JOURNAL OF CIVIL ENGINEERING PLANNING and DESIGN
Faculty of Civil Engineering and Planning Institut Teknologi Adhi Tama Surabaya - ITATS

Journal of Civil Engineering, Planning, and Design Vol. 2, No. 2, 2023; page 53 - 59

THE APPLICATION OF PPE AT THE JUANDA METEOROLOGICAL STATION (BMKG)

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Abstract. The application of Personal Protective Equipment (PPE) at the Meteorology, Climatology, and Geophysics Agency (BMKG) is an important step in maintaining employees' safety and health in their work environment. Even though BMKG is not involved in heavy industrial activities, there are still potential hazards and risks that need to be addressed in carrying out meteorological, climatological, and geophysical tasks. This study aims to describe the importance of implementing PPE in the BMKG environment, especially the Aviation Meteorological Station, where we took a case study at the Juanda Meteorological Station. First, we identify potential hazards that may be faced by BMKG employees, such as radiation risk, potential for hazardous gas explosions or fires, extreme weather conditions, and risks of physical injury. In the face of these risks, the use of proper PPE can help protect employees from hazardous exposures, and gas explosions and prevent injury. Next, we discuss the factors that need to be considered in implementing PPE at the BMKG. This includes a comprehensive risk assessment, identification of appropriate PPE for specific hazards, training of employees on the use and care of PPE, and regular monitoring and maintenance of the PPE used. Therefore, by implementing the Occupational Health and Safety Management System, in this case, the application of PPE, BMKG can ensure that employees have a safe and healthy work environment, reduce the risk of work accidents, and comply with applicable regulations and standards related to work safety.

Keywords: *Safety, Health, BMKG, PPE*

1. Introduction

The Occupational Health and Safety (OHS) management system is one of the main elements of the company's general management system (Darabont et al., 2017). The Occupational Health and Safety Management System is a system designed to identify, prevent, and control risks in the work environment and implemented in various types of organizations and sectors to protect the safety and health of employees. OHS management systems have existed for several decades and have demonstrated their key role in successfully improve the implementation of OHS in the workplace by ensuring integration into business planning and development processes. The adoption of the OHS management system also ensures more effective participation of workers in determining and implementing preventive measures. (International Labour Organization, 1996). A critical first step in protecting employees is to conduct a "hazard assessment" to identify physical and health hazards in the workplace. Potential hazards can be physical or health-related, and a comprehensive hazard assessment should identify hazards in both categories. Examples of physical hazards include moving objects, temperature fluctuations, high-intensity lighting, objects that can roll or pinch, electrical connections, and sharp edges. Examples of health hazards include excessive exposure to hazardous dust, chemicals, or radiation (OSHA, 2023).

As the Meteorology, Climatology and Geophysics Agency (BMKG), even though they are not involved in the production of goods or services such as the manufacturing or construction industries, there is still a need to ensure the safety and health of employees working at BMKG. Therefore, socialization of the importance of implementing occupational safety and health must be carried out. Forms of socialization of the application of OHS can be in the form of toolbox meetings, safety inductions, posters, safety signs, banners, safety permits, OHS training, disciplinary raids, and others (Alfons Willyam Sepang Tjakra et al., 2013). BMKG employees may be involved in activities such as weather monitoring, data collection, modelling, research, and processing of meteorological and geophysical information (BMKG, 2013). Even though the risks in the BMKG work environment may differ from risks in other industries, it is still important to apply the Occupational Health and Safety Management System principles to protect employees from the hazards and risks that may arise. This includes identifying potential hazards in the workplace, implementing preventative measures, providing workplace safety training for employees, providing appropriate personal protective equipment, and developing emergency response plans.

Occupational Safety and Health is a basic right for workers where one of the objectives of occupational safety and health is to prevent work accidents (Prabowo, 2019). Work-related accidents are accidents that are related to work, in cases where accidents occur because of work or when carrying out work. The causes of accidents are classified into 2, namely unsafe actions and unsafe conditions (Hadipoetro, 2014). The biggest contribution to work accident cases is the unsafe act factor, which is 80-85% (Budiono, 2003).

In this context, implementing the Occupational Health and Safety Management System at BMKG will help create a strong safety culture and provide good protection for employees in carrying out their duties related to meteorology, climatology, and geophysics. The Meteorology, Climatology, and Geophysics Agency (BMKG) has an important role in monitoring weather, climatology, and geophysics in Indonesia (BMKG, 2013). In carrying out these tasks, BMKG employees may be exposed to potential hazards and risks that need to be addressed to maintain their safety and health. Wearing personal protective equipment (PPE) and improving hand tools are generally suggested as desirable approaches to minimize the risks of tool-related injuries (Yang et al., 2020).

JCEPD-ISSN: 2830 - 3628

However, problems arise when the application of PPE in the BMKG environment is still a concern. In Barizqi's research (2015), it is known that workers who work in obedience to the use of PPE will always behave safely in carrying out their work. Meanwhile, if workers do not comply with existing regulations and feel that these regulations are only burdensome and make their work longer, they tend to behave insecurely because they feel more comfortable modifying their work so that it looks easier. This is what will result in an increased risk of minor work accidents and even more severe work accident risks. Safety performance that stood out the most was associated with incidents involving slips, trips, and falls. Furthermore, it was established that the mean safety performance across projects achieved a level of 2.33 sigma. This signifies a potential occurrence of 228,739 accidents per million opportunities (Sanni-Anibire et al., 2020).

In facing the background of this problem, the application of PPE within the BMKG environment is important to protect the safety and health of employees. Therefore, this study aims to identify how far the application of PPE is carried out at BMKG, in this case, namely the Juanda Meteorological Station. It is hoped that this will create a safer work environment and protect employees from risks and hazards that may arise in carrying out their duties.

2. Research Methods

The research method used in this research is a case study. By using a case study approach to describe the implementation of PPE in several units or sections of the BMKG. This could involve collecting data from units that are implementing PPE well and units that are not implementing it.

The details of our case study steps in this study, the first is Determination of Research Objectives. Identify the extent to which the application of PPE is carried out within the BMKG work environment and identify the application of PPE by the type of hazard risk.

The second is the Selection of Study Locations. The location of the case study within the BMKG environment that we chose was the Aviation Meteorology Station, where the Aviation Meteorology Station is the work unit that has the highest risk of work accidents. In this case, we chose the Juanda Meteorological Station as a case study.

The third is Preliminary Data Collection. We conducted initial data collection regarding the application of PPE at the Juanda Meteorological Station. The data collection process involved interviews with relevant staff, direct observation, and analysis of documents related to PPE.

And then the last is Case Identification and Evaluation. Determine the work division that has a priority level of needs in the application of PPE, and determine what types of PPE need to be completed.

3. Result and Discussion

The discussion in this study begins with the presentation of interview questionnaires with employees at the Juanda Meteorological Station, then continues with documentation from direct field observations regarding the presence or absence of PPE implementation, and finally, analyzes the presence or absence of related documents.

The 3 work divisions that we interviewed were the synoptic observation division, the aerology division, and the technicians. The synoptic observation division is a division with work in the form of observing weather elements in the tool park. The aerology division carried out aerial observation activities using radiosondes and balloon pilots. While technicians carry out repairs, maintenance, and installation of meteorological observation tools. The employees we interviewed from the observation division were Shanas, Diah, Ayu, Agatha, Endah, Adit, and Oky from the aerology division, namely Marlyn, Hasan, and Trya. Meanwhile, the technicians are divided into Arsy Alfan and Rizzal.

a. Questionnaire Result

Questionnaire data shows that there has been no implementation of the OHS management system at the Juanda Meteorological Station. Apart from that, the office has actually provided several personal protective equipment according to their respective main duties. However, the absence of written regulations regarding the use of personal protective equipment has resulted in the use of PPE not being carried out. The results of the questionnaire can be seen in table 1 below.

Table 1.
Questionnaire Results

Respondents	Has the Occupational Health and Safety Management System, in this case PPE, been implemented at the Juanda Meteorological Station?	What types of work / divisions require the use of PPE?	What PPE equipment already exists regarding the type of work that requires this PPE?	Is there a written policy or regulation on the use of this tool?
Shanas	Not yet	Observation of weather elements in the tool park	Umbrella, Hat, Boots	Not yet
Diah	Not yet	Observation of weather elements in the tool park	Umbrella, Hat, Boots	Not yet
Ayu	Not yet	Observation of weather elements in the tool park	Umbrella, Hat, Boots	Not yet
Agatha	Not yet	Observation of weather elements in the tool park	Umbrella, Hat, Boots	Not yet
Endah	Not yet	Observation of weather elements in the tool park	Umbrella, Hat, Boots	Not yet
Adit	Not yet	Observation of weather elements in the tool park	Umbrella, Hat, Boots	Not yet
Oky	Not yet	Observation of weather elements in the tool park	Umbrella, Hat, Boots	Not yet
Marlin	Not yet	Release of Radio Sonde and Balloon Pilot	None	Not yet
Hasan	Not yet	Release of Radio Sonde and Balloon Pilot	None	Not yet
Trya	Not yet	Release of Radio Sonde and Balloon Pilot	None	Not yet
Arsy	Not yet	Maintenance of Weather Radars dan Automatic Weather Station (AWS)	Safety shoes and helmets, gloves, safety climbing ropes	Already
Alfan	Not yet	Maintenance of Weather Radars and Anemometer	Safety shoes and helmets, gloves, safety climbing ropes	Already
Rizzal	Not yet	Maintenance of Weather Radars dan Automatic Weather Station (AWS)	Safety shoes and helmets, gloves, safety climbing ropes	Already

b. Field Observation Results

Based on the results of our observations, divisions, and types are suitable for work that requires the application of PPE, namely starting from filling radiosonde and pilot balloons (balloon pilots) using hydrogen/helium gas, then the maintenance of weather radars that have dangerous radiation exposure, then maintenance activities to climb the anemometer tower as high as 10 meters, and finally, the activity of observing weather elements, especially air temperature during extreme weather. Here are the details.

i. Filling balloons with dangerous gases (hydrogen or helium)

Fig. 1 Balloon Filling with Hydrogen / Helium Gas

Filling radiosonde and *pibal* balloons (balloon pilots) using hydrogen or helium gas has a high level of risk. Due to the nature of hydrogen gas is flammable and has high pressure. The use of helium gas is no less dangerous because if inhaled in large quantities, helium can cause asphyxia or lack of oxygen in the body, and if the balloon bursts or explodes, the resulting pressure can be a danger to people around it. However, in practice, the staff who filled the balloons did not equip themselves with any personal protective equipment. This can be seen in Figure 1.

ii. Maintenance of the Weather Radar

Fig. 2 Weather Radar Maintenance

JCEPD-ISSN: 2830 - 3628

Weather radar maintenance may pose risks such as radiation exposure, physical injury, electrical hazards, and extreme weather disturbances. Of course, at a height of more than 10 meters, adequate safety equipment is needed. However, in practice, when carrying out weather radar maintenance, the staff does not use personal protective equipment. This can be seen in Fig. 2.

iii. Maintenance of the Anemometer

Working at height, such as anemometer maintenance, certainly requires high expertise and discipline. The use of work safety equipment is necessary to avoid work accidents that cause fatal consequences. From the results of our direct monitoring, it turned out that the technician only equipped himself with a safety rope (harness). This activity can be seen in Figure 3.

Fig. 3. Anemometer Maintenance

iv. Observation of Weather Elements

Fig. 4. Observation of weather elements in the tool park

Observation of weather elements during normal weather conditions does not have a big risk, so it can be done as shown in Figure 4. However, when the weather turns extreme, such as heavy rain and lightning, it certainly requires a high level of vigilance from officials. So that adequate personal protective equipment is needed to anticipate work accidents.

c. Document Checking

Based on direct interviews with officials and related officers, no associated documents regulate the use of PPE in the work environment of the Juanda Meteorological Station. Including PPE in the Standard Operating Procedures in each unit is essential so that officers can maintain their safety and health while carrying out their duties. Typical PPE documents include PPE use guides, maintenance instructions, inspection checklists, training records, and certificates of compliance or testing. Standard Operating Procedures that outline the use of PPE ensure that staff are aware of the potential risks and know how to protect themselves adequately.

d. Identification and Evaluation

Several things that we can identify from the results of interviews and direct observations in the field are:

i. BMKG employees are less aware of the risks associated with their work and the need to use PPE. This lack of awareness can lead to a lack of appropriate use of PPE and potentially increase the risk of work accidents. Low awareness of Occupational Health and Safety (OHS) makes workers vulnerable to disease and work accidents (Purba & Sukwika, 2021; Tam & Fung,2008).

ii. Lack of understanding of the appropriate types and specifications of PPE. BMKG may not yet have clear guidelines on the types and specifications of PPE that are appropriate for each specific task and risk. This can result in employees using PPE that is inappropriate or not effective enough in protecting them from possible dangers. Training is very necessary

to support workers' awareness of wearing PPE, but sometimes it is not paid enough attention so that workers are still found working without PPE (Aigbkhaode et al., 2011).

iii. Limited resources or limited access to adequate PPE are obstacles to implementing PPE at BMKG.

iv. A strong safety culture among BMKG employees has not been emphasized enough. All workers in industry must have a safety culture that is integrated within them so that in carrying out work and operations they will always place safety aspects as a priority by implementing safe behavior at work (Buntarto, 2015; Soehatman Ramli, 2010).

The steps required and protective equipment that should be used based on each type of work are:

i. The activity of filling balloons with dangerous gas (hydrogen or helium).

This activity carries the risk of gas that can explode or be inhaled by officers. Steps to reduce risk include:

- Training and awareness
  Officers must be equipped with knowledge of potential hazards and how to deal with them. Special training must be provided to recognize the signs of gas danger and emergency actions to be taken.
- Use of personal protective equipment (PPE)
  Workers must use appropriate PPE, such as gas masks, protective glasses, and gloves, to protect themselves from gas exposure.
- Good ventilation
  An effective ventilation system should be installed in the workplace to reduce the concentration of toxic gases and replace them with fresh air.
- Gas monitoring and testing
  Routinely carry out gas monitoring and testing in the work environment to detect the presence of toxic gases and prevent unwanted incidents.

ii. Maintenance of weather radar and anemometer.

Maintenance of weather radar and anemometers is an activity carried out at altitude. According to the Regulation of the Minister of Manpower of the Republic of Indonesia Number 9 of 2016 concerning Safety and Health in Work at Height, several requirements must be met, including:

a) Make a Work Plan
   Basically, work planning for working at height includes:
   - Job Safety Analysis (JSA)/Job Safety Analysis;
   - Providing proper work safety equipment;
   - Ensure ergonomic conditions through the entry/exit paths provided;
   - Implement a permit system for working at heights and provide instructions.

b) Develop and Implement Work Procedures
   - Fall protection techniques and methods;
   - How to manage equipment;
   - Techniques and methods for supervising work;
   - Workplace security; And
   - Emergency preparedness and response.

c) Perform safe work techniques
   Because the radar and anemometer are fixed work floor types, fall prevention measures that must be taken include:
   - Installation of stable and strong safety fences that can prevent workers from falling from fixed work floors;
   - Ensure that each workplace has a safe and ergonomic entry (access) or exit (aggress) route;
   - Ensure that the length of the movement barrier rope does not exceed the distance between the anchor point and the edge of the building which has the potential to be a fall hazard;
   - efforts to reduce the impact of falls from heights can use collective fall arrest equipment in the form of nets or pads.

d) Use PPE, fall protection devices, and anchors
   Procedures for working at height must ensure that all workers use appropriate PPE when carrying out work at height. Fall protection devices consist of:
   - Collective fall prevention device consisting of:
     - walls, parapets, or safety fences with a minimum height of 950mm;
     - safety fences must be able to withstand a minimum load of 0.9 kilonewtons;
     - the fence gap has a maximum vertical distance of 470mm; And
     - sufficient and adequate floor safety to prevent falling objects (toeboard) is available.
   - Personal fall arrest device consisting of:
     - body belt (full body harness);
     - movement limiting rope (work restraint).
   - Anchor
     An anchor used for working at heights, hereinafter referred to as an anchor, is a place to anchor a fall protection device consisting of one or more mooring points that exist in nature, building structures, or have been deliberately created using engineering engineering.

e) Employ licensed workers
   Requirements for workers working at height:

- Competent; must refer to competency standards by statutory provisions, proven by Competency Certification, obtained through a competency test by an authorized institution by statutory provisions.
- Authorized in the field of OHS in work at height: proven by a OHS license issued by the Directorate General, valid for 5 years and can be extended for the same period.
- This requirement cannot yet be met, but what is currently being done is providing training to competent personnel.

iii. Observation of weather elements.

Weather element observation activities require officers to deal with the surrounding environmental conditions, both when the weather is in normal and extreme conditions. Steps to reduce risk include:

- Recognize the danger signs of extreme weather.
- Wear clothing appropriate to weather conditions, such as a warm jacket, hat, gloves and waterproof shoes.
- Drink enough water to keep the body hydrated in hot weather, and eat foods that can provide energy and nutrients to keep the body healthy in cold weather.
- Avoid working outdoors during extreme weather if possible. If not, arrange your work schedule to avoid extreme weather.
- Make sure the tools used in the work do not endanger yourself or others when exposed to extreme weather.
- Don't push yourself if you feel uncomfortable or sick due to extreme weather. Seek shelter immediately and ask for help if needed (Source: https://ahlik3.co.id/informasi/tips-bekerja-aman-di-cuaca ekstrim.html). The protective equipment needed and must be used based on each type of work can be seen from Table 2.

Table 2.
The protective equipments

NO	ACTIVITY	REQUIRED PPE
1	Filling Balloons With Dangerous Gas (Hydrogen Or Helium)	- gas masks - protective glasses - Safety gloves
2	Maintenance Of Weather Radar And Anemometer.	- Body Belt (Full Body Harness) - Movement Limiting Rope (Work Restraint) - Safety Helmet - Safety Gloves - Safety Shoes
3	Observation Of Weather Elements.	- a warm jacket - hat - gloves - waterproof shoes - Umbrella

IV. Conclusion

The conclusion from research on the application of PPE at the Juanda Meteorological Station is that there are still challenges in implementing PPE consistently and effectively across divisions. Several factors influencing the implementation of PPE include staff understanding and awareness, adequate availability of PPE, supportive policies and procedures, as well as culture and resistance to change.

The level of PPE implementation at BMKG still needs to be improved so that it can provide optimal protection for staff in carrying out their duties. In this study, it was found that good PPE implementation can contribute to reducing the risk of injury and accidents, as well as improving the health, welfare, and productivity of staff. Recommendations that can be drawn from this research include increasing training and awareness of staff about the importance of PPE, reviewing existing policies and procedures to ensure suitability and linkage with tasks, providing appropriate and easily accessible PPE and increasing communication and coordination between management and staff regarding PPE. The application of PPE in the BMKG environment needs to be emphasized again in relation to work that has a high risk, by equipping the body with safety equipment such as gas mask, protective glass, safety glove, safety helmet and safety shoes.

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