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Magnetic Field Analysis around SUTT 150 Kv

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Abstract
This article describes the results of a study on the measurement and analysis of magnetic fields in the area around a 150 kV High Voltage Overhead Line (SUTT). The main objective of this study is to assess the magnitude of the magnetic field generated by the SUTT and its potential impact on the environment. The approach used includes direct measurements using special equipment at a number of locations along the SUTT route. The results obtained show that the intensity of the magnetic field varies depending on the proximity of the measurement point to the SUTT, with the highest values recorded at the closest location and decreasing significantly at further distances. The analyzed data show that the detected magnetic field is still within the acceptable threshold based on applicable standards. These findings provide an important picture of the impact of the presence of a 150 kV SUTT on the surrounding environment, and emphasize the importance of continuous monitoring to ensure that the magnetic field level remains safe. This study is expected to be a reference in the management and planning of electricity systems in the future.

Keywords: *Magnetic field, 150 kV SUTT (High Voltage Overhead Line), Measurement, Distance from SUTT*

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INTRODUCTION

In the distribution of electricity in Indonesia, PT PLN (Persero) always prioritizes the health and safety aspects of the environment in every construction of its power lines. The problem that the author raises in this article is how PLN has calculated the electromagnetic field radiation on every transmission line that is built, especially the construction of SUTT. Because according to several scientific studies that have been conducted, if the electromagnetic field radiation from a SUTT is not taken into account, it can endanger the environment around the power line.

Understanding electromagnetic field radiation in high-powered power line systems, it is necessary to measure the electromagnetic field of the power line. It is expected that the measurement and modeling of the electromagnetic field that the compiler will do around the SUTT, Vocational School students in knowing the safe distance from the SUTT so as not to endanger themselves. The 150 kV High Voltage Air Line (SUTT) is an important part of the electric power transmission system that connects power plants with distribution centers. In the process of flowing electric current through the conductor wire on the SUTT, an electromagnetic field arises around it. One component of this electromagnetic field is a magnetic field, which is formed as a direct result of the flow of electric current in accordance with the Biot-Savart law and Ampere's law.

The magnetic field generated by a current-carrying wire can affect the surrounding environment, both on electronic equipment, communication systems, and its potential impact on human health if its intensity exceeds a certain threshold. Therefore, measuring the magnetic field around the SUTT installation is very important as part of the environmental safety study and technical evaluation of the transmission network. Measuring the magnetic field around the 150 kV SUTT is very important to ensure that the resulting field value does not exceed the threshold set by national and international standards. In addition, this measurement is also useful in evaluating the technical design of the transmission system, planning safe zones for settlements or activities around the SUTT network, and for the purposes of research and development of more environmentally friendly electrical technology.

Research on the intensity of electric and magnetic fields around high-voltage overhead power lines (SUTT) has been widely conducted in recent years, considering public concerns about the impact of exposure to electromagnetic fields on health and the environment. These studies generally highlight the variations in the intensity of electric and magnetic fields generated by SUTT, and assess whether the values are still within the safe limits set by national and international standards.

by national and international standards. Wahyuddin et al.'s (2023) research shows that the electric field strength generated by the 150 kV SUTT varies between phases, with the highest value in the T phase and the lowest in the R phase. The distribution of this electric field is influenced by the configuration of the line and the type of conductor wire used. In addition, the intensity of the magnetic field also varies on different line routes, with the Pare-pare - Barru - GI Pangkep route having the highest intensity. However, the measurement results show that both the electric and magnetic fields around the 150 kV SUTT are still within safe limits according to health and safety standards. However, this study also highlights the power loss due to the influence of electric and magnetic fields reaching 8.4333 MW, so that the management and calculation of power losses are very important for the efficiency of the transmission system. Researchers also recommend periodic monitoring and further research on the long-term impacts of exposure to electromagnetic fields on human health and the environment.

Research in natural tourism areas such as that conducted at Gumang Ganam Lake, Lombok, also highlights the importance of public outreach regarding radiation from SUTT. The measurement results show that the intensity of the electric and magnetic fields is still within safe limits, but special attention is needed regarding the potential impact on flora and fauna around the transmission line. Public awareness regarding the existence of SUTT and its potential risks also needs to be increased through education and outreach.

From a technical perspective, Kartojo et al. (2024) analyzed the construction of a 150 kV high-voltage underground cable (SKTT) in an industrial area. The results of the analysis showed that the use of aluminum cables with a trefoil configuration and the HDD burial method produced a maximum magnetic field value of 10.35 μT, still far below the permitted threshold. This shows that technological innovation in the construction of transmission networks can help reduce exposure to electromagnetic fields to the surrounding environment

Another study by Jahrudin et al. (2022) compared the intensity of electric and magnetic fields in three different locations: residential areas, plantations, and open fields. The results showed that the measured electric and magnetic fields remained below the safe threshold set by WHO, although the values varied depending on the location and distance from the conductor. This study also emphasizes the importance of routine monitoring and the need for further research to explore the long-term impacts and effective mitigation strategies to protect the community and environment around SUTT.

Other studies by Yulia et al. (2017) and Nainggolan et al. (2018) found that the highest magnetic field intensity was directly below the phase cable and decreased with increasing distance from the cable. The use of roofs or barriers was not significant in reducing the magnetic field intensity, but the presence of trees around the house can help reduce the induced voltage. All measurement results are still below the WHO safe limit, so in general there is no direct negative impact on the health of people living below or near the SUTT transmission network.

Overall, the existing literature shows that although the electric and magnetic fields around SUTT and SKTT vary depending on the configuration of the channel, location, and surrounding environment, the values are generally still within the safe limits set by international standards. However, it is important to continue to conduct periodic monitoring, long-term impact research, and public education to ensure environmental safety and health are maintained.

METHODS

This research is included in the category of descriptive qualitative research types and is continued by applying the descriptive research method, which is based on the Article Review method. According to Sugiyono (2013:147), the descriptive method is a research method used to analyze data by describing or depicting the data that has been collected as it is without intending to make conclusions that apply to the public or generalizations. Snyder (2020) said that article reviews are the current way in a particular field. The goal is to provide a complete and comprehensive understanding of the topic being discussed by combining the results of various studies and studies that review the literature to find trends, differences, and controversies in the literature.

Data were collected through literature studies or library studies based on journal articles published from 2020 to 2025, namely the last five years, and by conducting direct observations of the 150 Kv SUTT. The measurement of the 150 Kv SUTT took place at Jl Tidar Lingk. Karangbaru Lor, Sumbersari Jember. The measurements were carried out at 10.00-10.30. To measure the magnitude of the magnetic field around it, an EMF Field Tester measuring instrument was used, then most of the data used came from related research articles on the ELF magnetic field around the 150 Kv SUTT to compare the suitability between the results of observations made based on existing literature. The research was carried out by preparing tools and materials, then determining the measurement point, after that placing the sensor, then conducting research and finally recording the research data.

Researchers use search engines such as Google Scholar and ScienceDirect, which are known for offering access to scientific journals indexed by SINTA.

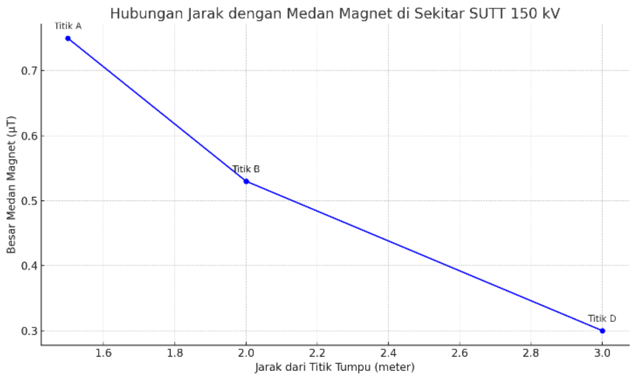
RESULTS & DISCUSSION

Results

From the results of measurements in the field, data was obtained on the strength of the magnetic field at various horizontal distances from the SUTT pole:.

No	Waktu	Nama Titik	Deskripsi lokasi	Koordinat	Jarak dari titik tumpu (m)	Besar medan magnrt (μT)	Suhu ($^\circ C$)
1.	10.00 WIB	Titik A	Tegak lurus di bawah konduktor tengah	-8.177661,113.743865	1.5	0,75	28
2.	10.10 WIB	Titik B	1 meter ke kiri dari titik A	-8.177936,113.743739	2.0	0,53	28
3.	10.20 WIB	Titik C	1 meter ke kanan dari titik A	-8.177828,113.743920	2.0	0,53	28
4.	10.30 WIB	Titik D	Di bawah menara SUTT	-8.177709,113.743744	3.0	0.30	28

The following is a graph of magnetic field measurement activities around the 150 Kv SUTT.



Discussion

A magnetic field is an area around a magnet that is still influenced by the magnet. A magnetic field occurs because of the presence of magnetic poles that have attractive and repulsive forces (Warawu, et al. 2021. The magnetic field around the High Voltage Air Duct (SUTT) is formed due to the electric current flowing through the conductor wire in the channel. This current creates a magnetic field that surrounds the wire according to the basic principles of electromagnetism. The greater the current that flows, the stronger the magnetic field that is formed (Cahyono, et al. 2023) When an electric current flows through a conductor (such as a wire), the electrons in the wire move, which produces a magnetic field around it. SUTT is designed to flow high voltage electric current to transmit electrical energy. The large current flowing through the wires in the SUTT produces a significant magnetic field around it.

The strength of the magnetic field around the SUTT is influenced by several main factors, namely:

1. Current.

The greater the current flowing, the stronger the magnetic field. The strength of the magnetic field produced by a conductor carrying electric current is directly proportional to the amount of current flowing. This means that the greater the electric current flowing through the wire, the greater the magnetic field produced around it. This is in accordance with the basic law of electromagnetism explained by Ampère's Law, which states that the magnetic field around a conductor is proportional to the amount of electric current flowing. Mathematically, this relationship can be described by the formula $B = (\mu_0 \times I) / (2\pi \times r)$, where B is the strength of the magnetic field, μ_0 is the permeability of a vacuum, I is the amount of current, and r is the distance from the wire. Therefore, the greater the I (current), the greater the B (magnetic field) will also increase.

2. Wire radius

The closer to the conductor, the greater the magnetic field produced. Conversely, the further away from the conductor wire, the smaller the magnetic field produced. The magnetic field produced by the conductor decreases as the distance from the conductor increases. The closer a point is to the current-carrying wire, the greater the magnetic field measured at that point. Conversely, the further a point is from the wire, the smaller the magnetic field strength felt. This phenomenon is explained by the Biot-Savart law, which states that the magnetic field decreases inversely with distance (1/r) from the current source. In other words, the magnetic field is not static, but rather decreases in intensity as the distance from the conductor increases.

3. wire configuration

The arrangement of the wires (e.g., the number of wires, the distance between the wires) also affects the strength of the magnetic field produced. The wire configuration, which includes factors such as the number of wires in a system, the distance between the wires, and how the wires are arranged, also plays an important role in the strength of the magnetic field produced. In an electrical transmission system, the number of wires used and the distance between the wires will affect the distribution of the magnetic field formed around the system. For example, in a twisted wire or solenoid (a coil of wire), the magnetic field produced can be much stronger and more focused because the wires are arranged in a circle or helix. The number of turns of wire also determines the intensity of the magnetic field; the more turns of wire in the coil, the stronger the magnetic field produced. In addition, the distance between the wires also affects the distribution of the field. In a power line system with wires that are quite far apart, the magnetic field produced will be weaker and more spread out, while in wires that are very close together, the magnetic field will be stronger and more focused around the line.

According to the literature that has been studied, the closer a point is to a conductor that carries electric current, the greater the magnetic field generated around that point. Conversely, the further the point is from the conductor, the smaller the intensity of the magnetic field formed (Syukri, et al. 2023). This is related to the basic principle of electromagnetism, which states that the magnetic field generated by an electric current is circular and weakens as the distance from the current source, namely the conductor, increases. From the results of measurements carried out directly in the field, the data presented in the table listed above were obtained. The first measurement was carried out at an ambient temperature of 28°C at 10:00, at point A which is directly below the center conductor. The measurement distance at point A is 1.5 meters vertically from the conductor. At this point, the magnitude of the measured magnetic field is 0.75 µT. The second measurement was carried out at the same temperature, namely 28°C, at 10:10, at point B which is located 1 meter to the left of point A, with a horizontal distance of 2 meters from the conductor. The measurement results show that the magnetic field produced is 0.53 µT. Furthermore, the third measurement was carried out at 10:20 with a constant ambient temperature, namely 28°C, at point C which is 1 meter to the right of point A, with a horizontal distance of 2 meters from the conductor. The measurement results at point C also showed a magnetic field value of 0.53 µT, the same as at point B. The fourth measurement was carried out at 10:30, with an ambient temperature of 28°C, at point D which is located under the SUTT tower at a horizontal distance of 3 meters from the conductor. The measurement results at point D showed that the measured magnetic field was 0.30 µT, the smallest value compared to other measurements.

From the measurement results, an in-depth analysis can be carried out on the relationship between distance and the magnitude of the magnetic field produced. The first measurement, which was carried out at point A with a distance of 1.5 meters vertically from the conductor, produced a magnetic field of 0.75 µT. This shows that the magnetic field detected at this point is the largest, because the measurement point is very close to the current source, namely the conductor. In the second and third measurements, which were carried out at points B and C, each 1 meter to the left and right of point A with a horizontal distance of 2 meters, the measured magnetic field was 0.53 µT. Although the distance is the same, the left and right positions of point A show that the magnetic field produced has the same strength, namely 0.53 µT. This indicates that the magnetic field is affected by the position relative to the conductor, but with a greater distance compared to point A, the measured magnetic field will be smaller. In the fourth measurement, which was conducted at point D with a distance of 3 meters horizontally from the conductor, the magnetic field produced was the smallest, which was 0.30 µT. This can be explained by the basic principle of physics which states that the magnetic field will weaken as the distance from the current source increases. The further the measurement distance from the conductor, the smaller the strength of the magnetic field detected.

The results of direct measurements of the magnetic field around the 150 kV High Voltage Air Line (SUTT) are also presented in the form of a graph. The graph shows a decrease in magnetic field strength as the distance from the conductor increases. Measurements taken at a distance of 1 meter, 2 meters, and 3 meters produced sequentially smaller magnetic field values, namely 0.75 µT, 0.53 µT, and 0.30 µT. This is in accordance with the basic principle that the magnetic field generated by an electric current will weaken with increasing distance from the conductor.

Based on the analysis of the measurement results, it can be concluded that distance has a major effect on the strength of the magnetic field produced. This result is in line with the theory that states that the magnitude of the electric current is directly proportional to the magnitude of the magnetic field produced. The greater the current flowing, the greater the magnetic field formed. In this case, in measurements made close to the conductor, such as at point A which is 1.5 meters vertically, the measured magnetic field value is greater, namely 0.75 µT. Conversely, in measurements made at a greater distance, such as at point D which is 3 meters horizontally, the magnetic field produced is smaller, namely 0.30 µT.

These results also show that the farther a point is from the conductor, the smaller the influence of the detected magnetic field. Therefore, understanding the relationship between distance and magnetic field is very important in the planning and management of electrical transmission systems, so that the impact on the environment and human health can be minimized.

CONCLUSION

Based on the measurement and analysis results, it can be concluded that the magnetic field around the 150 kV High Voltage Air Line (SUTT) shows a decreasing variation in value as the distance from the main conductor increases, in accordance with electromagnetic theory and the Biot-Savart Law. The highest magnetic field value was recorded directly below the conductor, while the lowest value was found below the SUTT tower. All measured values are still far below the safe threshold set by ICNIRP, so they do not pose a health risk to the surrounding community. In addition, the stability of the air temperature during the measurement ensures the accuracy of the data obtained. Thus, it can be concluded that the existence of the 150 kV SUTT built according to technical and safety standards does not have a significant negative impact on the environment or the health of the surrounding community.

REFERENCES

Ananda, P. and Jamaaluddin, J., 2020. Pengaruh Radiasi Elektromagnetik dari Saluran Udara Tegangan Ekstra Tinggi (SUTET) terhadap kesehatan.

Aulia, R., Firmansyah, M., & Adi, H. (2021). Analisis paparan medan listrik dan magnetik di sekitar saluran udara tegangan ekstra tinggi (SUTET) 500 kV terhadap standar ICNIRP. Jurnal Teknik ITS, 10(2), 123-130.

Cahyono, A.D, Sudarti ,Prihandono, T. (2023). ANALISIS RADIASI MEDAN MAGNET PERALATAN ELEKTRONIK RUMAH TANGGA TERHADAP KESEHATAN. ORBITA. Jurnal Hasil Kajian, Inovasi, dan Aplikasi Pendidikan Fisika

DI, B. S. U. T. T., & OBEL-OBEL, D. E. S. A. PROGRAM PENGEMBANGAN WISATA ALAM DANAU GUMANG GANAM DI. Jurnal Pepadu e-ISSN, 2715, 9574.

Firdaus, Adinda Rahma Huda. "Pola Distribusi Medan Listrik dan Medan Magnet ELF di Sekitar Tower SUTET 500 kV yang Melintas di Pemukiman Penduduk."

http://repository.stei.ac.id/6318/4/BAB%203.pdf. (n.d.). Retrieved from repository.stei.ac.id: http://repository.stei.ac.id/6318/4/BAB%203.pdf

Jahrudin, A., Noor, I., & Fitrian, A. (2022). Perbandingan kuat medan listrik dan medan magnet dari SUTT di daerah pemukiman, perkebunan, dan tanah lapang. Navigation Physics: Journal of Physics Education, 4(2), 124-132.

Kartojo I.H, Triwiyatno.A, Nisworo.S. 2024. Analisis Saluran Kabel Tanah pada Proyek Pembangunan Saluran Kabel Tegangan Tinggi 150kV Kawasan Industri Kapasitas 170MVA Sepanjang 6,5 kmr. Jurnal Profesi Insinyur Indonesia. Vol 2 (4) 257-263

Matni, M. A. B., Retriani, V., Raihan, R., Nurfadilah, A., & Karlina, D. L. (2024). Studi medan elektromagnetik pada efek radiasi elektromagnetik dari saluran udara tegangan ekstra tinggi (SUTET) untuk kesehatan manusia. Mars: Jurnal Teknik Mesin, Industri, Elektro dan Ilmu Komputer, 2(6), 177–182.

Nainggolan.D.V, Hindardi, Yulianti.B. 2018. ANALISIS PENGARUH EFEK KUAT MEDAN LISTRIK SALURAN TEGANGAN TINGGI TRANSMISI 70 KV-150 KV PADA LINGKUNGAN PERUMAHAN. (2018). JURNAL TEKNIK INDUSTRI. VOL.5 No.(2), 2018.

Nurislaminingsih, R. Rachmawati, T.S dan Winoto, Y.(2020) Pustakawan Referensi Sebagai Knowledge Worker. UNDIP E-Journal Systems (UEJS) Portal is an e-journal management and publishing system published

Saifulfala, H.S.(2021) PENGUKURAN MEDAN ELEKTROMAGNETIK DI SEKITAR SUTT 150KV SEKOLAH VOKASI UNIVERSITAS DIPONEGORO. Eprints2.undip

Siregar, M. H., & Simbolon, L. (2020). Studi medan elektromagnetik ELF di sekitar SUTT 500 kV Gandul-Kembangan. Jurnal Teknik Elektro Universitas Mercu Buana, 8(1), 45-50.

Syukri, M., Syukriyadin, S., Alfisyahrin, A., Siregar, R. H., & Iqbar, I. (2023). DAMPAK MEDAN MAGNET PEMBANGUNAN JARINGAN LISTRIK PLTA LUTEUNG 16 MW TERHADAP KESEHATAN MASYARAKAT. *JPMA - Jurnal Pengabdian Masyarakat As-Salam*, *3*(2), 57–62.

Wahyuddin, Afriansyah, Zahir Zainuddin, & Rizal A. Duyo. (2023). Analisis Kuat Medan Listrik Dan Intensitas Medan Magnet Dengan Menggunakan Jenis Kawat Terhadap Nominal Diameter Penghantar. Journal of Muhammadiyah's Application Technology, 2(3), 239-245.

Waruwu, L.Y. Rahmi, A. Anaperta, M.(2021). Rancang Bangun Alat Ukur Medan Magnet Berbasis Arduino Uno Menggunakan Sensor Efek Hall. Semesta Teknika, Vol. 24, No. 2, 129-139

Wati.L.L, Prihandono.T, Sudarti. Pengaruh Jenis Bahan Atap Dan Jarak Terhadap Intensitas Medan Elektromagnetik ELF Oleh SUTET 500 KV.2024. Jurnal Ilmu Fisika dan Pembelajarannya. Vol. 8, No. 2, Desember 2024, 63 – 72

Yulia.E, Sudarti, Yushardi, 2017. PENGARUH JENIS ATAP RUMAH TERHADAP PENURUNAN INTENSITAS MEDAN MAGNET DI BAWAH SUTT 150 KV. Jurnal Pembelajaran Fisika. Vol 6 No. 1, Maret 2017, hal 83-91.