Identification and Prioritization of Component Failure Risks in the Electrical System at the As Salam Mosque Using the FMEA Approach

Final Project

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Statement of Authenticity of Final Project

I, the undersigned, hereby declare that the contents of my Final Project, entitled **"Identification and Prioritization of Component Failure Risks in the Electrical System at the As Salam Mosque Using the FMEA Approach"**, are entirely my own work, compiled without the use of unauthorised materials, and do not constitute the work of any other party which I have claimed as my own. All sources cited or referred to in this work have been fully listed in the bibliography. Should this declaration prove to be untrue at a later date, I am willing to accept sanctions in accordance with the applicable regulations.

Batam, 24 Juli 2026

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Approval sheet

The Final Project is structured to fulfill one of the requirements for obtaining a degree
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Abstract

The rapid growth of electrical systems in Indonesia, particularly in mosques, faces significant reliability challenges due to fluctuating loads and substandard installations. With distribution disruptions causing over 70% of power outages and electrical failures triggering 30% of building fires, proactive risk management is essential. Currently, over 40% of small public buildings in Indonesia lack basic safety compliance, often due to community-led construction without adequate technical oversight. Reactive strategies have proven ineffective, necessitating a shift toward systematic approaches like Failure Mode and Effect Analysis (FMEA). Although FMEA effectively improves risk management by identifying potential failures through severity, occurrence, and detection metrics, its application remains limited to manufacturing and large-scale power systems. A critical research gap exists regarding its use in small-scale, high-variability environments like mosques. This study addresses this gap by applying FMEA to mosque electrical systems to prioritize risks via Risk Priority Numbers (RPN). By analyzing unique load patterns and installation deficiencies, this research aims to establish a proactive framework for early risk detection and targeted mitigation. The findings will contribute significantly to enhancing electrical safety standards and system reliability in places of worship, offering a scalable model for similar public facilities globally.

Keywords: Risk Management, FMEA, Mosque Electrical Systems, Electrical Safety, Reliability.

Foreword

In the name of Allah, the Most Gracious, the Most Merciful.

All praise and gratitude are due to Allah SWT for His blessings, mercy, and guidance, which have enabled the author to complete this Industrial Internship Report at PT Putra Kelana Makmur Group. May peace and blessings be upon Prophet Muhammad SAW, his family, and his companions.

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The author realizes that this report is not perfect and welcomes constructive suggestions for future improvement. It is hoped that this report will be useful for readers and contribute to the field of Manufacturing Electronics Engineering.

Batam, 24 July 2026

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***Abstract*—The rapid growth of electrical systems in Indonesia, particularly in mosques, faces significant reliability challenges due to fluctuating loads and substandard installations. With distribution disruptions causing over 70% of power outages and electrical failures triggering 30% of building fires, proactive risk management is essential. Currently, over 40% of small public buildings in Indonesia lack basic safety compliance, often due to community-led construction without adequate technical oversight. Reactive strategies have proven ineffective, necessitating a shift toward systematic approaches like Failure Mode and Effect Analysis (FMEA). Although FMEA effectively improves risk management by identifying potential failures through severity, occurrence, and detection metrics, its application remains limited to manufacturing and large-scale power systems. A critical research gap exists regarding its use in small-scale, high-variability environments like mosques. This study addresses this gap by applying FMEA to mosque electrical systems to prioritize risks via Risk Priority Numbers (RPN). By analyzing unique load patterns and installation deficiencies, this research aims to establish a proactive framework for early risk detection and targeted mitigation. The findings will contribute significantly to enhancing electrical safety standards and system reliability in places of worship, offering a scalable model for similar public facilities globally.**

Keywords: Risk Management, FMEA, Mosque Electrical Systems, Electrical Safety, Reliability.

I. INTRODUCTION

The rapid development of electrical systems has accompanied the increasing demand for energy in various sectors, including public facilities and places of worship. The reliability of electrical distribution systems is essential to ensure service continuity and user safety, as distribution network failures contribute to more than 70% of power system outages [1]. In addition, electrical failures account for over 30% of building fires, mainly due to poor installation quality and inadequate maintenance [2]. These issues are particularly relevant in Indonesia, where many public facilities, including mosques, are constructed through community initiatives with limited technical supervision, resulting in electrical installations that often do not fully comply with safety standards [4].

Mosques have unique electricity consumption patterns characterized by fluctuating loads during congregational prayers, religious activities, and social events. Such variations increase the likelihood of component degradation, overload, and system failures compared with buildings that experience relatively stable electrical loads [3]. However, maintenance practices in many mosques remain reactive, limiting their effectiveness in reducing electrical risks and improving system reliability [5].

Failure Mode and Effect Analysis (FMEA) is a systematic risk assessment method capable of identifying potential failure modes, their causes, and their impacts before failures occur. The method evaluates risks using three parameters—Severity (S), Occurrence (O), and Detection (D)—which are combined to determine the Risk Priority Number (RPN) for prioritizing corrective actions [6]. Previous studies have demonstrated that FMEA can significantly improve the effectiveness of risk management in engineering systems.

Despite its widespread application in manufacturing and large-scale power systems, the use of FMEA for small-scale electrical distribution systems, particularly in places of worship, remains limited. This research gap highlights the need for studies focusing on mosque electrical systems, which possess unique operational characteristics and risk profiles. Therefore, this study applies the FMEA approach to identify, evaluate, and prioritize component failure risks in the electrical system of the As Salam Mosque, providing recommendations to improve system reliability, safety, and maintenance planning.

A. METHOD

A. Design

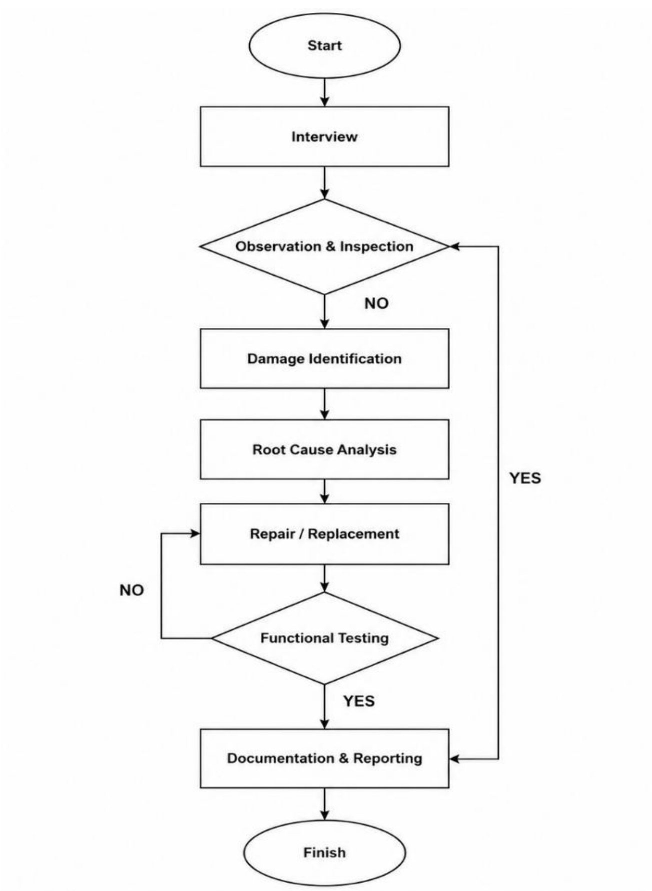


Figure 1. Flowchart project

In Figure 1 illustrates the research workflow used to identify and prioritize component failure risks in the electrical system of the As Salam Mosque using the Failure Mode and Effect Analysis (FMEA) method. The study begins with interviews with mosque administrators or personnel responsible for the electrical system to obtain information regarding system conditions, failure history, and maintenance practices. This is followed by observation and inspection of all electrical components to identify potential failures. If no damage is detected, the inspection results are documented and reported. Otherwise, the process continues with damage identification, root cause analysis, and repair or component replacement based on the identified failure.

After the corrective actions are completed, functional testing is performed to verify that the electrical system operates properly. If the test results do not meet the required criteria, the repair process is repeated until the system functions correctly. Finally, all inspection, repair, and testing results are documented and analyzed using the FMEA method by evaluating the Severity (S), Occurrence (O), and Detection (D) ratings to calculate the Risk Priority Number (RPN). The RPN values are then used to prioritize component failure risks and provide maintenance recommendations to improve the reliability and safety of the electrical system at the As Salam Mosque.

B. Analysis Object

Figure 2. Object location

Figure 2 shows the research object, namely the As Salam Mosque and its lighting system installed in several locations, including the roof near the mosque dome, toilet area, terrace, and garden and parking area. Each location has different environmental and operating conditions, such as weather exposure, humidity, limited accessibility, and installation area coverage. These conditions may affect inspection, maintenance activities, and the reliability of the lighting system. Therefore, a risk analysis is required to identify potential failures at each installation location.

Figure 3. Roof Lighting Near the Mosque Dome

Figure 3 shows the lighting system installed on the ceiling near the mosque’s dome. The installation location is at a considerable height with limited access, making the inspection, maintenance, and replacement of the lights more difficult. These conditions increase maintenance time and the risk of failures that could affect the reliability of the lighting system.

Figure 4. Mosque toilet lights

Figure 4 shows the lighting system installed in the mosque's restroom area. The humid environment and limited ventilation increase the likelihood of moisture entering the electrical components, which can accelerate component failure and reduce the reliability of the lighting system.

Figure 5. Mosque terrace lights

Figure 5 shows the lighting system installed on the mosque's terrace, which is directly exposed to outdoor environmental conditions. Constant exposure to sunlight, rain, dust, and temperature fluctuations can accelerate the deterioration of components and increase the risk of damage to the lighting system.

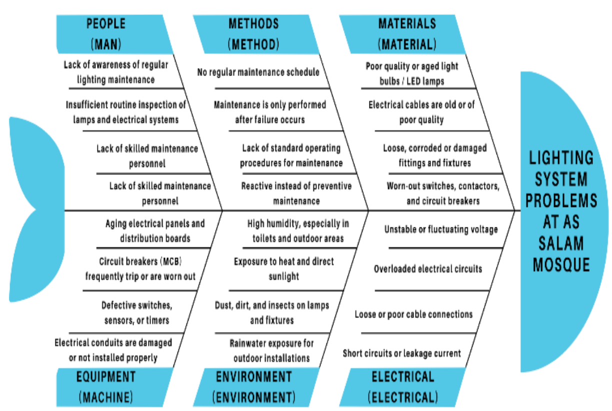
Figure 6. Mosque garden and parking lights

Figure 6 shows the lighting system installed in the mosque's garden and parking lot areas. The lights are spread across a fairly large outdoor area and operate for long periods at night. Exposure to environmental conditions and the vastness of the installation area make inspection and maintenance more challenging, thereby increasing the likelihood of malfunctions that could affect lighting quality and user safety.

A. Fishbone Analysis

The fishbone analysis identified several potential factors that may cause failures in the lighting system installed at Masjid As Salam. These factors are associated with human resources, maintenance methods, materials, equipment, environmental conditions, and electrical systems, which may affect the reliability of the lighting system. [4]

Figure 6. Fishbone Diagram



Where fishbone has 6 types of problems, namely;

TABLE I
PEOPLE (MAN)

Problems	**Discussion**
1. Lack of awareness of regular lighting maintenance	Maintenance personnel are not fully aware of the importance of routine maintenance, causing potential failures to go unnoticed.
2. Insufficient routine inspection of lamps and electrical systems	Lighting and electrical components are not inspected regularly, increasing the possibility of undetected damage.
3. Lack of skilled maintenance personnel	Maintenance activities are performed by personnel with limited technical knowledge and experience.
4. Lack of maintenance training	Personnel have not received adequate training on lighting system maintenance procedures.

TABLE II
METODS (METODE)

Problems	**Explanation**
1. No regular maintenance schedule	Maintenance is performed irregularly without a planned schedule, reducing system reliability.
2 Maintenance is only performed after failure occurs	Maintenance follows a corrective approach instead of preventing failures before they occur.
3. Lack of standard operating procedures for maintenance	The absence of standardized procedures leads to inconsistent maintenance practices.
4. Reactive instead of preventive maintenance	Maintenance focuses on repairing failures rather than preventing them, resulting in higher downtime.

TABLE III
MATERIALS (MATERIAL)

Problems	Explanation
1. Poor quality or aged light bulbs / LED lamps	Low-quality or aging lamps experience reduced brightness and shorter service life.
2. Electrical cables are old or of poor quality	Deteriorated cables increase the risk of electrical faults and power losses.
3. Loose, corroded, or damaged fittings and fixtures	Damaged fittings create poor electrical contact and may cause lamp failure.
4. Worn-out switches, contactors, and circuit breakers	Electrical protection and switching devices lose their performance due to aging and frequent operation

TABLE IV
EQUIMENT (MACHINE)

Problems	Explanation
1. Aging electrical panels and distribution boards	Aging electrical equipment becomes less reliable and more susceptible to failures.
2. Circuit breakers (MCB) frequently trip or are worn out	Frequent tripping or worn MCBs interrupt power distribution and indicate possible electrical issues.
3. Defective switches, sensors, or timers	Malfunctioning control devices prevent the lighting system from operating properly.
4. Electrical conduits are damaged or improperly installed	Damaged or poorly installed conduits expose cables to environmental hazards and mechanical damage.

TABLE V
ENVIRONMENT (ENVIRONMENT)

Problems	Explanation
1. High humidity, especially in toilets and outdoor areas	High moisture levels accelerate corrosion and reduce the lifespan of electrical components.
2. Exposure to heat and direct sunlight	Continuous exposure to heat and sunlight accelerates material degradation.
3. Dust, dirt, and insects on lamps and fixtures	Dirt accumulation reduces lighting performance and may damage electrical components.
4. Rainwater exposure for outdoor installations	Water ingress increases the risk of short circuits and insulation failure.

TABLE VI
ELECTRICAL (ELECTRICAL)

Problems	Explanation
1. Unstable or fluctuating voltage	Voltage fluctuations may damage lamps and reduce their operating life.
2. Overloaded electrical circuits	Excessive electrical loads increase overheating and the possibility of circuit failure.
3. Loose or poor cable connections	Poor electrical connections generate excessive heat and unreliable operation.
4. Short circuits or leakage current	Electrical faults may cause equipment damage, power outages, and safety hazards.

B. FMEA Assessment and RPN (Risk Priority Number) Assessment

Assessments in the Failure Mode and Effects Analysis (FMEA) method were conducted using a qualitative scale converted into numerical values to evaluate each potential failure in the As Salam Mosque lighting system. The assessments were based on three main parameters: severity (S), occurrence (O), and detection (D).

Data were obtained through direct observation of the lighting system's condition at several installation locations, such as the dome area, restrooms, terrace, garden, and parking lot, and were supplemented by interviews with mosque administrators or maintenance staff and a literature review.

The Severity (S), Occurrence (O), and Detection (D) values were determined based on the results of observations and interviews, referring to FMEA assessment parameters, and were then used to calculate the Risk Priority Number (RPN) as the basis for determining the priority of addressing failure risks in the lighting system.

The explanation of S,O,D and RPN is as follows:

I.(S) as a symbol for severity level. Determining the severity level (S) of the impact of each failure mode at this stage aims to assess the severity level of the impact caused by the failure that occurs based on the S parameter criteria compiled in the table below.

TABEL VII
FMEA SEVERITY (S)

Value	Severity Level	Detailed Explanation / Impact
1	Negligible	No impact on lighting system performance or user activities.
2	Very Minor	Minor disturbance with almost no effect on illumination quality.
3	Minor	Slight reduction in lighting performance without affecting normal operation.
4	Low	Small decrease in illumination level but the lighting system continues to operate normally.
5	Medium	Noticeable reduction in lighting performance; lighting remains functional within acceptable limits.
6	Moderate	Lighting performance decreases and maintenance is required to restore normal operation.
7	Significant	Lighting reliability decreases, affecting user comfort and routine activities.
8	Major	Failure of multiple lighting fixtures significantly reduces illumination in the affected area.
9	Critical	Lighting failure in critical areas creates safety risks and severely disrupts activities.
10	xtremely Hazardou	Complete lighting system failure resulting in unsafe conditions and interruption of mosque activities.

I. (O) as a symbol for Occurrence. Determine the probability of failure (O) for each failure mode. At this stage, use the O parameter criteria to assess how often the failure is likely to occur. The figure below explains the O parameters that will be used

TABEL VIII
FMEA OCCURRENCE (O)

Value	Severity Level	Possible Failure Rate
1	Never	Failure has never occurred.
2	Almost Never	Failure occurs very rarely.
3	Very Low	Failure occurs only under unusual conditions.
4	Low	Failure rarely occurs.
5	Medium	Failure occurs approximately once a month.
6	Moderate	Failure occurs several times in one month.
7	Moderately High	Failure occurs at least once a week.
8	High	Failure occurs several times in one week.
9	Very High	Failure occurs almost every day.
10	Very Frequent	Failure occurs every day or during every operating period.

II. (D) as a symbol for Detection. At this stage, use the D parameter criteria to assess or measure the ability to control failure modes by considering all control aspects and other indicators inherent in the analyzed process. If control or detection indicators are absent or low, then the detection capability is also low. Below is a table of indicators (D) that will be used.

TABEL IX
FMEA DETECTION (D)

Value	Detection Level	Criteria Based on Current Control
1	Certain Detection	Failure is always detected before affecting the lighting system. Automatic warning is available.
2	Very Easy	Maintenance personnel can detect the failure at an early stage.
3	Easy	Failure can be identified through routine inspection or monitoring data.
4	Fairly Easy	Failure is detected during schedule maintenance.
5	Medium	Failure can be detected, but not immediately after it occurs.
6	Moderately Difficult	Failure requires detailed inspection to be identified.
7	Limited	Failure is identified only after users notice reduced lighting performance.
8	Highly Limited	Failure is detected only during periodic inspections.
9	Very Difficult	Failure is identified only after significant disruption to the lighting system.
10	Extremely Difficult	Failure is almost impossible to detect before complete system failure occurs.

III. Risk Priority Number (RPN)

Risk Priority Number (RPN) is used to determine the priority level of each identified failure mode. The RPN value is calculated by multiplying the three FMEA parameters: Severity (S), Occurrence (O), and Detection (D). Each parameter is rated on a scale of 1 to 10, where a higher RPN value indicates a higher level of risk and a greater need for corrective or preventive action [9].

$$\mathbf{RPN} = \mathbf{S} \times \mathbf{O} \times \mathbf{D}$$

Since each parameter is rated from **1 to 10**, the maximum possible RPN value is:

$$10 \times 10 \times 10 = 1000$$

while the minimum possible RPN value is:

$$1 \times 1 \times 1 = 1.$$

The Failure Mode and Effects Analysis (FMEA) method is applied to identify potential failure modes within the lighting system and evaluate their associated risks using the Severity, Occurrence, and Detection ratings. The calculated Risk Priority Number (RPN) is then used to rank failure modes according to their level of criticality. Failure modes with higher RPN values are considered higher priorities for corrective actions and risk mitigation. By identifying and addressing potential failures before they occur, the FMEA approach supports the principle of preventive risk management, thereby improving the reliability, safety, and overall performance of the lighting system.

III. RESULT AND DISCUSSION

A. Data Analysis FMEA Before Result

1. Severity Result

TABEL X
SEVERITY RESULT

No	Failure Mode	Potential Effect	S
1	Roof lighting near mosque dome	Reduced illumination around the mosque dome and delayed maintenance due to difficult access	9
2	Toilet lighting system	Reduced lighting quality and increased risk of electrical problems caused by humidity	8
3	Terrace lighting system	Inadequate illumination affecting user comfort and safety	7
4	Garden & parking lighting	Reduced outdoor visibility and increased security risk during nighttime	8
5	Lighting control panel	Disruption of electrical power distribution to several lighting circuits	8

The Severity (S) assessment indicates that the lighting system has moderate to high consequences when failures occur. The highest Severity value (9) is assigned to the roof lighting near the mosque dome because maintenance activities are difficult due to the elevated installation location. Failure of this lighting system may reduce illumination in an important area of the mosque while delaying repair activities.

The toilet lighting system, garden and parking lighting, and lighting control panel each receive a Severity value of 8 because failures in these systems can significantly affect lighting performance, user safety, and electrical system reliability. Meanwhile, the terrace lighting system has a Severity value of 7, indicating that failures mainly reduce lighting effectiveness without causing complete interruption of the electrical system.

To reduce the Severity level, the following actions are recommended:

1. Perform scheduled inspections for lighting installed at elevated locations.
2. Install weather-resistant lighting equipment in outdoor areas.
3. Replace deteriorated lighting fixtures and electrical components.
4. Improve maintenance planning for critical lighting locations.
5. Conduct preventive maintenance on the lighting control panel.

2. Occurances Result

TABEL XI
OCCURANCES RESULT

No	Potential Cause	O
1	Limited maintenance access to roof lighting	**7**
2	High humidity in the toilet area	**6**
3	Normal wear and loose electrical connections on terrace lighting	**5**
4	Continuous exposure to rain and sunlight	**6**
5	Aging components in the lighting control panel	**5**

The Occurrence (O) values range from 5 to 7, indicating that failures occur with moderate frequency. The highest Occurrence value (7) is associated with the roof lighting near the mosque dome, where maintenance is often delayed because of difficult access.

The toilet lighting system and garden & parking lighting receive Occurrence values of 6 because environmental conditions such as humidity, rain, and sunlight frequently contribute to equipment deterioration. Meanwhile, the terrace lighting system and lighting control panel receive Occurrence values of 5, indicating that failures occur occasionally and can generally be minimized through regular maintenance.

To reduce the Occurrence level, the following actions are recommended:

1. Schedule routine inspections for all lighting systems.
2. Improve preventive maintenance activities.
3. Replace aging electrical components before failure occurs.
4. Protect outdoor lighting equipment from environmental exposure.
5. Perform regular inspections of electrical wiring and connections.

3. Detection Result

TABEL XII
DETECTION RESULT

No	Current Control	D
1	Periodic inspection of roof lighting	**6**
2	Routine inspection of toilet lighting	**5**
3	Visual inspection of terrace lighting and wiring	**5**
4	Preventive maintenance for outdoor lighting	**6**
5	Inspection of lighting control panel	**4**

The Detection (D) values range from 4 to 6, indicating that most failures can be identified through routine inspections and preventive maintenance. The lighting control panel has the lowest Detection value (4), meaning that abnormalities can be detected relatively easily during electrical inspections.

The roof lighting near the mosque dome and garden & parking lighting receive Detection values of 6 because their installation locations make inspection more difficult, resulting in a lower probability of early failure detection. The toilet lighting system and terrace lighting system receive Detection values of 5.

To improve failure detection, the following actions are recommended:

1. Increase the frequency of lighting inspections.
2. Establish a preventive maintenance schedule.
3. Record inspection and maintenance activities systematically.
4. Replace deteriorated components before failure occurs.
5. Improve inspection procedures for elevated and outdoor lighting installations.

B. RPN Result

TABEL XIII
RPN RESULT

No	Failure Mode	S	O	D	RPN
1	Roof lighting near mosque dome	9	7	6	378
2	Toilet lighting system	8	6	5	240
3	Terrace lighting system	7	5	5	175
4	Garden & parking lighting	8	6	6	288
5	Lighting control panel	8	5	4	160

Based on the FMEA RPN table above, the Risk Priority Number (RPN) values are calculated as follows:

Row 1: $9 \times 7 \times 6 = 378$
Row 2: $8 \times 6 \times 5 = 240$
Row 3: $7 \times 5 \times 5 = 175$
Row 4: $8 \times 6 \times 6 = 288$
Row 5: $8 \times 5 \times 4 = 160$

Based on the FMEA analysis, the roof lighting near the mosque dome has the highest RPN value (378), indicating that it is the highest priority for improvement because its elevated location makes inspection and maintenance difficult. The garden and parking lighting has the second highest RPN (288) due to continuous exposure to outdoor weather conditions.

The toilet lighting system has an RPN value of 240, mainly because high humidity can reduce the reliability of electrical components. The terrace lighting system has an RPN value of 175, indicating a moderate risk that can be minimized through routine inspection and maintenance. Meanwhile, the lighting control panel has the lowest RPN value (160), but preventive maintenance is still necessary to ensure stable operation.

Overall, the FMEA results indicate that maintenance priorities should focus on lighting systems with high RPN values, particularly those located in difficult-to-access and outdoor areas. Regular inspections, preventive maintenance, and the use of appropriate electrical equipment are recommended to improve the reliability of the electrical system at As Salam Mosque.

C. Field Observation Record Before Improvement

Table 1. Field Observation Record Before Improvement

Month	Roof Lighting	Toilet Lighting	Terrace Lighting	Garden & Parking	Control Panel
October 2025	4	2	1	2	1
November 2025	4	3	1	2	1
December 2025	5	2	1	3	1
January 2026	4	2	1	2	1
February 2026	4	3	1	2	1
March 2026	4	2	1	2	1
April 2026	4	2	1	3	1
May 2026	5	3	1	2	1
June 2026	4	2	1	2	1
Total Failures	**38**	**21**	**9**	**20**	**9**

Table X presents the frequency of failures in the lighting system at As Salam Mosque during the observation period from October 2025 to June 2026. The results show that roof lighting experienced the highest number of failures, with a total of 38 occurrences, followed by toilet lighting (21 occurrences) and garden & parking lighting (20 occurrences). Meanwhile, the terrace lighting system and the lighting control panel each recorded 9 occurrences, indicating a lower frequency of failures compared to the other lighting components.

The high number of failures in the roof lighting indicates that this component requires greater maintenance attention due to its installation location, which is difficult to access. Failures in the toilet lighting and garden & parking lighting are influenced by environmental conditions such as humidity and outdoor weather exposure. These failure frequency data are used as the basis for the Failure Mode and Effects Analysis (FMEA) to evaluate the severity, occurrence, detection, and risk priority of each lighting system component.

D. Before And After maintenance

Table 2. Before And After maintenance

No	Before and After Improvement	Description
1		Before improvement, the floodlight installed near the mosque dome produced insufficient illumination due to

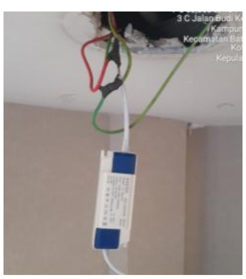
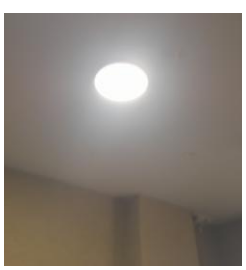
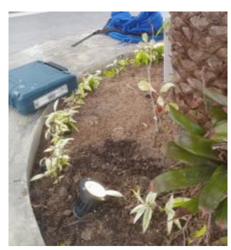
	 **Before**  **Repair**  **After**	weather exposure and aging components. After improvement, the damaged floodlight was replaced with a new LED floodlight, providing brighter illumination and improving the reliability of the roof lighting system.
2	 **Before**  **Repair**  **After**	Before improvement, the toilet lighting failed because the ballast box was damaged, causing the lamp to stop operating. After improvement, the damaged ballast box was replaced with a new driver, restoring normal lighting performance.
3	 **Before**  **Repair**  **After**	Before improvement, the terrace lighting did not operate properly due to a failed LED panel. After improvement, the non-functional lighting unit was replaced with a new LED panel, resulting in adequate illumination and improved lighting reliability.
4	 **Before**  **After**	Before improvement, the garden lighting system experienced reduced performance due to continuous exposure to rain and sunlight. After improvement, the damaged garden light was replaced with a weather-resistant fixture, improving illumination and system durability.

Table XV presents the comparison of the lighting system condition before and after the implementation of the proposed corrective actions. The improvements were carried out based on the recommendations obtained from the FMEA analysis to reduce the risk of failure in the electrical lighting system at As Salam Mosque.

The maintenance activities included replacing the damaged floodlight near the mosque dome, replacing the faulty ballast box in the toilet lighting system, installing a new LED panel for the terrace lighting, replacing the weather-damaged garden lighting, and performing preventive maintenance on the lighting control panel. These corrective actions successfully restored the functionality of the lighting system and improved the overall lighting performance.

After the improvements, all repaired lighting components operated normally and provided better illumination than before maintenance. In addition, preventive maintenance on the lighting control panel improved the reliability of electrical power distribution. These improvement results became the basis for evaluating the Risk Priority Number (RPN) after maintenance to determine the effectiveness of the corrective actions.

E. FMEA and RPN After Improvement

TABEL XIV
RPN AFTER

No	Failure Mode	S	O	D	RPN
1	Roof lighting	9	4	3	**108**
2	Toilet lighting	8	3	3	**72**
3	Terrace lighting	7	3	2	**42**
4	Garden & parking lighting	8	3	3	**72**
5	Lighting control panel	8	2	2	**32**

Table XVI presents the Risk Priority Number (RPN) after implementing the proposed maintenance improvements. The results indicate that all failure modes experienced lower Occurrence (O) and Detection (D) values, while the Severity (S) values remained unchanged because the impact of each failure mode did not change. Consequently, the RPN values decreased significantly. The roof lighting remained the highest-risk component with an RPN of 108, followed by the toilet lighting and garden & parking lighting with an RPN of 72 each. The terrace lighting and lighting control panel achieved the lowest RPN values of 42 and 32, respectively. These results demonstrate that the implemented maintenance actions effectively reduced the failure risk and improved the reliability of the electrical lighting system at As Salam Mosque

F. Comparison of Before and After Improvement

TABEL XV
RPN AFTER

No	Failure Mode	RPN Before	RPN After	Reduction (%)
1	Roof lighting	378	108	**71.4**
2	Toilet lighting	240	72	**70.0**
3	Terrace lighting	175	42	**76.0**
4	Garden & parking lighting	288	72	**75.0**
5	Lighting control panel	160	32	**80.0**

The percentage reduction in RPN was calculated using the following equation:

$$\text{Reduction } (\%) = \frac{\text{RPN Before} - \text{RPN After}}{\text{RPN Before}} \times 100\%$$

Table XVII compares the Risk Priority Number (RPN) values before and after implementing the proposed maintenance improvements. The results show that all failure modes experienced a significant reduction in RPN, indicating that the corrective actions effectively reduced the overall failure risk.

The roof lighting RPN decreased from 378 to 108 (71.4% reduction), while the toilet lighting decreased from 240 to 72 (70.0% reduction). The terrace lighting showed a reduction from 175 to 42 (76.0%), and the garden & parking lighting decreased from 288 to 72 (75.0%). The lighting control panel achieved the greatest improvement, with its RPN decreasing from 160 to 32, corresponding to an 80.0% reduction.

Overall, the comparison demonstrates that the implementation of preventive maintenance, component replacement, and improved inspection procedures successfully reduced the occurrence and detection of potential failures. These improvements significantly enhanced the reliability and operational performance of the electrical lighting system at As Salam Mosque.

G. Field Observation Record After Improvement

Table 3. Before And After maintenance

Month	Roof Lighting	Toilet Lighting	Terrace Lighting	Garden & Parking	Control Panel
October	1	1	0	1	0
November	1	0	1	0	0
December	1	1	0	1	0
January	0	0	1	0	0
February	1	1	0	0	1
March	0	0	0	1	0
April	1	1	1	0	0
May	0	0	0	1	0
June	1	0	0	0	0
Total Failures	**6**	**4**	**3**	**4**	**1**

Table XVIII presents the field observation records after implementing the proposed maintenance improvements. The observation results indicate a substantial reduction in the number of failures compared with the condition before improvement. During the observation period, roof lighting recorded the highest number of failures with 6 occurrences**,** followed by toilet lighting and garden & parking lighting, each with 4 occurrences. Meanwhile, terrace lighting experienced 3 failures**,** and the lighting control panel recorded only 1 failure, indicating the lowest failure frequency.

Compared with the observation results before improvement, the total number of failures decreased significantly for all lighting components. This reduction demonstrates that the corrective and preventive maintenance actions, including component replacement, routine inspections, and improved maintenance procedures, effectively reduced the occurrence of failures. The field observation results support the FMEA analysis, showing that the implemented improvements successfully enhanced the reliability and operational performance of the electrical lighting system at As Salam Mosque.

IV. CONCLUSION

Based on the field observation and FMEA analysis, the implementation of preventive maintenance successfully reduced the failure risk of the mosque electrical lighting system. The improvement process decreased the number of failures in all areas, including roof lighting, toilet lighting, terrace lighting, garden and parking lighting, and the lighting control panel. The RPN values also decreased significantly after improvement, with the highest risk reduction achieved by the lighting control panel at 80%, followed by terrace lighting at 76%. These results indicate that preventive maintenance and the FMEA method are effective in identifying, controlling, and reducing electrical failure risks, while improving the reliability, safety, and operational performance of the lighting system.

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REFERENCES

[1] R. A. Duyo, "Analisis Penyebab Gangguan Jaringan pada Distribusi Listrik menggunakan Metode Fault Tree Analysis di PT. PLN (Persero) Rayon Daya Makassae," Vertex Elektro, vol. 12, no. 02, pp. 1–12, 2020.

[2] C. Zhang, "Review of Structural Fire Hazards , Challenges , and Prevention Strategies," J. Fire, vol. 6, no. 137, pp. 1–15, 2023.

[3] D. E. Anyeler and D. B. Santoso, "PERENCANAAN SISTEM SOLAR PANEL ON – GRID FIXED ARRAY SEBAGAI PEMBANGKIT LISTRIK TENAGA SURYA PADA PEMBANGUNAN RUMAH SUSUN XYZ DI JAKARTA," JITET (Jurnal Inform. dan Tek. Elektro Terap., vol. 13, no. 3, pp. 2197–2211, 2025.

[4] A. Ariz, P. Siagian, and M. E. Dalimunthe, "Analisis Instalasi Sistem Kelistrikan dan Kualitas Isolasi Kabel Sementara : Kesenjangan Antara Perencanaan dan Pengerjaan pada Proyek Konstruksi PT . Growth Asia," JITET (Jurnal Inform. dan Tek. Elektro Ter., vol. 13, no. 385, 2025.

[5] A. Mehbodniya, A. Paeizi, M. Rezaie, M. Azimian, and H. Masrur, "Active and Reactive Power Management in the Smart Distribution Network Enriched with Wind Turbines and Photovoltaic Systems," J. Sustain., vol. 14, no. 4273, 2022.

[6] K. Chang, T. Fang, and Z. Li, "Using a Flexible Risk Priority Number Method to Reinforce Abilities of Imprecise Data Assessments of Risk Assessment Problems," J. Electron., vol. 14, no. 518, 2025.

[7] S. Sugianto and A. Mu'is, "PERENCANAAN SISTEM DISTRIBUSI LISTRIK PELAKSANAAN PROYEK APARTEMEN," Sinusoida, vol. XIX, no. 2, pp. 69–77, 2017.

[8] S. Hamid, J. Jamaaluddin, D. Hadidjaja, R. Saputra, and A. Wisaksono, "Analysis of DC MCB Usage Characteristics for AC and DC Load Usage Analisis Karakteristik Pemakaian MCB DC Untuk Pemakaian Beban AC dan DC," Procedia Eng. Life Sci., vol. 2, no. 2, pp. 3–8, 2022.

[9] M. Z. Degefa, I. B. Sperstad, and H. Sæle, "Comprehensive classifications and characterizations of power system flexibility resources," Electr. Power Syst. Res., vol. 194, no. 10.1016/j.epsr.2021.107022. December 2020, p. 107022, 2021, doi:

[10] N. Asyikin, M. Radzi, S. Member, and A. M. Zainal, "Active Electric Distribution Network : Applications , Challenges , and Opportunities," IEEE Access, vol. 11, no. December 2022, 2023.

[11] A. Alabsi et al., "Wireless Power Transfer Technologies , Applications , and Future Trends : A Review," IEE, pp. 1–20, 2022.

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BORANG REVISI PROPOSAL/ PROYEK AKHIR

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Judul : Identification and Prioritization of Component Failure Risks in the Electrical System at the As Salam Mosque Using the FMEA Approach
Pembimbing 1 : Widya Rika Puspita, S.Pd., M.Si.,Ph.D Pembimbing
Pembimbing 2 :
Penguji 1 : Muhammad Arifin,S.Si., M.Si. Penguji 2
Penguji 2 : Nadrah Wivanius, S.Si.,M.Si

No.	Pemberi saran/komentar/catatan revisi	Catatan perbaikan saat seminar	Perbaikan yang dilakukan	Paraf pembimbing / Tanggal acc	Paraf penguji / Tanggal acc
1.	Muhammad Arifin,S.Si., M.Si.	Tolong dirapikan proposalnya sesuai dengan templet	Saya sudah melakukan perapian terhadap proposal saya sesuai templet.		
2.	Nadrah Wivanius, S.Si.,M.Si	Buatlah table data yang menunjukkan adanya masalah tersebut disana	Saya sudah table data sesuai arahan yang tertuju pada proposal terbaru saya, di halaman 13 dibagian Data Collection		
		Buatlah Fishbone untuk mengetahui kemungkinan penyebabnya	Saya sudah membuat fishbone sesuai arahan yang tertuju pada proposal terbaru saya ,di halaman 14 dibagian Analysis Defect		
		Kemudian buat table FMEA nya	Saya sudah membuat table FMEA sesuai arahan di halaman 15 dibagian FMEA Data Analysis		

Job Assignment Matrix

Company Name: PT Putra Kelana Makmur Group
Department: General Affairs
Effective Date: 1 October 2026

No.	Employee Name	Department	Job Title	Assigned Work / Responsibility
1	Abdul Syamsudin	General Affair	Maintenance Electrical	Conducted observations and inspections of the lighting system, collected failure data, documented inspection results, assisted in maintenance activities, and performed functional testing of the lighting system as part of the Final Project preparation.
2	Yunan Alrifan	General Affair	KA General Affair	Provided guidance and approval during the implementation of the Final Project, coordinated maintenance activities, facilitated the data collection process, and ensured that all activities were carried out according to company procedures and Occupational Health and Safety (OHS/K3) standards.
3	Megi Dugusra	General Affair	Maintenance Electrical	Assisted Abdul Syamsudin during observations, inspections, failure identification, and preventive and corrective maintenance activities. In addition, provided technical guidance during the repair process and functional testing of the lighting system to ensure that the work was performed correctly and according to procedures.
4	Agil Wahdatul Prizelia	Human Resources Development	HRD	Assisted with internship administration processes, coordinated communication between the student and the company, and ensured that all internship activities were

				conducted in accordance with company policies and regulations.

Prepared By	Approved By
Name: **Abdul Syamsudin** Position: **Maintenance Electrical** Date: **19 July 2026**	Name: **Agil Windatri Prizelia, S.Psi** Position: **Human Resources Development (HRD)** Date: 07 - 08 - 2026

PKM
PUTRA KELANA MAKMUR

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08 September 2021

BERITA ACARA PENYERAHAN HASIL PROYEK

Nomor: -

Tanggal 7/8.. 2026

PELAKSANAAN KEGIATAN

MAGANG DAN PROYEK AKHIR

Pada hari ini Jumat tanggal Tujuh bulan Delapan tahun 2026, yang bertandatangan di bawah ini:

1. Nama : Abdul Syamsudin
   Jabatan : Magang Maintenance Electrical
   Alamat : Kepulauan Riau,Batam,Sungai Panas,Baloi Kolam ,RT 02,RW 16,Blok A,

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2. Nama : Agil Windatri Prizelia, S.Psi
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14 Juli 2023

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*Jika ada

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