

Research of Occupational Safety and Health (OSH) Implementation of Work in Electrical Distribution Network in Bali Area

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Keywords: Occupational, Safety, Health, Hazards, Personal, Task, Environment and Organization.

Abstract: This study conducted a study on the implementation of occupational safety and health (OSH) on the work of the electricity distribution network. The study was conducted by descriptive explanative method, where the data is obtained from the results of surveys, interviews, questionnaire filling and measurement. The sample was determined purposively by 18 workers. Data analysis is done with statistical calculations and discussions on prevalence. The results showed that in addition to electrical hazards there are still many sources of hazards that can cause accidents and diseases due to the electricity distribution network. Hazards can come from personal, task, organizational and environmental factors. Identification of the dangers of personal factors is a heavy workload, forced attitudes, unnatural positions in work and excessive use of muscle power. Environmental factors show exposure to very hot temperatures, very bright light and noise disturbances. While from the task factor can be found problems in standard of operating and procedure, the use of tools/materials work, fitting the work to the workers and supervision of the implementation of work. All factors that have potential to cause accidents and occupational diseases must be controlled so that the work can be done safely, comfortably, healthily, effectively and efficiently.

1 INTRODUCTION

1.1 Background

Occupational safety and health issues are still very high in the world, according to the ILO every year 2.78 million workers die from occupational accidents/occupational diseases. Nationally BPJS Indonesia recorded 173,105 cases in 2018 both occupational accidents and occupational diseases. While the dominant work accident occurred in electrical work, namely cases of electrocution as many as 78 cases, hit by objects as many as 59 cases, fell as many as 51 cases (Lidya, 2020).

Various OSH problems that arise in the work of the power grid, such as accidents due to work, occupational diseases, environmental problems, fitting between workers and their work, and many more problems related to occupational safety and health that can decrease the degree of health, productivity and ultimately decrease the level of welfare and quality of life of workers in electricity distribution network. For this reason, research is

needed on the implementation of OSH on the work of the electricity grid.

1.2 Research Issues

- What is the source of hazard causes of accidents and illnesses due to working conditions on electricity network?
- How much workload (heavy physical work and long working time) due to working on electricity network?
- How much is the level of awareness of workers to the factors of occupational safety and health in the work of electricity network?

1.3 Research Objectives

- Identify sources of occupational injury/illness that must be controlled immediately.
- Obtain measurable data on the source of accidents and illnesses due to poor working conditions, physical environment, workstations and work organization.

- c) Physical workload and subjective worker complaints due to harsh working conditions and regular and long-time work schedules.
- d) Determining the level of awareness of workers and companies to the factors of occupational safety and health (OSH).

2 RESEARCH METHODS

This research conducted a study on the implementation of occupational safety and health (OSH) on the work of the electricity distribution network. The study was conducted by descriptive explanative method, where the data is obtained from the walk through of surveys, literature study, interviews, questionnaire filling and measurement. The determination of research samples is done by means of purposive samples of 18 workers where samples are selected from the population based on criteria and conditions that are in accordance with the purpose of this study. Data analysis is done with statistical calculations and discussions on prevalence.

The research flow can be seen in the figure 1 below:

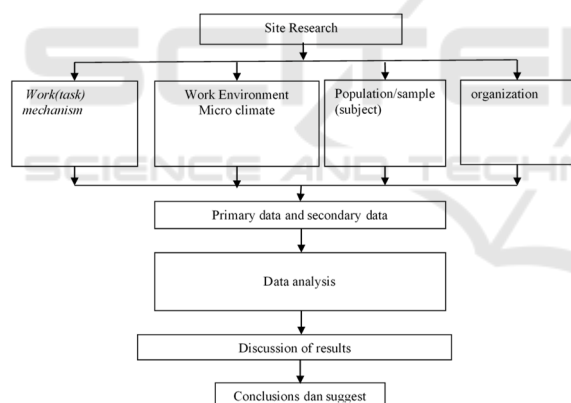


Figure 1: Research flow diagram.

Research done on work in electrical distribution network PT. PLN (Persero) in Bali area, on April-July 2021.

3 RESULTS AND DISCUSSION

3.1 Personal Factor

3.1.1 Research Subjects

The study subjects numbered 18 people, male and physically, mentally and socially healthy. age range

between 20-25 years as many as 8 people (44%), 25-30 years of 6 people (34%) and the age range of 30-35 years as many as 4 people (22%). High school education equivalent to 9 people (50%), Diploma of 8 people (44%) and Bachelor's Degree level of 1 person (2%). 8 unmarried subjects (44%) and 10 married (56%). working period of less than 2 years as much as 3 people (17%), between 2-5 years of 4 people (22%), working period of 5-10 years of 8 people (44%) and a working period of over 10 years of 3 persons (17%).

3.1.2 Body Mass Index (BMI)

From the results of the measurement of height and weight of the study subjects, it can be calculated the BMI of each subject. The BMI of the subject can be seen in the table 1 below:

Table 1: BMI data of research subjects.

Body data	Average	standard deviation	minimum	maximum
Height (cm)	167.1	7.66	153.50	182.30
weight (Kg)	60.37	6.17	50.20	72.50
Body mass index	21.56	2.50	17.96	25.11

BMI in the normal category is in the range of 17-25. Some subjects are likely to experience chronic energy deficiency as their BMI approaches 17. Chronic lack of energy at work can cause decreased work concentration, loss of work arousal, fatigue and pain (Skirbe, 2003).

While BMI above 25 is very risky to high blood pressure as well as obesity. In subjects with a BMI above 25, they were at 2.5 times more risk of having musculoskeletal disorders (MSDs) compared to subjects with a BMI below 20 (Drøyvold et al, 2005).

3.1.3 Heart Rate Pulse

According to Grandjean, (1993) Workload can be determined by taking measurements on the subject's pulse at rest and at work. The higher the pulse of work, the heavier the workload carried by workers. From the results of the study, the workload of the subject was categorized as heavy because it was in the range of 100-150 pulse per minute (ppm). The results of the subject's pulse measurement can be seen in the table 2 below.

Table 2: Heart Rate Pulse Measurement.

Pulse Rate	Average	Standard deviation	minimum	maximum
resting pulse rate (Ppm)	71.92	1.23	69	73
working pulse rate (Ppm)	120.03	7.84	109	146
working pulse (Ppm)	51.93	2.12	39	62

Heavy workloads come from basic workloads and additional workloads. Heavy workloads can lead to rapid fatigue, complaints on muscles and injuries to parts of the body that are exposed to continuous workload.

By using the pulse data in the table 2 above, it can be calculated %CVL (Percentage of Cardiovascular Load). %CVL can be used to determine the level of fatigue experienced by the subject in carrying out his work. The subject's %CVL calculation result is an average of 63.65%. This is categorized as a very laborious job and it is recommended to work a short time or work alternately.

3.1.4 Work Body Posture

Body Posture is how workers carry out their work in a good body attitude, natural and comfortable body position so that the work can be done well and smoothly without causing complaints to the body and other limbs.

From the results of the walkthrough survey, the attitude/position of the body while working is usually less noticed because it is concentrated in the work process, so that sometimes it gives rise to unnatural posture/position, forming a forced attitude, working too long on the electric pole let alone without scaffolding or good footing. This is reinforced by the results of filling out questionnaires as shown in the table 3 below.

Table 3: Forced/unnatural Attitude.

No.	Questions	Sample (persons)	Answers (%)	
			Yes	No
1.	Working in a squatting position	18	39	61
2.	Working in a standing position	18	83	17
3.	Working in a sitting, squatting and standing position alternately	18	72	28
4.	Work by bending/twisting wrist	18	61	39
5.	Keeping elbows away from body	18	67	33
6.	Reaching for something behind your body	18	22	78
7.	Working while moving/walking	18	72	28
8.	Doing something in a different place height above your shoulders	18	56	44
9.	Working with a flexed neck	18	67	33
10.	Using fingers to work/without tools	18	28	72
11.	Working at heights	18	78	28
12.	Working using a desk and bench	18	6	94
13.	Working with your feet on the ground correctly as on the floor	18	50	50

From the table 3 above it can be known that the dominant attitude of forced labor is up and down the electric pole, working on the pole with a position of drifting/hanging, movement on the pole. 39% worked in an underground sitting/squatting position, 83% stood up, 72% did work with a sitting, squatting and standing position as per circumstance/need, 61% worked by bending/twisting the wrist, 67%

worked by holding the elbow away from the body, 22% grabbed something behind the body, 72% worked while moving/walking, 56% worked something that was higher than the shoulders, 67% worked with a bent neck, 28% used fingers to work without the help of work tools, 78% worked at height / on poles, 94% worked without tables and chairs because working outdoors, 50% worked with legs not stepping on the ground/floor because working on poles.

Forced labor attitude and working conditions with unnatural body positions such as bowing during work, squatting and working hanging on poles is a poor work attitude to work, if this is done continuously for a long period of time will cause symptoms, disorders and pain in some parts of the body. Table 4 below showed some of the subject's complaints about the work of the electricity grid.

Table 4: Subjective worker complaints.

No.	Questions	Sample (persons)	Answer (%)	
			yes	No
1	Do you feel tired all over your body?	18	11	89
2	Do you have a headache?	18	11	89
3	Do you feel stiff in your shoulders?	18	50	50
4	Do you have back pain?	18	50	50
5	Do you feel thirsty?	18	83	17
6	Do you feel dizzy?	18	11	89

The subjective complaints above arise as a result of heavy workloads and are carried out with the wrong attitude of work, unnatural body positions and done by forced attitude (Wijesuriya et al, 2007).

3.1.5 Use of Muscle Power

The use of energy and muscle in work is largely determined by the weight of workload received by workers. The heavier the workload, the more energy is needed to move the muscles in the body. In addition to workload, the use of muscle and power can also be caused by the way of work, body attitude of working time, unnatural body movements, reach and distance with the body, problems of excess weight and weight of tools/materials and equalization of workload on the body. If the use of energy and muscles is done excessively and not in accordance with the ability and unbalance to the workload proportionally it will cause abnormal/unnatural body movements, the body forms a forced attitude so that it becomes quickly tired, pain in the limbs, feeling pain in the muscles can even be a trigger for the onset of work accidents (Kogi et al, 2003).

Table 5: Results of the muscle power use questionnaire.

No.	Questions	Sample (persons)	Answers (%)	
			Yes	No
1.	Does the job feel hard for you?	18	33	67
2.	Do you feel that your energy is still lacking when working when working?	18	28	72
3.	Do you pay attention to your posture/body position work?	18	60	40
4.	Holding things/loads with limbs?	18	17	83
5.	Is the load being lifted heavy?	18	44	56
6.	Reaching tools/materials out of reach?	18	11	89
7.	Lifting and placing something under your knees?	18	89	11
8.	Using finger clips with pressure?	18	72	28
9.	lifting and carrying tools/materials manually/without tools?	18	89	11

Observations through *walkthrough survey* showed that the dominant work and requires relatively large exertion of muscle power is the activity of lifting and transporting manually, up and down electric poles, working on poles with emergency footstools (without scaffolding), assembling and installing tools and work materials, tidying tools, materials and work without workstations (tables, chairs and workspaces). This is reinforced by the questionnaire data in the table 5 above.

From the use of energy and muscles in the above work it will have an impact with the emergence of some complaints in some parts of the body, especially in muscles that get heavy categorized work pressure. The muscles that are prone to excessive muscle stretching so that there are disturbances are on the shoulders, upper and lower arms, wrists, back, waist and buttocks. The impact of such a situation is the onset of a collection of symptoms or syndromes related to pain in the back, waist and back of the body or called musculoskeletal disorders (MSDs).

This is in accordance with the results of the analysis of filling out the muscle complaint questionnaire as presented in the table 6 below.

Table 6: Nordic Body Map Questionnaire Results.

No.	Type of Complaint	Sample (persons)	Answer (%)	
			pain	No
1	Left/right shoulder	18	89	11
2	Upper/lower arm	18	83	17
3	Wrist	18	78	22
4	Back	18	72	28
5	Waist	18	78	22
6	buttocks	18	61	39

3.2 Environments

The working environment conditions intended here are factors derived from the work environment

around the workplace that becomes a source of hazards as the cause of accidents or occupational diseases either directly or indirectly. Sources of hazards derived from the workplace environment such as: noise, vibration, light intensity, temperature, humidity, wind, rain, lightning, chemicals, dust, smoke, steam, gas, infrared, ultraviolet, etc. The impact that can be caused from the source of harm that comes from the work environment varies, ranging from long-term and instantaneous effects, there is an additional workload on the body, exposure that exceeds the threshold value, accumulation of harmful substances in the body. All of these impacts can lead to job disruption, injury, illness, poisoning and decreased productivity.

Table 7: The Working Environmental data.

No.	Variabel	Average	Standard Deviation	maximum
1	Air Humidity (%)	80.33	1.16	86.45
2	WBGT (°C)	29.28	1.91	31.52
3	Light intensity (Lux)	790	260.50	2100
4	Noise level (dBA)	70.16	8.07	90.1

The table 7 above shows that high heat exposure and the intensity of sunlight are very prominent, as work is done outdoors. WBGT values and light intensity need attention because they are already outside the allowable threshold value. For work performed continuously for 8 hours, the WBGT threshold value is for workloads in the weight category is 25°C, while the measurement results show that the average WBGT value is 29.28°C and the very high light intensity 2100 lux (NSA, 2004). In addition, noise is also close to the recommended threshold for working value of 85 dBA. Noise in this research site also reduces hearing to communicate, according to Grantham, (1992) 80 dBA noise levels are no longer appropriate for communication or coordination. When working with the above conditions will trigger an increase in blood pressure and pulse, loss of work motivation and early fatigue that ultimately decreases work productivity.

3.3 Task Factor

3.3.1 Operational and Procedure Standards

Standard of Operating Procedure (SOP) is a document related to the procedure performed chronologically to complete a job that aims to obtain the most effective work from workers at the lowest cost.

SOP in question is a guideline for the implementation of Occupational Safety and Health

(OSH) that can be a reference by anyone involved in the work of the electricity network both as workers, supervisors and responsible for project / work activities (Deskya, 2018).

Table 8: SOP work manual.

No.	Questions	Sample (persons)	Answers (%)	
			Yes	No
1.	Is there a working manual on the power grid?	18	61	39
2.	Is the work manual (SOP) in accordance with the work to be done?	18	56	44
3.	Do the existing SOPs apply the use of PPE, danger signs, warnings and OSH rules?	18	61	39
4.	Do you obey and follow all directions in the SOP at work?	18	56	44

From the table 8 above shows that almost half of the sample doubted about the importance of SOP and OSH in the workplace. Where 39% said there is no work manual, 44% said the manual is not in accordance with its work, 39% consider SOP has not applied the principles of OSH and 44% claim to have not followed the rules of OSH on the SOP. Workers who do not apply SOP in carrying out their work will have a 6 (six) times greater risk of accident compared to workers who comply with SOP in carrying out their work (Putri et al, 2017).

3.3.2 Work Tools and Materials

The use of tools and materials in the work is absolutely done, especially in the work of the electricity network. Work tools are tools used to assist in carrying out the work process from start to finish.

Work accidents arising from the use of 80% work materials are caused by human errors, such as: lack of worker skills, lack of operating certificate, overburdened usage, unclear signaling, limited operator visibility, work design errors, reckless/careless work, poor OSH compliance and irregular testing. Types of accidents that become a source of danger to the use of work equipment/materials such as: pinched hands, hit by objects, injured by incisions, scratched and punctured by sharp objects, hit by debris, etc.

From the table 9 above shows that there are still some problems regarding the use of work equipment and handling of work materials. Where 11% say that the complete unavailable work equipment, 17% said the complete unavailability of work materials, 11% said there was a discrepancy between the tool and the work material with the work, 17% admitted to using the equipment is not in accordance with the provisions, 22% installed work materials not in accordance with the rules and regulations, 28% used work equipment and installed materials without the

Table 9: Work equipment and materials.

No.	Questions	Sample (persons)	Answers (%)	
			Yes	No
1.	Is the work equipment fully available at the time of work?	18	89	11
2.	Are work materials completely available at the time of work?	18	83	17
3.	Are the work equipment and materials appropriate for the work to be done?	18	89	11
4.	Are you able to use work equipment in accordance with the provisions?	18	83	17
5.	Can you install work materials/materials according to the rules and regulations?	18	78	22
6.	Has the use of work equipment and installation of materials implemented the use of PPE, danger signs, warnings and OSH rules?	18	72	28
7.	Do you always comply with the rules and regulations in using work equipment and installing work materials?	18	78	22

method/principle of OSH and 22% claimed not to comply with all the rules and regulations of OSH in the use of work tools and materials.

According to Purnamasari (2020) the use of tools and materials used in a job must be adjusted to the availability of SOP, MSDS and reliable human resources such as skills, skills and skills of its operators, administration systems and organizations. SOP use tools and MSDS materials are used to regulate how applications, operations, maintenance and repairs. SOP made more emphasis on the provisions and regulations of OSH for control on the safety of the operation of equipment both manual and machines.

3.3.3 Fit the Man to the Task

From the table 10 below, the results were obtained that 33% of the sample was never given training on the work they would do, 83% needed education and training about their work tasks, 39% found it difficult to do their job, 22% felt they did not know the rules and conditions in work and 39% did not know the application of OSH in their work.

Table 10: Worker Adjustment to the Job.

No.	Questions	Sample (persons)	Answers (%)	
			Yes	No
1.	Have you been given any training on the work you do?	18	67	33
2.	Do you feel the need for education and training regarding your duties and work?	18	83	17
3.	Do you find it difficult when you do your job?	18	39	61
4.	Are the ways of doing the work assignments that you do are in accordance with the rules and regulations?	18	78	22
5.	Have the working methods/steps implemented the use of PPE, danger signs, warnings and OSH rules?	18	61	39
6.	Do you always comply with the rules and regulations in carrying out this way of working?	18	89	11

Adjustment between the demands of tasks in the job and the skills of workers must be considered well because between the demands of the task and the ability/competence of workers must be balanced and appropriate to carry out a job well. Hazards can also arise as a result of discrepancies between task demand and worker skills. In addition to having the ability, skills, skills and competencies in the job, workers are also ordinary people who still have many shortcomings, limitations, weaknesses and others that cause discrepancies between task demand and worker skills. Usually, to adjust it is done evaluation of the demands of the task so that it is in accordance with the ability of workers. But that doesn't mean workers can't be fixed to fit their duties. There are several adjustments that can be made to workers such as skill improvement through Education and Training (Ma'rifat, 2021).

3.3.4 Coaching and Supervision

Coaching and supervision of the implementation of OSH is absolutely implemented to ensure the implementation of OSH in accordance with existing rules. Coaching must continue to be carried out continuously to create working conditions and the implementation of OSH is getting ahead and better than before. Thorough supervision is carried out in the working organization to ensure that all work processes are in accordance with the plans and rules made earlier.

From the table 11 below, shows that there are 22% of respondents answered not always supervised by supervisors in work, 17% were disturbed by the presence of supervisors in the field, 50% had been reprimanded for using PPE, 61% had been reminded to always be careful in work, 33% said there was

Table 11: Development and Supervision of the implementation of OSH.

No.	Questions	Sample (persons)	Answers (%)	
			Yes	No
1.	Have you always been supervised by the OSH supervisor/foreman/inspector while working?	18	78	22
2.	Does the supervision interfere with your concentration while working?	18	17	83
3.	Have you ever been asked by the OSH foreman/inspector to always wear PPE in your work area?	18	50	50
4.	Have you ever been reminded by the foreman/OSH inspector to always be careful at work?	18	61	39
5.	Is there always a supervision/check on the suitability of work machines and equipment?	18	67	33
6.	Does the Supervisor always make sure all work is done properly?	18	78	22
7.	Has Supervision ever been carried out suddenly?	18	100	0
8.	Does the Supervisor always reprimand if a worker does a job that is not good?	18	50	50
9.	Does the company penalize workers who violate work procedures?	18	78	22

rarely an inspection of equipment/machines, 22% said there was rarely a good inspection, 50% often saw supervisors reprimand workers and 78% said companies do not give penalties if they violate the procedure work.

Coaching and supervision also aim to evaluate the performance that has been done and provide correction to irregularities and errors that have been done in the implementation of OSH. So that the emergence of sources of danger caused by violations and deviations from work plans, work rules, work instructions and SOP can be prevented as early as possible.

3.4 Organization

Organizational factors are factors that govern workers in carrying out the work process so that it runs smoothly and safely. Organizational factors here can also be used to minimize the threat of hazards that can cause work accidents or the onset of occupational diseases. Included in the organizational factors are working hours and rest times, rotating work, overtime work, effective movement in work, type of work and work time, SOP, posters etc.

The observations and interview results reinforced by the results of filling out questionnaires by workers show that the company does not have a working reference. The signs of danger in the work environment are severely lacking. Few apply short breaks and nutritional intake in the form of drinking and snacks. For others, drinking water is also not available. This condition of course endangers health and reduces the labor force of workers.

Another aspect of the organization that needs to be looked at is the condition of information, especially information about things that harm workers. The results of direct observations show that in the work area there are almost no signs of danger except for common signs such as signs of employment. While signs or information about the presence of hazardous materials, dangerous machines or warnings about the importance of the use of PPE do not exist at all.

The clear and detailed delivery of details of tasks, procedures and work procedures to employees can reduce the occurrence of errors. In the delivery of information, there are several systems that can be used, among others with oral communication, written information either delivered directly, installed on the bulletin board or in the form of work slogans installed in strategic places that can be seen by employees at any time and in the form of a workbook reference book. The use of the right information media with

proportional size, color and placement can facilitate the production process and increase work productivity (Manuaba, 2003).

Work timing is closely related to the ability of workers, the demands of tasks and the work environment. Improper work timing can create a working condition where there is an imbalance between the demands of the task and the ability of the worker. The demands of tasks that are less than the ability of workers will cause boredom and conversely the demands of tasks that exceed the ability of workers can cause early fatigue. Therefore, in making work time arrangements must be really pursued to be able to create a balance between the demands of the task, the work environment and the ability of workers (Grandjean, 1993).

4 CONCLUSIONS

The sources of hazards in the work of the electricity network are numerous and complexity, in addition to the dangers of electrical voltage, other hazards that can threaten the safety and health of workers are very diverse and specific. Identification of hazard sources can be classified into four factors, namely, personal factors, environmental factors, task factors and organizational. The workload of the electricity network is quite heavy and very laborious, this is indicated by the results of measuring the heart rate of workers between 100-150 beats per minute and %CVL of 63.65%. Sun heat exposure with WBGT above 31°C. The level of awareness of workers to the source of danger to the work of the electricity network is still low. This is evidenced by the results of research where there are several potential hazard factors that are still not understood, realized, violated even not in the know, such as nearly 90% of the work is done on electric poles with a forced attitude and without scaffolding, the remaining 10% of the work is done on the ground with various positions such as sitting, squatting and standing without using the workstation. 89% of jobs are lifting and transporting objects by manual means, 44% problems in SOP, 39% require adjustment between work, duties and responsibilities with personnel, 22% problems on the use of tools and work materials, 50% weakness in coaching and supervision.

It is advisable to conduct further research to anticipate the sources of hazard and risk to the work of the electricity network by involving experts in their respective fields.

ACKNOWLEDGEMENTS

The author would like to express his deepest gratitude to all those who have provided assistance both material and immaterially to complete this paper.

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