STRATEGIC MANAGEMENT OF DIGITALIZATION FOR POWER DISTRIBUTION SYSTEM RELIABILITY INDEX: DEVELOPMENT AND IMPLEMENTATION OF A DEV C++ APPLICATION

Rio Afrianda*
Universitas Dirgantara Marsekal Suryadarma, Indonesia
rio.sttpln@gmail.com

Abstract

PT PLN (Persero) is the state-owned company responsible for electricity supply in Indonesia, with a key mandate to ensure reliable power distribution that meets established service quality standards. This study aims to analyze outage events as a basis for reducing blackout frequency and minimizing customer complaints. Improved reliability not only decreases service interruptions but also enhances system efficiency and optimizes energy transfer. The research employs a qualitative approach by analyzing reliability indices, specifically SAIDI (System Average Interruption Duration Index) and SAIFI (System Average Interruption Frequency Index), supported by the development of an application using the C programming language, known for its simplicity, flexibility, and widespread use. The findings show that SAIDI analysis provides insights for improving subsystems, including components and equipment, while SAIFI highlights opportunities to enhance operational procedures for outage management and repair acceleration. The calculation results indicate that in 2022, the average SAIDI was 3.9152 hours/customer/year, and the average SAIFI was 0.0896 interruptions/customer/year. These results demonstrate the potential of integrating digital tools to strengthen strategic reliability management in power distribution systems.

Keywords: Reliability, SAIDI, SAIFI, Digitalization, C++

INTRODUCTION

The reliability of the electricity distribution system is a key aspect in maintaining the continuity of power supply to consumers. System reliability is highly influenced by the frequency of disturbances and the duration required to restore the system. Repeated outages not only reduce the effectiveness of power delivery but also affect customer service quality, industrial productivity, and the corporate image of electricity providers (Purwanto & Nugroho, 2022).

Reliability indices essentially serve as parameters that indicate the quality of power delivery from generation to the end customer. In international practice, the most commonly used parameters are the **System Average Interruption Duration Index (SAIDI)** and the **System Average Interruption Frequency Index (SAIFI)**. These indices are key performance indicators in evaluating distribution system reliability, as they reflect the average duration and frequency of interruptions experienced by customers within a given period (Putra et al., 2023; Susanto, 2021).

Demand for reliable electricity is continuously increasing, especially from strategic customers such as industrial zones, business centers, and public service facilities. Afrianda (2025a) emphasized that strategy management based on digitalization and strategic capabilities plays a crucial role in sustaining organizational performance, including in power generation and distribution companies. This is in line with the findings of Rahmawati et al. (2022), who highlighted that digitalization in distribution system management improves the accuracy of reliability calculations and accelerates decision-making processes for disturbance handling.

In the context of PT PLN (Persero) Unit Pelaksana Pelayanan Pelanggan (UP3) Cikokol, customer demand for power reliability is particularly high. Even minor disturbances can have a significant impact on service quality and industrial productivity. Therefore, analyzing reliability indices using SAIDI and SAIFI parameters is essential to obtain a more accurate overview of distribution system performance (Santoso et al., 2022).

Furthermore, advances in computational technology enable more efficient calculation of reliability indices through programming-based applications. In this study, the author employs **Dev C++** to calculate SAIDI and SAIFI as well as to analyze outage patterns. This approach is expected to contribute to reducing high outage levels while simultaneously improving electricity delivery quality and enhancing customer service.

Previous studies have widely examined the use of SAIDI and SAIFI as standard indicators for evaluating the reliability of power distribution systems (Susanto, 2021; Putra et al., 2023; Santoso et al., 2022). These studies primarily focused on descriptive assessment of distribution performance and identifying technical improvements for reducing outage duration and frequency. However, most of them relied on manual or conventional calculation methods, which often require significant time and are prone to human error.

Recent research highlights the importance of digital transformation in the electricity sector to enhance reliability and service quality. Rahmawati et al. (2022) demonstrated that digitalization accelerates the decision-making process and increases accuracy in reliability management. Nevertheless, existing works rarely integrate digital tools with a strategic management perspective to support the long-term sustainability of power companies.

Afrianda (2025a) emphasized that strategic management, when combined with digital innovation, plays a vital role in maintaining organizational performance in the electricity industry. Yet, there is still limited research that directly applies digital applications, such as programming-based tools, to calculate reliability indices while simultaneously framing them within a strategic management approach.

Therefore, this study fills the gap by developing and implementing a **Dev C++ application** for calculating SAIDI and SAIFI indices, not only to improve technical accuracy but also to support the strategic digitalization agenda of PT PLN (Persero). This integration of **technical computation** with **strategic management of digitalization** provides novelty compared to prior studies, offering both practical and managerial implications for enhancing power distribution reliability.

RESEARCH METHOD

This research is a descriptive quantitative study with an experimental approach through the development of software based on Dev C++ to calculate the reliability indices of the electricity distribution system, with a case study at PT PLN (Persero) UP3 Cikokol. The research object is disturbance data, outage duration, and the number of affected customers obtained from PLN's official reports during the period of January–December 2024. The data consist of primary data from field observations, interviews with distribution officers, and trial runs of the Dev C++ application, as well as secondary data from historical outage reports. The research variables include reliability indices (SAIDI and SAIFI), disturbance data, and distribution network configurations (radial, spindle, loop, and tie-line). Data were collected through documentation, field observation, and literature review from previous studies (Afrianda, 2025a; Santoso et al., 2022; Zhou et al., 2019).

Research Methodology Flowchart

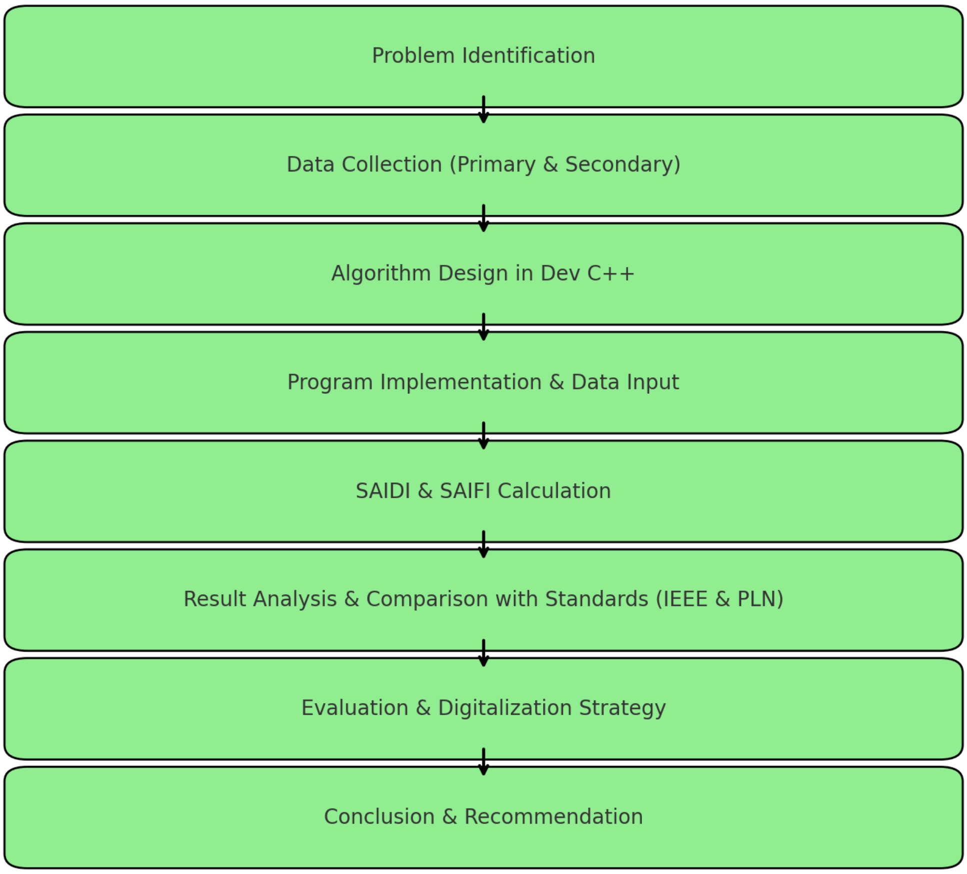


Figure 1. Research Methodology Flowchart

The research procedure involves problem identification, data collection, algorithm design in the Dev C++ application, program implementation to generate SAIDI and SAIFI values, analysis of results compared with IEEE 1366-2003 and PLN reliability standards, and evaluation of application implementation to support digitalization strategies in distribution management. Data analysis was conducted descriptively and quantitatively by calculating SAIDI and SAIFI indices to assess reliability performance and formulate strategies to improve electricity delivery quality.

System Average Interruption Duration Index (SAIDI)

SAIDI is an index obtained by dividing the total outage duration by the number of affected customers over a given period. This index can also be defined as the average outage duration experienced by each customer within one year. Thus, the smaller the SAIDI value, the better the reliability of the distribution system. According to IEEE Standard 1366-2003, SAIDI is widely applied by electric utilities worldwide as one of the key parameters for evaluating distribution system reliability performance (IEEE, 2003). Susanto (2021) emphasizes that the SAIDI value is critical in determining maintenance strategies and reliability improvements, as it directly correlates with customer satisfaction. Furthermore, Afrianda (2025a) highlights that digital transformation in strategic management of electricity companies, including the use of computational applications, can enhance the effectiveness of SAIDI data management to support reliability-based decision making. The equation is expressed as follows

$$SAIDI = \frac{\sum_{i=1}^{m} C_i t_i}{N} \boldsymbol{hours/customer/year}$$

m : number of outages in one year
Ci : number of customers affected by outages
ti : duration of each outage
N : total number of customers served

System Average Interruption Frequency Index (SAIFI)

SAIFI is an index that describes the average frequency of power interruptions experienced by customers within a given period. It is calculated by dividing the total number of customer interruptions by the total number of customers served. In other words, SAIFI reflects how often customers experience outages in one year. The smaller the SAIFI value, the better the reliability of the distribution system. According to IEEE Standard 1366-2003, SAIFI is one of the key indicators used to evaluate outage frequency in distribution systems and is often applied together with SAIDI to provide a comprehensive assessment of reliability performance (IEEE, 2003). Santoso et al. (2022) highlight that SAIFI plays a crucial role in analyzing disturbance patterns, as it serves as a basis for maintenance planning and investment in distribution infrastructure. Furthermore, Afrianda (2025a) emphasizes that the adoption of digitalization strategies in electricity companies enables real-time monitoring of SAIFI values, thereby supporting managerial decision-making in efforts to enhance distribution system reliability. The SAIFI equation is expressed as follows.

$$SAIFI = \frac{\sum_{i=1}^{m} C_i}{N} \; times/customer/year$$

m : number of outages in one year
Ci : number of customers affected by outages
N : total number of customers served

National Standard Values of SAIDI and SAIFI in 2022. The determination of reliability index thresholds for electricity distribution systems in Indonesia is regulated by national standards. According to the Directorate General of Electricity, Ministry of Energy and Mineral Resources (2022), the threshold for the **System Average Interruption**

Duration Index (SAIDI) is set at **10 hours/customer/year**, while the threshold for the **System Average Interruption Frequency Index (SAIFI)** is set at **8 times/customer/year**. These values serve as benchmarks for evaluating the reliability performance of electricity providers, particularly PT PLN (Persero), to ensure service quality for customers.

Afrianda (2025a) highlights that national standards for SAIDI and SAIFI are critical instruments in assessing the effectiveness of reliability management strategies in power companies, as these indices are directly linked to customer satisfaction and organizational performance sustainability. Similarly, Prakoso et al. (2023) assert that achieving SAIDI and SAIFI values below the national threshold reflects high efficiency in distribution system operations, while values exceeding the standard indicate the need for corrective actions such as preventive maintenance or infrastructure modernization. Therefore, SAIDI and SAIFI standards function not only as quality control tools but also as strategic indicators in supporting energy transition and enhancing the competitiveness of the national electricity sector.

Power loss due to electrical disturbances is a critical aspect in evaluating the reliability performance of distribution systems. In addition to reducing service quality to customers, disturbances also cause significant financial impacts for both electricity providers and customers, including industrial, commercial, and residential users. The cost of power loss can be calculated using the following formula:

Loss Cost (IDR)=Unserved Energy (kWh)×Electricity Tariff (IDR/kWh)

This formula allows for the estimation of loss costs on a monthly or annual basis, depending on the recorded outage data. Santosa and Wulandari (2021) argue that calculating disturbance-related losses is an essential tool to assess operational efficiency and to prioritize investments in more reliable infrastructure. In line with this, Afrianda (2025a) emphasizes that digitalization in power system management enables more accurate and timely assessment of outage-related losses, thereby supporting effective corrective strategies.

RESULT AND DISCUSSION

The researcher employed the **C programming language using the Dev C++ application** to calculate reliability indices, particularly the **System Average Interruption Duration Index (SAIDI)** and the **System Average Interruption Frequency Index (SAIFI)**. The source code is presented in **Appendix 2** to ensure research transparency and facilitate replication in future studies.

As shown in **Table 2**, the value of **Interruption Duration per Customer (ti)** is obtained by dividing the **number of affected customers (Ci)** by the **total outage duration** within a given period. This value serves as an essential component in the calculation of SAIDI. The required data for these calculations include:

1. **Number of interruptions per year (m)**
2. **Number of customers affected by outages (Ci)**
3. **Total outage duration within the period (ti)**
4. **Total number of customers served (N)**

This computational approach using the C language is expected to improve the speed, accuracy, and standardization of reliability index analysis. Afrianda (2025a) emphasizes that the integration of digital technology and automation in processing power system reliability data supports strategic decision-making and enhances customer service quality.

Table 1. Outage Customers and Outage Duration Data of PLN Cikokol

Bulan	Pelanggan Padam (Ci)	Lama Padam Per Pelanggan (Jam) (ti)	Total Lama Padam (Jam)
Januari	16108	9,653139008	155,493
Februari	11861	7,691808849	91,233
Maret	16106	7,584469403	122,155
April	21636	12,94491411	28,008
Mei	9038	4,491355706	40,593
Juni	10355	5,373944543	55,647
Juli	153725	85,3809582	1,312,519
Agustus	18622	9,563082864	178,084
September	14425	4,272592909	61,632
Oktober	56510	26,25148655	148,347
November	62903	35,95607737	226,175
Desember	28496	17,05081257	48,588
Total	**419785**		**2468472.778**

*Source: PT PLN UP3 Cikokol Document

Output from the Programming Source Code contained in Appendix 1:
Initial display after running.

```
---------------------------------------------------
Program Menghitung Indeks Keandalan SAIDI dan SAIFI
---------------------------------------------------
Pilih:
1. Menghitung Nilai SAIDI tahun 2022 Secara Berurutan
2. Menghitung Nilai SAIFI tahun 2022 Secara Berurutan
3. Menampilkan Hasil Perhitungan SAIDI dan SAIFI Secara Berurutan
4. Hasil Keandalan Rata - Rata Nilai SAIDI
5. Menghitung Total Kerugian karena terjadi gangguan tahun 2022
6. Menampilkan Hasil Perhitungan Kerugian
7. exit
Masukkan pilihan:
```

Figure 2. Initial display after running

```
------------------------------------------------------------------------------------------------------
No      Bulan           Pelanggan Padam(Ci)             Lama Padam(ti)          Jumlah Pelanggan
------------------------------------------------------------------------------------------------------
1       Januari         16108                           9.6531                  384646
2       Febuari         11861                           7.6918                  385627
3       Maret           16106                           7.5845                  386588
4       April           21636                           12.9449                 387267
5       Mei             9038                            4.4914                  387891
6       Juni            10355                           5.3739                  388729
7       Juli            153725                          85.3810                 389721
8       Agustus         18622                           9.5631                  390714
9       September       14425                           4.2726                  391645
10      Oktober         56510                           26.2515                 392464
11      November        62903                           35.9561                 393469
12      Desember        28496                           17.0508                 393469
------------------------------------------------------------------------------------------------------


Perhitungan Nilai SAIDI
Masukkan data yang akan dihitung:
```

Figure 3. Display C++ Option 1

```
------------------------------------------------------------------------
No      Bulan           Pelanggan Padam(Ci)             Jumlah Pelanggan
------------------------------------------------------------------------
1       Januari         16108                           384646
2       Febuari         11861                           385627
3       Maret           16106                           386588
4       April           21636                           387267
5       Mei             9038                            387891
6       Juni            10355                           388729
7       Juli            153725                          389721
8       Agustus         18622                           390714
9       September       14425                           391645
10      Oktober         56510                           392464
11      November        62903                           393469
12      Desember        28496                           393469
------------------------------------------------------------------------


Perhitungan Nilai SAIFI
Masukkan data yang akan dihitung:
```

Figure 4. Display C++ Option 2

No	SAIDI	SAIFI
1	0.4042	0.0419
2	0.2366	0.0308
3	0.3160	0.0417
4	0.7232	0.0559
5	0.1047	0.0233
6	0.1432	0.0266
7	33.6784	0.3944
8	0.4558	0.0477
9	0.1574	0.0368
10	3.7799	0.1440
11	5.7482	0.1599
12	1.2349	0.0724
Total	46.9824	1.0753

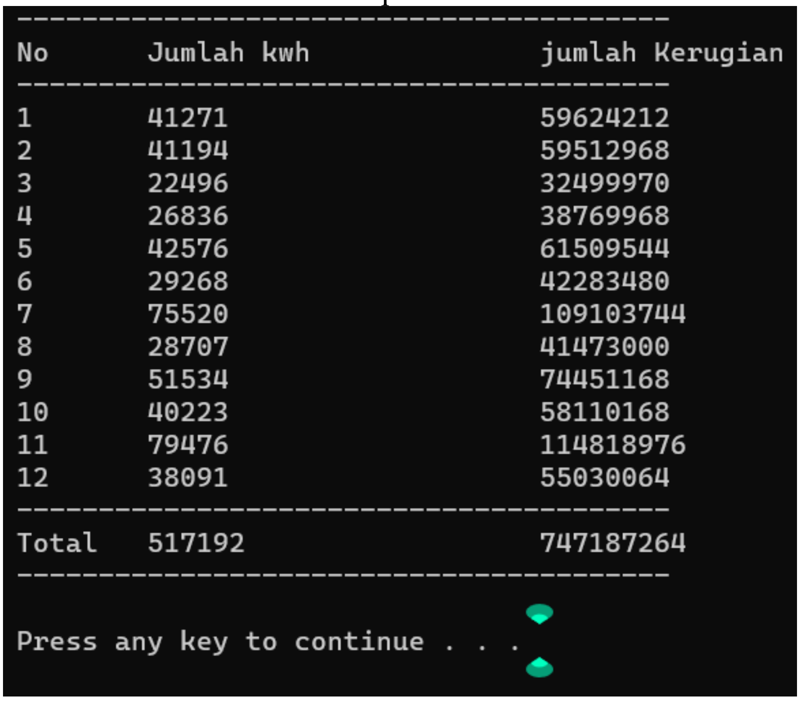
```
Press any key to continue . . .
```

Figure 5. Display C++ Option 3

```
Dari data perhitungan SAIDI
Di dapatkan Total Nilai SAIDI dalam tahun 2022 yaitu 46.9824
Rata - rata Nilai SAIDI dalam 1 tahun yaitu 3.9152

Nilai Total SAIDI termasuk andal

Di dapatkan Total Nilai SAIFI dalam tahun 2022 yaitu 1.0753
Rata - rata Nilai SAIFI dalam 1 tahun yaitu 0.0896

Nilai Total SAIFI termasuk andal

Press any key to continue . . .
```

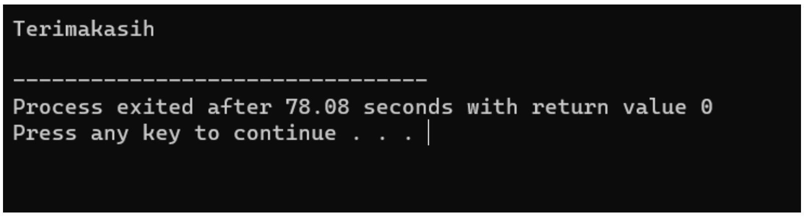
Figure 6. Display C++ Option 4

Tampilan 6:



```
----------------------------------------
No       Jumlah kwh              jumlah Kerugian
----------------------------------------
1        41271                   59624212
2        41194                   59512968
3        22496                   32499970
4        26836                   38769968
5        42576                   61509544
6        29268                   42283480
7        75520                   109103744
8        28707                   41473000
9        51534                   74451168
10       40223                   58110168
11       79476                   114818976
12       38091                   55030064
----------------------------------------
Total    517192                  747187264
----------------------------------------

Press any key to continue . . .
```

Figure 7. Display C++ Option 5



```
Terimakasih

--------------------------------
Process exited after 78.08 seconds with return value 0
Press any key to continue . . .
```

Figure 8. Display C++ Option 6

Reliability Index Calculation

Perhitungan indeks keandalan pada UP3 Cikokol berdasarkan data gangguan dan pemadaman yang terjadi. Dimana, data yang diperlukan yaitu Jumlah pelanggan padam, jumlah gangguan, dan lama padam. Cara untuk menentukan indeks keandalan, yaitu berdasarkan data-data gangguan padam di lapangan yang dilihat dari data saidi saifi dengan memperhitungkan jumlah pelanggan yang mengalami pemadaman dan lamanya waktu pemadaman.

Dari jenis gangguan yang terjadi maupun pemadaman yang terencana dan tidak terencana, berikut hasil perhitungan yang didapat dari data pada gambar 6 untuk tiap bulannya pada tahun 2022:

SAIDI and SAIFI Calculation Results:

So it can be seen that the total value of SAIDI in 2022 is 46.9824 hours/customer/year and the total value of SAIFI in 2022 is 1.0753 times/customer/year.

Where according to the calculation formula of SAIDI (System Average Interruption Duration Index) contained in the calculation formula of SAIFI (System Average Interruption Frequency Index) contained in the equation, it can be concluded that, if the results of the SAIDI and SAIFI values are large or exceed the limits of the National Standard values of SAIDI and SAIFI, then the reliability value of a distribution system will be said to be unreliable. So, when the SAIDI and SAIFI values are small or below the limits of the National Standard values of SAIDI and SAIFI in 2022, then the reliability value of a distribution system is said to be reliable. Where PLN as the largest electricity distribution company will experience an impact due to the large number of customers who have blackouts with a large duration of blackouts, which affects the amount of losses received because kWh are not distributed.

No	SAIDI	SAIFI
1	0.4042	0.0419
2	0.2366	0.0308
3	0.3160	0.0417
4	0.7232	0.0559
5	0.1047	0.0233
6	0.1432	0.0266
7	33.6784	0.3944
8	0.4558	0.0477
9	0.1574	0.0368
10	3.7799	0.1440
11	5.7482	0.1599
12	1.2349	0.0724
Total	46.9824	1.0753

Press any key to continue . . .

Figure 9. Results of SAIDI and SAIFI Calculations for UP3 Cikokol in 2022

Reliability Index Value Analysis for 2022

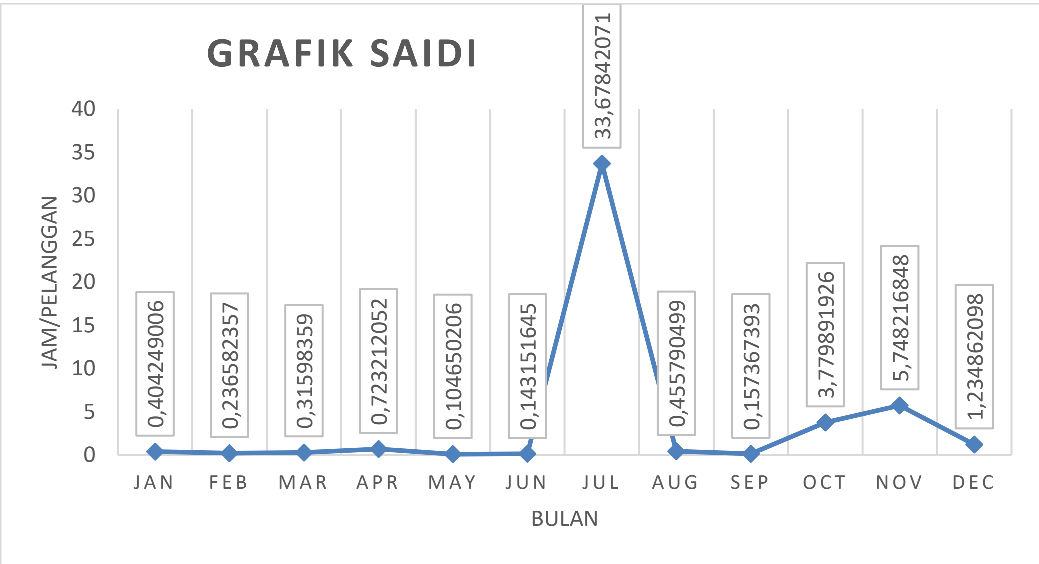


Figure 10. SAIDI Graph for 2022

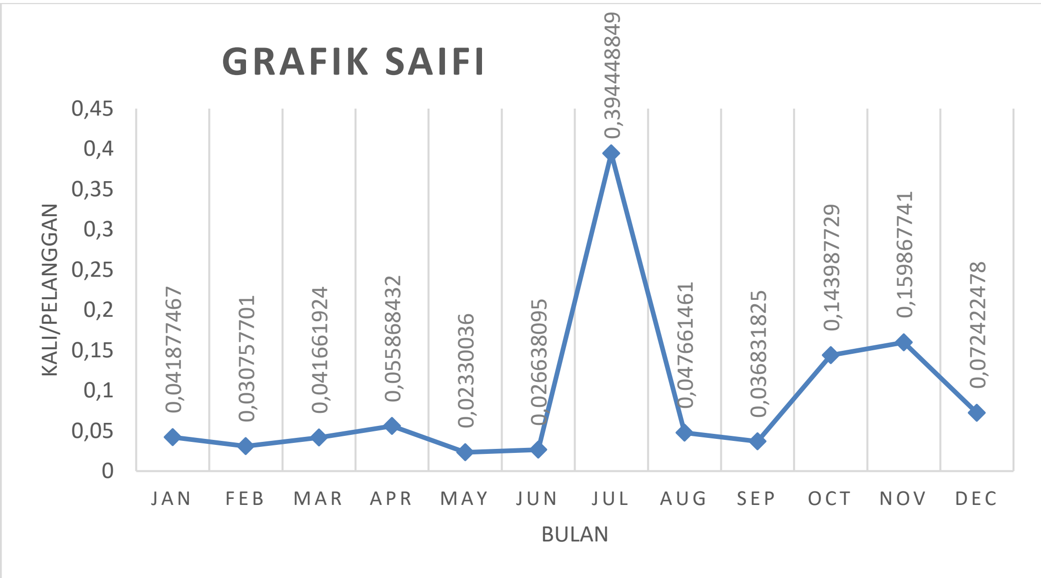


Figure 11. SAIFI Graph for 2022

Based on the results of the 2022 reliability index calculation at UP3 Cikokol, the graph above shows that the highest SAIDI and SAIFI values occurred in July with a SAIDI value of 33.6784 hours/customer/month and a SAIFI value of 0.3944 times/customer/month, which was caused by the Unplanned Outage Group (Transmission Group) which resulted in 135,255 customers experiencing outages. Meanwhile, the lowest SAIDI and SAIFI values occurred in May with a SAIDI value of 0.1047 hours/customer/month and a SAIFI value of 0.0233 times/customer/month.

Analysis/Discussion

Analysis of the UP3 Cikokol SAIDI and SAIFI in 2022 based on the 2022 National Standard Based on the 2022 National Standard, the UP3 Cikokol distribution system can be considered reliable if the average SAIDI value is ≤ 10 hours/customer/year and the SAIFI value is ≤ 8 times/customer/year.

SAIDI:

$$SAIDI_{AVERAGE} = \frac{SAIDI\ Total\ Value}{Number\ of\ Months}$$

$$= \frac{46{,}9824}{12}$$

$$= 3{,}9152\ Hours/Customers/Year$$

SAIFI:

$$SAIFI_{AVERAGE} = \frac{SAIFI\ Total\ Value}{Number\ of\ Months}$$

$$= \frac{1{,}0753}{12}$$

$$= 0{,}0896\ Hours/Customers/Year$$

So from the results of the analysis above, the reliability value based on the cause of the outage, seen from the average duration of the outage in 2022 (SAIDI = 3.9152 hours/customer/year) and for the average frequency of outages (SAIFI = 0.0896 times/customer/year) is said to be reliable because the average value of SAIDI and SAIFI meets the 2022 National Standard.

Analysis of Causal Factors Impacting SAIDI and SAIFI in 2022

After analyzing the most frequent outages each month, researchers identified various contributing factors, resulting in Table 2.

From the number of outages in 2022, as seen in Table 2, it can be concluded that the more frequent outages, the higher the SAIDI and SAIFI values, in accordance with the duration of the outage and the number of customers experiencing outages due to the outage. The largest outage, based on historical data from the past five years, was a jointing or ground cable connection problem. One way to address these ground cable connection problems is through a cable assessment. This method allows researchers to identify weak points that could cause problems.

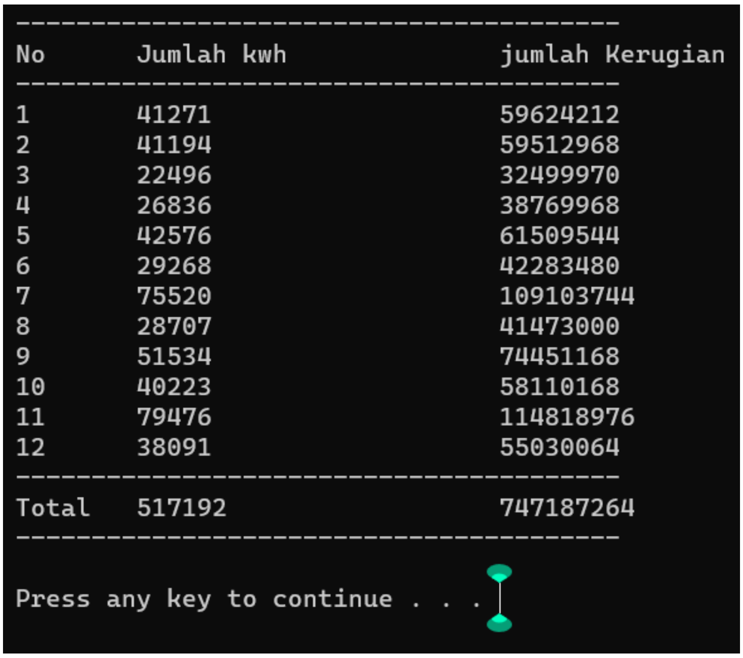
Table 2. Factors Causing Disorders

No	Disruption	Causing Factors	Number of Customers Outages
1	Unplanned Outage Group (Transmission Group)	Short Circuit (trip)	178.607
2	Substation Maintenance Dist. MV Cell Fasilitas 20 kV Gardu	Components damaged due to age	94.526
3	The root of the problem	Corona, SF6 gas runs out	39.961
4	Jointing SKTM	Broken Cable Connections, Third-Party Interference	29.517
5	SUTM Conductor	Broken conductor cable, Network hit by tree, kite caught in cable	14.306
6	SUTM Hardware Mounting Assembly	Broken conductor cable, Network hit by tree, kite caught in cable	8.394
7	Distribution Substation (Natural Disaster)	Flood	4.752
8	MV TIC SKUTM	Broken cable connection, Network hit by tree	4.294
9	MV Cell Distribution Substation (Wall)	Coronavirus, MV Cell damage, Animals entering MV Cell	4.191
10	Ground Cable	Natural phenomena (earthquakes, floods, etc.), Broken Cable Connections, Third-Party Interference	4.073
11	Distribution Substation Arrester (Pole)	Component damage due to age, Protection system failure	3.182

12	Distribution Substation Transformer (Pole)	Insulation failure, lightning strikes, bushing leaks	2.381
13	Primary/Secondary Distribution Substation Cable	Cable line disconnection, loose bolts causing fire, component theft	2.294
14	MV Cell Distribution Substation (Pole)	Coronavirus, MV Cell damage, Animals entering MV Cell	1.948

Total Losses Due to Disruptions in 2022

From the calculation results produced between (kWh not distributed multiplied by the basic electricity tariff) from January to December in 2022, the total loss of UP3 Cikokol in 2022 was obtained due to disruptions that occurred so that kWh was not distributed to customers, which was IDR 747,187,264. To reduce losses per year, it is necessary to carry out routine maintenance, be it daily maintenance, weekly maintenance, monthly maintenance, quarterly maintenance, and other maintenance to achieve the effectiveness of the work of an electrical component / device in the distribution substation (concrete and poles) or other components that support the reliability of a distribution system, thereby minimizing the long duration of blackouts due to disruptions that cause kWh not to be distributed to customers.



```
----------------------------------------
No      Jumlah kwh              jumlah Kerugian
----------------------------------------
1       41271                   59624212
2       41194                   59512968
3       22496                   32499970
4       26836                   38769968
5       42576                   61509544
6       29268                   42283480
7       75520                   109103744
8       28707                   41473000
9       51534                   74451168
10      40223                   58110168
11      79476                   114818976
12      38091                   55030064
----------------------------------------
Total   517192                  747187264
----------------------------------------

Press any key to continue . . .
```

Figure 12. Results of Calculation of Losses in Dev C++ caused by disruptions

CONCLUSION

From the results of calculations that researchers have done using the C programming language with the Dev C++ application, the results of the average outage duration index (SAIDI) in 2022 are 3.9152 hours/customer/year while for the average outage frequency index (SAIFI) in 2022 is 0.0896 times/customer/year. The relationship between the results of SAIDI and SAIFI calculations with the reliability value of a distribution system, namely if the SAIDI and SAIFI values are large or exceed the limits of the National Standard values of SAIDI and SAIFI, then the reliability value of a distribution system will be said to be unreliable. Meanwhile, when the SAIDI and SAIFI values are small or below the limits of the National Standard values of SAIDI and SAIFI in 2022, then the reliability value of a distribution system is said to be reliable. From the results of the calculations that have been carried out, the distribution system in UP3 Cikokol is said to be reliable. Several factors caused disruptions at the Cikokol UP3 in 2022, including cable breaks, kite strikes, and tree falls on the network. The SKTM was caused by connection or jointing disruptions and third-party work. The MV Cell was caused by corona, MV cell damage, and animals entering the MV Cell. The most common disruption factor was unplanned outages in the transmission group due to short circuits in the 500 kV network (trips). The largest disruption, based on historical data from the past five years, occurred in the jointing or ground cable connections. One way to address these ground cable connection disruptions is through cable assessments. This allows researchers to identify weak connection points that could cause disruptions.

REFERENCES

Afrianda, R. (2025a). Pengaruh Penerapan Manajemen Strategi, Tekanan Pemangku Kepentingan yang Dimediasi Kapabilitas Strategis terhadap Keberlangsungan Kinerja Organisasi (Studi pada Perusahaan Pembangkit Listrik di Indonesia). SINERGI: Jurnal Riset Ilmiah, 2(7). https://doi.org/10.62335/sinergi.v2i7.1527

Afrianda R, et.al., 2020. "Pengaruh Ketidakseimbangan Beban Terhadap Efesiensi Transformator Distribusi Studi Gardu PT PLN (PERSERO) Area Bekasi" Vol. 10 No. 1 (2020): JURNAL ILMIAH SUTET https://doi.org/10.33322/sutet.v10i1.1277

Afrianda, R. (2025b). Workload, Recognition, and Environment: Key Drivers of Employee Stress–A Case Study at PT PLN Unit X. Jurnal Ilmiah Manajemen Surya Pasca Scientia, 14(2). https://doi.org/10.35968/jimspc.v14i2.1596

Afrianda, R., & Zainal, V. (2025). The Influence of Strategic Management Implementation, Stakeholder Pressure Mediated by Strategic Capabilities on the Sustainability of Organizational Performance. Indicators: Scientific Journal of Management and Business, 9(2), 36–46. http://dx.doi.org/10.22441/indikator.v9i2.32900

Buku Laboratorium Algoritma dan Pemrograman (Smart Electronic System Laboratory) 2022/2023, hal 14-16.

Erhaneli, 2016. "Evaluasi keandalan sistem distribusi tenaga listrik berdasarkan indeks keandalan SAIDI dan SAIFI pada PT. PLN (Persero) Rayon Bagan Batu tahun 2015". Jurnal Teknik Elektro ITP, Vol.5, No.2, hal. 121-122

Hajar, 2018. "Analisa Nilai SAIDI SAIFI sebagai indeks keandalan penyediaan tenaga listrik pada penyulang Cahaya PT. PLN (Persero) Area Ciputat, Jurnal Energi & Kelistrikan Vol. 10 No. 1, hal. 70-77

Kementrian Energi dan Sumber Daya Mineral Republik Indonesia tahun 2022, "Capaian SAIDI dan SAIFI Tunjukkan Mutu Layanan Listrik Kian Optimal"

Monantun Syufrijal, 2014. Buku Jaringan Distribusi Tenaga Listrik (29)

Mulianda, 2017. "Analisis Keandalan Sistem Jaringan Distribusi PT. PLN (Persero) Banda Aceh Menggunakan Metode Section Technique", Jurnal Program Studi Teknik Elektro dan Komputer Fakultas Teknik Universitas Syiah Kuala, Vol.2, No.4, hal 15-20

Purwanto, A., & Nugroho, D. (2022). Reliability evaluation of distribution system using SAIDI and SAIFI indices. Jurnal Energi dan Kelistrikan, 14(2), 55–64.

Putra, Y., Wibowo, A., & Sari, D. (2023). Distribution system reliability assessment in supporting power quality improvement. Journal of Electrical Engineering Research, 11(1), 22–31.

Rahmawati, I., Kurniawan, A., & Setiawan, H. (2022). Digital transformation in electricity distribution reliability management. International Journal of Energy Systems, 9(4), 210–220.

Santoso, B., Prasetyo, R., & Gunawan, T. (2022). Analysis of distribution reliability indices for customer satisfaction improvement. Jurnal Teknologi dan Energi, 8(3), 45–54.

Saragih Richy, 2016. "Pemrograman dan Bahasa Pemrograman". STMIK-STIE Mikroskil, 12-13.

SPLN 68-2:1986. "Tingkat Jaminan Sistem Tenaga Listrik". Jakarta: Perusahaan Umum Listrik Negara, 1-16

Susanto, H. (2021). Evaluation of reliability indices for distribution system planning. Indonesian Journal of Electrical Power Systems, 5(2), 67–74.

SPLN 59:1985. "Keandalan Pada Sistem Distribusi 20 kV dan 6kV". Jakarta: Perusahaan Umum Listrik Negara, 5-14

Wahyudi Drajad, "Evaluasi Keandalan Sistem Distribusi Tenaga Listrik Berdasarkan SAIDI Dan SAIFI Pada PT. PLN (Persero) Rayon Kakap", Jurnal Program Studi Teknik Elektro Fakultas Teknik Universitas Tanjungpura, 1-6.