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RISK ASSESSMENT AND WORKPLACE CONFORMITY AUDIT, BLAST-FURNACE WORKER, C.S. ARCELOR MITTAL GALATI

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ABSTRACT

Risk assessment is the first step towards safer and healthier jobs, and it is the way to reduce accidents at work and occupational diseases. Taking into consideration the need for good management of the risks of accident and professional disease at the unit level and the new legal requirements, the evaluation of the risk factors for injury and professional illness at the – blast-furnace worker- from C. S. ArcelorMittal Galati taken into consideration for this study.

KEYWORDS: risk assessment, blast-furnace, worker platform, INCDPM-Bucharest method

1. Introduction

The furnace is the actual iron-producing aggregate necessary for the steel process in the converter. The casting of the cast iron is a continuous process, feeding of the furnace with raw materials and coke is done rhythmically as the material column descends as a result of the coke combustion, the melting process and the periodic discharge of the resulting products.

The continuity of this process makes a complex and diverse range of risk factors for injury and occupational disease to act on service staff. Many of these measures have a direct impact on reducing the cost per tonne of cast iron, but all have an important contribution to lower the cost of incidents.

Consequences of incidents of any nature can be viewed as human, economic, environmental, social etc.

2. Objectives

Taking into account the need for good management of the risks of accident and occupational disease at the unit level and the new legal requirements, it was decided to carry out the evaluation of the risk factors for injury and professional illness at the workstations. For this the INCDPM - Bucharest method was used as a theoretical and working method. Based on the theoretical and practical premises, the steps of the method were carried out by making the hierarchy of risk factors.

Identifying deadlines that are more important at a given time to perform the measures is done in line with the generic hierarchical order:

- Intrinsic prevention measures;
- Collective protection measures;
- Individual protection measures.

3. Theoretical considerations

Risk assessment should be structured to ensure that all relevant hazards and risks are addressed. First, we try to eliminate them. If we cannot, we reduce them.

The starting point in optimizing the prevention of occupational accidents and occupational illnesses in a system is the assessment of the risks in the system.

The risk assessment involves identifying all the risk factors in the system under consideration and quantifying their size based on the combination of two parameters: the severity and frequency of the maximum possible effect on the human body.

The system of work can be defined as the set of components with intercondition relations between them during space and time of different activities in order to transform inputs into the system (materials, subassemblies, energy, bought / supplied) in the outputs of the system (products, services, delivered / sold) to meet market needs.

Components of the work system are the workload; worker (executor); means of production; working environment (Figure 1).

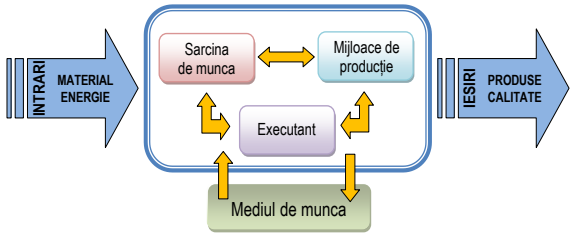


Fig. 1. *Components of the work system*

Risk factors in the work system show that the space of manifestation of the risk factors is the work process. By turning from possibility into reality, the action of the risk factors becomes an effective danger for the performer, which can lead either to the violent injury of the organism, by damaging anatomic integrity, causing the annulment of one or more of the physiological functions. In the event of such events, risk factors have been caused by (real) injury or professional illness.

Variations are movements that deviate from normal walking, i.e. sudden dysfunctions of the elements involved in the realization of the work process. By definition, they are specific to accidents at work. Variations are inherent to all elements of the work system: rolls objects, a machine starts off or does not respond to the stop command, the performer stops and falls, fluid jets, kickbacks, etc.

States are properties, properties, human deficiencies, defects in relatively permanent means of production, which is why we find them especially in the etymology of occupational diseases. Not just the static elements listed above represent states; through its relatively permanent character, and the functional movement of a toothed wheel is a condition that can lead to an accident at work and not a professional illness.

However, a very rigorous delimitation of the two categories is not possible. Under certain conditions, the specific difference is only given, the level and duration of exposure of the human body, so that a disease factor can become an injury factor and vice versa.

Legislation Romania. This risk assessment principle is already included in the European standards (IEC 812/85, EN 292-1 / 1991, EN 1050/96) and underlies the various practical methods. Thus, SR EN 292-1 / 1996, taken over in Romania according to the European standard mentioned, in chap. 6, states that the "factors" to be taken into account in the risk assessment are:

a) the likelihood of injury or damage to health;

b) predictable maximum severity of damage to or damage to health.

The obligation to assess the risks to jobs in our country derives from the current legislation in the field. Thus, in Law no. 319 of July 14th, 2006 to Art. 7, it is specified:

(3) The employer has the obligation to implement the measures stipulated in paragraph (1) and (2), on the basis of the following general principles of prevention:

a) avoiding risks;

b) assessing the risks that cannot be avoided;

c) combating risks at source;

(4) Without prejudice to other provisions of this law, taking into account the nature of the activities in the undertaking and / or establishment, the employer shall:

a) assess the risks to the safety and health of workers, including the choice of work equipment, chemical substances or preparations used and the fitting-out of workplaces;

The INCDPM method was endorsed by the Ministry of Labour and Social Solidarity in 1993 with constant improvements. Application of the method is useful to society because it allows:

- radiography of the existing situation at each workplace, highlighting the acceptable and unacceptable risks, as well as the measures to be taken;
- comparison and ranking of jobs by gravity criterion;
- rigorous economic and social justification for the managerial decision regarding the order of adopting the preventive measures;
- an objective basis in the discussions between the board of directors and trade union representatives and other workers on pay and compensation.

In order to carry out the assessment of the risks of injury and occupational disease for the workstation "furnace platform - Furnace Department", the field shift was made for the establishment of the analysis team. With this team, the following steps were taken:

- theoretical premises were presented to carry out a risk assessment in accordance with the new legal requirements and the new realities on the ground, including organizational ones;
- the purpose of the work system was identified by defining the work process.
- the means of production were identified on the ground and listed.
- for the determination of the workload, the job sheet was presented to us.
- determination bulletins for analysing work environment parameters were purchased.
- it has come to the practical identification of risk factors on the ground and discussions with workers. By direct observation and logic deduction the risk factors for each component were established;
- with the help of the physician and the Possible consequences of the action of risk factors on the human body (appendix to the course support), the

maximum foreseeable consequence for the identified risk factors was established;

- based on the identification of the maximum foreseeable consequence and using the grading scale, the introduction into seriousness classes was made;
- using the rating grid, based on the severity and frequency previously obtained, the factors at the appropriate risk levels;
- using the calculation formula, the weighted average risk factor was established, establishing the partial risk level for the analysed workstation;
- we have made the hierarchy of risk factors for the prioritization of prevention and protection measures according to the level of risk;
- a list of proposed preventive measures has been prepared to reduce risk factors;
- the report of the analysis with the interpretation of the evaluation results was drawn up.

4. Method of research

4.1. Work process

➢ ***The production of iron*** in the quantity required by the Business Plan and the quality established by the Company Standard.

4.2. Elements of the work system

4.2.1. Means of production

➢ ***The furnace itself, plant and machinery:***

- Caution for preheating the air;
- Dust bag, for blast furnace treatment;
- Apparatus for batch loading in the furnace;
- Water cooling system;
- Machine for punching and punching the cast iron hole;
- A blast furnace installation in the blast furnace;
- The base of the bunkers with the associated equipment for the preparation of the batch loading batch;
- The control room; synoptic panel

➢ ***Means of transport:***

- Railways for unloading slag and cast iron;
- Cast iron pots, slag pots; wagons;

➢ ***Raw materials:***

- Coke; crowded; pellets; iron ore; coal dust; hot air (t_{max} = 1250 ^{o}C); combustible energy fluids: (furnace gas; CH_4;) furnace cooling water; oxygen breathing pipes; iron bars (rods).

➢ ***Products obtained:***

- First fusion cast iron; slag; blast furnace powder.

➢ ***Refractory materials:***

- Table for closing the cast iron hole; refractory concrete; refractory materials for lining pig iron and slag gutters;

➢ ***Tools:***

- Row; crowbar; sledge - hammer; electric and pneumatic hammers; rolling stock; winches; winches.

4.2.2. Work task

➢ ***Arrival to the program:***

- Taking over the exchange; is appropriately equipped with E.I.P.; is trained for the operations to be performed; is assigned to the workplace;

➢ ***Maintain drainage gutters (cast iron, slag):***

- Performs operations to close the cast iron hole after cast iron and furnace slag;
- Evacuation of cast iron deposits on the bottom of the gutters and basin;
- Prepares discharge of cast iron and slag furnace;
- Preparation of concrete;
- Performs the operations for closing the cast iron hole and the separation basin;
- Tight fitting of the metallic section sections;
- Preparation of concrete;
- Applying the refractory concrete by casting or the stamping mass in successive thin layers;
- Executes the vibration of the cast concrete, i.e. the compaction of each stamped layer;
- Perform the drying and heating of the refractory mass, respectively the concrete according to the diagram;
- Removes the metallic pattern on the sections;
- Refract the threshold and the dips with refractory mass;
- Verifies compliance with the levelling between the slag gutter and the separation basin threshold;
- Mounts the methane gas burners on the bottom of the gutters;
- Covers gutters and basin repaired with caps or panels of thermal insulating sheet;
- Monitors the burning of methane gas and regulates the flame according to the heating diagram;
- Participates in planned and accidental repairs;

Damage and prevention and remediation

➢ ***Boiling of the cast iron in the trough***

prevention:

- Observation of drying and heating times or of the concrete diagram;
- Ensuring efficient drying with a sufficient number of methane gas burners;
- Thermal insulation of the outside surface of the gutters during drying and heating.

➢ ***Remedy:***

- Reducing the operation of the furnace;
- The iron drain hole is blocked;
- The upper slag is discharged;
- Changing the discharges to the other casting chamber, if possible;
- Rapid recovery of the affected gutter is carried out if there are no other evacuation possibilities.

➢ ***Perforation of the gutter or basin prevention:***

- Regular checking according to the graph, of the wear condition of the refractory lining and whenever deemed necessary;
- Observing the working instructions.
- ***Remedy:***
- Immediate reduction and closing of the furnace;
- Local repair of affected area by stamping with Kermix table or concrete.

➢ ***Passing the cast iron into the slag pot prevention:***

- Observing the distance of approx. 10 m from the main gutter to the slag and the threshold of the cast iron gutter after the basin;
- Verifying the section and the hole position of the basin shovel;

➢ ***Remedy:***

- Reduction of the furnace;
- Partial breaking of the cast iron threshold;
- Stopping the furnace.

➢ ***Passing the slag to the cast iron pots prevention:***

- Checking the diameter of the cast iron drain hole under the basin shovel;
- Control of the integrity of the basin separator;
- Compliance with the technology of closing the cast iron outlet in the pool.

➢ ***Remedy:***

- Partial breaking of the dyke from the slag;
- Reduction of furnace operation in order to reduce the casting and slag flow;
- Stopping the furnace.
- Provides cleanliness at work;
- Teaching exchange:
- Does not leave the workplace before the next exchange arrives;
- Check with the operator of the next shift the technical condition of the machines;
- Communicates to the master the deficiencies found, and he records them in the turnbook.

➢ ***Prohibited actions:***

- Stamping the refractory mass over the cast iron washings;
- The use of masses or concrete in places other than those for which they were intended;
- Applying superimposed layers of refractory mass or refractory concrete of 40 mm thicker;
- Accidental wetting of refractory lining with water;
- Insufficient compaction of each layer of the table;
- Failure to observe the drying and heating time of the stamped lining;
- Interruptions to the casting of refractory concrete;
- Non-observance of the heating rate of the refractory concrete of 30 °C / h;
- Non-observance of the temperature ranges when heating the concrete at 150 °C and 450 °C;
- The use of watertight or watertight gutters;
- The use of tilting gutters with solid edges or degraded lining, with the risk of splashes with cast iron and slag;
- Blocking with materials, or debris, the bridges serving the dump gutters.

4.2.3. Work environment

- The furnace operates on the furnace discharge platform. The main features of the work environment are specified in the analysis bulletins.
- We note that there are exceedances of the admissible values for the following noxes: inhaled powders, coke dust, noise level, CO, phenols, sulphur dioxide, HPA and 3,4 Bp.
- The level of illumination is reduced at some work points and is very high in the melt area.
- It is also noted: the presence of infrared radiation, air currents and high temperature variations between discharges, especially during the cold season.
- High level of noise at some points of intervention - especially in the area of winds.

5. Risk factors identified

5.1. Means of production

➢ ***Mechanical risk factors***

- Grip, driven by winches, winches, perforated machine and plugged into cast iron outlets.
- Hitting by car and / or CF vehicles when traveling through the combustion chamber.
- Self-locking cooling system operation.
- Sliding parts, materials - uninsured against

uncontrolled movements.

- Routing of parts, cylindrical materials.
- Flipping equipment, subassemblies, etc.
- Free fall of parts, tools, materials from the upper parts.
- Free spill of molten material – e.g. to perforating the gutters.
- Spillage of the cast iron and slag as a result of blocking or loss of geometric properties of exhaust ports or gutters.
- Design of bodies or particles - incandescent splashes, sparks, dust, various particles entrained by air currents.
- Deviation from the normal trajectory of the masses transported by the rolling bridge.
- Surprise by large-scale parts in the balancing phase.
- Jet, cast iron eruption, slag, incandescent coke - accidental perforations reinforcement - water vapor spray - scalding.
- Contact with dangerous surfaces or contours (stinging, sharp, slippery, abrasive, adhesive) - undamaged surfaces, dangerous contours, etc.).
- Work in the vicinity of pressure vessels (technical gas cylinders) and pressure circuits (hot air ducts).

➢ ***Thermal risk factors***

- High temperature of objects or surfaces - gutters, joists, pipes, bark etc.
- Flames, flame - bursts, accidental release of gaseous bags, burning of the material on the gutters with the burner.

➢ ***Electric risk factors***

- Direct-current electric shock - Unprotected current paths or damaged insulation;
- Indirect touch electrocution - Connections to the damaged earthling system;
- Electrocution by step voltage - ex. to access to the furnace bundles due to the lighting system and leaks and accumulations of water or water-soaked powders.
- Electrical equipment must be provided with operating instructions;
- Instructions for intervention and first aid in case of electric shock.

➢ ***Chemical risk factors***

- Work with flammable substances: ex. Coke;
- Carcinogens present in the workplace atmosphere (e.g. HPA, 3.4 Bp, etc.).

5.2. Work environment

➢ ***Physical risk factors***

- High air temperature - work in the vicinity of the furnace, slag, cast iron, etc.
- High temperature variations, especially during the cold season, between the discharge phase and the one in which the furnace is plugged.
- Airflow - sealing, natural and forced draft.
- High level of noise at some points of intervention - especially in the area of winds.
- Low illumination level on some travel paths.
- Glow - contrast between incandescent metal or slag and the general environment.
- IR radiation - in the vicinity of gutters, pots, etc.
- Natural disasters - ex. the surprise of earthquake.
- Massive dust accumulation.

➢ ***Chemical risk factors***

- Accumulation of toxic gases - ex. hydrogen sulphide, CO, N_2, SO_2, etc. - intoxications
- Accumulation of explosive gases or vapors - Dissociation of water into the furnace at accidental penetration - (Cooling unit destruction) - In the furnace discharge phase can lead to the occurrence of hydrogen - Explosion
- Carcinogenic substances present in the workplace atmosphere (e.g. HPA, 3.4 Bp, etc.)

5.3. Work task

➢ ***Inappropriate content***

- Omissions in preconditioning of work operations
- Allowing workers to move to work areas without having a gas mask or accessing it in case of danger

➢ ***Physical overload***

- Dynamic effort - large trails, manual handling of large masses.

➢ ***Psychological overload***

- Difficult short-term decisions - for corrections or liquidation of "INCIDENT" situations.

5.4. Worker (Executer)

➢ ***Wrong actions***

- Execution of unforeseen work tasks or in a manner other than technical working conditions.
- Incorrect routing of the cast iron or slag flows into the pot followed by empty discharge.
- Incorrect burying or clogging. Incorrect operation of the machine (e.g. non-cleaning of its components).
- Inappropriate fixing of working parts on machines.
- Spill in slag pots containing water, ice, foreign elements.
- Incorrect attachment of loads to lifting gear.
- Adjusting working parameters outside of the conditions imposed by technology.
- Non-synchronization - teamwork with other employees (e.g. with crane, winch, etc.).

- Travels, stops in dangerous areas - on the access roads, CF, under the load of the lifting means, in the area of the wind gullies, on any platform from the elevation of the wind gullies upwards.
- Falling at the same level: by unbalance, by sliding, by obstacles - uneven surfaces, loaded with dust, accumulations of water along the travel route, elements deposited on the surface of the access ways and covered with dust.
- Falling from height: walking, emptying, unbalance, and sliding - lack of railings, technological gaps, etc.
- Accidental communication - failure to observe the crane signalling code.

➢ ***Omissions***

- Omitting operations that ensure their own security.
- Not using E.I.P. and other means of protection (which have been provided by the employer).

5.5. Risk evaluation

The result obtained from previous procedures is identified in the Risk Assessment Grid and enrolled in the Job Sheet. With the help of the scale of risk / security levels, then these levels are determined for each risk factor in part. This gives a hierarchy of the size of the risks in the workplace, which gives the possibility to set a priority of the prevention and protection measures, depending on the risk factor with the highest level of risk.

The global risk level (Nr.) in the workplace is calculated as a weighted average of the risk levels set for the identified risk factors. For the result obtained to reflect as accurately as possible the reality, the risk factor rank is used as weighting element, which is equal to the level of risk.

In this way, the highest risk factor will also have the highest rank. This eliminates the possibility that the offset effect, which involves any statistical mean, masks the presence of the maximum risk factor.

The formula for calculating the global risk level is the following:

$$N_{rg} = \frac{\sum_{i=1}^{n} r_i \cdot R_i}{\sum_{i=1}^{n} r_i}$$

where:

- N_{rg} is overall job risk level;
- r_i, rank of risk factor "i";
- R_i, risk level for risk factor "i";
- n, the number of risk factors identified.

The level of security (Ns) per job is identified on the Risk/Security Level Scale, built on the inverse principle of risk and security levels.

Both the level of global risk and the level of security are enrolled in the Workbook.

The evaluation of the identified risk factors is done by completing the LABOR EVALUATION FILE, (Table 1) which contains, in addition to the risk factors and the manifestation form, the maximum consequence, the severity, the probability and the partial risk level for each identified risk.

Table 1

COMPANY: S.C. ARCELOR MITTAL - GALAŢI	**WORK EVALUATION FILE**	**NUMBER OF PERSONS EXPOSED:** -50
DEPARTMENT: BLAST-FURNACE		**EXPOSURE TIME:** 8 h/sch.
WORKING: BLAST-FURNACE WORKER		**EVALUATION TEAM:** Eng. AdrianVASILIU

COMPONENT SYSTEM FOR WORK	RISK FACTORS IDENTIFIED	THE RISK FACTOR MANIFEST FORM	3[1]	4[2]	5[3]	6[4]
MEANS OF PRODUCTION	*RISK FACTORS MECHANIC*	1. Grip, drive by winches, winches, perforated machine and plugged cast iron outlets.	DEATH	7	2	4
		2. Hitting by means of car and / or CF transport when moving through the combustion chamber.	DEATH	7	2	4
		3. Self-locking cooling system operation.	DEATH	7	1	3
		4. Sliding parts, materials - uninsured against uncontrolled displacements.	DEATH	7	1	3
		5. Routing of parts, cylindrical materials.	DEATH	7	1	3
		6. Flipping of equipment, subassemblies, etc.	DEATH	7	1	3
		7. Free fall of parts, tools, materials from the higher odds.	DEATH	7	1	3
		8. Free spill of molten material - e.g. to perforating the gutters.	DEATH	7	1	3
	RISK FACTORS THERMAL	9. Spillage of the cast iron and slag as a result of blocking or loss of geometry of the discharge holes or gutters.	DEATH	7	1	3
		10. Design of bodies or particles - incandescent sprays, sparks, dust, particles entrained by air currents.	DEATH	7	1	3
		11. Deviation from the normal trajectory of the masses transported by the rolling bridge.	DEATH	7	1	3
		12. Surprise by large-scale parts in the balancing phase.	DEATH	7	1	3
		13. Jet, cast iron eruption, slag, incandescent coke - accidental perforations reinforcement, water vapor spray, scalding.	DEATH	7	2	4
		14. Contact with dangerous surfaces or contours (stinging, sharp, slippery, abrasive, adhesive)	ITM 3-45 days	2	5	3
		15. Work in the vicinity of pressure vessels (gas cylinders) and pressure circuits (hot air ducts).	DEATH	7	1	3
		16. High temperature of objects or surfaces - gutters, joists, pipes, bark, etc.	INV gr. III	4	6	5
		17. Flames, flame - bursts, accidental release of gaseous bags, burning of material on gutters with burner.	DEATH	7	1	3
	RISK FACTORS ELECTRIC	18. Electrocution by direct contact - Unprotected current paths or damaged insulation.	DEATH	7	1	3
		19. Electrocution by indirect touch - connections to the damaged earthling system	DEATH	7	1	3
		20. Electrocution via step voltage - ex. to access the furnace's dimensions due to the lighting system	DEATH	7	1	3
	RISK FACTORS CHEMICAL	21. Working with flammable substances and fluids: ex. coke, methane gas, oxygen, hydraulic oil.	DEATH	7	1	3
ENVIRONMENT	*RISK FACTORS PHYSICAL*	22. High air temperature - work in the vicinity of the furnace, slag, cast iron, etc.	ITM 45-180 days	3	6	4
		23. High temperature variations in the cold season between the discharge phase and the one in which the furnace is	ITM 3-45 days	2	5	3

[1] **PREVIOUS MAXIMUM CONSEQUENCE**
[2] **THE GRAVITY CLASS**
[3] **PROBABILITY CLASS**
[4] **RISK PARTIAL LEVEL**

COMPONENT SYSTEM FOR WORK	RISK FACTORS IDENTIFIED	THE RISK FACTOR MANIFEST FORM	3^1	4^2	5^3	6^4
FOR WORK		plugged.				
		24. Air streams - sealing, natural and forced draft.	ITM 3-45 days	2	6	3
		25. High level of noise at some points of intervention - especially in wind gullies.	INV gr. III	4	6	5
		26. Low illumination level on some moving paths - dirty body lighting).	ITM 3-45 days	2	6	3
		27. Brightness - contrast between incandescent metal or slag and the general environment.	INV gr. III	4	6	5
		28. IR radiation - in the vicinity of gutters, pots, etc.	ITM 3-45 days	2	6	3
		29. Natural disasters - ex. the surprise of earthquake.	DEATH	7	1	3
		30. Massive dust accumulations (according to attached measurement bulletins).	INV gr. III	4	6	5
	RISK FACTORS CHEMICAL	31. Accumulation of toxic gases - ex. hydrogen sulphide, CO, N_2, SO_2, etc. - intoxications	DEATH	7	6	7
		32. Accumulation of explosive gases or vapours - dissociation of water in the furnace at accidental entry - explosion	DEATH	7	3	5
		33. Carcinogenic substances present in the workplace atmosphere (e.g. HPA, 3.4 Bp, etc.)	DEATH	7	6	7
TASK FOR WORK	***CONTENT INCORRECT***	34. Omissions in preconditioning of work operations	DEATH	7	2	4
		35. Allowing workers to move to work areas without their gas mask	DEATH	7	1	3
	OVERUSE PHYSICS	36. Dynamic effort - large trails, manual handling of large masses	ITM 45-180 days	3	6	4
	OVERUSE MENTAL	37. Difficult short-term decisions - for corrections or liquidation of "INCIDENT" situations.	ITM 3-45 days	2	6	3
WORKER (EXECUTER)	**ACTIONS WRONG**	38. Execution of unforeseen work tasks or other than those, technical work provisions	DEATH	7	3	5
		39. Incorrect routing of the cast iron or slag flows into the pot followed by empty discharge.	DEATH	7	1	3
		40. Incorrect burying or clogging. Incorrect operation of the snapping machine	DEATH	7	1	3
		41. Inappropriate fixing of working parts on machines.	DEATH	7	1	3
		42. Spill in slag pots containing water, ice, foreign elements.	DEATH	7	1	3
		43. Incorrect cutting at the winds.	DEATH	7	1	3
		44. Incorrect attachment of loads to lifting equipment.	DEATH	7	1	3
		45. Adjusting working parameters outside of the conditions imposed by technology	DEATH	7	1	3
		46. Non-synchronization - teamwork with other employees (e.g. with crane, cowboy, etc.)	DEATH	7	1	3
		47. Travels, stops in dangerous areas - on the access roads, CF, under the load of the means of lifting.	DEATH	7	1	3
		48. Falling at the same level: by unbalance, sliding, and obstruction - uneven surfaces covered with dust.	ITM 45-180 days	3	3	3
		49. Fall from heights: idle, unbalanced, sliding - lack of railings, technological goals	DEATH	7	1	3
		50. Accidental communication - failure to observe the crane signalling code.	DEATH	7	1	3
	OMISSIONS	51. Omitting operations that ensure their own security.	DEATH	7	1	3
		52. Not using E.I.P. and other means of protection (which have been provided by the employer)	DEATH	7	1	3

The global risk level for the job is:

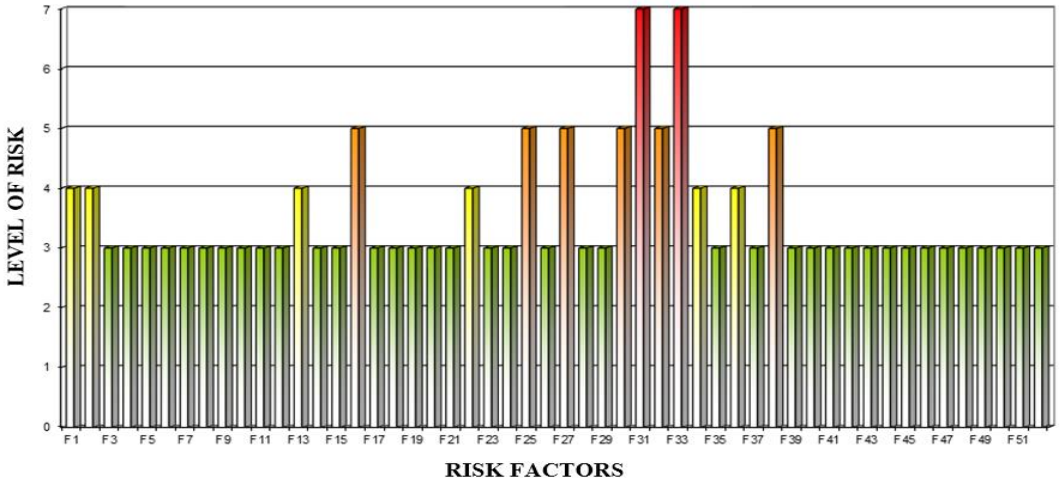
$$N_{rg52} = \frac{\sum_{i=1}^{52} R_i \cdot r_i}{\sum_{i=1}^{52} r_i} = \frac{2(7\cdot 7) + 0(6\cdot 6) + 6(5\cdot 5) + 38(3\cdot 3) + 0(2\cdot 2) + 0(1\cdot 1)}{2\cdot 7 + 0\cdot 6 + 6\cdot 5 + 6\cdot 4 + 38\cdot 3 + 0\cdot 2 + 0\cdot 1} = \frac{9686}{182} = \mathbf{3,76}$$

6. The evaluation results

6.1. Global risk level

The level of global risk calculated for the workplace is equal to 3.76, which is considered to be an unacceptable level of employment. The result is supported by the "Assessment Sheet", which shows that out of the total of 52 identified risk factors, 14 exceeded as a partial risk level the value of 3, 2 being in the category of maximum risk factors 6, being in the category of high risk factors, and the other 6 falling within the category of medium risk factors (Graph 1).

From the Analysis Sheet analysis, 82.69% of identified risk factors can have irreversible consequences on the performer (DEATH or INVALIDITY).



Graph 1. *Risk factors for blast-furnace worker*

Table 2

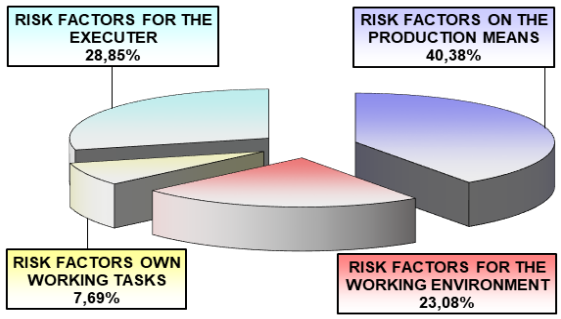
Number factor	RISK FACTORS WHICH ARE INCOMPATIBLE	Partial of risk
F31	Accumulation of toxic gases - ex. hydrogen sulphide, CO, N_2, SO_2, etc. – intoxications	7
F33	Carcinogenic substances present in the workplace atmosphere (e.g. HPA, 3.4 Bp, etc.)	7
F16	High temperature of objects or surfaces - gutters, joists, pipes, bark, etc.	5
F25	High level of noise at some points of intervention - especially in wind gullies.	5
F27	Brightness - contrast between incandescent metal or slag and the general environment.	5
F30	Massive dust accumulations (according to attached measurement bulletins).	5
F32	Accumulation of explosive gases or vapours - dissociation of water into the furnace at accidental penetration - during the furnace drain phase can lead to the occurrence of hydrogen - explosion	5
F38	Execution of unforeseen operations, or in a manner other than technical working conditions.	5
F1	Grip, drive by winches, perforated machine and plugged cast iron discharge holes.	4
F2	Hitting by means of car and / or CF transport when moving through the combustion chamber.	4
F8	Free spill of molten material – e.g. to perforating the gutters.	4
F13	High air temperature - work in the vicinity of the furnace, slag, cast iron, etc.	4
F34	Omissions in preconditioning of work operations	4
F36	Dynamic effort - large trails, manual handling of large masses	4

In order to reduce or eliminate the 14 risk factors (which are in the unacceptable field), the generic measures presented in the "Proposed Action Sheet" are required. Regarding the distribution of risk factors on generating sources, the situation is as follows:

- The factors of the means of production (40.38 %);
- The factors of the working environment

(23.08 %);

- The factors of the work load (7.69 %);
- The factors of the executer (28.85 %).



Graph 2. *Distribution of risk factors*

7. Conclusions

Taking into account the need for good risk management at the unit level and the new legal requirements, it has been decided to carry out an assessment of the risks of occupational injury and illness at the workstations. For this, the method of the National Institute for Research and Development for Labour Protection was used as a theoretical and working method. The team that has been set up has proceeded on the basis of the theoretical and practical premises of the method by making the Job Assessment Sheet and the proposed Measures Sheet.

After determining the partial risk levels for the risk factors identified on the components of the work system, we have the following distribution:

- risk factors for the means of production 40.38%;
- risk factors for the contractor 28.85%;
- risk factors related to the working environment 23.08%;
- risk factors related to the work load 7.69%.

It can be concluded that the workload is too risky but produced with means of production that have many risks in a moderately hazardous environment through less risky performers.

Another interpretation, closer to reality, can be made according to the proportion of unacceptable risk levels in each component of the work system, as follows: The worker performs risky, risk-free tasks with little risk with too low-risk means.

It is certain that the risk level of the environmental factors, the important decrease of the level of the workstation certified by the analysis bulletins, is the highest and the achievement of the proposed measures can be achieved. The levels of the risk factors of the contractor are high and, by diminishing them with technical and organizational measures, significant decreases in risk levels can be achieved.

The prioritization of the deadlines for the implementation of the measures is done in accordance with the generic hierarchical order:

- measures of intrinsic prevention;
- collective protection measures;
- individual protection measures.

The decrease in the number of technical incidents and incidents and accidents must be the general risk target of 4.53 to 3.67 for the blast-furnace worker Platform has shown the possibility of raising the level of safety through technical and organizational measures, the employer in all stages of the production process. In the Blast-Furnace Department by lowering the number of accidents and lowering the level.

This is a beginning for the continuous improvement of all the components of the work process (people, the environment, working processes, material goods).

References

[1]. ***, *Codul Muncii*.
[2]. ***, *Directiva Consiliului European nr. 89/391/1989*.
[3]. ***, *Documentatie ArcelorMittal Galati*.
[4]. ***, *Legea securităţii şi sănătăţii în muncă nr.319/2006*.
[5]. ***, *Norma metodologică de aplicare a prevederilor Legii nr.319 / 2006. aprobate prin HG 1425/2006*.
[6]. ***, *Evaluarea riscurilor de accidentare şi îmbolnăvire profesionala - Metoda I.N.C.D.P.M. Bucuresti*.