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RESEARCH REGARDING ON WORK SAFETY IN MAKING STEEL AT LD CONVERTER

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ABSTRACT

This paper presents the tasks and work environment of workers working at the LD converter. Risk factors identified and assessed and suitable measures for reducing or eliminating them, resulting a safer environment for the development of production activities in specific job and decreased risk of work accidents in this sector.

KEYWORDS: environment, risk factors, LD converter

1. Work system components of evaluated

1.1. Workload

The task of the worker at convertizorului LD comprises a number of distinct activities, and for each of them was made a documentation specifies what is described in the technical working instructions provided by the UOR, as follows:

At receipt and handing work jobs should be followed:

- must be present at the work ,least with 15 min. before the beginning of the work program [1];
- at the end of work, surrender next exchange, machinery and equipment and recorded in the report of activity status. [2];
- acknowledgment of the state of operation of machinery and equipment, possible breakdowns [3];
- check the operation of the booth AMC converter [4];
- ensure the smooth running of the plant material and the addition of slag and steel transfercarelor [5];
- check operation with compressed air at lift lance and tipping converter [6].
- before loading iron, execute the following:
  - operation state of the outlet
  - operation state at the converter masonry [7];
- to inform on the status of the installation of heat recovery and dust control, fume removal (boiler) [8];
- check the status of blowing lance and operating parameters of the wires [9];
- depending on many factors, such as temperature and analysis at liquid iron, steel mark,condition of masonry, condition of ladle,will make the determination of the charged,and will send the amount of hot metal, iron and oxigen required [10];
- after the announcement and confirmation from the boiler "ready" (green signal) will give command the smelter worker II of upload converter [11];
- after loading iron, check again the status masonry converter [12];
- after charging "liquid iron walk the convecter, a few times, after that brings upright and locks tilting from the cockpit [13];
- instilling charge as technological instructe, for type steel, following operating parameters, and where appropriate, amend the oxygen, flow and lance position [14];
- during blowing, ordering smelter worker II, the amount of filler material and when it should be added [15];
- after blowing, the converter tilting command fails, the command of cabins [16];
- supervises the tipping of the converter [17];
- supervises the sampling the temperature, from steel and slag then command to the smelter worker,to position convector to the vertical position [18].

1.2. Work environment

The main characteristics of the work environment are specified in analysis reports.

According to analysis bulletins are allowed exceedances of the following pollutants: dust, CO, lime dust, noise.

The work environment is characterized by:

- low light levels at some points of the work and very high in the viewing area of the molten steel;
- the presence of infrared radiation;
- by draft.

2. Research on risk factors, at making steel in convector LD

Risk factors identified in the work areas at making steel in convector LD are divided into:

2.1-Risk factors identified in the use of means of production

2.2 - Risk factors in the workplace

2.3 - Risk factors of the work task

2.4 - Risk factors of the performer

2.5 – Omissions

2.1 Risk factors identified in the use of means of production

The risk factors identified in the production areas are:

2.1.1. Mechanical risk factors

Grip drive by unprotected transmission (eg belt conveyors, etc.).

Flow of steel, pig iron, slag, incandescent ,in the phases of handling ladles;

Flick the automobiles and railways to move through the plant premises (not used warning beep);

Slip of parts, materials, etc. stored without stability;

Roll of parts, materials based cylindrical or stored without stability;

Rolling of cylindrical parts **(**CO_2 extinguishers);

Free fall of parts, tools, parts, materials, the higher altitudes;

Free leak of molten material;

Accidental discharge of incandescent alloy;

Accidental collapse iron and alloying elements stored

Throwing by currents of air or pneumatic installation, of some particles steel, cast iron or slag

Deviation from the normal trajectory of large masses handled with cranes

Balance of ladle, followed by discharge;

Absence of any insurance (wire ties) in case of jet, eruption of molten material, powder, oil under pressure, etc.;

Dangerous contact with surfaces or contours (sharp, slippery, abrasives, adhesives) - unfinished surfaces, contours dangerous;

Working in the vicinity of pressure vessels.

2.1.2. Thermal risk factors

Objects or surfaces with high temperature - splashes of molten material, heated surfaces, trails technological steam, hot water, etc.

Flames - outbursts, thermal process;

2.1.3.Electrical risk factors

Electrocution by direct touch - current paths unprotected;

Electrocution by indirect touch - faulty earthing, accumulation of fluid.

2.1.4. Chemical risk factors

Explosives - mixture of oxygen.

2.2. Risk factors identified in the work environment in making steel in LD converter

2.2.1. Physical risk factors

High temperature of the air - especially in the converter's vicinity;

Low temperature of the air, in the cold weather - especially at elevation + 43m;

Airflow - natural draft, hoods operation, enclosure leakage;

High noise level - according to the attached analysis bulletins determinations;

Vibrations caused by the movement of vehicles (cranes, pushing machine, etc.);

Low level lighting on some routes of travel.

Brightness-focus convector, material incandescent etc;

Radiation - in the vicinity of the converter, ladles etc.

Natural disasters – earthquakes;

Dust excess - especially at higher rates, in the vicinity of the converters - according to the attached analysis bulletins determinations.

2.2.2. Chemical risk factors

Accumulation of toxic gases - from the steelmaking area and weighing area (eg. exhaust gases of forklifts);

Flammable or explosive gases and vapors - gained at steel making (oxygen, acetylene);

2.3. Risk factors of work task

2.3.1. Physical strain

Dynamic effort - long trails at manual handling of heavy masses (eg barrels alloying materials).

2.3.2. Mental overload

- Difficult decisions in a short time - to fix or liquidation situations of "INCIDENT

2.4. Risk factors of contractor

2.4.1. Wrongful

Execution of contingency operations in the work load;

Commands in time, other than those imposed by technology;

Execution of maneuvers, without ensuring compliance with the security conditions;

Wrong positioning of the ladles;

Setting parameters work outside the conditions imposed by technology;

Not ensure synchronization with other workers to teamwork;

Moving and stationary in hazardous areas - the car ways, or taxiways, forklifts, lifting equipment under load, in the face of convector etc.;

Fall on the same level: the imbalance, sliding - uneven surfaces loaded with dust, accumulation of water on access roads;

Falls from heights: by stepping into the void, the imbalance by sliding - handrails missing, technological voids concealed by accumulations of dust, uncovered or unmarked;

Not comply with the code signal crane;

2.5. Omissions

Omission of operations that ensures their safety

Failure personal protective equipment (E.I.P), individual work equipment (E.I.L), and other means of protection provided (which was granted by the employer).

3. Measurements and recordings of specific's area risk factors at making steel in LD converter

After studies and research, targeting the risk factors for the workers at the convector, were measured a total of 47 cases corresponding to specific activities in this area, with level corresponding to the hazard, at the job's analysis; was constructed diagram of Figure 1.

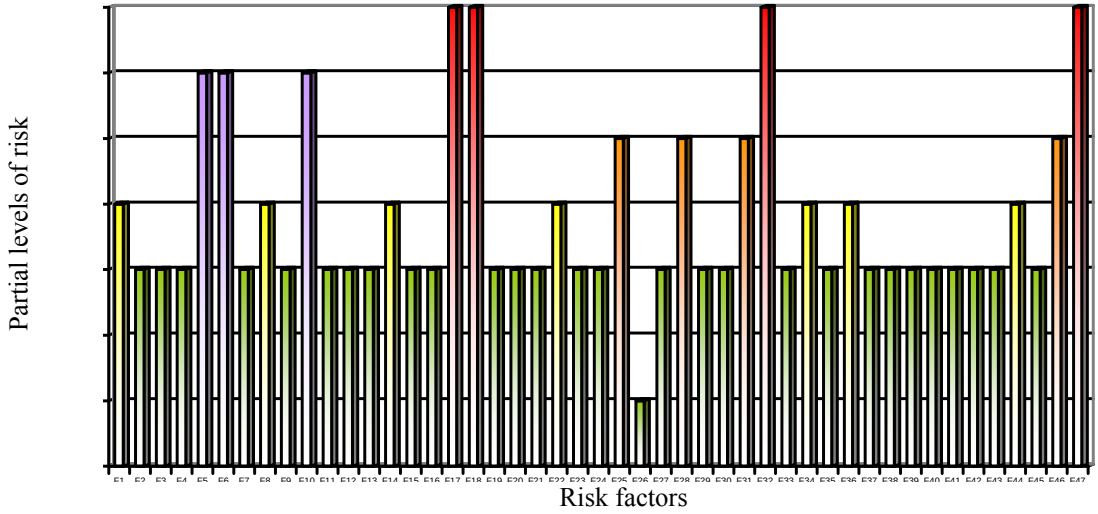

Fig. 1. *Diagram of risk factors for those working in steelmaking in converter (partial levels of risk)*

Explaining risk factors F1 through F47, are given below:

F1-Grip drive by unprotected transmission (eg belt conveyors, etc.).

F2-Flow of steel, pig iron, slag, incandescent ,in the phases of handling ladles

F3-Flick the automobiles and railways to move through the plant premises (not used warning beep)

F4-Slip of parts, materials, etc. stored without stability

F5-Roll of parts, materials based cylindrical or stored without stability

F6-Rolling of cylindrical parts (**CO2** extinguishers)

F7-Free fall of parts, tools, parts, materials, the higher altitudes

F8-Free leak of molten material

F9-Accidental discharge of incandescent alloy

F10-Accidental **collapse fier vechi** and alloying elements stored

F11-Throwing by currents of air or pneumatic installation, of some particles steel, cast iron or slag

F12-Deviation from the normal trajectory of large masses handled with cranes

F13-Balance of ladle, followed by discharge.

F14- Absence of any insurance (wire ties) in case of jet ,eruption of molten material, powder, oil under pressure, etc..

F15-Dangerous contact with surfaces or contours (sharp, slippery, abrasives, adhesives) - unfinished surfaces, contours dangerous

F16-Working in the vicinity of pressure vessels.

F17-Objects or surfaces with high temperature - splashes of molten material, heated surfaces, trails technological steam, hot water, etc.

F18-flames - outbursts, thermal process

F19-Electrocution by direct touch - current paths unprotected

F20-Electrocution by indirect touch - faulty earthing, accumulation of fluid

F21-Explosives - mixture of oxygen

F22-High temperature of the air - especially in the converter's vicinity

F23-Low temperature of the air, in the cold weather - especially at elevation + 43m

F24-Airflow - natural draft, hoods operation, enclosure leakage

F25-High noise level - according to the attached analysis bulletins determinations

F26-Vibrations caused by the movement of vehicles (cranes, pushing machine, etc.)

F27-Low level lighting on some routes of travel.

F28-Brightness-focus convector, material incandescent etc

F29-Radiation - in the vicinity of the converter, ladles etc

F30-Natural disasters - earthquakes

F31-Dust excess - especially at higher rates, in the vicinity of the converters - according to the attached analysis bulletins determinations.

F32-Accumulation of toxic gases - from the steelmaking area and weighing area (eg.exhaust gases of forklifts).

F33-Flammable or explosive gases and vapors - gained at steel making (oxygen, acetylene)

F34-Dynamic effort - long trails at manual handling of heavy masses (eg barrels alloying materials)

F35-Difficult decisions in a short time - to fix or liquidation situations of "INCIDENT"

F36-Execution of contingency operations in the work load

F37-Commands in time, other than those imposed by technology

F38-Execution of maneuvers, without ensuring compliance with the security conditions

F39-Wrong positioning of the ladles

F40-Setting parameters work outside the conditions imposed by technology

F41-Not ensure synchronization with other workers to teamwork

F42- Moving and stationary in hazardous areas - the car ways, or taxiways , forklifts, lifting equipment under load, in the face of convector etc..

F43-Fall on the same level: the imbalance, sliding - uneven surfaces loaded with dust,accumulation of water on access roads

F44-Falls from heights: by stepping into the void, the imbalance by sliding - handrails missing, technological voids concealed by accumulations of dust, uncovered or unmarked

F45-Not comply with the code signal crane

F46-Omission of operations that ensures their safety

F47-Failure personal protective equipment (E.I.P), individual work equipment(E.I.L), and other means of protection provided (which was granted by the employer).

Using the risk factors level, or workers at LD convector,we can calculate the overall risk level at the job using the formula:

$\mathbf{N_{rg11}} = \Sigma R_i r_i / \Sigma r_i$

in which: - $\Sigma R_i r_i$ is the sum of risk factors considered work area; Σr_i - is the sum of the partial workplace risk assessment.

For the worker at LD convector, after the introduction of parameters in formula, results diagram in Figure 1. ***Level of risk achieved is Nrg = 4.3.***

$$\mathbf{N_{rg11}} = \frac{\sum_{i=1}^{47} R_i r_i}{\sum_{i=1}^{47} r_i} = \frac{4(7x7) + 3(6x6) + 4(5x5) + 7(4x4) + 28(3x3) + 0(2x2) + 1(1x1)}{4x7 + 3x6 + 4x5 + 7x4 + 28x3 + 0x2 + 1x1} = \frac{769}{179} = \mathbf{4,3}$$

4. Interpretation of the results of the evaluation of risk factors

Overall risk level calculated for worker at LD convector,equals 4.3, a value that it falls into the category of jobs with unacceptable level of risk. The result is supported by the "Assessment Sheet of worker at LD convector" in which it is observed that out of 47 risk factors identified (Fig. 1), (18 above, as part of the risk level, the 3, 4 falling within the category of high risk factors (NVPR = 7), 3 fits into the category of high risk factors (NVPR = 6), 4 falling the category of high risk factors (NVPR = 5), and the other seven being in the category of environmental risk factors (NVPR = 4). The 18 risk factors, which are situated into unacceptable range are: F17, F18, F32, F47, F5, F6, F10, F25, F28, F31, F46, F1, F8, F14, F22, F34, F36, F44.

To reduce or eliminate the 18 risk factors (which are in the range unacceptable) are required generic measures, listed in "Safety measures proposed" for the worker at LD convector.

Regarding the distribution of the generating sources of risk's factors, the situation is as follows (see Fig. 2):

• 44.68%, factors belonging to the means of production
• 25.53% working environment factors;
• 4.26% work task factors;
• 25.53% factors belonging to the contractor.

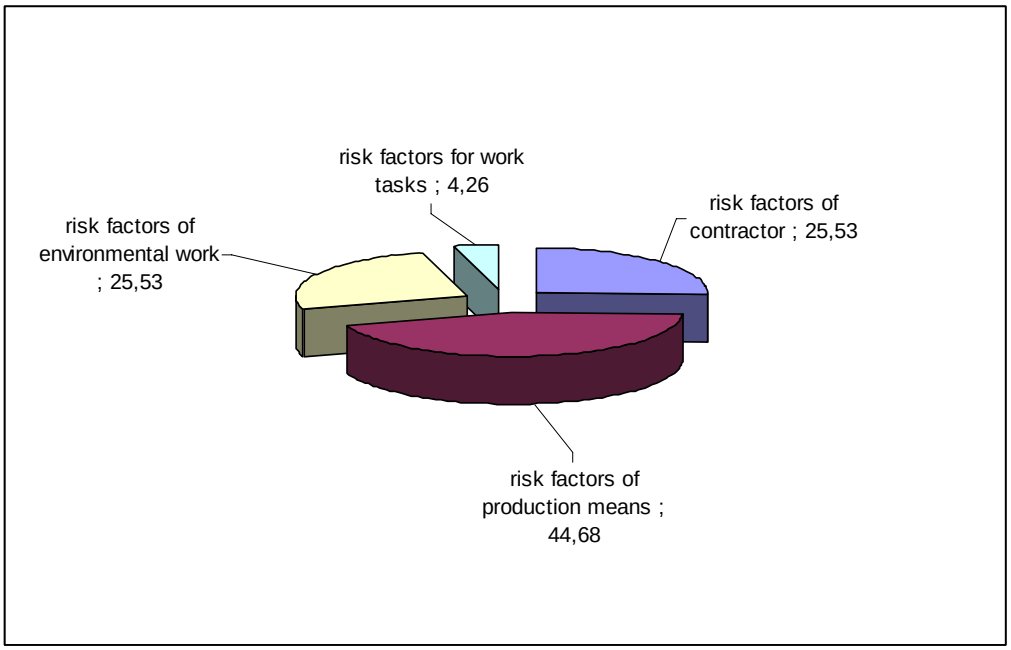

Fig. 2. *Distribution of risk factors identified by elements of the work system*

Analysis of the formular of evaluation, shows that 78.72% of the identified risk factors may have irreversible consequences on the worker.

5. Measures and proposals

To ensure job security in the convector area, measures technical and organizational proposed are:

For high risk factors F17, F18, F32, F47 (NVPR = 7),

-marking hazard areas at contact with surfaces that have high temperatures

-development of optical systems and audible warning of the presence of toxic gases

Equipment required to appropriate activity to be carried, out according to regulations

For high risk factors F5, F6, F10 (NVPR = 6),

Insurance against uncontrolled movement, materials handling, using dangerous procedures

Maximum load allowed by stacking

-Leveling transport routes in the warehouse

-Sizing access roads and removal of all material that prevents the passage

-Insurance against uncontrolled movement of materials through proper fence, anchor handling as hazardous procedures, leveling, anchoring etc.

For high risk factors, F25, F28, F31, F46 (NVPR = 5),

Measures to combat noise's source - is achieved through changes to the technical equipment if possible, or by adopting special attenuators devices, the choice of technical equipment in conditions comparable technology priority, will be given to those that produce noise the lowest

-Measures to combat noise at receiver - consists in isolating the staff working in noise

-Adopt, where possible, working methods with minimal release of dust

For environmental risk factors, F1, F8, F14, F22, F34, F36, F44 (NVPR = 4),

- Repair and installation of all protective devices

- Marked with warning signals, all contact areas with high temperature, with potentially dangerous

- Restriction on possible areas where fluid flow is possible incandescent

- Check all fluid routes, and remedy them

- Restriction on possible areas where there is potential for fluid jets

- Repairing railings and other items to prevent falls from height

- Equipment needed in case of signaling toxic gases and vapors, purchase personal protective equipment, appropriate activity to be carried out according to regulations.

6. Conclusions

-For steelworker job security, as required following main conclusions:

-Training on the risk of accidental contact, with surfaces that have high temperature;

-Training on how to use the means of protection

-Regular training of employees on the consequences of the entry into hazardous areas;

-Potentially marking occurrence of flames, gases or vapors;

-Introduction of mandatory wearing gas mask, in areas where toxic gases or vapors may occur;

-Monitoring health;

-Verifying and the permanent control of the workers;

-Perform periodic measurements of pollutants in the work environment;

-Signaling areas where there is danger of falling from height, marking and completion with anchorages.

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