

Professional paper

RISK ASSESSMENT USING THE MATRIX METHOD FOR THE JOB "POWER LINE FITTER" IN A BUSINESS ENTITY

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ABSTRACT

The assessment of workplace hazards involves recognizing the likelihood of occurrence and the severity of potential injuries or occupational diseases to employees. The risk assessment is performed by a team of experts from various scientific and professional fields to objectively evaluate the attributive and/or numerically expressed level of risk, which will inform the employer and the employee about the extent of exposure to a harmful event. In this paper, the risk assessment of one workplace "Power line fitter" in a business entity was carried out, using the qualitative matrix method. The risk assessment for the mentioned workplace showed that it is a workplace with a medium risk of working at height, the danger of direct contact with parts of the electrical installation and live equipment, and harmful climatic influences - work in an open space, which was confirmed by the use of other risk assessment method.

Keywords: risk, risk assessment, transmission line fitter, workplace with increased risk

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1. INTRODUCTION

The Law on Occupational Safety ("Official Gazette of the Federation of Bosnia and Herzegovina", No. 79/20) [1] stipulates for the first time the employer's obligation issue an Act on risk assessment in written form, in which all workplaces in the working environment are assessed and adopted appropriate measures, all aimed at reducing work injuries and occupational diseases. The general goal of the occupational safety system in the Federation of Bosnia and Herzegovina is to recognize and assess all risks at the workplace and in the working environment for each worker, based on identified hazards and harms and following the systematization

of workplaces. That is why it is important to understand the work organization, work process, work tools, materials, raw materials used in the work process, personal protection equipment, and other essential elements. To carry out an assessment of occupational risk at the workplace, it is necessary to know: the location of the workplace, which equipment, materials, and work processes are used, which hazards have already been identified, which protective measures have been used, which injuries have been reported, etc. The competence of evaluators is also reflected in their adequate choice of method and use. The method should be described clearly in the

documentation for easy understanding. Risk assessment methods can be [2]:

- quantitative,
- semi-quantitative,
- qualitative.

Qualitative methods are mostly based on logical reasoning and personal experience, and they use a risk ranking matrix, so they are quite subjective. Quantitative methods are based on reliable statistical data that is not easy to provide. Combined methods utilize numerical values obtained through quantitative and qualitative analyses, which are then assessed and ranked using expert evaluation techniques. Semi-quantitative methods, which are a combination of various approaches, are the most commonly used techniques. This group includes the AUVA (matrix), KINNEY (tabular) method, etc., which are most often used in our practice. Common to these methods is that they use ranking. By applying the matrix of both variables, probability and consequence can be qualitatively categorized and quantitatively graded (ranked). The method is straightforward, but it has limitations. It fails to detect minor differences and is unsuitable for evaluating rare events, as it cannot determine the probability of an unwanted event or the significance of its consequences. They are easily understood by those responsible for safety and security at work, as well as by company management.

The method for risk assessment, prescribed in the Federation of Bosnia and Herzegovina, with a matrix of five levels, generally has all the mentioned advantages and disadvantages.

2. RISK ASSESSMENT FOR THE JOB "POWER LINE FITTER" IN A BUSINESS ENTITY

Job title "Power line fitter" After collecting the necessary documentation, recording the organization of work, and describing the current state of health and safety at work, a description of the technological and work process is made: Description of the technological and working process:

- Directly participates in the preparation of works and works on maintenance of transmission lines;

- Directly participates in the preparation of works and works on the construction of transmission lines;
- Works in the capacity of responsible works manager;
- Immediately implements occupational safety and fire protection measures;
- Controls the correctness and maintains work equipment, personal and collective protective equipment;
- Keeps technical documentation;
- Implements technical recommendations, unique technical standards, regulations, and instructions for operation and maintenance of equipment;
- Implements the quality management system policy;
- Participates in part of the functional tests;
- Participates in internal technical inspections;
- Performs other tasks on the order of the direct manager;
- He is responsible for his work to the head of the Service;
- He is responsible for all jobs and tasks assigned to him by law, company acts, employment contracts, orders, decision or decisions of the authorized manager, as well as for those jobs and tasks that can reasonably be said to fall under the terms of the contraction work, i.e. the scope of work of employees in the Company[3].

2.1. Hazard grouping

Mechanical hazards:

- Insufficient protection due to rotating or moving parts;
- Free movement of parts or materials that can cause injury to the employee;
- Impossibility or limitation of timely removal from the workplace, exposure to closure, mechanical impact, collision, etc.;
- Other factors that may appear as mechanical sources of danger.

Hazards related to workplace characteristics:

- Work at height in terms of occupational safety regulations;
- Possibility of slipping or tripping (wet or slippery surfaces);

- Physical instability of the workplace;
 - Other hazards that may arise in connection with the characteristics of the workplace and the way of working.
- Dangers related to the use of electricity:
- Danger of direct contact with live electrical installation and equipment parts;
 - Danger of indirect contact;
 - Danger due to lightning strikes and consequences of atmospheric discharge.
- 2.2. Grouping of harms**
- Harms that arise or appear in the work process:
- Chemical harm, dust and fumes - inhalation, suffocation;
 - Physical harm (noise);
 - Physical damage (vibrations);
 - Physical harm (electromagnetic radiation);
 - Harmful climatic influences (outdoor work).
- Harms resulting from mental and psychophysical efforts:
- Efforts or physical strain (manually carrying loads, pushing or pulling loads);
 - Non-physiological position of the body (long-term standing, walking, occasional crouching, kneeling);
 - Strain on certain organs and systems (sight), mental strain;
 - Efforts when performing certain jobs that cause psychological burdens (stress);
 - Responsibility in receiving and transmitting information, using appropriate knowledge and abilities, responsibility in rules of conduct;
 - Harms related to the organization of work such as working longer than full time, preparedness in case of intervention.

Table 1. Established lists of hazards and harms

No.	Established hazard lists	Established hazard lists
1.	Insufficient protection due to rotating or moving parts	Chemical hazards, dust and fumes - inhalation, suffocation
2.	Free movement of parts or materials that may cause injury to the employee	Physical harm (noise)
3.	Impossibility or limitation of timely removal from the workplace, exposure to closure, mechanical impact, collision, etc.	Physical harm (vibration)
4.	Other factors that may appear as mechanical sources of danger	Physical harm (electromagnetic radiation)
5.	Work at height in terms of occupational safety regulations	Harmful climatic influences (outdoor work)
6.	Possibility of slipping and tripping (wet and slippery surfaces)	Efforts or physical strain (manually carrying loads, pushing or pulling loads)
7.	Physical instability of the workplace	Non-physiological position of the body (long-term standing, walking, occasional crouching, kneeling)
8.	Other hazards that may arise in connection with the characteristics of the workplace and the way of working	Strain of certain organs and systems (sight), mental strain
9.	Danger of direct contact with live parts of the electrical installation and equipment	Efforts when performing certain jobs that cause psychological burdens (stress)
10.	Danger of indirect contact	Responsibility in receiving and transmitting information, using appropriate knowledge and abilities, responsibility in rules of conduct
11.	Danger due to lightning strikes and consequences of atmospheric discharge	Harms related to the organization of work such as working longer than full time, preparedness in case of intervention

3. RISK ASSESSMENT OF HAZARDS AND HARM AND METHODS AND MEASURES FOR ELIMINATING, REDUCING, OR PREVENTING RISKS

The risk assessment is based on the analysis of the probability of the occurrence and severity of injuries, occupational diseases, or damage to the worker's health related to work, caused at the workplace and the workplace in the working environment and is carried out in the manner established in Articles 14 and 15 of the Rules on Risk Assessment ("Official Gazette of Federation of Bosnia and Herzegovina", No. 23/21) [4].

3.1. Risk assessment method

According to the matrix method, risk is calculated using the formula: $R = V \cdot P$, where V represents the probability and P denotes the consequence. Table 2 displays the probability categories and their classifications; Table 3 outlines the consequences and provides their definitions. To define the risk (R), a scale with 5 ranking levels is used, shown in Table 4. The risk matrix can also be represented in a table for better visualization of multiple risks and their comparisons, as shown in Table 5.

Table 2. Probability categories and category description

No.	Probability category	Description of the category
1.	Insignificant	Very low probability of occurrence, only in exceptional situations
2.	Low probability	There is a possibility, but it is unlikely
3.	Medium probability	The possibility exists, under certain circumstances, probably possible
4.	High probability	Increased chance of occurrence, very likely expected
5.	Extremely large	Almost certainly, a high possibility of the occurrence

Table 3. Consequence severity category and category description

No.	Category of severity of consequences	Description of the category
1.	Very easy	Negligible damage to health does not involve sick leave, absence from work
2.	Easy	Mild and temporary reversible damage to health that may require medical assistance and temporary incapacity for work
3.	Medium weight	Significant impairment of health that requires longer treatment and may cause a permanent reduction in work ability
4.	Heavy	Permanent and/or progressive impairment of health, causing permanent incapacity for work
5.	Very severe (fatal)	Severe impairment of health with handicap - death or multiple injuries regardless of the severity of the injury

Table 4. Levels of risk and description of the category

No.	Levels of risk	Description of the category
1.	Insignificant	The risk is negligible, no protective measures are required
2.	The risk is acceptable	The protection should be improved if it is possible
3.	Medium high risk	Necessary measures to improve protection, monitor health status
4.	Big risk	The risk is high, immediately take measures to improve protection, health control, warn workers of the danger
5.	A very big risk	The risk is very high (unacceptable), immediately stop the work process, take urgent measures

Table 5. Table view of the risk matrix

		Severity of consequence - illness or injury				
		A	B	C	D	E
Probability		Very easy	Easy	Medium	Difficult	Very difficult, deadly
I	Insignificant	1	1	1	2	2
II	Small	1	1	2	3	3
III	Medium	2	2	3	3	4
IV	High	2	2	3	4	5
V	Extremely high	2	3	4	5	5

3.2. Risk assessment to hazards and harms and determination of ways and measures to eliminate, reduce, or prevent risks for the "Power line fitter" position

In Table 6, the identified hazards and harms for the "Power line fitter" workplace are listed, according to the Matrix method, the elements required for risk assessment were determined and the risk assessment was carried out. Also, the necessary measures to eliminate, reduce, or prevent risks are listed.

The risk arising from the established dangers and harms is unacceptable and the position of "Power line fitter" in the business entity is a position with medium increased risk.

3.3. Ways and measures to eliminate reduce or prevent risks

Table 7 lists the measures to eliminate, reduce, or prevent risks for the "Power line fitter" workplace.

Table 6. Identified hazards and harms and risk assessment for the workplace "Power line fitter"

HAZARDS		Probability category	Consequence Severity Category	Risk level	
Mechanical hazards	Insufficient protection due to rotating or moving parts	Working with a drill, grinder, and chainsaw (cleaning the route under and around power lines)	I	D	2
	Free movement of parts or materials that may cause injury to the employee	Working with a chainsaw (cleaning the route under and around power lines)	II	B	I
	Impossibility or limitation of timely removal from the workplace, exposure to closure, mechanical impact, collision, etc.	Use of an official vehicle, participation in public transport (arrival and departure from work)	I	D	2
	Other factors that may appear as mechanical sources of danger	Usage of hand tools	I	B	1
Hazards related to	Work at height in	Regular work	III	D	3

	HAZARDS		Probability category	Consequence Severity Category	Risk level
the characteristics of the workplace	terms of occupational safety regulations	activities on lines, work in baskets, on hanging ladders (20-50 m)			
	Physical instability of the workplace	Work on a hanging ladder	I	D	2
	Other hazards that may occur in connection with the characteristics of the workplace and the way of working	Bite snakes, sting ticks, hornets, bees, wasps.	I	D	2
Dangers related to the use of electricity	Danger of direct contact with parts of the electrical installation and equipment	Regular work activities, work on equipment replacement, reconstruction, rehabilitation, construction and maintenance of transmission lines	III	D	3
	Danger of indirect contact	Use of devices powered by electricity, work on equipment maintenance	II	C	2
	Use of devices powered by electricity, work on equipment maintenance	Regular work activities, work on equipment replacement, reconstruction, rehabilitation, construction and maintenance of transmission lines	I	D	2
	HARMS		Probability' category	Consequence Severity Category	Risk level
Harms that arise or appear in the work process	Chemical harm, dust and fumes - inhalation, suffocation	Control and maintenance of pillars (use of paints and varnishes, thinners)	II	B	1
	Physical harm (noise)	Use of manual electric tools (drill, sander), work with a chainsaw	I	D	2
	Physical harm (vibrations)	Use of manual electric tools (drill, sander), work with a chainsaw	I	C	1
	Physical harm	Regular work	II	C	2

	HAZARDS		Probability category	Consequence Severity Category	Risk level
	(electromagnetic radiation)	activities, work on equipment replacement, reconstruction, rehabilitation, construction and maintenance of transmission lines			
	Harmful climatic influences (outdoor work)	Regular work activities, work on equipment replacement, reconstruction, rehabilitation, construction and maintenance of transmission lines	III	C	3
	Efforts or physical strain (manually carrying loads, pushing or pulling loads)	Regular work activities	II	C	2
	Non-physiological position of the body (long-term standing, walking, occasional crouching, kneeling)	Regular work activities	II	C	2
Harms arising from psychological and psychophysical efforts	Strain of certain organs and systems (sight), mental strain	Regular work activities	II	B	1
	Efforts when performing certain jobs that cause psychological burdens (stress)	Regular work activities	I	B	1
	Responsibility in receiving and transmitting information, using appropriate knowledge and abilities, and responsibility in rules of conduct.	Regular work activities	II	B	1
Harms related to work organization	Harms related to the organization of work such as working longer than full time, preparedness in case of intervention	Overtime, standby	I	B	1

Table 7. Measures to eliminate, reduce, or prevent

HAZARDS	MEASURES TO ELIMINATE, REDUCE, OR PREVENT RISKS
Working with a drill, grinder, and chainsaw (cleaning the route under and around power lines)	<ul style="list-style-type: none"> - Careful handling; - Train employees for safe and healthy work; - Compliance with instructions for safe and healthy work; - Usage of personal protective equipment.
Working with a chainsaw (cleaning the route under and around power lines)	<ul style="list-style-type: none"> - Usage of personal protective equipment.
Use of an official vehicle, participation in public transport (arrival and departure from work)	<ul style="list-style-type: none"> - Maintenance and checks of the vehicle's technical correctness; - Strict compliance with traffic regulations; - Adapting driving to road conditions.
Usage of hand tools	<ul style="list-style-type: none"> - Compliance with work instructions and maintenance of work equipment; - Increased attention during work; - Training for the safe and healthy work of employees.
Regular work activities on lines, work in baskets, on hanging ladders (20-50 m)	<ul style="list-style-type: none"> - Before starting work at a height, it is necessary to take all the prescribed technical measures in terms of securing the workplace from falling from a height (proper construction and installation of ladders, baskets, ropes, and belts), follow the instructions for safely performing work; - Workers who work at height must meet certain health conditions, good hearing, and balance, good near vision, and proper color vision, then depth sensibility is required, preserved function of the locomotor, cardiovascular, and nervous systems; - Mandatory use of personal protective equipment (protective clothing, vest, raincoat, protective footwear, protective gloves, helmet, protective glasses, protective belt and rope, etc.).
Working on hanging ladders (physical instability of the workplace)	<ul style="list-style-type: none"> - Hanging ladders should only be used in exceptional cases when other equipment is not justified; - The hanging ladder must be secured before usage so that it does not swing; - Ensure that workers have a permanent and safe handhold and support; - Usage of personal protective equipment.
Get bitten by snakes, stung by ticks, hornets, bees, wasps,...	<ul style="list-style-type: none"> - Personal protective equipment (clothing with long sleeves and pants, gloves, deep shoes, head and neck covering); - First aid kit.
Regular work activities, work on equipment replacement, reconstruction, rehabilitation, construction, and maintenance of transmission lines	<ul style="list-style-type: none"> - Observe the 5 golden rules; - Installation of safety boards; - Usage of safe tools and safe work procedures; - Only qualified and trained workers can work on high-voltage plants; - Usage of personal protective equipment.
Usage of devices powered by electricity, work on equipment maintenance	<ul style="list-style-type: none"> - Daily visually control the correctness of the connection lines of the computer, accompanying equipment and other electrical devices; - Do not touch damaged parts of equipment and electrical installations.
Regular work activities, work on equipment replacement, reconstruction, rehabilitation, construction and maintenance of transmission lines (danger of lightning strikes)	<ul style="list-style-type: none"> - Technical protection of electrical installations against direct and indirect lightning strikes; - Interruption of work on the transmission network in the event of the arrival of a thunder cloud.
HARMS	MEASURES TO ELIMINATE, REDUCE OR PREVENT RISKS
Inspection and maintenance of pillars (use of paints and varnishes, thinners)	<ul style="list-style-type: none"> - Usage of personal protective equipment, usage of safe paints and varnishes.

Usage of manual electric tools (drill, sander), work with a chainsaw - noise	<ul style="list-style-type: none"> - Usage of personal protective equipment.
Regular work activities, work on equipment replacement, reconstruction, rehabilitation, construction, and maintenance of transmission lines (radiation electromagnets)	<ul style="list-style-type: none"> - Technical measures to reduce radiation of electromagnetic fields; Including, as necessary, the usage of safety switches, protective equipment, or similar health protection mechanisms; - Limit access and time of stay in the area of electromagnetic fields by placing warning signs, protective fences, etc.; - Training to work in a safe manner; - When climbing a power line, observe safety distances from live lines; - A maintenance program of equipment and instruments in proper condition; - Measures to prevent the discharge of sparks and electrical contacts by technical means and training of workers; - Usage of personal protective equipment.
Regular work activities, work on equipment replacement, reconstruction, rehabilitation, construction, and maintenance of power lines (outdoor work)	<ul style="list-style-type: none"> - It is necessary to use personal protective equipment according to the regulations (clothing, footwear), stop work in case of storms and high temperatures, occasionally short stoppage of work, and stay in cooled rooms in summer, and in heated rooms in winter; - Inform and educate workers about the prevention of possible consequences of working at high temperatures; when working outdoors at high temperatures, take in plenty of fluids, and one glass of water every 15-20 minutes.
Efforts or physical strain (manually carrying loads, pushing or pulling loads)	<ul style="list-style-type: none"> - There must be enough space at the workplace so that the worker can easily change his position and perform the necessary movements during work; - When manually transferring loads, or pushing or pulling them, work in pairs and use equipment or machinery.
Efforts or physical strain (manually carrying loads, pushing or pulling loads)	<ul style="list-style-type: none"> - The workplace must be designed so that the employee works in a forced non-physiological position as short as possible; - Physical activity and a program of appropriate exercises; - Minimize the duration of non-physiological positions during work; take short breaks when working in non-physiological body positions.
Strain of certain organs and systems (sight), mental strain	<ul style="list-style-type: none"> - Using more frequent, shorter breaks during work.
Efforts when performing certain jobs that cause psychological burdens (stress)	<ul style="list-style-type: none"> - It is recommended that the employer occasionally organizes counseling and education on the topic of overcoming stressful situations; - Compliance with work procedures and work instructions; - Consultations with workers on decisions regarding the organization of work whenever possible and when it serves the purpose of achieving optimal working conditions; creation of realistic work plans and adherence to them;
Responsibility in receiving and transmitting information, using appropriate knowledge and abilities, responsibility in rules of conduct	<ul style="list-style-type: none"> - Fostering non-violent communication between managers and employees; - Performing tasks according to priorities; - Compliance with the law on prevention of abuse at work.

4. CONCLUSION

The paper presents the risk assessment of the transmission line fitter job using the qualitative matrix method. Regardless of which method is used, the result of the risk assessment should always be the same. The workplace is assessed as a medium-risk workplace in relation to work at height,

danger from direct contact with live parts of electrical installation and equipment, harmful climatic influences - and work in open space. In this case, the mentioned workplace, at another business entity, was also assessed as a workplace with medium increased risk using the AUVA method. The choice of method depends on the appraiser,

working conditions, and other required elements. Sometimes methods can be combined, all with the aim of better evaluation. All methods are based on the same principles and have the same purpose. It can be concluded in principle that the largest number of methods match the key elements of the assessment. All methods for risk assessment are insufficiently precise and possess a certain amount of subjectivity. The choice of appropriate legal and natural persons who must be competent for risk assessment is of extreme importance for proper risk assessment. Of course, they must have the appropriate expertise, knowledge and ability. In many companies, the variety of work tasks and the complexity of the technological process exceed the competence of a single evaluator. Therefore, it is extremely important to assemble a competent

multidisciplinary risk assessment team in order for the Risk Assessment Act to be valid. Sometimes appraisers know how to overestimate and sometimes underestimate the risk.

Conflicts of Interest

The authors declare no conflict of interest.

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