Journal of Infrastructure, Policy and Development 2024, 8(7), 3880.
https://doi.org/10.24294/jipd.v8i7.3880

Article

Enhanced framework to mitigate maintenance strategy failure of electric power plant during crises

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CITATION

Al Ameeri TA, Ab Rahman MN, Muhamad N. (2024). Enhanced framework to mitigate maintenance strategy failure of electric power plant during crises. Journal of Infrastructure, Policy and Development. 8(7): 3880. https://doi.org/10.24294/jipd.v8i7.3880

ARTICLE INFO

Received: 28 December 2023
Accepted: 1 March 2024
Available online: 16 July 2024

Abstract: In engineering, a design is best described based on its alternative performance operation. In this paper, an electric power plant is analysed based on its effective operational performance even during critical situation or crisis. Data is generated and analysed using both quantitative and qualitative research approach. During maintenance operation of an electric power plant, some components are susceptible to wide range of issues or crises. These includes natural disasters, supply chain disruptions, cyberattacks, and economic downturns. These crises significantly impact power plant operations and its maintenance strategies. Also, the reliable operation of power plants is often challenged by various technical, operational, and environmental issues. In this research, an investigation is conducted on the problems associated with electric power plants by proposing a comprehensive and novel framework to maintenance the power plant during crises. Based on the achieved results discussed, the framework impact and contribution are the integration of proactive maintenance planning, resilient maintenance strategies, advanced technologies, and adaptive measures to ensure the reliability and resilience of electric power plant during power generation operations in the face of unforeseen challenges/crisis. Hypothetical inferences are used ranging from mechanical failures to environmental constraints. The research also presents a structured approach to ensure continuous operation and effective maintenance in the electric power plant, particularly during crisis (such as environmental issues and COVID-19 pandemic issues).

Keywords: power plant; crisis preparedness; environmental compliance

1. Introduction

Electric power plants are at the heart of global energy systems. They provide the necessary electricity to fuel economic growth and social development (Ahmadi et al., 2019). However, these plants are susceptible to disruptions caused by crises that can lead to unplanned downtime, increased maintenance demands, and compromised reliability. This article focuses on developing an enhanced framework that addresses maintenance strategy issues during crises and ensures uninterrupted power supply.

Electric power plants are essential infrastructures that generate, transmit and distribute electricity to meet the energy needs of industries, households, and businesses in a country (Ali et al., 2021). The uninterrupted operation of power plants is imperative to sustain economic and social activities. However, electric power plants encounter numerous crises that can lead to outages, reduced efficiency, and environmental hazards (Farghali et al., 2023). It is imperative to identify the critical challenges faced by power plants and establish a framework for maintenance during crises, thereby ensuring sustained energy supply and minimizing downtime.

1.1. State-of-the-art

During crises, such as natural disasters, extreme weather events, or pandemics, electric power plants are exposed to various challenges that disrupt their intermittent operations. These issues and challenges include but are not limited to electrical equipment failures, supply chain disruptions during procurement, workforce or maintenance professionals' availability issues, and increased demand fluctuations from customers (Hossain et al., 2021). However, power plants experience unplanned downtime, increased maintenance demands, and compromised reliability, which can have severe economic and social impacts. One of the primary challenges encountered by power plants is the need to ensure the uninterrupted supply of electricity regardless of a crisis time. The failure to ensure this critical requirement is made can result in significant disruptions to industries, households, and businesses, leading to financial crisis, downfall of productivity, and potential safety risks (Ali et al., 2022). Furthermore, power plants also encounter problems that can degrade their efficiency and pose environmental hazards. These issues include equipment degradation, inefficient maintenance practices, and suboptimal asset management strategies (Lo Prete and Blumsack, 2023). In the time of crises, these existing problems can exacerbate the challenges faced by power plants, making it difficult to address them effectively (Baduge et al., 2022). Moreover, the novel framework of this paper also encompasses contingency planning, including strategies for rapid response, emergency repair protocols, and alternative power supply options in terms of maintenance management strategy. These measures will further strengthen the resilience of power plants and ensure the sustained supply of electricity during crises.

By implementing the novel framework used in this paper, power plant operators in UAE can minimize downtime, optimize maintenance activities, and enhance the overall reliability of their facilities, even in the face of unprecedented challenges. This approach will contribute to the long-term sustainability and resilience of the global energy systems, facilitating continued economic growth and social development.

1.2. Predictive maintenance during environmental crises

Predictive maintenance uses data and analytics to identify when equipment is likely to fail, allowing for timely repairs or replacements. During crises, the availability of spare parts and maintenance personnel may be limited (Basit et al., 2020). The framework incorporates predictive maintenance algorithms to predict equipment failures in advance, enabling the allocation of resources efficiently.

1) Predictive maintenance is a major parameter in this framework. It involves utilizing historical data, sensor information, and machine learning algorithms to predict when equipment is likely to fail (Çelik et al., 2022). This predictive capability allows plant operators to schedule maintenance activities precisely when they are needed, reducing both unplanned downtime and unnecessary maintenance.
2) Machine learning models analyses data patterns from various sensors and equipment health indicators (Dhar et al., 2020). For instance, vibrations, temperature, pressure, and electrical current data are monitored to identify deviations from normal operating conditions.

3) By predicting failures in advance, maintenance teams can procure necessary spare parts, allocate skilled personnel, and plan maintenance activities efficiently, even when external resources are scarce during crises (Ehyaei et al., 2020).

Another contribution of this paper is the proactive implementation of best maintenance strategy during crises. Also, a comprehensive review conducted on electric power plant using live diagnosis monitoring of tools. Similarly, we also examined COVID-19 impact due to energy production demand and maintenance cost, thereby presenting impacts of power plants to the environment.

2. Literature review

This section of the research work explores the literature reviews for various electric power plants maintenance management techniques. It also provides a scientific and technical perspective to enhance framework adoption concerning the best maintenance strategy in UAE electric power plant.

2.1. Environment constraints for electric power plant maintenance during crisis

Maintenance strategy in an electric power plant faces some challenges in the environmental. Another challenge of accessibility is possible because of electronic component damage caused by the crisis or hazards (Elavarasan et al., 2020). These involves challenges of flooding, road closures, or power outages. For safety reasons, the environment around the power plant becomes unsafe due to hazardous materials, and radiation. This crises situation can lead to limited resources availability for maintenance of the electric power plant. In a comprehensive analysis conducted in Gorjian et al. (2021), resource constrains includes electronic components of the power plant spare parts, tools, and personnel.

In this paper, a framework is developed to mitigate the issues of crisis on an existing maintenance strategy in the electric power plant. These include planning ahead of time by considering the likely environmental constraints and the natural hazards such as wind, power etc. Also, in the research, implementing remote monitoring is necessary to assess the nature of electronic equipment and by identify potential problems before they lead to failures. Implementing the gaps in related works on best maintenance strategy for power plant is conducted. Other alternatives are examined in Han et al. (2020) for the introduction of mobile maintenance equipment in UAE. This can also be exploited in other cities around UAE and beyond that can potentially face crises. Finally, capacity building to the electric power plant personnel is required to be conducted frequently (Yodo et al., 2023). This is an eye opener for the maintenance staff to be frequently updated on some of the procedures of responses during normalcy and emergency in the electric power plant.

2.2. Mechanical failures during crisis

In electric power plants, mechanical failures can occur at any time during normal operation hours especially when an inappropriate maintenance strategy is implemented (Farghali et al., 2023). Numerous factors that trigger mechanical failures in an electric plant are as follows.

1) Degraded equipment: Lack of frequent maintenance on old equipment can cause to failure. In an unexpected crises situation, the electrical equipment may not be able to switch operation to another redundant equipment with same function. This unending operation will result to equipment over-use and can fail at any time. During crisis such as economic, natural, or otherwise, power plant can lead to failure.
2) Human error: This is caused by mistakes made during maintenance or equipment operation. Maintenance operator of electrical equipment requires to have shifting hours in every twenty-four hours to avoid staff fatigue or stress. This will mitigate the impact of human error especially during crisis.
3) Natural disasters: Natural disasters, such as floods, earthquakes, or storms, can also cause mechanical failures in power plants. These events can damage equipment, disrupt power supplies, and make it difficult to perform maintenance especially when power plant have no equipment redundancy to switch operation.
4) Sabotage: Sabotage is a deliberate act of destruction that can cause mechanical failures in power plants. This is a rare occurrence, but it is a potential threat that must be considered.

Preventing mechanical failures in electric power plants during a crisis involves adequate conduct of preventive maintenance strategy. It also involves training of professionals managing the electric power plant for proper operating procedures. The deployment of high-quality equipment and materials in the electric power plant facility sites. Implementation of modern machines that can monitor the operation of electrical condition and running contingency plan instead of managing failures.

2.3. Disruptions in procurement of critical power plant resources

Procurement is known as supply chain process. This form of disruptions can have a significant impact on power plant operations during a crisis. This is because power plants rely on a variety of inputs to be procured. These includes fuel, spare parts, and power plant personnel. Absence or short of these vital resources leads to major outages or service disruptions (Yodo et al., 2023). Among the major supply chain and disruptions of resources in the power plant includes fuel supply interruptions. This can be vulnerable to supply chain to power plants that rely on fossil fuels, such as coal, oil, or natural gas. Similarly, logistical challenges are a major challenge during any form of crisis. Therefore, even when fuel is available, transporting can be difficult in the power plants due to damaged roads or bridges, or due to the closure of ports or airports. Finally, challenge of saboteurs can create supply chain disruptions in many cases. The act is deliberate to destruct a power plant facility and is conducted by individuals or groups who want to disrupt power supplies.

A technical aspect related to supply chain disruptions in power plants is the procurement of spare parts. Power plants require a wide range of specialized equipment and components to efficiently maintain their power operations. However, during disruptive event, the procurement of these spare parts can become challenging to the maintenance operators. Similarly, the procurement process for critical spare parts includes identifying which specific parts of the equipment required, identifying procurement managers, quality assurance and reliability evaluation, negotiating contracts, and on-time delivery management (Khaledi and Saifoddin, 2023). Any disruption to power plant maintenance issues will results to a significant impact of operation in the power plant. However, when power plant faces breakdown maintenance issue of a critical electric component whereas the spare part is not readily available, it can lead to extended downtime and a decrease in power generation capacity. This impact cause serious implications to the overall stability of the power grid and the availability of electricity to consumers. Therefore, to avoid and mitigate such risks, power plant operators often maintain strategic inventory reserves of critical spare parts. These strategy act as a buffer and help ensure a timely replacement of failed components (Dagher et al., 2023). However, it is crucial to manage the inventory effectively, considering factors such as component reliability, lead time for delivery, and cost optimization.

2.4. Human/professional error

In an electric power plant, human or professional error can impact performance of power plant in both normal condition and crisis condition. The impact of human error concerning crisis is caused by human stress and fatigue caused by increased working hours, interruptions of normal working procedures due to lack of personnel shifting, limited supply of electric power plant resources, communication issues due to network communication challenges, and making Ad hoc decision-making to the power plant (Bhusal et al., 2023). However, these constrain is addressed critically in this research paper based on the following maintenance strategy during a crisis in the following ways. These are:

1) The UAE energy industry must consider training all maintenance personnel targeting crisis to manage stress and fatigue when working in the power plant.
2) The UAE energy industry must initiate a crisis-based procedure of power plant operation for immediate implementation.
3) The UAE energy industry must ensure additional recruitment of maintenance personnel to mitigate human resource shortage.
4) The UAE energy industry must ensure periodic monitoring and evaluation of electric power plant personnel, their adopted maintenance strategy, and stakeholders.
5) The UAE energy industry must ensure electric power plants promote a culture of safety and error reporting.

2.5. Engineering crisis on electric power plant

In UAE electric power plants, the devastating consequence of engineering crises has significant impact. This impact affects not only the stability of the power grid but poses significant risks to human life and the environment. Engineering crises in electric power plant can occur due to a wide range of factors. These are equipment failure, design flaws, human error, or natural disasters (Kostenko and Zaporozhets 2023). The solution to manage these engineering crises is crucial to ensuring the reliability and safety of power plants. One of the most common engineering crises in power plants is equipment failure. Power plants rely on a vast array of complex machinery to generate electricity, including turbines, boilers, generators, and control systems. If any of these critical components fail, it can lead to a sudden loss of power generation, resulting in blackouts and disruption of services. Equipment failures can stem from various causes, such as wear and tear, inadequate maintenance, manufacturing defects, or improper operation. Design challenges also give rise to engineering crises in power plants. During the design phase, engineers must ensure that the power plant is robust, efficient, and capable of withstanding expected operational conditions (Ibn-Mohammed et al., 2021). However, errors or miscalculations in the design process can have severe consequences. Challenges in the structural design of power plant components or inadequate consideration of potential hazards can lead to unexpected failures and accidents. For instance, improper pipe sizing, inadequate cooling systems, or insufficient redundancies can result in catastrophic events like pipe bursts, reactor meltdowns, or explosions.

Addressing these challenges requires a multi-faceted approach that focuses on proactive maintenance, robust design considerations, effective operator training, and comprehensive emergency response plans (Ambarwati et al., 2024). By continuously improving and adopting best practices in engineering, power plants can mitigate the risks associated with crises and ensure the reliable and safe generation of electricity.

3. Methodology

In this research paper, analytical assessment of the best maintenance strategy to adopt during crisis in electric power plant will be considered. For analysis purpose, data is collected using both primary and secondary technique. The primary technique involves interviewing professionals in the electric power plant field. Whereas the secondary technique involves accessing online related works such as indexed journals and other research works. Therefore, interview is conducted inform of a questionnaire on a specific electric energy company in UAE known as TAQA.

3.1. Risk assessment as a framework for maintenance during crisis

During crisis, this manuscript can be a useful tool in identifying, evaluating, and prioritizing risks. Assessment of risk is a major parameter to effectively manage crisis in an electric power plant (Han et al., 2020; Yazdi, 2024). This framework assists the plant to identify potential threats by developing a strategic plan to mitigate those threats.

In this research the basic framework is developed by identifying the risks potentially in the power plant in term of assets, operations, and professionals involved. Similarly, risk evaluation is also a major tool considered as a framework in this research. Immediately a risk is identified, the likelihood and impact of the risk must be evaluated. This will help you to prioritize the risks and focus your mitigation efforts on the most serious threats. Finally, prioritize the risks in the power plant is also a vital tool. But developing a mitigation plan is highly crucial. Immediately risk is prioritized, mitigation plan must be created. The strategy for mitigation is as follows.

i) Backup and disaster recovery plans.
ii) Supply chain diversification.
iii) Security measures.
iv) Training and awareness programs.

3.2. Crisis preparedness as a framework to mitigate maintenance strategy issues

Crisis preparedness is the process of planning and preparing for a crisis. It is a critical part of crisis management, as it helps organizations to be ready to respond quickly and effectively when a crisis does occur. As a framework, crisis preparedness should include establishing a crisis management team and developing a crisis plan by outlining the electric power plant response unit such as natural disasters, cyberattack, human error, supply chain disruption, etc. Similarly, there is always a need for capacity development with adequate backup plan and maintaining the same plan.

3.3. Environmental compliance as a framework for maintenance during crisis

Environmental compliance is the process of ensuring that an organization’s activities comply with environmental laws and regulations (Khaledi and Saifoddin, 2023). This can be a challenge during a crisis, as there may be disruptions to normal operations and resources may be limited. In an electric power plant, the factors of environmental compliance for maintenance during a crisis includes identifying environmental regulations, evaluation of crises impact based on environmental compliance, framework to maintain environmental compliance during the crisis by implementing monitoring and compliance plan and reporting of compliance (Lo Prete and Blumsack, 2023). In this research, hypothesis is exploit on the need for a better maintenance strategy for energy production and cost during crisis. Hypothesis application for best maintenance strategy is presented below as in **Table 1** (Lo Prete and Blumsack, 2023).

Table 1. Hypothetical application of maintenance strategy.

Hypothesis-1	H01	There is no significance relationship between installed capacity and its impact on advantages might arise from implementing a maintenance plan for a power plant during crisis.
	H11	There is a significance relationship between installed capacity and its impact on advantages might arise from implementing a maintenance plan for a power plant during crisis.
Hypothesis-2	H02	There is no significance relationship between size of plant and its impact on the maintenance of a plant is an essential step in minimizing crisis.
	H12	There is a significance relationship between size of plant and its impact on the maintenance of a plant is an essential step in minimizing crisis.
Hypothesis-3	H03	There is no significance relationship between ill effect of power plant and its impact on the maintenance practices that plant use when there is crisis.
	H13	There is a significance relationship between ill effect of power plant and its impact on the maintenance practices that plant use when there is crisis.
Hypothesis-4	H14	H14: There is a significance relationship between frequency of power outrage and its impact on the maintenance of a power plant during crises.
	H04	There is no significance relationship between frequency of power outrage and its impact on the maintenance of a power plant during crises.
Hypothesis-5	H05	There is no significance relationship between regulatory issue and its impact on the maintenance practices use when there is crisis in plant.
	H15	There is significance relationship between regulatory issue and its impact on the maintenance practices use when there is crisis in plant.

Table 1. (*Continued*).

Hypothesis-6	H06	There is no significance relationship between infrastructure modernization and its impact on the maintenance practices use when there is crisis in plant.
	H16	There is significance relationship between infrastructure modernization and its impact on the maintenance practices use when there is crisis in plant.
Hypothesis-7	H07	There is no significance relationship between planned maintenance training to personnel improves crisis and its impact on the maintenance of a plant is an essential step in minimizing crisis.
	H17	There is a significance relationship between planned maintenance training to personnel improves crisis and its impact on the maintenance of a plant is an essential step in minimizing crisis.
Hypothesis-8	H08	There is no significance relationship between effective management & risk assessment and its impact on the maintenance practices used when there is crisis in plant.
	H18	There is no significance relationship between effective management & risk assessment and its impact on the maintenance practices used when there is crisis in plant.

4. Discussion

In this section, variables considered as parameter are analyzed from a continuous academic thesis work based on hypothesis. The parameters are listed based on the values considers in tabular form. Variables considered includes the electric power plant capacity installed. Similarly, it is crucial to identify the appropriate maintenance strategy for the electric power plant during crisis.

Based on these hypothetical considerations, the Pearson chi square is chosen to have a significance value of 0.575, which is higher than *p*-value of 0.05. this means the null hypothesis is adopted with no significant link between installed capacity and the benefit that could come from electric power plant maintenance strategy during a crisis. In addition, electric power plant capacity or size is to be analysed based on its number of employees recruited in the maintenance management section. The capacity is directly proportional to the number of employees recruited for effective maintenance processes.

The above considerations and technique of data collection adopted in this framework is crucial to mitigate electric power plant crises. **Table 2** below presents the parameters computed based on values generated (Lo Prete and Blumsack, 2023), and based on TAQA electric power plant data generated in the UAE.

Table 2. Chi-square tests (a).

Parameter	Value	df	Asymptotic significance (2-sided)
Pearson chi-square	18.192[a]	20	0.575
Likelihood ratio	19.003	20	0.522
N of valid cases	67		

a. 28 cells (93.3%) have expected count less than 5. The minimum expected count is 0.13.

Based on the information of **Table 2** above, the computed Pearson chi square carries a significance value of 0.616, which is higher than the computed *p*-value of 0.05. The null hypothesis is accepted and based on the computed values, there is a significant relationship between electric power plant capacity or size based on its recruited maintenance personnel and its impact on maintenance performance. **Table 3** below present the computed asymptotic significance based on the parameters considered in TAQA electric power plant in the UAE.

Based on information generated in **Tables 2** and **3** (Lo Prete and Blumsack, 2023), the major variables considered in an electric power plant are as follows.

i) The operation state or condition of electric power plant.
ii) The appropriate maintenance strategy used during crisis.

Table 3. Chi-square tests (b).

Parameter	**Value**	**df**	**Asymptotic significance (2-sided)**
Pearson chi-square	6.283[a]	8	0.616
Likelihood ratio	7.171	8	0.518
N of valid cases	67		

a. 10 cells (66.7%) have expected count less than 5. The minimum expected count is 0.48.

Therefore, the Pearson chi square has a significance value of 0.337, which is higher than the *p*-value of 0.05. So, we accept the null hypothesis and conclude that there is no significant link between how bad a power plant is for people and how it affects how the plant takes care of itself when there is a problem. Additional other variables are as follows.

i) What is the frequency of light outage in the electric power plant.
ii) What is the benefit of having appropriate maintenance strategy.

We can see that the Pearson chi square has a significance value of 0.03, which is less than the 0.05 *p*-value. The null hypothesis is rejected that leads to a significant link between the number of power outages and how they affect the maintenance of a power plant during emergencies.

Table 4. Chi-square tests (c).

Chi-square tests			
	Value	**df**	**Asymptotic significance (2-sided)**
Pearson chi-square	17.780[a]	16	0.337
Likelihood ratio	16.894	16	0.392
N of valid cases	67		

a. 22 cells (88.0%) have expected count less than 5. The minimum expected count is 0.12.

Table 5. Chi-square tests (d).

Chi-square tests			
	Value	**df**	**Asymptotic significance (2-sided)**
Pearson chi-square	26.401[a]	15	0.034
Likelihood ratio	30.838	15	0.009
N of valid cases	67		

a. 23 cells (95.8%) have expected count less than 5. The minimum expected count is 0.22.

Based on **Tables 4** and **5** above, the two variables considered are as follows:

i) Does the professional have adequate experience for spotting and predicting potential problems in the electric power plant during crises.
ii) Identify what maintenance practices is used in the electric power plant during crisis.

The Pearson chi square's significance value is 0.00, which is less than the 0.05

p-value (Lo Prete and Blumsack, 2023). So, we don't accept the null hypothesis and come to the conclusion that there is a significant link between regulatory issues and how they affect maintenance practices when there is a crisis in a plant. From hypothesis 6, it was found that the two variables agree that descriptive, informal, and qualitative assessment methods are used to compare the amount of risk and what kinds of maintenance do you do when something goes wrong in your plant? We can see that the Pearson chi square's significance value is 0.00, which is less than the 0.05 *p*-value. So, we don't accept the null hypothesis and come to the conclusion that there is a significant link between infrastructure modernization and how it affects maintenance practices when there is a problem with a plant.

Table 6. Chi-square tests (e).

Chi-square tests			
	Value	**df**	**Asymptotic significance (2-sided)**
Pearson chi-square	46.631[a]	16	0.000
Likelihood ratio	22.781	16	0.120
N of valid cases	67		

a. 19 cells (76.0%) have expected count less than 5. The minimum expected count is 0.03.

Based on **Table 6** above, hypothesis 7 can be deduced using two variables as follows.

i) What is your opinion on professional capacity development based on planned maintenance in an electric power plant during crisis?
ii) Mention your opinion on maintaining the electric power plant in best operational state during crisis.

Therefore, the Pearson chi square has a significance value of 0.02, which is less than the 0.05 *p*-value (Lo Prete and Blumsack, 2023). So, the null hypothesis is rejected and come to the conclusion that there is a significant relationship between planned maintenance training for staff and how it affects the maintenance of a plant, which is an important step to take to reduce crisis.

Table 7. Chi-square tests (f).

Chi-square tests			
	Value	**df**	**Asymptotic significance (2-sided)**
Pearson chi-square	79.891[a]	20	0.000
Likelihood ratio	22.938	20	0.292
N of valid cases	67		

a. 27 cells (90.0%) have expected count less than 5. The minimum expected count is 0.01.

Also, hypothesis 8 in **Table 7** above examines the two variables based on what quantitative risk assessment methods included and what maintenance practices use when an plant is in crisis/trouble (Lo Prete and Blumsack, 2023). It is evident that the Pearson chi square's significance value is 0.00, which is less than the 0.05 *p*-value. So, the null hypothesis is rejected and come to the conclusion that there is a significant relationship between effective management and risk assessment and how that affects the maintenance practices used when there is a crisis in the plant.

Table 8. Chi-square tests (g).

Chi-square tests			
	Value	**df**	**Asymptotic significance (2-sided)**
Pearson chi-square	28.534[a]	16	0.027
Likelihood ratio	32.381	16	0.009
N of valid cases	67		

a. 20 cells (80.0%) have expected count less than 5. The minimum expected count is 0.18.

For simplicity of **Table 8** above, hypothesis 9 is depended on the preceding deduced statements. This involve identifying the impact of the professional capacity development as stated based on the principles of planned maintenance strategy of electric power plant during crisis.

This means that based on the outcome of the Pearson chi square presented, the asymptotic significance has direct translation towards the impact of the professional capacity development as indicated in research of Lo Prete and Blumsack (2023). An extension of the results is computed ahead in **Table 9** below.

Table 9. Chi-square tests (h).

Chi-square tests			
	Value	**df**	**Asymptotic significance (2-sided)**
Pearson chi-square	75.904[a]	16	0.000
Likelihood ratio	19.697	16	0.234
N of valid cases	67		

a. 20 cells (80.0%) have expected count less than 5. The minimum expected count is 0.01.

Progressively, the impact of the professional capacity development of maintenance professional in the electric power plant has increased by increasing the number of engagements using likelihood ratio as stated in research of Lo Prete and Blumsack (2023). This impact will enhance the livelihood ratio of the electric power plant during any form of crisis.

5. Conclusion

To maintain an electric power plant effectively using the best maintenance strategy, a novel approach is required to be implemented even during crises situation. Based on responses made by maintenance expert in UAE power plants, not all electric power plants are immune to all forms of crises and challenges triggered due to maintenance hazards. Some of the challenges of electric power plants assessed in this paper presents the benefits and drawbacks of adopting random maintenance strategy alternatives. However, analysis is conducted using hypothesis at different level, to determine the statistical values at all intervals of the hypothesis. Similarly, this paper developed an enhanced framework of maintenance strategy for power plants during crisis. However, it is recommended that the framework is required to have plans for dealing with emergencies like natural disasters, broken equipment, and other things that can’t be predicted. This will make sure that the plant can respond quickly and effectively to emergencies, which will keep operations and the community as safe as possible.

Author contributions: Conceptualization, TAAA and MNAR; methodology, TAAA; software, NM; validation, TAAA, MNAR and NM; formal analysis, TAAA; investigation, TAAA; resources, TAAA; data curation, TAAA; writing—original draft preparation, TAAA and MNAR; writing—review and editing, TAAA; visualization, TAAA; supervision, MNAR and NM; project administration, TAAA; funding acquisition, MNAR, NM and TAAA. All authors have read and agreed to the published version of the manuscript.

Conflict of interest: The authors declare no conflict of interest.

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