Area of application: basic principles

From planning through to the commissioning of complex plants

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Aim of this publication

The aim of this publication is to contribute towards ensuring that occupational health and safety requirements are correctly taken into account in the planning of a plant. When commissioned, the plant must not only be functional, but also safe. Corrections are easier to make in the planning phase than when the plant has been completed if welding torches and concrete cutting machines are required. Complex and costly retrofitting can be avoided given good planning.

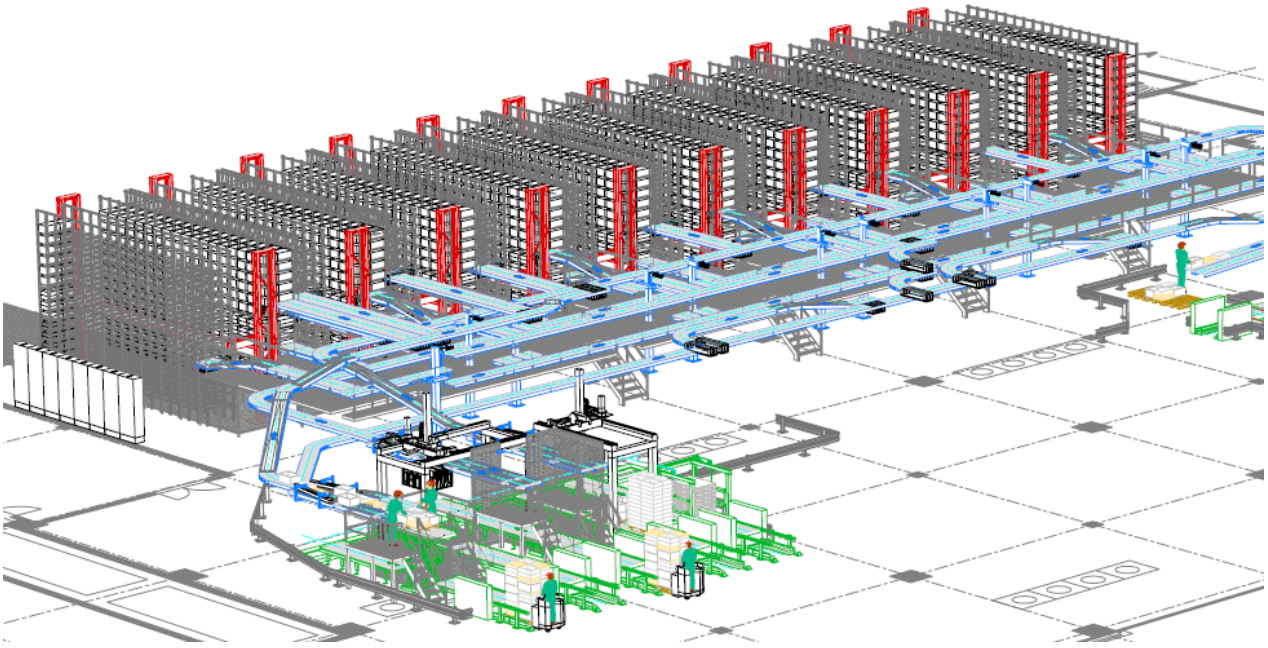

Fig. 1: Layout of a logistics centre (example)

This publication has been compiled with an eye toward extensive plants in the field of material handling and storage technology. However, the comments made can be applied to all possible plants that come under Machinery Directive 2006/42/EC.

This publication was first issued in July 2007 when Machinery Directive 98/37/EC still applied. This issue has been updated. The provisions that have come into force in the meantime have been taken into account.

Further publications and links on the topic can be found on our website:
www.suva.ch/certification-e

Change in emphasis in occupational safety

Technical progress evokes new risks. While the workforce previously worked from dawn to dusk on machines with which they were familiar, they are nowadays responsible for looking after extensive, automatic production lines with intricately linked sub-machines. The main hazards have shifted away from working under normal conditions to the varied work of troubleshooting and maintenance, from brawn to the exceptionally demanding work done by specialist staff. When machinery malfunctions today, the member of staff must get the production line running again as quickly as possible. Pressure of time is frequently very high as costs incurred by lengthy outages can be enormous and it is very tempting to remedy faults without stopping the machinery. The complexity of a plant can often overwhelm a member of staff in this situation. Concepts for the safe repair of malfunctions and for maintenance form an important component of the occupational safety of plants. These aspects must be taken into account if the essential health and safety requirements of Machinery Directive 2006/42/EC are to be fulfilled.

When there is a conflict of interests such as, for example, between fire protection and occupational safety, it is vital as early on as at the planning phase to find solutions that meet both the demands of fire protection as well as of personal safety to the best possible degree. Particular attention must be paid to this topic in high-bay warehouses. Nowadays, automatic warehouses are in operation using oxygen-reduced atmospheres. Access by personnel is unavoidable for troubleshooting and maintenance purposes. However, they must be able to do their work without incurring any risk to their health. Precisely which conditions for this have to be met is given on Suva's website under www.suva.ch/fachthemen → *Working in oxygen-reduced atmospheres.*

Procedure to be followed to acquire CE conformity

The correct **procedure for acquiring CE conformity for machines** is explained in the Suva publication with order number **CE08-18**. Basically, the same procedure must be applied for complex plants as for simple, manageable machines. A couple of focal points that are particularly important for complex plants are explained in greater detail below.

- **Who is responsible** for CE conformity for the entire plant?
  According to Machinery Directive 2006/42/EC, this is the distributor (the manufacturer or his authorized agent) and, in the case of complex or extensive plants, it is usually the general contractor. He obtains machines and incomplete machines or constructs them to some extent himself to make a plant.
- The **declaration of conformity** for machines substantiates the compliance of the machinery with the relevant safety provisions. The **declaration of installation** for incomplete machines verifies which basic health and safety demands of the Machinery Directive have been taken into consideration and which further provisions, e.g. the EMC guideline, have been fully observed by the manufacturer.

- For **assembly into an entire plant,** the measures required must, above all, be taken with regard to the **interfaces**. There are interfaces involving low risks. In this case, each machine in a subsystem can be supplied independently with a declaration of conformity. In the event of high-risk interfaces, the sub-supplier supplies an installation declaration with the part supplied. He must also supply installation instructions with the installation declaration. These must show how the part-system must be fitted so that the general contractor can confirm the conformity of the entire system. The interfaces must at any rate be arranged in such a manner that there are no vulnerabilities. Each sub-supplier defines the terms for the interfaces to ensure that his machinery is also compliant with regard to the interfaces.
- Very often, the problems to be solved are at control system level. As a result, the control system company usually handles the task of the general contractor nowadays.
- The particular safety aspects of the relevant plant must also be taken into account, e.g. demands on availability, pressure on deadlines, hygiene, explosion protection.

The following remarks complement the comments listed in Suva publication CE08-18 on the seven steps that lead to CE conformity. The supplements regarding complex and extensive plants, in particular, those in the field of material handling and storage technology:

1 Inspection of the relevant regulations

What are primarily relevant are the regulations that set out the machine requirements. However, further provisions must be observed such as the demands on the building, labour law regulations and accident insurance law regulations as well as fire protection provisions.
Regarding machine safety: Which provisions must be adhered to where this is concerned? For the entire plant as well as for the part-machines, the essential health and safety requirements of European **Machinery Directive 2006/42/EC** must be fulfilled. The directive on electromagnetic compatibility (EMC) 2014/30/EU must be taken into consideration for the electrical equipment. In addition, the basic requirements of the Low-Voltage Directive 2014/35/EU must be met. Because this is integrated in annex I, Section 1.5 in Machinery Directive 2006/42/EC anyway, the Low-Voltage Directive need not, however, be listed in the declaration of conformity.
These European directives are primarily directed at distributors. They also apply in Switzerland to permit the free movement of goods with the EU. Suva publication “Swiss laws under the European Firmament” (order number: CE00-2) goes into this topic in greater detail. Basically speaking, all technical solutions are possible as long as they meet the essential health and safety requirements.

2 Construction according to essential health and safety requirements

2.1 Risk assessment, risk reduction

Annex I of Machinery Directive 2006/42/EC contains a requirement under *General principles* in §1:

The manufacturer of a machine or his authorized agent must ensure that a risk assessment is carried out to identify the health and safety requirements that apply to the machine. The machine must then be designed and constructed with due regard for the results of the risk assessment.

Particularly when planning complex plants, it is important to conduct this assessment at a very early point in time before it is too late for the best solutions. The publication "Risk assessment and reduction - The Suva method for machinery" (order number 66037) deals with this topic in detail. Software for compiling risk assessments can be found at this Internet address: www.suva.ch/risikobeurteilung

Complex and extensive plants must be subdivided into sub-machines for the risk assessment. The interfaces between the sub-machines must be investigated very carefully. The point of this is safety when part-machines interact as well as interfaces with the building, e.g. when maintaining the building in the area of a complex plant.

2.2 Safety aspects in the first layout

Safety aspects must be taken into account when the first layout is drafted.

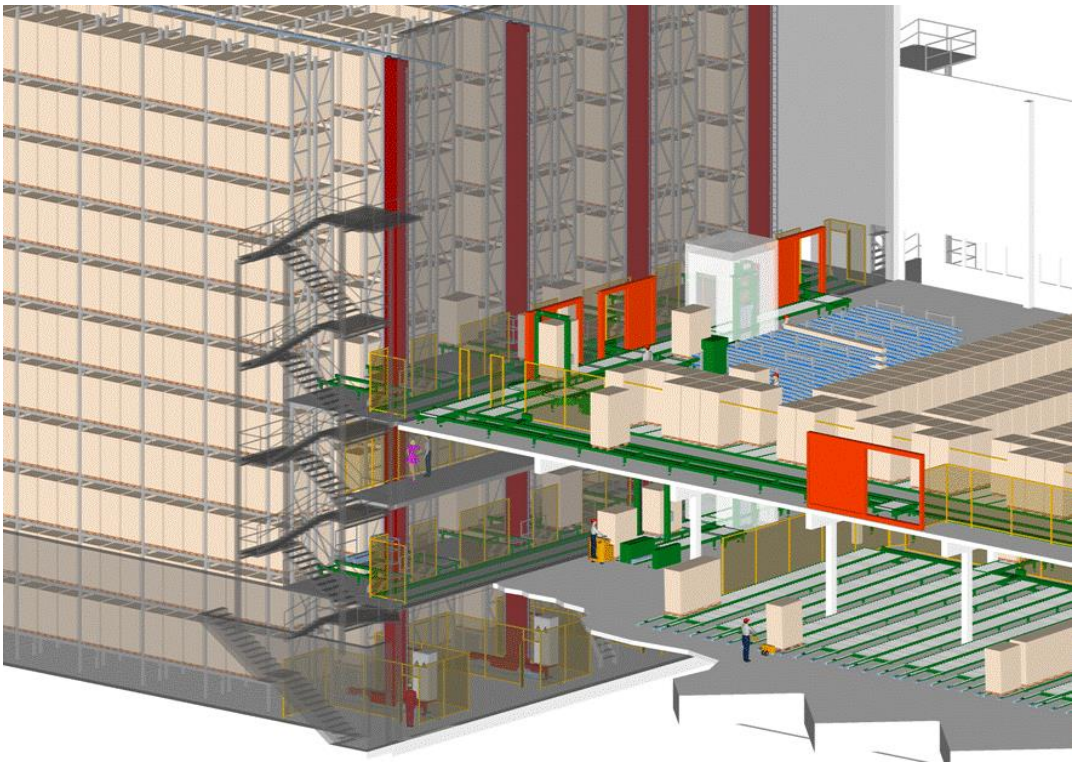

Fig. 2: Access to the driving lane of storage and retrieval machines in the basement, material flow on the upper floors, visitors' gallery on a mezzanine floor

Example: if the conveyor technology is arranged overhead in the high-bay shelving warehouse, appropriate access can be arranged to each driving lane of a storage and retrieval machine. This access is required for maintenance, troubleshooting, as firefighters' access points and as escape and rescue routes. If the conveyor technology is at driving lane level, it is usually impossible to find a meaningful solution as safety and material flow collide (e.g. the conveyor system with the pallets blocks access for troubleshooting as well as the escape and rescue routes). If safety aspects are only integrated at a subsequent date, it is often too late for the best solutions or they are only feasible with a lot of work.

2.3 Safety concept of the entire plant

Safety must be guaranteed both in normal operation as well as in special operating modes. A couple of aspects are singled out below:

a) Normal operation

- Automatic machinery often operates at high speeds. This leads to long braking distances. In plants like this, personal safety can usually only be guaranteed when people are unable to access the driving lanes. As a result, only solutions involving full protective cladding usually meet their goal, which means prevention of access with separating safety devices. Particular attention is necessary where material flow apertures are concerned.
  Plants with lower velocities can usually also be locally secured, for example, with breakaway devices, by securing belt run-on positions.
- Workplaces must be ergonomically designed and equipment must be included in the planning where necessary (e.g. adjustable working heights for the operator, equipment for lifting heavy loads).
- Adequate lighting must be provided.
- Sound levels must be minimised or reduced to permissible values.
- Draughts must be avoided wherever possible.
- Any accesses and routes above conveyor belts must be secured.
- Escape and rescue routes must be secured without exception.

b) Special operation (setting up, remedying faults) and maintenance

- The special operating modes must, themselves, be constructed safely. This includes, for example:
  - The driving of storage and retrieval machines must only be possible in secured areas (with closed doors) and from a secured driving position.
  - Preventing unexpected starting (q.v. §2.5 also).
  - Ensuring that the permissible speed for test operation is not exceeded.
- All parts of the plant that require maintenance must be accessible, for example via servicing platforms.
- Personal safety equipment such as protective equipment against falls from a height (safety harness, rope shorteners, retractable-type fall arrester, endless loop, snap-hooks, safety helmet – with integral head lamp) must be available for the work to be done. In addition, roping material is required for the person who may have to give help.

2.4 The level of the bar

The level of the bar, i.e. the level of safety, is specified in the harmonised standards listed, which apply to the relevant machine. Where the manufacturer is concerned, it is assumed that he fulfils the essential health and safety requirements of Machinery Directive 2006/42/EC if he builds according to these standards (presumption of conformity). The risk assessment must show the risks and the verification must be correspondingly documented.
The standards structure is explained in the publication “The universe of European standards for machine safety” (order number: CE00-6).

A safety concept must have strong foundations of a technically high safety level. The operator may require a higher safety level as is set forth in the European standardizing. This is because the operator usually wants a plant that does not involve him having to battle with imposing behavioural measures every day. Technical safety measures need not be costly in every case! Example: At the entrance to the locked area of a storage and retrieval machine, the correct entry sequence can be requested (access rule): unauthorised entry is prevented in that a malfunction is generated in the event of a sequential error by means of which manual or automatic operation is blocked. This malfunction may only be acknowledged by technicians.
Frequently, the tough struggle to increase safety results in inexpensive and practice-oriented solutions.

2.5 Safety-switch concept

To ensure that maintenance can be safely carried out, the area of the plant concerned must be switched off if necessary. Each functional unit must be able to be shut down safely. For this purpose, it is vital to provide safety switches that prevent any unexpected starting and which are accessible at the immediate location of the intervention or in its immediate vicinity. The publication “The maintenance switch (safety switch)”, order number CE93-9, takes a closer look at the topic of safety switches. Particular attention must be paid to this topic in the case of extensive plants. Excessively large shutdown areas reduce the availability of the plant while caution is required in the event of excessively small areas due to adjacent plant that has not been switched off. A happy medium must be worked out.

2.6 Operating instructions

The instructions for the use, maintenance and repair of the entire plant and its part-areas must be available. The instructions must offer practice-related assistance wherever possible. It is an excellent idea to support the instructions with illustrations. The focus should be on recording the correct behaviour. Although the plant must be constructed in such a way that abuse or incorrect use are avoided as far as necessary, references are required indicating that, for example, protection devices may not be bypassed.

3 Technical file

The technical file (according to annex VII of Machinery Directive 2006/42/EC) must provide the verification that the machine resp. the entire plant meets essential health and safety requirements. The basis of this substantiation is a risk assessment and a risk-reduction investigation.

4 Conformity assessment

4.1 Machines that do not come under annex IV of Machinery Directive 2006/42/EC

The process for acquiring CE conformity is set out in the Suva publication with the order number CE08-18. In the case of extensive plants (e.g. a logistics centre), several sub-suppliers are usually involved. Each must do what is necessary for his part to acquire CE conformity. The provider of the entire plant (usually the general contractor) is responsible for assembling the whole. He is also responsible for guaranteeing the interfaces as far as they are in his area of responsibility.

4.2 Machines that come under annex IV of Machinery Directive2006/42/EC

In the case of machines and/or parts of a plant that come under annex IV of Machinery Directive 2006/42/EC, the conditions set forth in Article 12, paragraphs 3 and 4, must be followed. In the field of material handling and warehousing technology, this affects, for example, equipment for lifting people when there is a danger of falling from a height of more than 3 metres. These include, for example, storage and retrieval machines and pallet lifts if they have operating positions or emergency control positions.

4.3 Conformity assessment

The assessment must take place according to Appendix VIII of Machinery Directive 2006/42/EC. For this purpose, manufacturers often compile a test book. In the case of storage and retrieval machines, the acceptance examination is regulated in EN 528, §9.1.1 c). It must be conducted by a qualified person authorised to do this. Manufacturers can conduct this examination using their own members of staff conditional on their fulfilling the conditions mentioned.

5 Declaration of conformity

The manufacturer must submit to the operator a declaration of conformity for the entire plant (Article 5, §1e) of Machinery Directive 2006/42/EC). This declaration is based on the sub-supplier’s conformity and installation explanations. For his area of duties, each one must have the technical documentations available according to annex VII of Machinery Directive 2006/42/EC and be able to produce them on request. The general contractor is responsible for ensuring that when the part-systems and part-machines are assembled, the interface problems are solved in such a way that the entire system functions correctly. This is also the case with regard to safety and safety verification. He usually compiles the declaration of conformity.

And what happens when the operator acts as the general contractor?
He, too, must make available the technical documentation according to annex VII of Machinery Directive 2006/42/EC and issue a declaration of conformity as the use of his own design is equated with placing it on the market.

6 CE marking

If a declaration of conformity has been issued, the manufacturer is entitled to apply the CE marking to the specification plate (Machinery Directive 2006/42/EC, article 16 and annex I, 1.7.3).

7 Placing on the market

The distributor has done his job when he notes at the commissioning stage that the safety concept produced at the planning phase concept also proves itself in practice on the completed plant!

Fig. 3: Same plant as in Fig. 1, here prior to commissioning

Enforcement of the provisions on occupational safety and product safety

Together with the other supervisory bodies, Suva supervises compliance with the provisions on occupational safety and product safety within companies. To ensure the required separation between enforcement and consultancy, the enforcement tasks are not handled by Suva's Technology Sector, but by other sectors of occupational safety:

- **Planning approval**
  Based on the federal labour law on work in industry, commerce and trade (ArG), the "planning approval procedure" and, in other cases, the "planning evaluation procedure" are applicable to industrial companies. The local cantonal inspectorate for industrial safety on whose territory the project is being built is responsible for this. Suva is usually requested to produce a supplementary report.
- **Market supervision of the distributor**
  Within the framework of enforcing the product safety law (PrSG), the regulation on product safety (PrSV) and the machinery ordinance (MachV), Suva's supervisory bodies check the distributors of new plants (compliance with essential health and safety requirements).
- **Plant inspections**
  Within the framework of the execution of the accident insurance law (UVG) and of the regulation on the accident prevention (VUV), Suva's offices responsible check the enterprises concerning the procurement (Article 24, VUV) of compliant work equipment.

Assessment prior to commissioning

Within the framework of consultancy for CE conformity, Suva's technology sector will be pleased to view and inspect with the distributor, planner and operator of the completed plant whether the safety concept discussed at the project phase has been correctly implemented and meets the solutions implemented to meet health and safety requirements.

When inspecting a plant within the framework of an order for CE conformity as well as during the inspection by the enforcement authorities, it is a matter of a random sample inspection to check the main safety aspects. The distributor bears responsibility for the comprehensive test. There is nothing in the way of the commissioning of the entire plant if the distributor can substantiate that all parts of the plant meet essential health and safety requirements. Within the framework of the planning approval process, the operator must inform the enforcement authority.

Final remarks

Occupational safety is a fascinating and challenging task especially in the case of complex plants that often involve difficult, but usually resolvable conflicts of interest.

Suva's technology sector will be pleased to provide advice at any phase of CE conformity: during planning, planning approval, commissioning and handover to the operator as well as after completion and in the case of a retrofit.