# Increasing Hard Skills in Fire Alarm Systems for Graduates of Vocational High Schools and General High Schools

**RULIYANTA, RADEN AGUSTINUS SUWODJO KUSUMOPUTRO, ANDINI PUTRI AYU**

Department of Electrical Engineering, Universitas Nasional
Email : ruliyanto@civitas.unas.ac.id

## ABSTRACT

*The fire alarm system is an early warning system for fire hazards in buildings and must be owned by large buildings. The Inalum building is a new building with a green building concept. The building will be operational in 2021 and inaugurated by the Minister of BUMN of the Republic of Indonesia. The partner's problem is that not all employees in charge master the operation of the fire alarm Master Panel. Because as a green building requirement, Inalum is obliged to employ residents. As a result, building management workers need to be more experienced. The purpose of this activity is to provide training to increase the capability of the fire alarm system in the training given the introduction, operation, re, and maintenance of fire alarm systems. This activity received positive feedback with a level of satisfaction with an average score of 4.37 on a scale of 5 from the trainees. Evaluation of the success of the training activities, which was initially 45.60% through the initial test at the start of the training, increased to 77.16% after the training. This evaluation means a significant increase in the trainees' ability by 33.56%.*

**Keywords**: *Fire Alarm, Training, NFSA 72, SNI 03-3985-2000, MCFA.*

## 1. INTRODUCTION

A fire alarm system in a building is one of the critical requirements that must be in place to obtain a functional certificate. This equipment is minimal but has a significant function as an early warning of fire danger **(Amini et al., 2023) (Azrini et al., 2016).** The fire alarm system standard most widely referred to in the world is NFSA 72 (National Fire Protection Association) **(Annex, 2013)**. This association regulates the standardization of fire monitoring systems in several groups. Meanwhile, at the national level, the Indonesian National Standards Agency issued a standard for an early warning system for fire hazards **(Suharto, 2008)**. SNI 03-3985-2000 regulates procedures for planning, installing and testing fire detection and alarm systems to prevent fire hazards in buildings. Other standards include SNI 03-7012-2004, namely smoke management systems in malls, atriums and large volume rooms **(Badan Standarisasi Nasional, 2004) (Badan Standarisasi Nasional, 2000)**.

In office buildings, alarms often occur. This alarm is due to a fire or a sensor responding to particular objects, thus triggering an alarm. However, it does not rule out the possibility that the alarm sounds, but there is no fire incident. This alarm is called a false alarm. The cause is, for example, the alarm switch being touched by a human. However, the most frequent cause of false alarms is due to smoke detectors catching smoke or dust due to someone smoking or the presence of dust. The alarm will panic the entire building community, especially in offices or malls where there are lots of public visitors. Officials or authorized building managers must immediately extinguish the alarm before it causes panic in the building. The alarm will actually sound when it detects a fire **(Pratama et al., 2022)**. The alarm occurs because the sensor gets a response. The head detector detects heat, or the smoke detector captures smoke particles. The presence of gas can also be detected with an appropriate detector **(Abdullah et al., 2021)(Statistik, 2020)(Wibowo et al., 2021)**. There are various types of detectors used, such as smoke detection, heat detection, fire detection, gas detection and others. When the fire extinguisher system detects water flowing in the hydrant pipe, this can also trigger a fire alarm via the flow switch.

The problem that often occurs when the alarm goes off is that the officers on duty need to understand how to turn off the alarm. The impact is that all visitors and the building community will run away from the building. This condition should not happen because it will create a panic condition. This problem can be solved; it is necessary to provide training for officers responsible for its operation. This training must be given to all officers on guard in a building **(Kustija et al., 2023)(Zayadi & Prasetyo, 2023)**. The officers who must be able to control the fire alarm system are technicians and security guards. The reason for choosing activities in this building was because the technicians did not understand the fire alarm system. This building also often experiences alarms, and technicians are slow to resolve them. The impact was that the entire building community came out to save themselves.

The objective of this training is to provide the ability to detect fires, operate the master fire alarm panel, and provide education to officers regarding fire alarm system maintenance. The material includes an introduction to the fire alarm system control panel, detection zones, equipment integration, and fire detectors. This training hopes that the technicians and other officers on duty will be able to control the operation of the fire alarm system equipment. Furthermore, in turn, the system functions well to prevent fires, and if a false alarm occurs, the system can be handled deftly by the officers.

## 2. METHOD

The method we use in this activity is in the form of training. The title of this activity is "Fire Alarm System Operation Training for Technicians and Security Guards in the Inalum Building". The training material presented is in the form of theory and practice **(Amar et al., 2022)**. The activity methods in this research are given according to the block diagram in Figure 1 **(Wibowo et al., 2021)**. Before it was carried out, this activity had been discussed with the Building Manager of the Inalum Building to adapt to partner needs through a correspondence process.



**Figure 1. Process of Implementing Training Activities**

The partner for this activity is the Kuala Tanjung Inalum Building Management in Batubara Regency, North Sumatra Province. This building has just started operating and was inaugurated on January 6, 2021, by the Minister of BUMN of the Republic of Indonesia. The location of the building is in Batubara Regency, North Sumatra Province. This location was chosen because, in this building, frequent alarms occur. This alarm arises due to work still being carried out at several points in the building. The impact of work dust triggers an alarm because the smoke detector responds to dust or sensitive particles. It is hoped that all officers will understand how the fire alarm system works and how to deal with it if an alarm occurs due to fire. Participants involved in this activity consisted of 5 security guards and 12 technicians. The activity time is Sunday, August 8, 2021. Sunday was chosen because the building was empty, and when the alarm sounded, it did not cause panic. Figure 2 is a photo of the Inalum Building in Kuala Tanjung.



**Figure 2. Inalum Building in Kuala Tanjung Nort Sumatera**

In this training, primary material in fire alarm systems is provided. The training participants are asked to operate the Main Fire Alarm Panel or MCFA. After that, participants are required to practice how to find the location where the alarm source occurs. Details of the material provided are given in Table 1. MCFA functions to control all existing fire detection equipment. In addition to control, MCFA provides resources to the entire network. Apart from using the main electricity supply, the MCFA is required to have a backup battery. Table 1 shows detail of training materials.

**Tabel 1. Detail of Training Materials**

| Material | Description |
|---|---|
| Standard MCFA | International and National standard |
| Fire Alarm Component | Part of fire alarm system |
| Installation | Installation and zoning area |
| Type of Fire Alarm | Full and semi addressable |
| Troubleshooting | Fire Alarm Troubleshooting |
| Maintenance | Periodic maintenance |

The type of fire alarm used in the Inalum Building is sub-addressable. In this type, each module is connected to the detector in parallel and is divided into room zones. Each floor consists of several zones **(Ruslan et al., 2021)**. The advantage of a model like this is that installation is simple. The downside is that if a fire occurs, the master panel only shows the fire zone. Officers must look for location points following the installation flow in the zone where the alarm occurs. The sensor that triggers the alarm will have an indicator ON. An example of a smoke detector and its components is shown in Figure 3. Technicians must understand fire alarm installation.

The wiring system must be understood. A Single Line Diagram (SLD) fire alarm system is needed to determine the position of all existing sensors **(Hajar et al., 2020)**. This SLD must be understood for zone mapping so that if an alarm occurs, it will be easy to trace.

**Figure 3. Smoke Detector and Its Components**

Participants who could find the results of this training were asked to complete a test at the beginning and end of the training. In this test, multiple-choice questions are given. The results are compared to measure the level of success of this training. The questions asked at the beginning and end of the training are the same. In addition, training participants are asked for feedback on the training activity process. This feedback aims to evaluate the quality of the training carried out. The evaluation uses the Mean Opinion Score (MOS) method to measure satisfaction level scores. The satisfaction score scale is given in Table 2.

**Table 2. Satisfaction assessment scale based on MOS**

| Score | Description |
|:-----:|:-----------------|
| 5 | Very satisfied |
| 4 | Satisfied |
| 3 | Enough |
| 2 | Less satisfied |
| 1 | Very dissatisfied |

## 3. RESULTS AND DISCUSSION

### 3.1 Activity Process

Training activities are carried out on Sundays. The building is empty, and no residents are carrying out activities. Training starts at 08.00 WIB until 15.00 WIB. The participants were given basic theory to understand fire alarm systems. Figure 4. a is the process of providing training materials carried out in the Control Room. The operation of the Fire Alarm Main Panel is shown in Figure 4. b. In this room are located the MCFA and several essential building equipment.

In this training, all training participants are required to understand the work of MCFA. The results of discussions during the training found that problems that often occur at partner locations are false alarms. The alarm goes off without any fire. If this early alarm is not immediately addressed at the MCFA, it will result in a general alarm where all fire warning alarms sound. The entire community in the building rushed out of the building to evacuate.

**Figure 4. (a) Process of Delivering Material in The Control Room (b) Instructor Explaining MCFA Reading to Training Participants**

The most crucial component in MCFA is the power supply. If a real fire occurs, the building's electrical power will be turned off. In order for the MCFA to continue operating when the building's electricity goes out, backup power is needed. Figure 5 is the MCFA backup panel containing the battery. The battery capacity must be continuously monitored. This MCFA must be routinely checked at least 2 (two) times a month by filling in the available logbooks.



**Figure 5. MCFA Buckup Panel**

At the final training session, a trial was carried out on handling alarm conditions using direct practice. One of the officers gave a smoke trigger to one of the detectors at a random location. Training participants are asked to look for the source point of the alarm. Once found, training participants must be able to repair smoke detectors whose sensors are active. Figure 6. (a) is the process of repairing a fire alarm installation. Meanwhile, in Figure 6. (b) is the process of handling active smoke detectors in this training.

If the alarm sounds, the steps that officers must take are as follows:

1. Look at the Master Control display for the location/zone that triggered the alarm.

2. Once the zone is known, ask the officer to look for active sensors in that zone. The active sensor indicator lights red. The cause may be a fire or simply responding to a disturbance in the sensor.
3. While the officer is looking for the source of the active sensor position, turn off the alarm (silence) so as not to generate a general alarm.
4. Once the active sensor is found, check what triggered it. If the cause is fire, immediately take action to extinguish the fire. If it is due to something other than a fire, then the sensor is replaced with a new one. Some sensors can be reused after being cleaned or reset.



**Figure 6. (a) Fire Alarm System Installation (b) Repair of The Sensor that Triggers The Alarm**

## 3.2 Monitoring and Evaluation of Activities

A training assessment form was distributed to monitor the effectiveness of this activity. Participants are asked to fill in training feedback using the Google Form application that has been provided. This satisfaction assessment refers to the MOS method, which is commonly used today. The evaluation list is given in Table 3. The evaluation results of the training activity assessment are given in Figure 7.
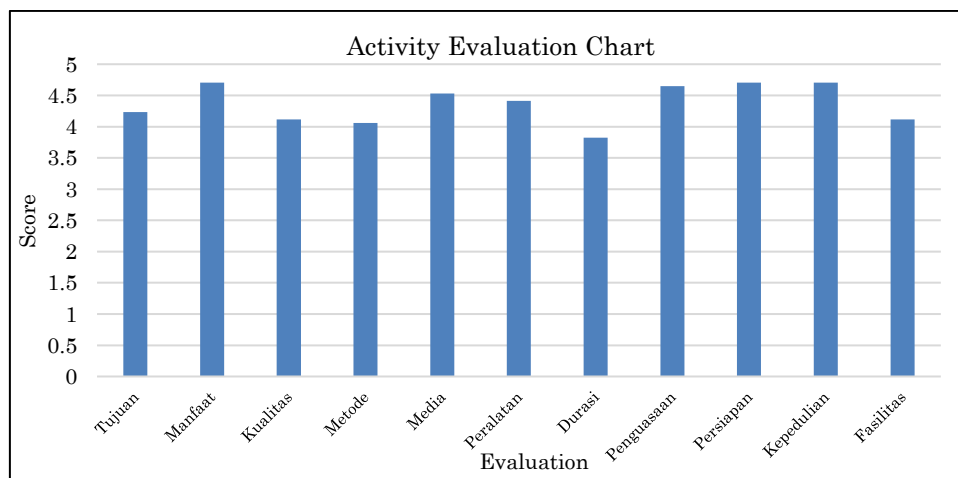


**Figure 7. Activity Evaluation Results Based on Participant Assessments**

Based on the assessment graph in Figure 7, it can be seen that almost all participants gave a score above 4. The average evaluation score for this activity was 4.37 on a scale of 5. This training was assessed by the participants as satisfactory and in accordance with their needs. Meanwhile, the training duration needs to be considered sufficient for this training (table 3).

**Table 3. List of Evaluation Questions**

| Evaluation | Component | Mark |
|---|---|---|
| Material Training | Objective | A1 |
| | Benefit | A2 |
| | Quality | A3 |
| Methods of Training | Training methods | B1 |
| | Instructional Media | B2 |
| | Training Equipment | B3 |
| | Training duration | B4 |
| Process | Material Mastery | C1 |
| | Preparation | C2 |
| | Concern | C3 |
| Fasility | Facility | D1 |

Next, the outcomes of this training are measured. The method is to ask the same questions as the initial questions before training. The list of questions is given in Table 4, which consists of 15 questions.

**Table 4. List of Questionnaire Questions for Activity Evaluation**

| No | Material | Mark |
|---|---|---|
| 1 | MCFA | Q1 |
| 2 | Fire Alarm Standard | Q2 |
| 3 | Fire Alarm Installation | Q3 |
| 4 | System Semi-addressable (Zone) | Q4 |
| 5 | Smoke detector | Q5 |
| 6 | Heat Detector | Q6 |
| 7 | End of Line | Q7 |
| 8 | Flow Switch | Q8 |
| 9 | Zona | Q9 |
| 10 | Module Control | Q10 |
| 11 | Battery Back up | Q11 |
| 12 | Troubleshooting | Q12 |
| 13 | Fire location detection | Q13 |
| 14 | Maintenance | Q14 |
| 15 | Safety Protection | Q15 |

The training output results are given in Figure 8 below. The average test score that participants answered was 45.60%. Meanwhile, the average value of correct answers given during the post-test was 77.16%. This result answer means there is a significant increase of 33.56%.
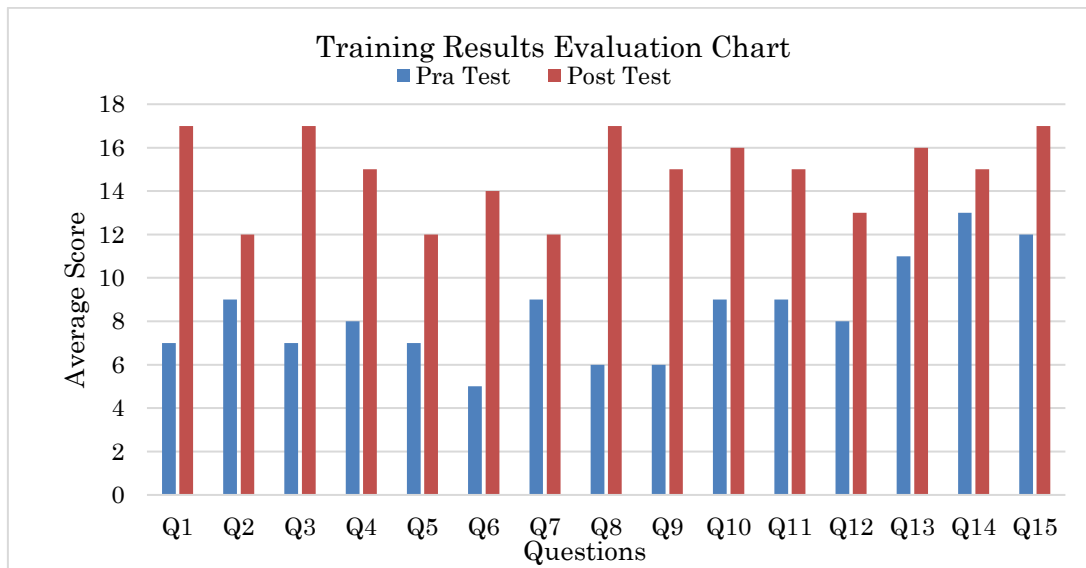
**Figure 8. Training Outcome Evaluation Results**

### 3.3 Problems

Based on the results of discussions with training participants, false alarms often occur. This false alarm should not be underestimated; as officers, we must not assume there are false alarms. Every alarm must be responded to in an integrated manner by all levels of officers. The source of each alarm must be found and repaired as soon as possible. Avoid disconnecting the fire alarm installation on the module when carrying out repairs. Avoid disconnecting the installation and replacing it with an end-of-line resistor so that the alarm stops sounding.

The problem for the management of the Inalum Building as a partner for this activity lies in the quality of human resources. Generally, building management workers need to gain experience in operating fire alarms. They are working for the first time and are fresh graduates from the equivalent vocational school. Meanwhile, managers are required to accept residents as a condition of green building.

However, the building management remains optimistic and capable of operating this building. Management will improve hard skills and soft skills for its employees through partner programs with internal and external parties to improve work quality and provide excellent service. The next continuation of the training program is emergency response training in this building. This activity involves the entire building community and related officials in the surrounding environment.

## 4. CONCLUSIONS

Partners need training to introduce the fire alarm system because the workers need to gain experience operating the fire alarm system. The evaluation of this activity received a positive score with an average satisfaction level of 4.37 on a scale of 5. Meanwhile, the evaluation of the activity's output was originally 45.60% before the training, increasing to 77.16% after the training. This result means that there is a significant increase in the knowledge of training participants by 33.56%. Advice given to work partners is to evaluate the fire extinguisher system immediately. A fire alarm is only an early warning, while if a fire actually occurs, the fire extinguisher system must work to extinguish the fire automatically.

## ACKNOWLEDGEMENT

## LIST OF REFERENCES

Abdullah, A., Nugraha, W., Astutik, R., Mandala, Y., & Pandjaitan, P. (2021). Bimbingan Teknis Masyarakat Waspada dan Siap Sedia Mencegah Kebakaran. *Darmabakti: Jurnal Inovasi Pengabdian dalam Penerbangan*, 22–30.

Amar, M. I., Darmawan, R., Rally, T., Nabila, A., Rahayu, A. M., Isvandiary, A. A., Indriani, M., & Hidayat, Z. I. (2022). Pendampingan Pelaksanaan Kegiatan Pekan Posyandu Untuk Mencegah Stunting Kota Depok. *JMM (Jurnal Masyarakat Mandiri)*, *6*(3), 2188–2194.

Amini, R., Saragih, I., & Lestari, F. (2023). *Kerentanan Kebakaran Saerah Perkotaan: Analisis Risiko dan Pemetaan di Jakarta Timur, Indonesia*. *4*, 1974–1981.

Annex, H. (2013). *National Fire Alarm and Signaling Code 2013 Edition*. 16–362.

Azrini, M., Denny, H. M., Widagdo, L., Masyarakat, F. K., & Diponegoro, U. (2016). Studi Tentang Perilaku Operator Dalam Kesiapsiagaan Penanggulangan Bahaya Kebakaran Di Pt. X Suralaya. *Jurnal Kesehatan Masyarakat (e-Journal)*, *3*(3), 524–533.

Badan Standarisasi Nasional. (2004). SNI 03-7012-2004 tentang Spesifikasi sistem manajemen asap di dalam mal, atrium dan ruangan bervolume besar. *Badan Standarisasi Nasional*, *2*, 7012.

Badan Standarisasi NasionalI. (2000). SNI 03-3985-2000, Fire Alarm. *Badan Standarisasi Nasional*.

Hajar, I., Damiri, D. J., Yuliasyah, Y., Jumiati, J., Lesmana, M. S. P., & Romadhoni, M. I. (2020). Desain Instalasi Listrik Bangunan Bertingkat (Studi Kasus: Pesantren Khoiru Ummah Sumedang). *Terang*, *3*(1), 31–40.

Kustija, J., Afifah, A. U., Hasbullah, H., & Surya, I. (2023). Solutions to Preventing Mistake in Building Electrical Installation and Maintenance In Urban Area Based on Skills Training. *REKA ELKOMIKA: Jurnal Pengabdian Kepada Masyarakat*, *4*(2), 100–107.

Pratama, F., Ismiyah, E. I., & Rizqi, A. W. (2022). Analisis Risiko ( K3 ) Metode Hazard Identification Risk Assesment And Risk Control ( HIRARC ) di. *Jurnal Ilmiah GIGA*, *25*(November), 88–95.

Ruslan, M., Al-Amin, M. S., & Emidiana, E. (2021). Perancangan Sistem Fire Alarm Kebakaran Pada Gedung Laboratorium XXX. *Jurnal Tekno*, *18*(2), 51–61. https://doi.org/10.33557/jtekno.v18i2.1412

Statistik, B. P. (2020). *Jumlah Objek Bencana Kebakaran Menurut Jenis dan Kota Administrasi di Provinsi DKI Jakarta, 2020*. BPS. https://jakarta.bps.go.id/statictable/2021/09/10/288/jumlah-objek-bencana-kebakaran-menurut-jenis-dan-kota-administrasi-di-provinsi-dki-jakarta-2020.html

Suharto, H. W. (2008). Sistem Peringatan Dini Akan Bahaya Kebakaran. *TESLA Jurnal Teknik Elektro UNTAR*, *10*(2), 75–78.

Wibowo, W., Pratama, W., Astriawati, N., Santosa, P. S., & Sahudiyono, S. (2021). Antisipasi Risiko Kebakaran Melalui Pelatihan Penggunaan Alat Pemadam Api Portable. *SELAPARANG Jurnal Pengabdian Masyarakat Berkemajuan*, *4*(2), 357.

Zayadi, A., & Prasetyo, C. H. (2023). *Pelatihan Hard Skill Teknik Tata Udara untuk meningkatkan Pemuda Karang Taruna*. *7*(4), 3863–3871.