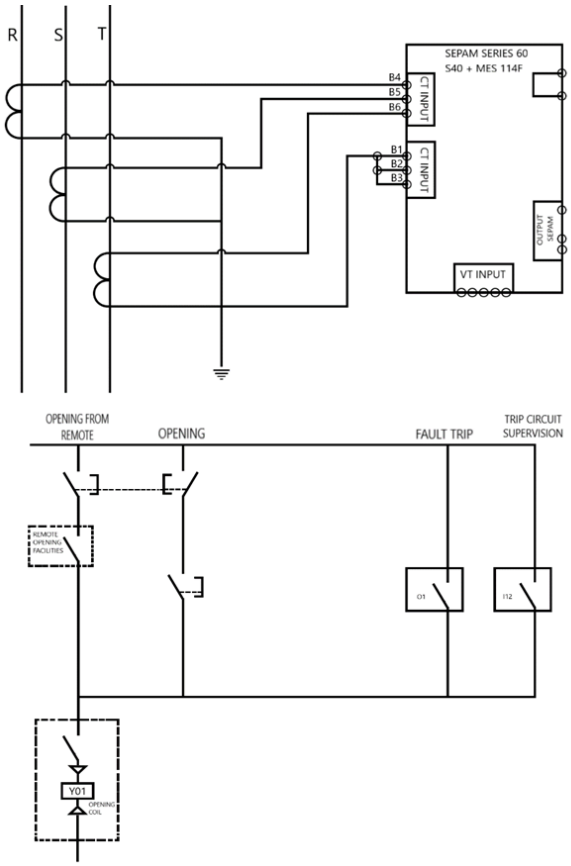

Figure 5. Wiring CT to SEPAM to Opening Coil from CB

When the Current Transformer shows high measurement results and exceeds the ground fault setting in SEPAM, SEPAM will process this and then order the opening coil to open, which will then trigger the Circuit Breaker and cut off the electricity network in the MV panel. **Figure 4.** Core Balance Current Transformer (CBCT). CBCT is a type of CT that has the function of reading/monitoring amperage for ground faults. Its function is almost the same as CT, but the difference is that CBCT is more sensitive in amperage readings. Following is the protection process from a CBCT to being able to open the MV panel.

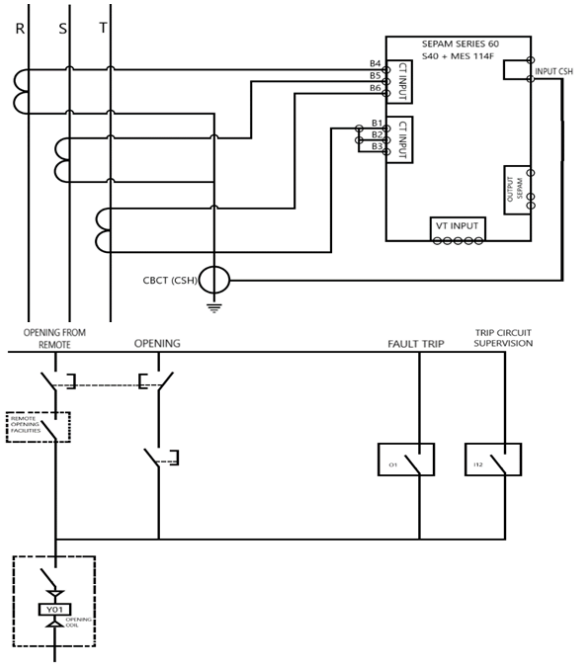

Figure 6. Wiring CBCT to SEPAM to Opening Coil from CB

From the figure, it's explained that CBCT is located or installed on the CT secondary cable, and then the CBCT will work by responding to a trouble ground fault through the main busbar which is responded to by the CT panel MV and the response will be sent to the protection relay (SEPAM), in SEPAM later it will be sent to the protection relay SEPAM. In SEPAM later it will be known the cause of the problem and the protection relay output SEPAM will go to the opening coil where the coil will open and cause the CB to open and finally the voltage flowing for the load used will stop.

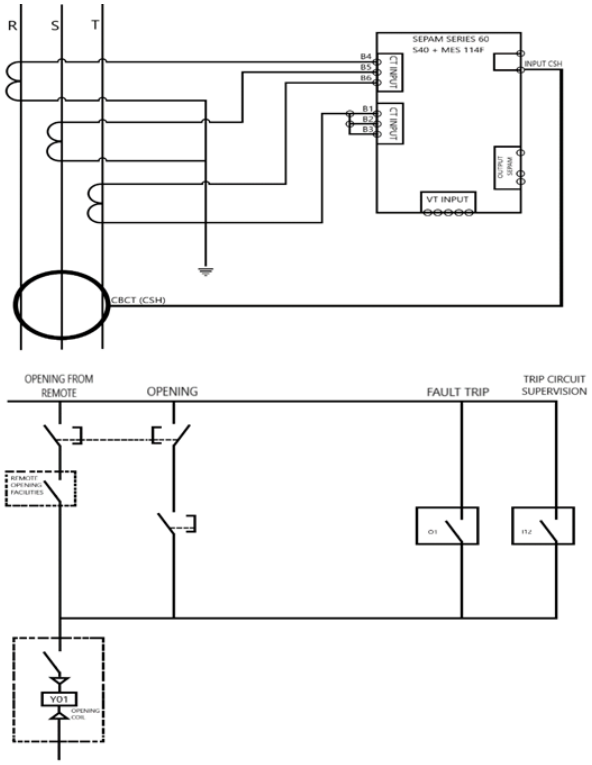

Figure 7. Wiring CBCT Towards SEPAM to Opening Coil from CB

From the figure it is explained that the CBCT is installed on the main cable, and the tool will work by responding to a trouble ground fault through the main cable, the response will be sent to the protection relay (SEPAM), then the cause of the problem can be identified. From the output of the protection relay, it will go to the opening coil where this coil will open and cause the CB to open too, and finally, the voltage flowing for the load used will stop.

Figure 8. Indicator when a Ground Fault has occurred

If a ground fault has occurred, it can be recognized by the technician working because there is a light indicator on the SEPAM that shows that a ground fault has occurred. That the use of ground fault protection in the MV MPH M-03 panel uses the ampere setting of the CBCT with the CSH sensor because the MV MPH-M03 Panel already has a CBCT installed but only the ground fault protection system has not been activated. For ampere settings using the Schneider brand CBCT, CSH must follow the ampere settings that have been determined in the MV Main panel at MPH M-01 (Schulze et al., 2011).

The use of this Ground Fault Relay aims to make protection in the distribution of Medium Voltage electricity from the source to the load that will be used more securely and prevents damage to equipment in the event of a disturbance (Pillai et al., 2004). The use of this Ground Fault Relay will make it easier for technicians at MPH to know that the MV panel leading to which sub-station is experiencing interference (ground fault) (Alwie et al., 2020; Roberts et al., 2001).

Conclusion

During research activities that have been carried out for approximately 6 (six) months, observe and find problems that can interfere with the safety of flight operations. The problem is found in the MV panel protection system at MPH, which is a ground fault protection system that has not been activated. This protection system should be used for safety in the operation of voltage transmission and distribution. In this case, researchers will activate the ground fault protection system on the MV MPH M-03 panel. It is hoped that the use of this ground fault protection system can provide more security for mv panels, equipment and safety for technicians who work. The use of the MV panel ground fault protection system should be applied more for the protection of the MV MPH panel which has not been activated by the ground fault protection system, this is because the ground fault protection function is to protect equipment from short circuits between the phase and ground and secure technicians who work as a result of losses that generated. It is also expected to be able to check the MV panel in the protection section and equipment for panels regularly to anticipate in advance if there is a damaged part in the protection device before it cannot be used to secure the panel.

References

Alwie, R. dan A. furwanti, Prasetio, A. B., & Andespa, R. (2020). Analis Penempatan, Penyettingan, & Koordinasi Over Current Relay (OCR), Ground Fault Relay (GFR) & Reclouse Pada Penyulang Baru. *Jurnal Ekonomi Volume 18, Nomor 1 Maret201*, *2*(1), 41–49.

Daniel, B. K., & Harland, T. (2017). Higher Education Research Methodology. *Higher Education Research Methodology*. https://doi.org/10.4324/9781315149783

Dehnert, J., Stopp, J., Windisch, P., & Schönherrt, B. (2020). Correction to: Quick-Erect Stopping System for Radiation Protection and Mine Rescue in Small-Scale Mining (Mining, Metallurgy & Exploration, (2020), 37, 6, (1807-1817), 10.1007/s42461-020-00261-2). *Mining, Metallurgy and Exploration*, *37*(6), 1819. https://doi.org/10.1007/s42461-020-00353-z

Didik Aribowo. (2021). Analisa Sistem Elektrikal Pada Gedung Control Building Sudirman Central Business District Jakarta. *Analisa Sistem Elektrikal Pada Gedung Control Building Sudirman Central Business District Jakarta*, *2*(10), 10.

El-Sherif, N. (2017). Ground-Fault Protection: All You Need to Know. *IEEE Transactions on Industry Applications*, *53*(6). https://doi.org/10.1109/TIA.2017.2746558

Habsy, B. A. (2017). Seni Memehami Penelitian Kuliatatif Dalam Bimbingan Dan Konseling : Studi Literatur. *JURKAM: Jurnal Konseling Andi Matappa*, *1*(2), 90. https://doi.org/10.31100/jurkam.v1i2.56

Imanuddin, M. Y., & Achmad, F. (2023). Perencanaan Sistem Proteksi Pada Distribusi Tenaga Listrik Pada Proyek Kyo Apartment di PT. Alkonusa Teknik Interkon. *Jurnal …*, *5*, 1633–1639.

Maletckii, B. &, & Astafyeva, E. (2021). Determining spatio-temporal characteristics of coseismic travelling ionospheric disturbances (CTID) in near real-time. *Scientific Reports*, *11*(1), 1–16. https://doi.org/10.1038/s41598-021-99906-5

Nam, J. W., Joung, J. G., Ahn, Y. S., & Zhang, B. T. (2020). Pengembangan Sistem Relay Pengendalian & Penghematan Pemakaian Lampu Berbasis Mobile. *Lecture Notes in Computer Science (Including Subseries Lecture Notes in Artificial Intelligence and Lecture Notes in Bioinformatics)*, *3005*(November), 73–83. https://doi.org/10.1007/978-3-540-24653-4_8

Nurmalasari, I., Nurwijayanti, & Hindardi. (2021). *Analisa Pemilihan Relai Proteksi Pada Panel Listrik Untuk Studi Kasus Tegangan Menengah 20kV*. 1–11.

Pillai, P., Bailey, B. G., Bowen, J., Dalke, G., Douglas, B. G., Fischer, J., Jones, J. R., Love, D. J., Mozina, C. J., Nichols, N., Normand, C., Padden, L., Pierce, A., Powell, L. J., Shipp, D. D., Stringer, N. T., & Young, R. H. (2004). Grounding and Ground Fault Protection of Multiple Generator Installations on Medium-Voltage Industrial and Commercial Systems - Part 2: Grounding Methods Working Group Report. *IEEE Transactions on Industry Applications*, *40*(1). https://doi.org/10.1109/TIA.2003.821642

Roberts, J., Altuve, H. J., & Hou, D. (2001). Review of Ground Fault Protection Methods for Grounded, Ungrounded, and Compensated Distribution Systems. *27th Annual Western Protective Relay Conference*, 40.

Schulze, R., Heil, U., Groß, D., Bruellmann, D. D., Dranischnikow, E., Schwanecke, U., & Schoemer, E. (2011). Artefacts in CBCT: A review. *Dentomaxillofacial Radiology*, *40*(5), 265–273. https://doi.org/10.1259/dmfr/30642039

Sibuea, A. R. (2021). *Analisis Langkah-Langkah Pendekatan Saintifik pada Pembelajaran Tematik Terpadu di Sekolah Dasar Menurut Para Ahli (Doctoral dissertation, Universitas Negeri Padang)*. 50–61.

Sungkowo, H. (2014). Kajian Proteksi Motor 200 KW,6000 V, 50 HZ dengan SEPAM 1000+ Seri M41. *Jurnal ELTEK*, *12*(01).

Tavakoli, M., & Nafar, M. (2020). Human reliability analysis in maintenance team of power transmission system protection. *Protection and Control of Modern Power Systems*, *5*(1). https://doi.org/10.1186/s41601-020-00176-6

Zhao, L., Li, X., Ni, M., Li, T., & Cheng, Y. (2019). Review and prospect of hidden failure: protection system and security and stability control system. *Journal of Modern Power Systems and Clean Energy*, *7*(6), 1735–1743. https://doi.org/10.1007/s40565-015-0128-9