

RISK ASSESSMENT AND SAFE ACCESS MANAGEMENT IN LONG PRODUCTS ROLLING MILL MACHINERY

1. Case metadata

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19641D Risk Assessment

2. Organisations involved

Halyvourgiki S.A.

Ergonomia S.A.

3. Description of the case

3.1. Introduction

HALYVOURGIKI INC. is a steel production company located in Elefsina (Attica, Greece). It covers an area of 1.060.000 m² and employs 560 workers. The specific rolling mill plant of the company has an annual production capacity of 300.000 tones of long steel products (steel for the reinforcement of concrete) of a wide diameters' range (8mm to 20mm). The production line's entire length is 240m and it covers an area of 6480m².

In dangerous areas the moving parts of the machinery (e.g. stands) and the movement paths of steel products (red-incandescent or extremely hot products moving with high speed) could be the cause for serious or fatal accidents and therefore they presented high risks for workers safety. A Health and Safety management system, combining technical and organisational measures for preventing uncontrolled access in dangerous areas of the production line was implemented.

3.2. Aims

The aim of the project was to reduce a risk that was initially assessed as unacceptable in the rolling mill plant. The rolling mill plant is a long open-access area, where a reheating furnace, a cooling bed, a descaler, a fast finishing block and cold shears were sorted one after the other. Such moving parts that are easily accessible by workers comprised an unacceptable risk.

Another aim of the project was to enhance safety awareness and safety culture among workers and the administration, through an integrated implementation of good practices at the rolling mill plant.

3.3. *What was done, and how?*

A Risk Assessment Study was performed for this production process and the related tasks, which was conducted by an external safety consultancy (ERGONOMIA SA) in close collaboration with HALYVOURGKI INC, and the risks identified were assessed in a risk scale.

Some of the risks related to workers' safety that were classified as high and critical were attributed to:

- The probability of steel bars ejection from the line due to the high speed movement from the last stands to the 72m cooling bed.
- The probability of steel bar ejection from the line or steel serpentine creation in stands, in case of a cobble.
- The probability of sudden or/and unannounced start-up of the production line, while the workers still execute operations close to it, in cases of cobble removal, maintenance etc, either due to lack of coordination between the workers in the production line and the operator in the control room, or between the workers and the operator of local control panels.
- The possibility of workers approaching various areas of production line for maintenance or inspection (e.g. stands, shears) prior to the completion of production interruption (full shut down of machinery).
- The possibility of workers approaching the production line due to deviation from the specified safe walking routes.
- The bypass of local safety devices of the production line in order to perform an urgent task or as a result of a violation of safe work practices.

Various organisational and technical measures have been drawn and implemented to control these risks (e.g. total enclosure with metal coverings of dangerous paths of the production line – see figure 1), resulting to a reduction of the relevant risk value. Nevertheless, an unintended or unannounced access of workers in dangerous areas of the production line or the lack of co-ordination between the workers involved in various tasks render always these factors as important causes of accidents.

Figure 1. View of the path of the production line already covered

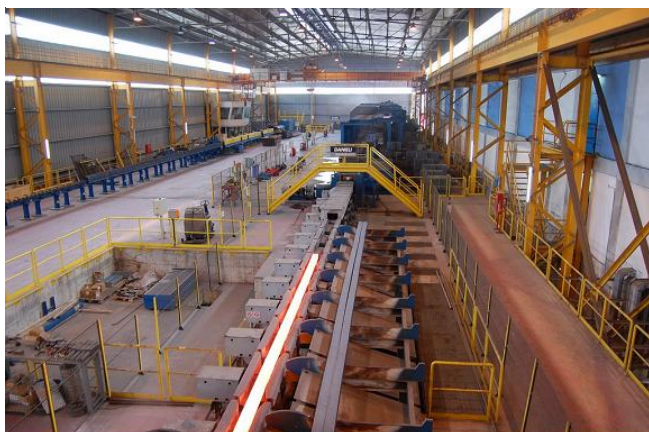


Source: Halyvourgiki S.A.

CASE STUDIES

It is stressed that the length of the production line (240m) (see figure 2) does not facilitate the constant observation of workers movement from the central control room; therefore in case of an emergency, the immediate reaction (pressing the emergency stop button) that can always be applied by the control room operator was difficult.

Figure 2. Panoramic view of the production line



Source: Halyvourgiki S.A.

Elimination of risks due to uncontrolled access to bars production rolling mill line

In order to eliminate the risks identified in the risk assessment study, HALYVOURGIKI INC in collaboration with DANIELI & C. Officine Meccaniche Spa (the manufacturer and supplier of the line) developed, installed and tested a technical solution, which was unique among similar plants in terms of the integrated approach adopted for the safety issues addressed.

The basic principles of this technical solution were:

- Segmentation of the production process in particular regions and determination of the essential works required in each one of them.
- Isolation of dangerous areas with the installation of suitable robust metal fences (see figure 3).
- Access and exit control in each area of the production line, through access doors equipped with electromagnetic lock (safety guards), that opened only after the completion of specific electronic commands from local control panels (see figure 4).
- Access permits are always given by the central control room, whereas the opening of the safety guards provided the possibility of executing only specific operations in the production line or the complete interruption of the production process.
- The Operating Mode of the line in the specific area and the provided operation options were strictly determined and were electronically controlled, depending on the nature of the work for which the access permit was given (Intervention for maintenance – repair, adjustment of production parameters, inspection of production line).
- To prevent closing the door and restarting the operation, the opening procedure requires the control at the local control panel to be locked with a padlock.
- Installation of light and sound warning signals informing the operators about the area-operating mode of the production line (see figure 5).

Figure 3. Installation of metal fences



Source: Halyvourgiki S.A.

Figure 4. Access and exit control system



Source: Halyvourgiki S.A.

Figure 5. Safety guards



Source: Halyvourgiki S.A.

Figure 6. Close view of the light and sound system



Source: Halyvourgiki S.A.

Description of the solution for safe access to bars production rolling mill line

The safe access in various areas could be achieved in several Operating Modes of the production line locally, depending on the nature of the work for which the access permit was given. In more detail:

1. Area Production Mode: All the safety guards of the area were closed. Access was not possible. The violation of a safety guard without following the access request procedure caused emergency shut down of the line in the area.
2. Area Lock Mode: For an access permit to be given it was required to complete the production cycles, stop the machines, dissipate all energies, unlock the safety guard and finally opening. The area was in safety and could not run in production. All machines were stopped and preset-off, hydraulic and pneumatic circuits were depressurized, safety emergency circuits were in safe status.
3. Area Adjustment Mode: For an access permit to be given it was required to complete the production cycle, stop the machines without dissipation of energies, unlock of safety guard and finally opening. Only manual control was permitted and the area could not run in production. Machines could operate in manual mode with reduced speed. Semi-automatic cycles could be performed for testing. To perform any task at least two operators were required: one (or more) entering the area for completing the job and the other supervising and monitoring through the local control panel. In order for the machines to operate in adjustment mode, the second operator had to keep a "panic" button continuously pressed, which if it was released caused an immediate emergency stop at the area. All manual controlled operations were carried out according to the "two hands" logic (both hands are used simultaneously).
4. Area Inspection Mode: For an access permit to be given it was required again to complete the production cycle, unlock the safety guard, fully open, while the main control room was informed for "single billet" controlled operation. The Area could run as in production but with limited material (one billet at a time). The operations were carried out by two operators: one entering the operating area and the other supervising and controlling through the local control panel. If it was necessary the process could be stopped immediately with the emergency button.

Safe access procedure

The Safe Access System that was described requires the precise application of a procedure, which included a series of functions that had to be followed by the workers engaged in the operations in the dangerous area. The training of workers in the application of this procedure was necessary. It is noted that any deviation of the proper implementation of this procedure did not create any risk for the workers involved, although disturbances and delays at the production process may occur.

Subsequently, an example is presented in detail in order to demonstrate the sequence of functions for the maintenance – repair procedure in an area in Production Mode.

During normal operation (production):

- The area mode selector is in “Production Mode”.
- “Access Request” push-button lamp is off.
- The red light on the turret is switched on and all others off.

When the operator wants to access the area:

- The operator must press the “Access Request” push-button in the local control panel: an access request is done and the relative lamp starts blinking (see picture 7).

Figure 7. Operator pressing the "Access-Request" button



Source: Halyvourgiki S.A.

- The operator in the central control room will be informed by the control panel of the safety system (HMI) that there is an access request by the specific local control panel and, if he wants to allow the access, transfers the possibility for operating the line to the local control panel that sent the access request. Before doing this, if necessary, the operators can communicate via the existing intercom of the local control panel and the main control room.
- The “Access Request” push-button lamp stops blinking and is on continuously to inform the operator that it is possible to turn the mode selector in “Lock” position.
- The operator by turning the selector in “Lock” puts the area in safety condition: the production cycles are completed, subsequently all motors are de-energized and the hydraulic and pneumatic circuits are discharged, de-energizing safely shut-off valves.
- The electric-lock of the safety guard is automatically unlocked when the hydraulic and pneumatic pressure is off.
- Now the green light on the turret is switched on while the other lights go off to indicate that access is permitted in the area (AREA LOCKED).
- Before entering the area the operator must insert the multiple locking device on the mode selector and apply the padlock to ensure that nobody can close the door and restart the area.

CASE STUDIES

- If other operators enter the area they must apply the padlock on the multiple locking device too.

At the end of the operations in the area:

- The operator must close the safety guard.
- Any other operator in the area must remove his personal padlock from the multiple locking device. The last operator must take away the multiple locking device.
- The operator must turn again the key selector in “Production” mode.
- For few seconds before operation is restored, the yellow light will blink and the horn will sound to inform the imminent restart of the area.

Only then it is possible to resume operation to the preset mode by the central control room through HMI and restart production. It is also necessary that no other access requests (and access permits) from other areas of the production line are given. In such an occasion production cannot be resumed unless the central control room is ensured through the control panel that all guards are closed and locked.

3.4. *What was achieved*

The following results were achieved:

- Reduction of the relevant risk value of an unintended or unannounced access of workers in dangerous area of the production line.
- Through training, safety awareness was promoted to all workers in the plant. Not only they were trained how to use the new implemented access control, but they also realised the actual risk of not following the safety procedures along with the reasons that led to this investment.
- Reduction of workers stress due to the unknown conditions that may lead to a work accident, as now the access control is double checked, through specific logical circuits of electric locks.

3.5. *Success factors*

The key factors that contributed to the success of the changes introduced are the following:

- All individuals involved (in all organisations involved) were experts on their specific fields, which assures that every aspect of the project was taken into account. Health and Safety Department, the combined team from Production and Maintenance Departments, the manufacturer and supplier of the production line, the administration and the Safety Consultancy participated in the design of the project.
- The workers themselves were also involved throughout the whole process. They reported thoughts and aspects, they had a chance to test the system, they were trained to use it and moreover they were trained on the project’s philosophy to understand the reasons and the results of such an attempt better.
- The most important aspect of this project was the quality of the automatic system implemented, which was based on manufacturers’ knowledge and know-how and has a carefully designed format to achieve the segmentation of the production process, so as it was easy to simultaneously have a control room intervention and a local controlled access.
- An external safety consultancy performed the Risk Assessment study, providing a different and specialised viewpoint.

3.6. Further information

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3.7. Transferability

The philosophy of the technical solution for safe access to dangerous areas may also be applied in other cases of production lines that have respective or similar characteristics and in particular where visual contact between the control room and the work area is difficult or impossible. Additionally, the implementation of an access control system is transferable to all companies manufacturing basic iron and steel or ferro-alloys. However, the principle of involving external safety experts and the equipment supplier, along with the actual users, in the solution of a certain safety problem is transferable to all companies facing safety problems with sophisticated equipment.

4. References, resources

Information provided by Halyvourgiki S.A. in the framework of the Good Practice Award Competition 2008/2009.