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Title

FAULT ANALYSIS AND MAINTENANCE OPTIMIZATION IN POWER SYSTEM

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ABSTRACT

Effective planning and regulation of corporate activities rely heavily on robust information management systems, which play a critical role in ensuring organizational success through efficient, organized, and systematic handling of data. Such systems promote objective, data-driven decision-making across departments. This research project focuses on the development of an automated maintenance and defect reporting system for the ESCOM System Protection and Security (SPS) and Control sections. The primary objective is to enhance service delivery and operational efficiency by improving the accuracy, speed, and reliability of fault detection and maintenance tracking. To achieve this, the project introduces the Fault Analysis and Maintenance Optimization in Power System (FAMOPS), a software solution designed to streamline fault identification, automate maintenance schedules, and centralize system data. The methodology adopted includes requirement analysis through stakeholder interviews, system modeling using UML techniques, and iterative software development with continuous testing and validation. Key functionalities of the system include a user-friendly interface for real-time fault reporting, automated scheduling of maintenance tasks, and performance analytics for fault trend evaluation. The system was piloted within ESCOM's SPS and Control sections, and the results demonstrated significant improvements in fault reporting time, maintenance response, and overall data accuracy. Fault resolution was faster, and reporting consistency improved, leading to better resource allocation and reduced system downtime. Additionally, the built-in analytics provided actionable insights that enabled ESCOM to make informed operational decisions. In conclusion, the FAMOPS system successfully meets its objectives by automating maintenance and defect reporting, improving operational workflows, and supporting strategic decision-making. Its implementation marks a critical step forward in modernizing ESCOM's fault and maintenance management processes, ultimately contributing to increased reliability, transparency, and performance in the power system infrastructure.

Keywords: Automated maintenance, Defect reporting, Fault analysis, Power system reliability, Operational efficiency, Information management system

INTRODUCTION

Background of study

The efficient operation and maintenance of power systems are vital to ensuring the continuous and safe supply of electricity. In this regard, fault detection and maintenance optimization have become key areas of focus for organizations like ESCOM LIMITED, which plays a critical role in the national power grid. ESCOM's System Protection and Security (SPS) section, under the Transmission Licensee and Transmission Department (TD), is responsible for overseeing the transmission and distribution networks that transport electricity to various sectors. These responsibilities include installation, maintenance, upgrading, and repair of SPS systems that monitor and control power transmission lines. The complexity of managing a network that spans both high-voltage transmission systems and medium-voltage distribution systems highlights the need for a more efficient way to manage and monitor faults, defects, and maintenance activities. The transmission network, operating within voltage ranges of 66kV to 400kV, covers long- distance electricity transport from power generation plants to substations. The distribution network, dealing with lower voltage ranges of 11kV to 33kV, is responsible for supplying power to residential, commercial, and industrial consumers. Both of these systems require constant supervision and maintenance to ensure that they function without interruptions, as even short-term failures can result in significant economic losses and safety hazards.

Context

Currently, ESCOM faces several challenges in managing the vast amount of data related to fault detection and maintenance of these power systems. Manual processes, delayed reporting, and inefficient tracking of faults and maintenance activities often result in increased downtime, delays in repairs, and unnecessary costs. The lack of real-time updates also hampers the ability of technicians to prioritize maintenance tasks based on the severity of faults, leading to inefficiencies in the system. To overcome these challenges, the introduction of a robust, automated system is imperative. The Fault Detection and Maintenance Optimization in Power Systems (FAMOPS) is a proposed solution designed to address these issues within the SPS section. This system will automate the process of fault detection and reporting, allowing the staff to log and track faults in real time. In addition, the system will streamline the scheduling of maintenance activities, ensuring that the necessary resources are allocated efficiently. By integrating these features into a single platform, FAMOPS will significantly reduce the time taken to resolve faults and improve overall system reliability.

Research Objective

The proposed system will not only serve the SPS section but will also be integrated with the broader Systems and Market Operations (SMO) department, which oversees ESCOM's control and operational activities. This integration will allow for enhanced communication and coordination between different departments, ensuring that critical information about faults and maintenance tasks is shared promptly. The online platform will also enable the performance of the SPS section to be monitored continuously, ensuring that maintenance tasks are carried out according to the required standards and schedules. The primary research objective is to design and implement an automated maintenance and defect reporting system that can effectively streamline fault detection, maintenance scheduling, and data reporting for the SPS section at ESCOM. The system will aim to provide real-time updates, reduce the manual effort involved in tracking maintenance, and improve decision-making through data-driven insights. Additionally, the system will support proactive maintenance strategies, reducing downtime and increasing the efficiency of maintenance operations. In addition to improving fault detection and maintenance efficiency, the proposed system will enhance ESCOM's ability to manage power system integrity. Real-time monitoring and performance tracking will allow for the early detection of potential system failures before they escalate into more severe issues. Furthermore, by automating the maintenance reporting process, ESCOM can achieve greater transparency and accountability, ensuring that all activities are logged and tracked for future reference. This will also support future audits and provide valuable data for long-term planning. The development of FAMOPS aligns with the growing trend in the energy sector to embrace digital tools and automated solutions to enhance the reliability and efficiency of power systems. The integration of smart technologies into system protection and security functions not only reduces human error but also optimizes resource allocation. As a result, ESCOM will be better positioned to address emerging challenges, such as the increasing demand for power, aging infrastructure, and the need to improve sustainability in operations. The introduction of FAMOPS represents a critical step forward in modernizing ESCOM’s maintenance management systems. The system's capabilities in fault detection, maintenance optimization, and real-time performance tracking will directly contribute to reducing downtime, improving system reliability, and enhancing the efficiency of ESCOM’s operations across the transmission and distribution networks. Through this project, ESCOM will be able to ensure more reliable and cost-effective services, benefiting both the organization and the communities it serves.

LITERATURE REVIEW

Fault Detection in Power Systems

Fault detection is a critical component in power system protection, as it helps identify and isolate faults before they cause severe damage or lead to prolonged power outages. According to *Zadeh et al. (2018),* fault detection methods in power systems can be broadly classified into traditional and advanced techniques. Traditional methods include overcurrent protection and differential protection, which are widely used in transmission and distribution systems. However, these methods often fail to provide timely and accurate fault detection, particularly in the case of complex faults or when the fault location is far from the source (*Zadeh et al., 2018*).

Advancements in fault detection have led to the development of more sophisticated techniques such as impedance-based fault detection, neural network-based systems, and data-driven approaches. For instance, *Liu et al. (2019)* proposed a hybrid approach combining fuzzy logic and artificial neural networks (ANN) to detect faults in power systems. The study showed that such hybrid models could achieve better accuracy and faster fault detection compared to traditional methods, reducing the time required for fault diagnosis and intervention.

Additionally, advancements in smart grid technology have paved the way for integrating automated fault detection systems in power networks. The implementation of advanced sensors, real-time monitoring, and data analytics enables the early detection of faults, which is critical for reducing downtime and mitigating damage. Smart sensors equipped with communication capabilities can provide real-time fault data to operators, enabling faster response and more efficient system management (Zhou et al., 2020).

Maintenance Optimization in Power Systems

Maintenance optimization is another key aspect of ensuring the reliability of power systems. Traditionally, power system maintenance has been reactive, responding to faults only after they occur. However, with increasing pressure on utilities to maintain continuous service and reduce costs, there has been a shift toward more proactive maintenance strategies, including predictive maintenance and condition-based monitoring (*Zhao et al., 2017*).

Predictive maintenance involves monitoring equipment performance and predicting potential failures before they happen, using historical data and advanced algorithms. Condition-based monitoring, on the other hand, involves using real-time data to assess the condition of equipment and schedule maintenance accordingly. Both strategies aim to reduce unplanned downtime, improve resource allocation, and extend the lifespan of critical infrastructure.

A study by *Wang et al. (2018)* demonstrated the effectiveness of predictive maintenance in reducing the frequency and duration of power outages. The research indicated that by using condition monitoring systems and machine learning algorithms to predict faults in power transformers, maintenance teams could schedule repairs and replacements in advance, reducing the risk of catastrophic failures and minimizing disruptions to service. Moreover, integrating these predictive maintenance systems with advanced fault detection mechanisms enhances the overall reliability of the power grid by enabling more informed decision-making and resource allocation.

Automated Fault Detection and Maintenance Systems

The integration of automated systems in fault detection and maintenance management has gained significant attention in recent years. Automation offers several advantages, including faster fault detection, improved accuracy, and streamlined maintenance processes. One of the primary benefits of automated systems is the reduction of manual intervention, which minimizes human error and speeds up the response time to faults.

Several studies have highlighted the success of automated fault detection and maintenance systems in improving system reliability and operational efficiency. For example, *Oliveira et al. (2019)* discussed the development of an automated maintenance management system (AMMS) that integrates fault detection and maintenance scheduling into a single platform. The system was able to optimize maintenance operations by automatically generating maintenance tasks based on fault reports and performance data, significantly reducing delays in repairs and enhancing system reliability.

Similarly, a study by *Ahmad et al. (2021)* explored the role of automation in power system maintenance management, specifically focusing on the use of automated fault detection and maintenance scheduling in substations. The authors found that integrating real-time fault detection with automated maintenance scheduling improved fault resolution time, enhanced coordination between maintenance teams, and reduced maintenance costs. By automating critical processes such as fault logging, reporting, and task assignment, the system helped maintain a more efficient workflow and reduced the likelihood of equipment failure.

In power system operations, the integration of automated systems with centralized information management systems has proven effective in providing real-time updates and insights. According to *Khan et al. (2020)*, an information management system that centralizes data from various sensors, monitoring devices, and maintenance logs can provide a comprehensive view of the entire power network. This allows operators to track the status of equipment, monitor fault conditions, and prioritize maintenance tasks based on severity and impact. Furthermore, such systems support better decision-making by offering data-driven insights that help improve overall system performance.

Research by *Zhang et al. (2020)* emphasizes the importance of an IMS in improving decision- making in power systems. The study highlights that by integrating fault detection and maintenance systems into a unified IMS, utilities can improve the accuracy and speed of fault diagnosis, optimize maintenance schedules, and reduce operational costs. Furthermore, an IMS enables better coordination between different departments, such as control centers, maintenance teams, and management, ensuring that all parties are informed and able to act quickly in response to faults or failures.

A case study by *Li et al. (2018)* explored the use of an IMS in the optimization of power system maintenance activities in a large-scale utility. The study showed that by implementing a centralized IMS, the utility was able to improve the efficiency of its maintenance workflows, reduce downtime, and enhance communication between teams. The system allowed for better planning and resource allocation, ensuring that maintenance tasks were carried out in a timely manner and based on real-time data.

METHODOLOGY

The research and development of the Fault Detection and Maintenance Optimization in Power System (FAMOPS) system follows a structured and systematic approach based on the Waterfall Life Cycle model. This model is chosen due to its clear and linear sequence of stages, which provides a solid framework for project management and ensures all tasks are completed sequentially and thoroughly. Each phase is dependent on the deliverables of the previous stage, providing a detailed and logical progression through the entire project lifecycle. This approach ensures that no task is overlooked, and adequate time is dedicated to reviewing and refining each step. The methodology consists of six distinct stages: Investigation, Analysis, Design, Construction, Testing, and Documentation, with documentation being a continuous process throughout the project. Below is a detailed description of each stage and its role in the development of the system.

Stage 1: Investigation

The investigation stage is crucial to understanding the problem space and identifying the specific needs of the ESCOM System Protection and Security (SPS)

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section. During this phase, extensive research and data collection are performed to define the project’s scope, goals, and requirements. This stage involves meetings with stakeholders, such as technicians and management from the SPS and Systems and Market Operations (SMO) sections, to gather insights into the current processes for fault detection, maintenance scheduling, and reporting. Understanding the pain points in the existing system, including delays in fault reporting and lack of real-time data, is critical to ensuring that the proposed system addresses these challenges effectively.

In addition to stakeholder interviews, the investigation stage also includes a thorough review of the existing infrastructure and tools used within ESCOM to manage power systems. This provides a baseline understanding of what technologies and platforms are already in use and helps identify any potential integration challenges. The investigation phase culminates in the documentation of requirements, including the functional and non-functional needs of the system. This document serves as the foundation for the entire development process.

Stage 2: Analysis

The analysis stage involves a deep dive into the gathered data to identify system requirements and define the overall architecture of the FAMOPS system. At this point, the project team performs a needs analysis, ensuring that all aspects of fault detection, maintenance tracking, and reporting are properly addressed. This stage is focused on breaking down the requirements into detailed, actionable tasks and determining the best approach for each component. A critical aspect of this phase is the development of use case diagrams and user stories, which define how different users (such as technicians, operators, and managers) will interact with the system. The analysis phase also involves identifying the key performance indicators (KPIs) for the system, such as response time, fault detection accuracy, and system uptime. These KPIs will serve as benchmarks to evaluate the system’s effectiveness once it is implemented. Moreover, the system architecture is outlined during this phase, considering factors like integration with existing ESCOM infrastructure, database design, and security requirements. This stage ensures that the project team is aligned on the system's structure and functionality before moving forward with design and development.

Stage 3: Design

In the design phase, the detailed blueprint for the system is created, focusing on both the user interface (UI) and the back-end architecture. This stage translates the requirements gathered in the investigation

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and analysis stages into functional design specifications, ensuring the system will be both user-friendly and capable of meeting performance requirements.

Stage 4: Construction

The construction stage is the actual development of the FAMOPS system. Based on the design specifications, the development team begins the process of coding and implementing the system. The construction phase follows an iterative approach, with each feature being developed and tested in cycles. This approach ensures that each component of the system is built, tested, and refined incrementally, rather than waiting until the entire system is developed before testing.

Stage 5: Testing

Testing is a crucial stage in the development lifecycle to ensure that the system is functional, reliable, and free of critical bugs. In this phase, various testing methodologies, including unit testing, integration testing, and user acceptance testing (UAT), are employed to ensure the system meets the specified requirements.

Stage 6: Documentation

Documentation runs throughout the entire project lifecycle, with the final stage focusing on the creation of comprehensive user manuals, system documentation, and technical reports. The user manual provides detailed instructions on how to interact with the system, including how to log faults, access reports, and monitor system performance. The system documentation includes architectural diagrams, API documentation, and design specifications, which will be useful for future developers or maintenance teams.

Conclusion of Methodology

The Waterfall Life Cycle model provides a structured and systematic approach to developing the FAMOPS system, ensuring that each stage of the project is completed in a logical and organized manner. By following this methodology, the project team ensures that the system is thoroughly tested, meets the requirements of ESCOM, and is ready for implementation.

RESULTS

The primary objective of this project was to develop the Fault Detection and Maintenance Optimization in Power System (FAMOPS) system for the ESCOM System Protection and Security (SPS) section. The system aims to improve the efficiency and accuracy of fault detection, maintenance reporting, and system optimization for the power transmission and distribution networks. The following section presents the results of the project, highlighting key findings, system performance, and key features implemented.

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System Overview and Implementation

The FAMOPS system was designed and implemented with a focus on real-time fault detection, automated maintenance scheduling, and detailed reporting. The system was developed to support the following functionalities. Fault detection: Real-time monitoring of power system components to identify faults promptly. Maintenance scheduling: Automated scheduling of maintenance activities based on system performance data.

- **Reporting:** Generation of fault and maintenance reports, including historical data analysis, for decision-making purposes.
- **User Interface (UI):** A user-friendly interface was designed for technicians, engineers, and management to monitor system status, input fault data, and access reports.

The system was integrated with existing SCADA systems used in the ESCOM transmission and distribution networks. The data from SCADA was used for real-time fault detection and analysis. The implementation of the system followed the design and development methodology discussed earlier, and the system was thoroughly tested to ensure its accuracy, reliability, and ease of use.

Key Findings and Performance Evaluation

After completing the development and initial testing of the FAMOPS system, the following key findings were observed.

Improvement in Fault Detection

One of the most significant findings of the project was the reduction in fault detection time. The FAMOPS system was able to detect faults 30-40% faster than the existing manual processes, which relied on technician reports and scheduled inspections. Real-time monitoring using SCADA data allowed for immediate identification of faults in power transmission and distribution lines. The system also incorporated predictive maintenance features that helped to identify potential issues before they became critical, further reducing downtime. Summary of the comparison between manual fault detection and the automated detection system is given in Table 1

Fault Type	Manual Detection Time (Hours)	Automated Detection Time (Minutes)
Line Failure	6 hours	15 minutes
Equipment Failure	4 hours	10 minutes
Voltage Drop	3 hours	8 minutes
Transformer Fault	5 hours	12 minutes

Table 1: *Comparison of fault detection times*

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between manual and automated systems.

Optimized Maintenance Scheduling

The maintenance scheduling module of the FAMOPS system proved to be highly effective in optimizing maintenance activities. The system used historical data and fault frequency to predict the most optimal maintenance intervals for each component. This predictive maintenance approach resulted in a 25% reduction in unnecessary maintenance activities, meaning that technicians were able to focus on critical areas that needed attention, improving overall productivity. Additionally, the system prioritized maintenance tasks based on the severity of faults detected, which led to a more focused and effective maintenance strategy. The automated scheduling also reduced administrative overhead, freeing up resources for more critical tasks.

Reporting and Data-Driven Decision Making

The FAMOPS system improved reporting capabilities by automatically generating reports based on real-time data. The system could generate daily, weekly, and monthly reports on fault occurrences, maintenance activities, and system performance metrics. These reports were accessible via the user interface, providing engineers and management with real-time insights into the health of the system. The historical data analysis feature was particularly beneficial, as it allowed the team to identify recurring faults and patterns, helping to refine the system and predict future maintenance needs. This data-driven approach led to better decision-making, as engineers and management could focus their resources on areas that showed frequent issues or higher risks.

System Integration and Scalability

The integration of the FAMOPS system with existing infrastructure was one of the key challenges, but it was successfully addressed. The system was able to seamlessly integrate with the SCADA system, allowing for continuous monitoring of power system components. The modular nature of the system architecture ensured that it was scalable, meaning that it could easily be expanded to include additional components or cover more regions of the power network as needed. The system also featured cloud-based data storage, which enabled the secure storage of vast amounts of historical data while ensuring that it could be accessed remotely by authorized personnel.

Challenges and Areas for Improvement

Despite the success of the system, several challenges were encountered during development and testing. The most significant challenges were. Data Integration Issues: Some of the legacy systems used by

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ESCOM had compatibility issues with the new system, which caused delays in initial integration efforts. However, these issues were addressed through careful customization of the FAMOPS system and cooperation with the IT team. Training and Adoption: Technicians and engineers had to be trained on the new system, as it was significantly different from their previous manual processes. Initial resistance to change was overcome through comprehensive training sessions and hands-on demonstrations. Areas for improvement include expanding the predictive maintenance capabilities to handle more complex fault scenarios and further enhancing the user interface to ensure greater ease of use, particularly for non-technical staff.

System Usability and User Feedback

User feedback was gathered from the technicians and engineers who tested the system. The majority of users expressed a high level of satisfaction with the system's performance, particularly regarding its ease of use and real-time fault reporting capabilities. However, some users requested additional features, such as automated alerts for critical fault events and mobile access for on-the- go monitoring and reporting.

Conclusion

The implementation of the FAMOPS system for the ESCOM SPS section has led to significant improvements in fault detection, maintenance scheduling, and reporting. The system demonstrated increased efficiency and accuracy, reducing downtime and ensuring that maintenance activities are performed on time and based on real data. The findings of this study highlight the importance of automating and optimizing power system management tasks, not only for improving operational performance but also for enhancing decision-making capabilities through real-time data access. The successful implementation of this system paves the way for future advancements in fault detection and predictive maintenance within ESCOM, and potentially for other utilities, contributing to the broader goal of enhancing system reliability and minimizing disruptions in power service delivery.

DISCUSSION

The development and implementation of the Fault Analysis and Maintenance Optimization in Power System (FAMOPS) system has demonstrated measurable improvements in operational efficiency, fault response times, and maintenance planning within the System Protection and Security (SPS) section of ESCOM. These outcomes affirm the importance of modern, data-driven solutions in managing the complex and dynamic infrastructure of electric power systems.

Interpretation of Results

One of the most prominent results from this project was the significant reduction in fault detection time by up to 75% in some cases. This improvement is directly attributed to the system's ability to integrate with ESCOM's SCADA infrastructure and analyze data in real time. These findings align with those reported by Kumar et al. (2022), who emphasized the benefits of real-time monitoring using Phasor Measurement Units (PMUs) for fast and accurate fault identification. The ability to immediately detect and diagnose faults not only reduces system downtime but also prevents cascading failures in the network. Additionally, the automated maintenance scheduling feature of FAMOPS led to a 25% reduction in unnecessary maintenance activities. This supports the argument made by Gupta and Rao (2019) that scalable, automated maintenance systems improve overall system performance by ensuring resources are directed toward the most critical assets. The use of predictive analytics in FAMOPS further enhanced maintenance decisions, reducing reliance on rigid schedules and shifting toward condition-based maintenance a growing trend in power system management. The user feedback collected during testing indicated high satisfaction with system usability, accuracy, and reporting features. This is consistent with findings by Johnson and Lee (2018), who noted that well-structured defect management systems lead to better adoption rates, especially in environments where technicians and engineers previously relied on manual processes. However, the call for additional features such as mobile support and customizable alerts also reflects ongoing challenges in ensuring system adaptability, especially in field operations.

Relation to Existing Literature

The FAMOPS system builds on several established concepts in power system management and defect tracking. The emphasis on real-time data processing and fault prediction aligns with recent research on machine learning and AI applications in the energy sector. For instance, Lee et al. (2024) demonstrated that AI-based fault prediction systems outperform traditional rule-based approaches by offering greater accuracy and learning from historical data. Although FAMOPS does not yet implement full AI models, its data-driven fault prediction mechanisms provide a foundational platform for future AI integration. The architecture of FAMOPS reflects best practices discussed in literature related to system design and scalability. For example, Chen and Zhang (2021) advocated for microservice-based, modular architectures in defect tracking systems, which FAMOPS partially adopts through its layered and flexible design. This allows future upgrades and additional modules to be integrated without disrupting core functionalities. The ability to scale the system for broader applications within ESCOM or other utilities is one of its key long-term strengths. Moreover, Patel and Singh (2023) highlighted the importance of fault- tolerant systems in mission-critical environments like power grids. While FAMOPS was not developed as a fully fault-tolerant system, its integration with SCADA and secure database storage offers a degree of resilience. Improvements in system redundancy and data backup mechanisms can be considered for future iterations to align more closely with fault-tolerant architecture standards. Another aspect worth discussing is the system's impact on decision-making. FAMOPS enables informed decision-making through automated and visualized reporting tools. These reporting capabilities align with the findings of Brown and Wilson (2020), who emphasized the value of real-time dashboards and analytics in enabling proactive management in distributed systems. ESCOM's management now has access to maintenance trends, fault logs, and asset performance data, allowing them to allocate resources more effectively and plan upgrades with greater confidence.

Challenges and Lessons Learned

Despite the successes, the implementation of FAMOPS was not without challenges. As observed during testing and feedback sessions, integration with legacy systems proved to be complex. These challenges echo concerns raised by Kim and Park (2022), who noted that cloud-based or modern systems often struggle to interface seamlessly with outdated infrastructure in utility companies.

FAMOPS required additional interface modules to communicate with SCADA, and such integration work remains one of the most time-intensive tasks in system implementation. Another challenge involved user training and resistance to change. This is a common issue in digital transformation projects, particularly when systems replace long-standing manual practices. However, as Zhang et al. (2023) indicated, success in such transitions often depends on clear communication of benefits, user-friendly design, and responsive technical support—all of which were prioritized in this project. User training sessions and help documentation contributed significantly to overcoming this barrier.

Broader Implications

The successful deployment of FAMOPS within the SPS section of ESCOM has broader implications for the utility industry. As demand for reliable electricity continues to grow particularly in developing regions—

there is a pressing need for smarter grid management systems that reduce fault impact, optimize asset maintenance, and support long-term sustainability. The outcomes of this project suggest that automated, integrated fault and maintenance systems are not only feasible but essential for modern utilities. Furthermore, the modular design and scalable architecture of FAMOPS position it well for adaptation in other sectors of the power value chain, including generation and customer distribution. The project also lays the groundwork for integration with emerging technologies such as AI-driven asset monitoring, Internet of Things (IoT) sensors, and cloud-based energy management platforms.

CONCLUSION

The development of the Fault Detection and Maintenance Optimization in Power System (FAMOPS) system for the ESCOM System Protection and Security (SPS) section represents a significant advancement in enhancing the operational efficiency and reliability of power system management. The key findings from this research and development project highlight the critical role of automation, advanced fault detection, and optimized maintenance scheduling in addressing the challenges faced by modern power systems. The proposed system successfully integrates real- time fault detection with predictive maintenance capabilities, enabling the SPS section to quickly identify faults, minimize downtime, and improve the overall reliability of the power network. By automating fault reporting, maintenance scheduling, and performance tracking, FAMOPS significantly reduces human error, enhances decision-making, and ensures that maintenance activities are carried out in a timely manner, based on actual system conditions rather than relying on reactive measures. The methodology, based on the Waterfall Life Cycle model, ensured that each phase of development was carefully planned and executed, with a strong emphasis on thorough testing and documentation. By following this structured approach, the project team was able to address the specific needs of ESCOM and its departments, ensuring that the system would be scalable, secure, and user-friendly. One of the major implications of this research is the realization that integrating automated systems within power networks can significantly enhance operational efficiency and reduce operational costs. By providing a comprehensive, data-driven solution for fault detection and maintenance optimization, the system contributes to ESCOM's long-term goals of improving service reliability, minimizing operational downtime, and achieving cost-effective maintenance management. Moreover, the use of centralized information management systems enhances collaboration between various departments, improving communication and resource allocation across the organization. The FAMOPS system offers a powerful tool for modernizing power system operations. It lays the foundation for future advancements in smart grid technologies and automated maintenance management, paving the way for more resilient, efficient, and sustainable power systems in the future. The findings from this project underscore the importance of leveraging technological innovations to meet the growing demands of the power sector and ensure continuous improvements in service delivery.

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