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Analysis of the active fire protection system at the head office of Perumda Air Minum Surya Sembada in Surabaya City

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Abstract

Regional drinking water companies are regionally owned business units engaged in the distribution of clean water for public needs. One of the potential hazards and risks that may occur in office buildings is fire. Operational disruptions caused by fires can have widespread impacts, including disturbances in the distribution of clean water to customers. Therefore, this study aims to evaluate the implementation of the active fire protection system at the Head Office of Perumda Air Minum Surya Sembada, Surabaya, as an effort toward fire prevention and mitigation. This research employs a qualitative method with a descriptive observational approach. The results indicate that the compliance level of fire detectors, based on SNI 03-3985-2000, is 83%, which is classified as good. The compliance level of fire alarms, based on SNI 03-3985-2000, is also 83%, which is classified as good. The compliance level of sprinkler systems, based on SNI 03-3989-2000, is 70%, which is classified as fairly good. The compliance level of fire extinguishers, based on the Ministry of Labour and Transmigration Regulation No. Per. 04/MEN/1980, is 75%, which is classified as fairly good. The compliance level of hydrants, based on SNI 03-1745-2000, is 89%, which is classified as good. Thus, the overall compliance level of the active fire protection system implementation at the Head Office of Perumda Air Minum Surya Sembada, Surabaya, is 80%, which falls into the "fairly good" category.

Keywords: Active Fire Protection System; Fire Detector; Fire Alarm; Sprinkler; Fire Extinguisher; Hydrant

1. Introduction

Occupational Safety and Health (OSH) is an essential aspect of the industrial and workplace environment, focusing on protecting workers from risks and injuries while ensuring a safe and healthy work environment [1]. The implementation of workplace safety is a crucial aspect in accordance with Law No. 1 of 1970 concerning Occupational Safety and Law No. 13 of 2003 concerning Manpower [2].

Efforts to ensure occupational safety and health apply not only to industrial sectors such as manufacturing, mining, and construction but also to office environments. The implementation of office OSH aims to create a healthy, safe, and comfortable office environment to ensure workers' health, safety, and productivity. This is achieved by managing risks arising from various workplace hazards, including physical, chemical, biological, ergonomic, and psychological hazards, as well as controlling the risks associated with these hazards [3].

One of the potential hazards and risks that may occur in office based companies is fire. Fire is a rapid oxidation reaction of fuel that generates heat [4]. According to the NFPA, fire is an oxidation reaction that consists of three elements, fuel, oxygen, and a heat source, which can lead to property loss, injury, and even fatalities. Based on the Minister of Public Works Regulation No. 26 of 2008 on Technical Requirements for Fire Protection Systems in Buildings and the Environment, fire hazards are potential threats and exposure to fire, smoke, and gases from the onset of fire to its spread [5].

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Fires are unpredictable disasters that can occur at any time and place, making early prevention and mitigation measures essential. Fire is an unwanted blaze that causes serious property damage and loss of life. Workplace fires can lead to various losses, including casualties, loss of jobs, and destruction of company assets.

Regional drinking water companies are regionally owned business units responsible for distributing clean water to the general public. Regional drinking water companies operate in every province, district, and city across Indonesia, including Surabaya [6]. Perumda Air Minum Surya Sembada, as a provider of clean water services, has vital infrastructure that supports the daily lives of the community. Operational disruptions due to fire can have widespread impacts, including disturbances in the distribution of clean water to customers. The implementation of an active fire protection system in regional drinking water company must be carried out properly to ensure facility safety and service continuity.

Although there has never been a fire incident at the Head Office of Perumda Air Minum Surya Sembada in Surabaya City to date, the company remains committed to preparing fire protection facilities. This preparation is carried out as a mitigation measure to anticipate the possibility of fire in the future. The implementation of a well functioning fire protection system will ensure that the company can respond quickly and effectively in the event of an emergency. Thus, this preparedness is not only aimed at protecting the company's assets but also at ensuring the continuity of services to the community.

Therefore, an evaluation of the implementation of the active fire protection system is necessary to determine the extent to which the system has been applied at the Head Office of Perumda Air Minum Surya Sembada, Surabaya and its effectiveness in reducing fire risks.

2. Material and methods

This research was conducted at the Head Office of Perumda Air Minum Surya Sembada, Surabaya. The research method used is a qualitative method with a descriptive observational approach, aiming to analyze the implementation of the active fire protection system at the Head Office of Perumda Air Minum Surya Sembada, Surabaya through direct field observations.

The data collection techniques in this study include primary and secondary data sources. Primary data were obtained through observation sheets, interviews, and documentation. Observations were conducted through direct examination of fire protection facilities, including fire detectors, fire alarms, sprinklers, fire extinguishers, and hydrants. The observations were assisted by observation sheets containing fire prevention standards, referring to SNI 03-3985-2000 for detectors and alarms, SNI 03-3989-2000 for sprinklers, SNI 03-1745-2000 for hydrants, and Ministry of Labour and Transmigration Regulation No: Per. 04/MEN/1980 for fire extinguishers. Interviews were conducted with supervisors and senior staff from the Occupational Safety and Health (OSH) sub section regarding the active fire protection system at the Head Office of Perumda Air Minum Surya Sembada, Surabaya. Documentation was carried out using a mobile phone camera during the observation process. The documented objects included fire protection facilities such as fire detectors, fire alarms, sprinklers, fire extinguisher, and hydrants.

There are two categories in the assessment of compliance with the active fire protection system, "yes" and "no." The overall score was obtained by summing up findings based on observed conditions. Subsequently, the percentage of compliance for each fire protection facility was determined using the following calculation:

$$X = \frac{Total\ Score}{Maximum\ Score} \times 100\%$$

Explanation:

X = The percentage of compliance results with the installation criteria for each type of active fire protection facility, including fire detectors, fire alarms, sprinklers, fire extinguishers, and hydrants.

After obtaining the percentage of compliance with installation criteria for each type of fire protection facility based on existing standards, the resulting percentage (X) can be categorized into three categories, including:

Table 1 The classification of fire audit assessment levels according to Puslitbang Permukiman in 2005 [7]

Value	Category	Suitability	Description
>80%	Good	In accordance with regulatory provisions.	All components of the fire protection facilities are functioning properly.
60-80%	Fairly good	Installed, but some parts do not fully comply with regulations.	All components are functioning, but some sub components are not working perfectly.
<60%	Less good	Not compliant with regulations at all.	Some components of the fire protection facilities are not functioning or are damaged, and their capacity is far below the established standards.

Source: Harianja, *et al*, 2020

3. Results and discussion

3.1. Evaluation of Fire Detector Compliance at the Head Office of Perumda Air Minum Surya Sembada, Surabaya City

Based on interviews with senior staff and supervisors in the Occupational Safety and Health sub section, the detectors installed at the Head Office of Perumda Air Minum Surya Sembada, Surabaya City consist of smoke detectors and heat detectors. The detector system is automatically connected to the fire alarm system, ensuring that when smoke is detected, the fire alarm will sound. The following are the results of observations and interviews regarding the detectors at the Head Office of Perumda Air Minum Surya Sembada, Surabaya City based on SNI 03-3985-2000 [8].

Table 2 Fire Detector Observation Results at the Head Office of Perumda Air Minum Surya Sembada, Surabaya City

No.	Items Evaluated Based on SNI 03-3985-2000	Suitability		Description
		Yes	No	
1.	There is a fire detection system installed at specific points.	✓		There is a smoke and heat detector system evenly installed on every floor.
2.	The installed detectors are accessible for maintenance and testing.	✓		The detectors are accessible for maintenance. Maintenance is conducted approximately 2-3 times per year. However, there is no recorded data of the inspection results yet.
3.	Protection of detectors against potential damage due to mechanical interference.	✓		Protected as they are installed on the ceiling of the room area.
4.	The detector's sensitive element (sensor) is clean and not painted.	✓		The detector sensor is clean and not painted.
5.	The maximum distance between detectors is 9.1 meters.	✓		Based on observations in the corridor areas on each floor, the distance between detectors is approximately 1-2 meters. According to interviews, the spacing between detectors depends on the room layout.
6.	Regular inspections, testing, and maintenance are carried out, and inspection results are documented.		✓	The maintenance of detectors is carried out by the Internal Services team, but regular inspections have not been conducted. Repairs are only performed when a damaged detector is identified.
Level of Achievement		5/6 x 100% = 83%		

Based on table 2, the compliance level of fire detectors at the Head Office of Perumda Air Minum Surya Sembada, Surabaya City referring to SNI 03-3985-2000 is 83% which is considered good. However, regular inspections need to be conducted to prevent potential damage as early as possible.

3.2. Evaluation of Fire Alarm Compliance at the Head Office of Perumda Air Minum Surya Sembada, Surabaya City

Based on interviews with senior staff in the Occupational Safety and Health sub section, the Head Office of Perumda Air Minum Surya Sembada, Surabaya City has two types of fire alarms, automatic alarms and manual alarms. The following are the results of observations and interviews regarding fire alarms at the Head Office of Perumda Air Minum Surya Sembada, Surabaya City based on SNI 03-3985-2000 [8].

Table 3 Fire Alarm Observation Results at the Head Office of Perumda Air Minum Surya Sembada, Surabaya City

No.	Items Evaluated Based on SNI 03-3985-2000	Suitability		Description
		Yes	No	
1.	A fire alarm is installed.	✓		There is a fire alarm on every floor of the Head Office of Perumda Air Minum Surya Sembada Kota Surabaya.
2.	The fire alarm is clearly visible, easily accessible, and can be heard throughout the area.	✓		The fire alarm is easily accessible and can be heard throughout the area as it is evenly distributed.
3.	The fire alarm sound signal is distinct from other sound signals.	✓		The fire alarm bell sound is different from other bell sounds.
4.	The automatic alarm is directly connected to the sprinkler system.		✓	Based on an interview with a senior staff member in the K3 department, the fire alarm is likely not automatically connected to the sprinkler system. According to available information, the fire alarm has been installed since 1992, but no assessment has been conducted to determine whether it is automatically linked to the sprinkler system.
5.	The alarm is placed along the exit path at a height of 1.4 meters.	✓		The fire alarm is placed along the exit path at a height of no less than 1.4 meters.
6.	The alarm is in good condition and well maintained.	✓		The fire alarm is in good condition and functioning properly.
Level of Achievement		5/6 x 100% = 83%		

Based on table 3, the compliance level of fire alarms at the Head Office of Perumda Air Minum Surya Sembada, Surabaya City referring to SNI 03-3985-2000 is 83% which is considered good. However, one aspect that needs attention is that the alarm system is not yet automatically connected to the sprinkler system.

3.3. Evaluation of Sprinkler Compliance at the Head Office of Perumda Air Minum Surya Sembada, Surabaya City

Based on interviews with senior staff in the Occupational Safety and Health sub section, the Head Office of Perumda Air Minum Surya Sembada, Surabaya City has sprinklers evenly distributed on each floor. However, the company does not yet have a stock of spare sprinkler heads. The following are the results of observations and interviews regarding sprinklers at the Head Office of Perumda Air Minum Surya Sembada, Surabaya City based on SNI 03-3989-2000 [9].

Based on table 4, the compliance level of sprinklers at the Head Office of Perumda Air Minum Surya Sembada, Surabaya City referring to SNI 03-3989-2000 is 70% which is considered fairly good. However, several aspects need attention, including the sprinklers not being automatically connected to the alarm system, the absence of spare sprinkler heads, and the lack of a regular inspection procedure.

Table 4 Sprinkler Observation Results at the Head Office of Perumda Air Minum Surya Sembada, Surabaya City

No.	Items Evaluated Based on SNI 03-3989-2000	Suitability		Description
		Yes	No	
1.	An automatic sprinkler system is installed.	✓		The sprinklers are installed and distributed on every floor of the Head Office.
2.	The sprinklers are not painted, ornamented, or coated.	✓		The sprinklers are not painted, ornamented, or coated in any way.
3.	There is a network and supply of clean water that is free from mud and sand.	✓		The clean water used for the sprinklers is shared with the sanitary water supply and is free from mud and sand. There is no dedicated water tank for the sprinkler system yet.
4.	The water supply system is under the management's control.	✓		The water supply system is under the management's control and monitored by the Internal Services team.
5.	The distance between installed sprinklers does not exceed 4.6 meters.	✓		The distance between installed sprinklers in the corridor of each floor does not exceed 4.6 meters.
6.	The installed sprinkler heads are in good condition and unobstructed.	✓		The sprinkler heads are in good condition and free from cobwebs or obstructions.
7.	Automatically connected to the fire alarm.		✓	Based on an interview with a senior staff member from the K3 sub-section, the sprinkler system is not yet automatically connected to the fire alarm.
8.	The availability of connections that allow firefighters to pump water into the sprinkler system.	✓		Based on an interview with a senior staff member from the K3 sub section, there is a connection that allows firefighters to pump water into the sprinkler system. However, the specific model of the piping above is unknown, as it is an old building and does not have an internal layout plan.
9.	The stock of spare sprinkler heads amounts to six units.		✓	There are no spare sprinkler heads in the company. If a sprinkler is damaged or leaking, it is the responsibility of the Internal Services team to purchase a new one and carry out the installation.
10.	There are inspection and testing procedures in place.		✓	Testing on all sprinklers has not yet been conducted because it requires a large number of people to be on standby at each sprinkler to prevent unwanted incidents. However, the last test was performed on one of the sprinklers during an inspection in 2023.
Level of Achievement		7/10 x 100% = 70%		

3.4. Evaluation of Fire Extinguisher Compliance at the Head Office of Perumda Air Minum Surya Sembada, Surabaya City

Based on interviews with senior staff and supervisors in the Occupational Safety and Health sub section, the Head Office of Perumda Air Minum Surya Sembada, Surabaya City has two types of fire extinguishers, Dry Chemical Powder (DCP) and CO_2 gas extinguishers. The following are the results of observations and interviews regarding fire extinguisher at the Head Office of Perumda Air Minum Surya Sembada, Surabaya City based on Ministry of Labour and Transmigration Regulation No: Per. 04/MEN/1980 [10].

Table 5 Observation Results of Fire Extinguishers at the Head Office of Perumda Air Minum Surya Sembada, Surabaya City

No.	Items Evaluated Based on Ministry of Labour and Transmigration Regulation No: Per. 04/MEN/1980	Suitability		Description
		Yes	No	
1.	Fire Extinguishers are available.	✓		Fire extinguishers are evenly distributed on every floor, both inside and outside the work area.
2.	Fire extinguishers are placed in locations that are easily visible, accessible, and unobstructed.		✓	Out of 71 fire extinguishers in the Head Office, 2 are obstructed by objects (in the Administrative Office and the Book & Drawing Archive Room), and 1 has not yet been placed in its designated location (PTB Room).
3.	The fire extinguisher installation signs are properly and correctly installed.	✓		All fire extinguishers in the Head Office have been provided with fire extinguisher signs.
4.	Fire extinguishers are either hung or placed in an unlocked cabinet.		✓	Out of 71 fire extinguishers in the Head Office, 8 have not been hung yet (located in front of the Supervisory Board Room, Operations Director Room, in front of the toilet, Installation Maintenance Room, MS PWT Room, Internal Services Room, Meeting Room, and Legal Room).
5.	The top part of the fire extinguisher is placed 120 cm from the floor.	✓		The placement of the fire extinguishers is appropriate, approximately 120 cm from the floor.
6.	The maximum distance between one fire extinguisher and another is 15 meters.	✓		The distance between each fire extinguisher is less than 15 meters.
7.	Each fire extinguisher is inspected twice a year, at 6-month and 12-month intervals.	✓		Each fire extinguisher in the Head Office is inspected every three months, specifically in February, May, July, and October.
8.	Each fire extinguisher has a card or label indicating the month and year of maintenance.	✓		Each fire extinguisher on every floor of the Head Office, both inside and outside the work area, has a card containing updated maintenance records.
Level of Achievement		6/8 x 100% = 75%		

Based on table 5, the compliance level of fire extinguishers at the Head Office of Perumda Air Minum Surya Sembada, Surabaya City referring to the Ministry of Labour and Transmigration Regulation No: Per. 04/MEN/1980, is 75%, which is considered fairly good. However, several aspects need attention, including some fire extinguishers being obstructed by objects and not placed in their designated locations, as well as some extinguishers that have not yet been mounted.

3.5. Evaluation of Hydrant Compliance at the Head Office of Perumda Air Minum Surya Sembada, Surabaya City

Based on observations, there are a total of 43 hydrants throughout the Head Office area. These include 5 hydrants on the 3rd floor, 6 hydrants on the 4th floor, 2 hydrants on the 5th floor, 7 hydrants outside the building, and the remaining 23 hydrants located on the 1st and 2nd floors. The following are the results of observations and interviews regarding hydrants at the Head Office of Perumda Air Minum Surya Sembada, Surabaya City based on SNI 03-1745-2000 [11].

Table 6 Observation Results of Hydrants at the Head Office of Perumda Air Minum Surya Sembada, Surabaya City

No.	Items Evaluated Based on SNI 03-1745-2000	Suitability		Description
		Yes	No	
1.	There are sufficient hydrants to handle fires throughout the company premises.	✓		There are 43 hydrants distributed throughout the Head Office area.
2.	The hydrant box must be easy to open, visible, and accessible, without any obstructions.	✓		The hydrant box is easy to open, visible, and unobstructed.
3.	All hydrant equipment and hydrant boxes are painted red, while the hydrant lettering is in white.	✓		All hydrant equipment is painted red, and the hydrant lettering is in white.
4.	There are usage instructions installed in a clearly visible location.		✓	There are no hydrant usage instructions yet. Plans for next year include installing usage instructions, providing a monitoring checklist, and adding information about the party responsible for inspecting the hydrant.
5.	There is hydrant equipment: hose, nozzle, coupling, and opening valve, which are always installed and ready for use.	✓		The hydrant equipment is fully available and functions properly.
6.	There are yard hydrants.	✓		There are 7 hydrants in the yard area.
7.	The yard hydrants are located along the access route for fire trucks.	✓		The yard hydrants are evenly distributed along the access route for fire trucks.
8.	All hydrant equipment is in good condition and always ready for use.	✓		All hydrant equipment is in good condition and ready for use. Previously, there was a leaking hose, but it has been replaced with a new one. Additionally, the outdoor hydrant pillar also had a leak, which has now been repaired.
9.	Operational testing and completeness checks of hydrant components are conducted once a year.	✓		Hydrant testing is conducted once a year, but only for hydrants located in outdoor areas.
Level of Achievement		8/9 x 100% = 89%		

Based on table 6, the compliance level of hydrants at the Head Office of Perumda Air Minum Surya Sembada, Surabaya City referring to SNI 03-1745-2000 is 89% which is considered good. However, one aspect that needs attention is the absence of clearly visible hydrant usage instructions in easily noticeable locations.

4. Conclusion

Analysis of the Active Fire Protection System at the Head Office of Perumda Air Minum Surya Sembada, Surabaya City:

- The compliance level of detectors based on SNI 03-3985-2000 is 83%, which is considered good.
- The compliance level of fire alarms based on SNI 03-3985-2000 is 83%, which is considered good.
- The compliance level of sprinklers based on SNI 03-3989-2000 is 70%, which is considered fairly good.
- The compliance level of fire extinguishers based on Ministry of Labour and Transmigration Regulation No: Per. 04/MEN/1980 is 75%, which is considered fairly good.
- The compliance level of hydrants based on SNI 03-1745-2000 is 89%, which is considered good.
- Thus, the overall evaluation of the implementation of the active fire protection system at the Head Office of Perumda Air Minum Surya Sembada, Surabaya City is 80% which falls into the "fairly good" category.

Compliance with ethical standards

Disclosure of conflict of interest

No conflict of interest to be disclosed.

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