KESANS: International Journal of Health and Science
2808-7178 / 2808-7380
http://kesans.rifainstitute.com/index.php/kesans/index

Electronic Permit to Work (e-PTW) System as an Effort to Control Hot Work Risks and Fire Protection System Safety at PT. XYZ

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Article Information
Submitted: **22 May 2026**
Accepted: **12 June 2026**
Publish: **25 June 2026**

Keyword: e-PTW; Permit to Work; Hot Work; Fire Protection Impairment; HIRADC; Occupational Safety and Health; Case Study;

Abstract
Introduction: *This study is motivated by the high risk of fire and safety incidents in large-scale commercial buildings, particularly those arising from Hot Work and Fire Protection Impairment activities that are inadequately controlled through conventional paper-based permit systems.* ***Objective:*** *This study aims to describe the development, implementation, and evaluation of the effectiveness of the Electronic Permit to Work (e-PTW) system for controlling risks associated with Hot Work and Fire Protection Impairment activities at PT. XYZ Building Complex, Jakarta.* ***Method:*** *Using a qualitative approach with a case study design, data were collected through in-depth interviews with stakeholders (HSE, Engineering, Security, and Tenant), observations, document analysis, and a questionnaire to contractors. The e-PTW system was developed using the Jotform platform with features such as forced compliance, sequential workflow, photo evidence upload, automatic notifications, audit trail, and HIRADC risk assessment integration. The system was implemented in stages through socialization, training, pilot testing, and full rollout.* ***Result and Discussion:*** *The findings show that e-PTW successfully reduced risk levels of Hot Work and Fire Protection Impairment from Extreme/High to Medium/Low categories. User satisfaction reached an average score of 4.05 (Effective). The system also improved permitting efficiency, transparency, accountability, inter-divisional coordination, and strengthened the safety culture.* ***Conclusion:*** *Although challenges such as contractor resistance and the need for continuous training persist, this study concludes that e-PTW is an effective digital transformation tool that enhances safety management in large-scale commercial buildings.*

How to Cite **Didik Mustakim, Nur Rokhman/Electronic Permit to Work (e-PTW) System as an Effort to Control Hot Work Risks and Fire Protection System Safety at PT. XYZ/Vol. 5, No. 9, 2026**
DOI https://doi.org/10.54543/kesans.v5i9.651
e-ISSN/p-ISSN **2808-7178 / 2808-7380**
Published by **CV. Rifainstitut/KESANS: International Journal of Health and Science**

Introduction

The building management industry is a sector that has high operational complexity because it involves the activities of residents, tenants, visitors, internal workers, contractors, and subcontractors in the same environment. In large-scale commercial buildings, safety risks are not only related to routine work activities, but also non-routine work that has high potential hazards, such as hot *work* and temporary disconnection of fire protection systems (*Fire Protection Impairment*). Both types of work require strict control because they can trigger fires, cause damage to assets, disrupt building operations, and threaten life safety if not controlled systematically (Oktaria, Rahmi, & Dewi, 2025); (Prastiyoko, 2026); (Nurlita & Hartomy, 2026); (Oktaviani, 2024)

One of the main instruments in the control of high-risk jobs is the *Permit to Work* (PTW) system. The PTW serves as an administrative mechanism to ensure that hazards have been identified, risks have been assessed, control measures have been established, and work can only be started after obtaining authorization from the authorities (Jonathan & Hery Irwan ST, 2025); (Novarisandy, Muhamadiah, Alamsyah, & Edigan, 2022); (Saputra, Yuliana, Andhika, & Fatharoni, 2026). However, the implementation of paper-based PTW still has various drawbacks, such as slow approval processes, documents that are easily lost or damaged, handwriting that is difficult to read, potential for filling errors, and limitations in real-time monitoring. This condition causes safety supervision to tend to be reactive and less supportive of the need for quick decision-making in high-rise building environments.

At PT. XYZ, manual PTW system is used to control *Hot Work* and *Fire Protection Impairment* work. The licensing process is carried out through filling out a paper form by the contractor, then the documents are physically distributed to related parties such as HSE, Engineering, Security, and Fire Safety Manager to obtain approval. Although the procedure has been regulated in the company's operational system, its implementation still faces obstacles in the form of delayed approval, low transparency of work status, difficulty in tracing documents, and the risk of forgetting to reactivate the fire protection system after the work is completed. These problems show the need for a more integrated, documented, and able system to provide direct monitoring.

The development of digital technology provides an opportunity to improve the weaknesses of manual PTW through the implementation of *Electronic Permit to Work* (e-PTW) (Mahanta & Kunar, 2023). The e-PTW system allows the process of applying, verifying, approving, monitoring, and closing permits to be carried out electronically. Features such as *sequential workflow*, *forced compliance*, digital signatures, photo evidence uploads, automated notifications, and digital databases can strengthen accountability and reduce the potential for *human error*. In the context of large-scale commercial buildings, e-PTW not only serves as an administrative tool, but also as a risk control system that helps ensure that each stage of hazardous work meets safety requirements before it is implemented (Liawatimena, 2020).

Based on these problems, this study focuses on the implementation of an electronic work permit system to control the risk of heat application work and disconnection of the fire protection system in the PT. XYZ. The formulation of the problem in this study is directed at how the process of implementing e-PTW is carried out, how effective is e-PTW in reducing the risk of high-risk work, and what factors support and hinder the implementation of the system. The purpose of this study is to analyze the process of making and implementing e-PTW, evaluate its effectiveness in controlling the risk of *Hot Work* and *Fire Protection Impairment*, and identify obstacles and opportunities for

improvement in the implementation of the electronic work permit system in the building management environment. This description was prepared based on the design and data of the thesis research which contains the background of building risks, problem formulation, objectives, and focus on the implementation of e-PTW at PT. XYZ

Method

This study uses a case study design with a qualitative approach supported by descriptive quantitative analysis. A qualitative approach is used to describe the e-PTW implementation process, implementation constraints, and user perceptions of the effectiveness of the system. Descriptive quantitative analysis was used to process the results of contractor questionnaires on ease of use, procedural compliance, and risk reduction.

The research was conducted in the Building Complex of PT. XYZ, Central Jakarta, with the object of research in the form of the application of the electronic work permit system in hot *work and the* termination of the fire protection system (*Fire Protection Impairment*). The research subjects consist of personnel who are directly involved in the work licensing process, namely HSE Manager, HSE Coordinator, HSE Staff, Engineering, Security, and implementing contractors. The interview informants were selected *purposively*, while the questionnaire respondents consisted of 120 contractors using e-PTW.

Data collection was carried out through observation, in-depth interviews, questionnaires, and document review. Observations were made on the flow of submission, approval, implementation, monitoring, and closure of work permits. Interviews were used to obtain information about the weaknesses of manual PTW, digital system needs, experience of using e-PTW, and implementation barriers. The questionnaire was used to assess the effectiveness of e-PTW on a scale of 1–5, while a document review was carried out on work permit forms, log audit data, HIRADC results, and questionnaire recapitulation.

The e-PTW system was developed using the Jotform Enterprise platform with key features of digital forms, *sequential workflow*, *forced compliance*, electronic signatures, photo uploads, automatic notifications, digital data storage, and report export. This feature is used to ensure that each work permit passes a complete verification stage before the work is carried out. Risk analysis was carried out using the HIRADC method on two representative works, namely welding of hollow frames in the tenant area and sprinkler relocation. The level of risk is calculated by the formula:

$$R = K \times P$$

R is the risk level, K is the severity, and P is the likelihood level. Each job is analyzed based on initial risks, control measures, and residual risks after the implementation of e-PTW.

Qualitative data is analyzed through data reduction, data presentation, and conclusion drawn, then validated using triangulation of sources and methods. Quantitative data was analyzed descriptively by calculating the average questionnaire score. Scores of 4.21–5.00 were categorized as very effective, 3.41–4.20 effective, 2.61–3.40 moderately effective, 1.81–2.60 ineffective, and 1.00–1.80 highly ineffective.

Results and Discussion

1. Results

The results of the study show that the paper-based manual Permit to Work system at PT. XYZ still has weaknesses in the implementation of high-risk work, especially in hot work and fire protection system disconnection or Fire Protection Impairment. The main drawbacks found are the slow approval process because documents have to move physically between parts, the risk of lost or tucked documents, difficulty tracking work permit history, and the unavailability of real-time job status monitoring. This condition creates a safety gap, especially when the fire protection system has been turned off but has not been reactivated immediately after the work is completed.

The implementation of e-PTW is carried out by digitizing the flow of application, approval, implementation, monitoring, and closure of work permits. This system contains digital form features, tiered approval flows, electronic signatures, uploading photos of field conditions, automatic notifications, digital data storage, and monitoring dashboards. In the Hot Work Permit, e-PTW ensures that the data on the location, type of work, equipment, fire extinguisher, PPE, fire watch, and area inspection have been completed before the permit is approved. In Fire Protection Impairment, e-PTW ensures that the location of the disconnected system, the duration of the disconnection, mitigation measures, and verification of the reactivation of the fire protection system are clearly documented.

Table 1
Summary of Findings on the Implementation of e-PTW

Aspects	Findings in the PTW Manual	Changes After e-PTW
Approval process	Relying on the transfer of physical documents and manual signatures.	Submission and approval are carried out through a tiered digital flow.
Documentation	Documents are prone to being lost, damaged, or difficult to find during an audit.	Permission history is automatically stored and searchable through the database.
Supervision	Job status is difficult to monitor in real-time.	The dashboard displays permission status, job location, and the parties involved.
Safety	The completeness of the requirements is highly dependent on the discipline of filling out the form.	Forced compliance prevents the process from continuing if the safety data is incomplete.
Reactivation of the protection system	There is still a risk of forgetting after the work is done.	Notifications and digital close-outs help ensure the system is reactivated.

The display of the e-PTW dashboard interface in Figure 1 and Figure 2 shows that the system is able to display work permit data centrally. Information regarding approval status, job location, contractor identity, signed documents, and applicant data can be monitored by the HSE team without having to search through physical files.

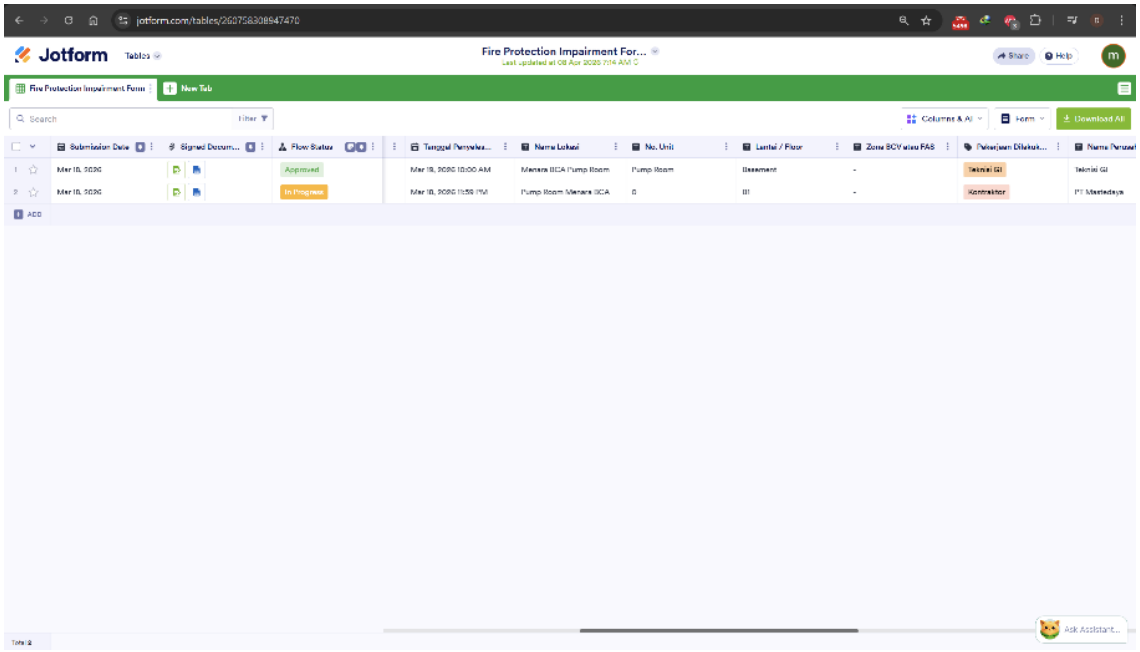

Figure 1. Display of e-PTW Hot Work Permit interface

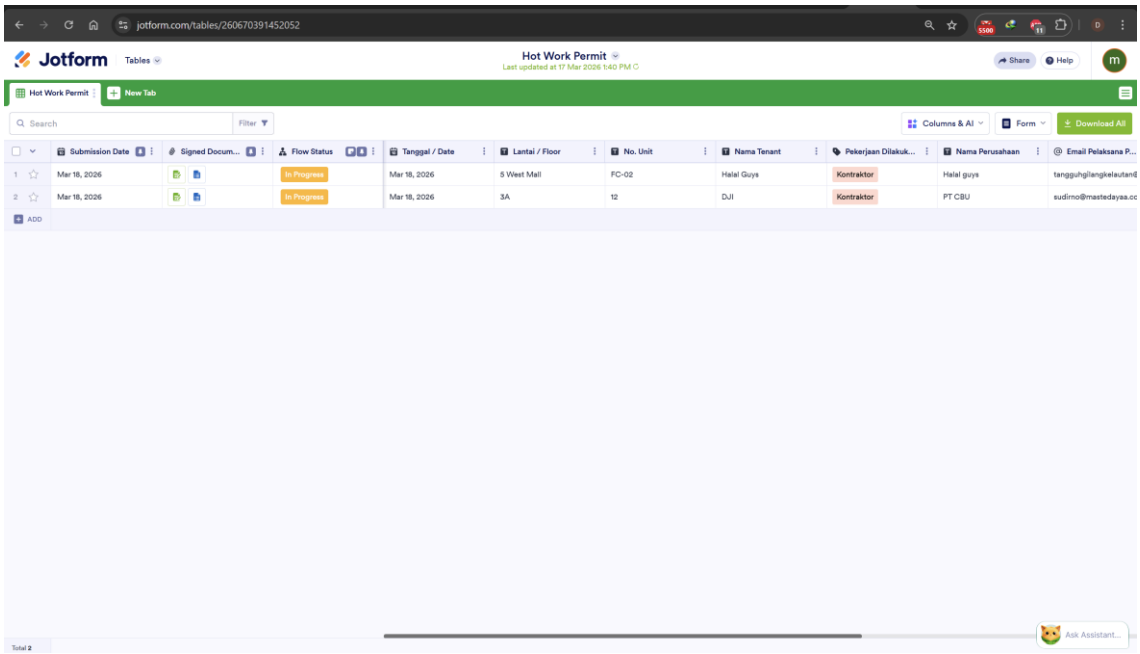

Figure 2. Interface display of e-PTW Fire Protection Impairment

The digital approval flow in Figure 3 shows that the Hot Work Permit application is processed sequentially, starting from applicant submission, user review, Security verification, to HSE approval. This mechanism ensures that permits cannot be issued until all authorized parties have validated them according to their respective responsibilities.

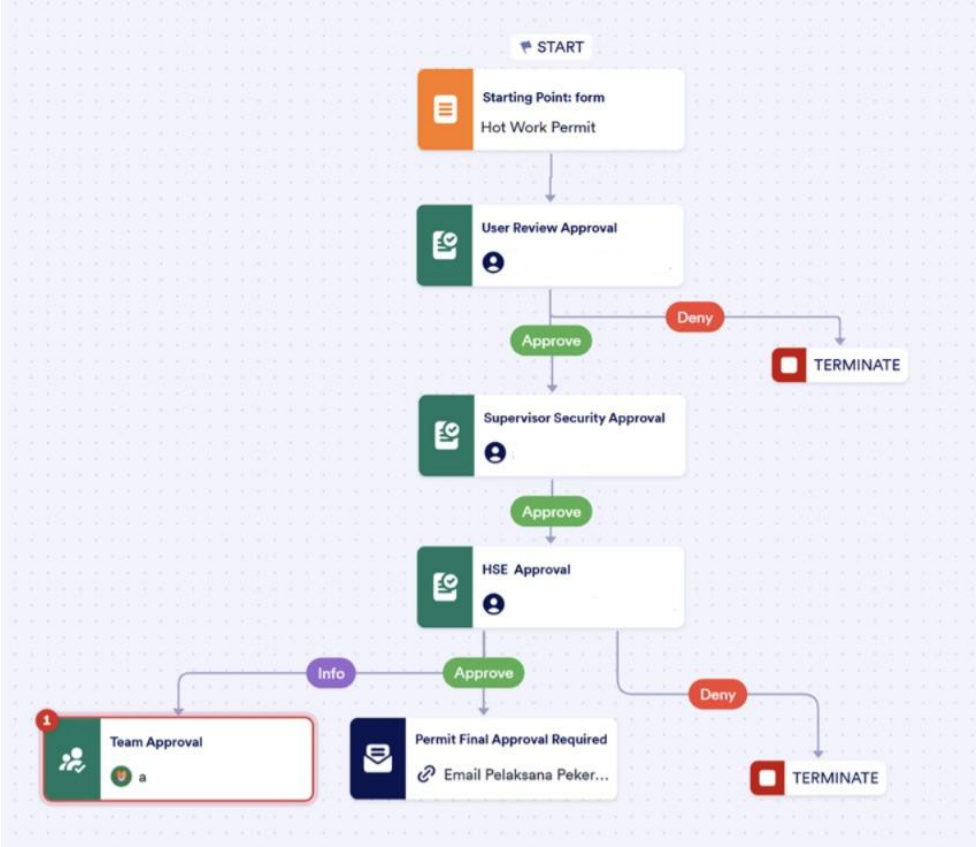

Figure 3. Hot Work Permit digital approval workflow

The results of the HIRADC analysis show that the implementation of e-PTW is able to reduce the level of risk in the two main jobs analyzed. In hollow frame welding work in tenant areas, the highest initial risk was found at the stage of site preparation and welding implementation with a risk value of 20. After control through e-PTW is implemented, such as cleaning the 11-meter radius area, providing fire extinguishers, using PPE, designation of fire watches, and photo verification, the residual risk drops to 4 to 6.

Table 2
Summary of Risk Reduction in Hot Work Jobs

Stages of Work	Major Hazards	Initial Risks	Control via e-PTW	Residual Risk
Equipment preparation	Appliance damage or gas leakage	12	Equipment checklist, regulator checks, and logbook.	4
Hot Work Permit Application	Incomplete documents	6	Forced compliance and multi-stage approval.	2
Tenant location preparation	Flammable material	20	Cleaning of an 11-meter radius, fire blanket, and photo evidence.	6
Implementation of welding	Sparks and heat	20	Fire Watch, fire extinguisher, PPE complete, and digital verification.	4
Trimming and grinding	Sparks and dust	16	Ventilation, Fire Watch, respirator, and face shield.	6
Housekeeping	Residual flammable material	12	Final inspection and close-out e-PTW.	4

In sprinkler relocation work, the highest risk arises when the fire protection system is disabled and pipe cutting work is performed. The initial risk of 20 can be lowered to 4 after the system implements permission validation, compensation measures, uncontrolled simultaneous work bans, and system reactivation verification.

Table 3
Summary of Risk Reduction in Fire Protection Impairment Work

Stages of Work	Major Hazards	Initial Risks	Control via e-PTW	Residual Risk
Application for an impairment permit	Protection system turned off	15	Compensating measures, extra Fire Watch, and ERT notifications.	4
Drain sprinkler system	Flooding and water pressure	12	Gradual drain, drain pump, and photo proof.	8
Existing pipe cutting	Hot Work when impairment is active	20	Simultaneous prohibition of Hot Work and impairment without control and isolation of zones.	4
Installation of pipes at height	Falling from a height	15	Certified scaffolding and full body harness.	6
System recharging	System reactivation error	12	Reactivation checklist, pressure	2

			test, and Engineering verification.	
Housekeeping	Residual materials and waste	12	Final inspection and close-out permit.	4

Figure 4 and Figure 5 show an example of the digital form display used by the user. In the Hot Work Permit, the form emphasizes location data, type of work, equipment, and safety requirements. In Fire Protection Impairment, the form emphasizes the identification of the disconnected system as well as mitigation measures during the fire protection system inactivity.

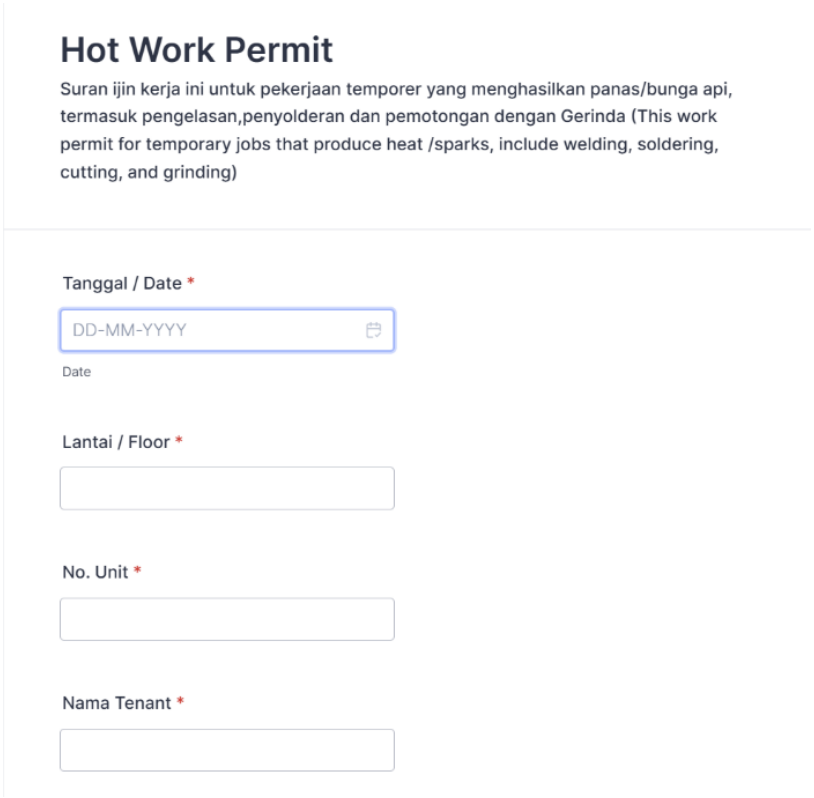

Figure 4. Face display e-PTW Hot Work

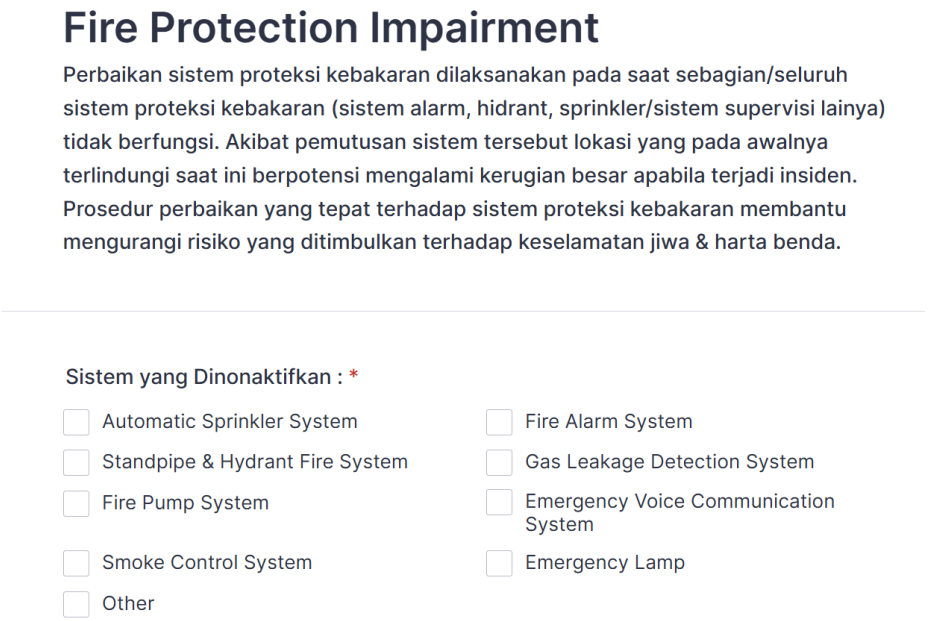

Figure 5. Face display of e-PTW Fire Protection Impairment

The results of the questionnaire of 120 contractors showed that e-PTW was well received by users. The average overall score reached 4.05 which was in the effective category, with a positive response percentage of 98.3% and no negative responses. The highest score is found in the forced compliance feature with a score of 4.4, which shows that the obligation to fill in complete data helps prevent missed risk mitigation measures.

Table 4
Summary of Statistics of Contractor Questionnaire Results

Statistics	Value	Remarks
Number of respondents	120	Contractors who use e-PTW.
Number of questions	40	Includes usability, awareness, compliance, and risk mitigation.
Average overall score	4,05	Effective category.
Minimum score	3,8	It is in the aspect of notification and search of permission history.
Maximum score	4,4	It is found in the forced compliance feature.
Positive response	98,3%	The combination of Strongly Agree and Agree answers.
Neutral response	1,7%	Very low.
Negative response	0%	No Disagree or Strongly Disagree answer found.

The results of interviews with HSE Managers, HSE Coordinators, and HSE Staff strengthened the results of the questionnaire. The informant stated that e-PTW makes the work permit process faster, documents easier to find, job status easier to monitor, and coordination between HSE, Engineering, Security, and contractors becomes clearer. Automatic notifications are considered to help reduce the risk of forgetting to reactivate

the fire protection system. The obstacles that are still found are weak signals in the basement area and some contractors who are not used to using digital applications.

2. Discussion

The implementation of e-PTW has been proven to strengthen the function of Permit to Work as an administrative control for high-risk jobs. In a manual system, the effectiveness of control relies heavily on individual discipline in filling out forms, carrying documents, requesting signatures, and closing work permits. In digital systems, some of these processes are controlled by the system through sequential flows, mandatory content validation, notifications, and automatic storage. This change makes work permits not only an administrative document, but also an active risk control tool.

The reduction in risk on Hot Work work occurs because e-PTW ensures that the main source of hazard has been controlled before work begins. Sparks, heat, flammable materials, and the use of hazardous work equipment cannot be controlled by form alone, but require real verification in the field. Through photo uploads, digital checklists, and tiered approvals, the system helps ensure that the area has been cleaned, fire extinguishers are available, PPE is used, and fire watch personnel have been assigned. Thus, the possibility of fire occurrence can be reduced more consistently.

In Fire Protection Impairment, e-PTW has an important role because the temporary disconnection of sprinklers, hydrants, or fire alarms can reduce the building's ability to detect and extinguish fires. In this condition, delays in information or forgetfulness to reactivate the system can have serious consequences. The e-PTW system helps reduce these risks through recording impairment locations, work deadlines, compensation actions, automatic notifications, and verification of system reactivation. The integration between Hot Work and Fire Protection Impairment permits is also an important element because it can prevent hot work from being carried out in areas where the fire protection system is inactive without additional control.

The forced compliance feature is the strongest finding in this study because it is able to reduce human error. In the manual system, blank columns or incomplete checklists can still pass if the inspection is not thorough. In e-PTW, users cannot continue the process if important information has not been filled in. This mechanism makes procedural compliance more structured and reduces the likelihood of safety stages being missed due to haste, forgetting, or lack of thoroughness. An example of the implementation of fire mitigation checklist and digital signature validation is shown in Figure 6.

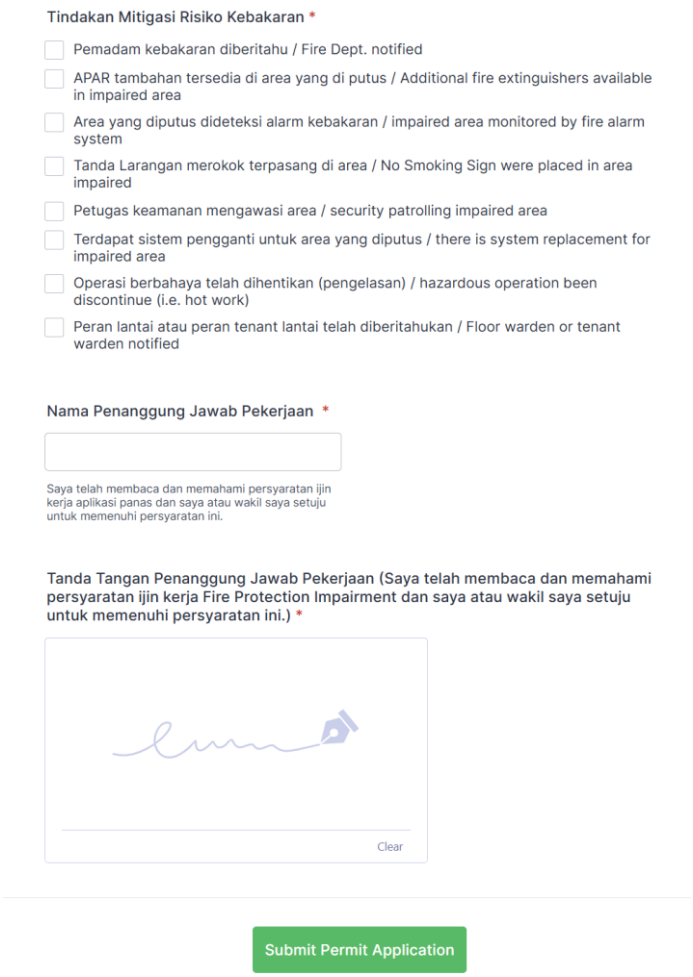

Figure 6. Fire mitigation measures and digital signature fields on Fire Protection Impairment

In addition to reducing risk, e-PTW also increases accountability and audit readiness. Each work permit is stored in the form of digital data that contains the application time, applicant's identity, job location, supporting documents, electronic signatures, field photos, approval status, and closing time. This data makes the tracking process easier than paper systems that are prone to loss or damage. For HSE management, work permit history can be used to evaluate risky work trends, identify areas of frequent problems, and assess contractor compliance.

However, e-PTW cannot replace the entire function of human supervision. Some residual risks are still at a moderate level, especially in work at heights, sprinkler system refills, and jobs that require special technical competence. This indicates that digital systems must remain supported by field inspections, contractor training, equipment maintenance, evacuation route readiness, and direct supervision by HSE officers. With this support, e-PTW can become an effective, efficient, and suitable risk control system for large-scale commercial building environments.

Conclusion

The implementation *of Electronic Permit to Work* (e-PTW) is effective in improving the risk control of hot *work applications and the* disconnection of fire protection systems (*Fire Protection Impairment*) in the PT. XYZ. The e-PTW system is able to overcome the weaknesses of manual PTW through digital approval flows, *forced compliance*, automatic notifications, photo documentation, and more traceable data storage.

The results of risk analysis and user evaluation show that e-PTW can reduce occupational risk from high to extreme categories to be more controlled. In addition, the average questionnaire score of 4.05 indicates that the system is considered effective by users, especially in improving efficiency, procedural compliance, data transparency, and work safety

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