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Editorial

Practical tips and new discoveries

‘Safety doesn’t sell,’ said Lido Anthony „Lee“ Iacocca, the former head of the American car manufacturer Ford, at the beginning of the 1970s. Rather than spend a few dollars on additional safety components, he preferred the costs that come with compensation and litigation. It was an unsustainable position, and just a few years later, realising that he had to change course, began promoting the company’s new models complete with airbag safety with the self-mocking slogan, ‘Who said that you can’t teach an old dog new tricks?’.

Nowadays, the safety of employees and customers is always front and centre. But there’s more to it, and functional machine safety, productivity and efficiency must go hand in hand together. In this edition of MRL News, we will look at a concrete example of how smart safety solutions can bring cost benefits and help to enhance operational efficiency in the form of a modular safety solution for food processing machines that tec.nicum designed for Weber Maschinenbau GmbH.

Similarly, we have a specific user example to demonstrate how overtravel time measurements can not only be time-optimised as a service provided by tec.nicum, but can be used to help improve maintenance management.

In addition, we will also take a look at a white paper from ZVEI, which considers a new approach to implementing fault-tolerant safety functions, without neglecting personal safety.

We also have an article containing practical tips that should be borne in mind when compiling instructions for use.

And finally, we preview our series of events of 2020s tec.nicum on tour until at the end of the year, but with the following caveat: in spring, we were forced to cancel a number of dates due to the coronavirus pandemic and at the time of publication, reliable predictions of the future course of the emergency were not available.

We hope that you enjoy reading the latest edition of MRL News!

Best regards
The editorial team

tec.nicum on tour
Dates for 2020

‘tec.nicum on tour’ 2020 began in February with two successful seminars,
but with the onset of the coronavirus pandemic, several dates had to be cancelled in spring. We remain hopeful that dates in the second half of the year will be able to go ahead as planned.

Three topics are on the programme for tec.nicum on tour in the second half of the year:
- Machine safety and product liability: Current information and details on legislation and standards
- A brief introduction to new products from the Schmersal Group
- Human-robot collaboration: Safety challenges in day-to-day design work

Registration is required as places at individual event locations are limited and in demand.

The programme, schedule and registration form can be found here:
www.tecnicum.com/academy/tecnicum-on-tour/

We look forward to seeing you!

08/07/2020	Neu-Ulm (under reserve)
10/09/2020	Münster
29/09/2020	Nuremberg
13/10/2020	Kranzberg
10/11/2020	Wettenberg
07/12/2020	Dresden

Intelligent networking

Modular safety solution for food processing machines

In the food industry, but in other sectors of machinery manufacture too, flexibility is becoming an increasingly important characteristic of machines and systems.

At the same time, it is important that the existing superiority offered by safety systems is maintained, enabling not only the required level of safety but also operational efficiency and cost benefits. The system manufactured by market and technology leader Weber Maschinenbau GmbH for processing cold cuts is a good example of how these requirements can be implemented. The system incorporates a higher-level emergency-stop concept with PROTECT PSC1 safety controller as the logic component, designed and installed by tec.nicum. The service package included the commissioning and validation of the system by tec.nicum, Schmersal's service division.

In the food industry, individual machines are often integrated to form interlinked complete plants. Today's machines need to be more flexible in operation than they did just a few years ago. Weber Maschinenbau, a leading system supplier for slicing applications, based in Breidenbach, Hessen (Germany), meets these demands by planning, developing and manufacturing complete lines for slicing production, which are characterised by intelligent networking of the line modules.

An efficient solution for complex systems: the PROTECT PSC1 safety controller

Production line with seven machine modules

For this complex system from Weber Maschinenbau, designed for processing cold cuts, tec.nicum designed and installed a higher-level emergency-stop concept with PROTECT PSC1 safety controller as the logic component. The system comprises a total of seven machine modules: two slicers, which cut the meat products into slices, two pickers, which place the products in layers into the packaging, a thermoforming packaging machine, a labeller and end-of-line equipment (final inspection, stacking). The entire line extends over a length of approximately 50 metres. tec.nicum needed to equip not only the slicers – high-performance cutting machinery capable of reaching a speed of 2,000 cuts per minute – but the system's other modules as well, including the overall plant, with emergency-stop functionality.

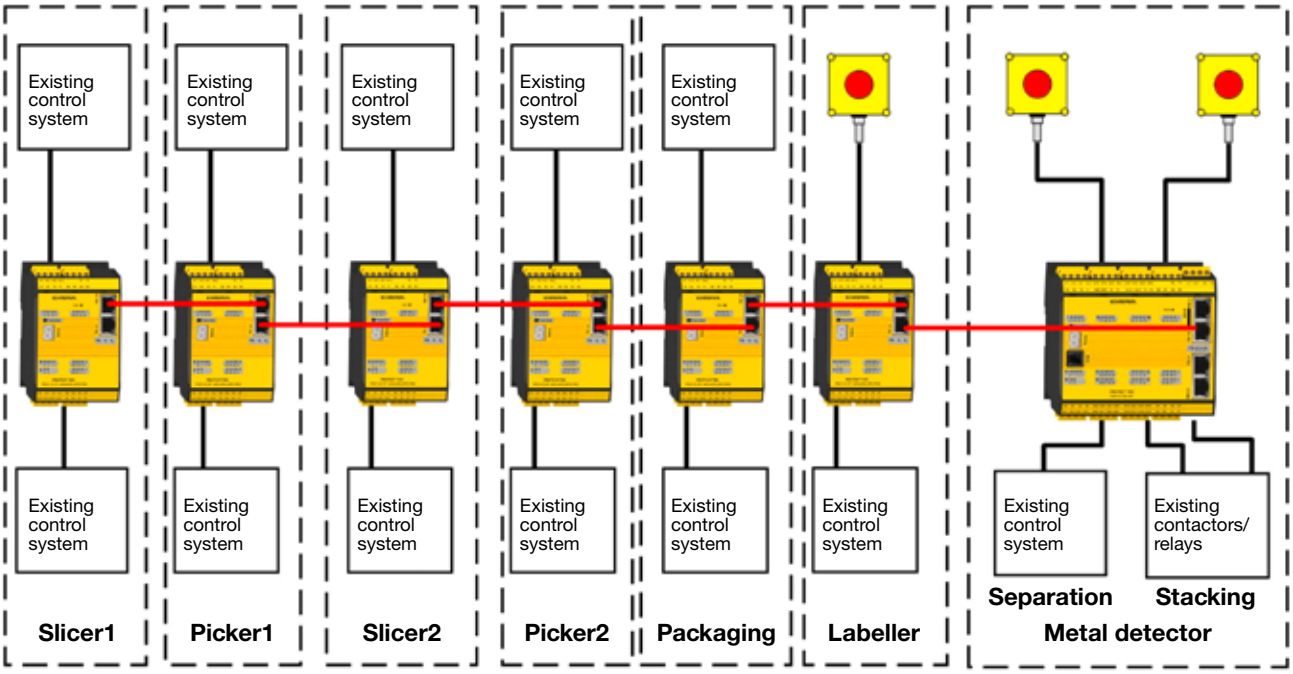
The emergency-stop function needed to be designed so that when an emergency-stop command device is triggered, the machine's hazardous movements and operation come to a halt safely and appropriately. Emergency-stop functions are divided into categories according to technical conditions: stop category 0, used on the Weber Maschinenbau system, requires the immediate shutdown of the machine by switching off the energy supply.

PSC1 safety controller with up to eight expansion modules

Nearly 30 emergency-stop command devices were fitted to ensure that the machines could be stopped at all relevant points across the system, as stipulated by EN ISO 13850. A concept needed to be developed for secure signal evaluation.

For complex systems, the PROTECT PSC1 safety controller is an efficient solution. The key components of this control system are two freely programmable compact controllers (PSC1-C-10 and PSC1-C-100). In the basic version, both have fourteen safe inputs (up to PL e in accordance with EN ISO 13849 or SIL 3 in accordance with IEC 61508), four safe semiconductor outputs, two safe relay outputs, two signalling outputs and two pulse outputs for sensors with contacts.

Safe I/O expansion modules are available for both versions; these modules can be installed both centrally in the switch cabinet and decentrally. The decentralised



tec.nicum designed and installed a higher-level emergency-stop concept using the PROTECT PSC1 safety controller

modules communicate with the compact controller via Ethernet SDDC (Safe Device to Device Communication).

The six expansion modules incorporated into the Weber Maschinenbau line for safe signal evaluation of the emergency-stop command devices were connected to the PSC1-C-100 via an internal safety-oriented Ethernet bus. When an emergency-stop command device is activated on one of the machine modules, all other machine modules in the line are switched off by the PSC1 safety controller.

Minimal wiring

Networking the machines in the safety chain through the Ethernet bus and the PSC1 safety controller considerably reduced the amount of wiring. 'It is a simple, convenient and very fast safety solution', explains Waldemar Stetinger, Applications Engineer at Schmersal. 'The modular design enables the safety components to be quickly modified if one of the seven machines is converted or extended for a new product.'

'The system equipped with the PSC1 system has been in operation at our customer's site for almost two years now. The customer has since ordered a second system which was put into operation at the beginning of 2019, also with the PSC1 controller. A happy customer is for us a clear indication that it is a good safety solution,' explains Dennis Kasek, Project Manager at Weber Maschinenbau.

Commissioning and validation

Weber Maschinenbau also relied on Schmersal's tec.nicum service division for the implementation of this safety solution: tec.nicum worked with the client to develop the safety concept and took care of the commissioning and validation including the requisite documentation. Tobias Keller, Safety Consultant at tec.nicum, explains:, 'Validation in accordance with EN ISO 13849-2, which shows that the design of the safety-related parts of control systems meet the requirements of EN ISO 13849-1, still lacks attention. Prompt integration of validation prevents costly design defects.' In addition, only careful validation completes the requirements of the CE Conformity procedure, which is mandatory for market access within the EU.

Dennis Kasek sums up the PSC1 system, 'The networking of the individual modules and the resulting minimal wiring – that's a smart solution.'

Stop time measurements as a service

'Stop time' is an important parameter in machine safety. Since the stop time of a machine or system can vary with time, regular stop time measurements are a useful tool, and tec.nicum can now offer stop time measurements as a service. Measurements can also be carried out on larger machinery fleets with speed and simplicity, making them a real asset in maintenance management.

Stop time is an important factor in machine safety and is responsible for determining the safety clearance, i.e. the distance between the danger area and the protective device. Experience in practice shows that the stop time of a machine or system can increase during operation, in part due to mechanical wear. Other factors such as the the weight of a workpiece or the pressure in the pneumatic system changing can also have a negative impact on the stop time. Consequently, it is important to check stop time at regular intervals. Last but not least, measuring stop time is also required to ensure that the requirements of the standards, directives and regulations are satisfied as applicable to the machine(s) in question. Standard EN ISO 13855 provides comprehensive information on calculating safety clearances and approach speeds. In addition, the standard also provides concrete specifications on carrying out Stop time measurements.

Service provision in Belgium (example)

tec.nicum offers stop time measurements as part of a comprehensive package of services. 'There is increasing demand for qualified support in numerous areas of machine safety, and in response to this, Schmersal established an autonomous business division for safety services at the beginning of 2016,' explains Remy van Bokhoven, Sales Engineer at Schmersal Belgium.

'tec.nicum is a closely knit network of certified functional safety engineers.' A long-standing customer of Schmersal appointed tec.nicum Belgium to carry out Stop time measurements on its machinery fleet on-site at its plant in Belgium. The project involved nearly 200 machines, all of which required stop time measurements.

The customer's plant in Belgium accommodates a considerable number of older machines and systems. In 2018, tec.nicum Belgium carried out Stop time

Stop time measurement results can act as a useful set of data for wider maintenance management.

measurements on all of the company's older machines equipped with opto-electronic safety devices or two-hand control stations, a total of 184 machines. The engineers from tec.nicum Belgium and the UK completed the assignment in under two months. 'We started at the beginning of November 2018 and we were finished by Christmas. Everything went to plan thanks to thorough preparation and good cooperation with the customer, so there were no production delays at all,' explains Remy van Bokhoven. 'We now know the correct stopping time for every machine. With that, we can now check whether all safety clearances are being complied with. Every machine now has a measurement report.' The test document details the measurement results and confirms the machine's compliance with the applicable directives and standards. If the measurement results show that any of the machines are no longer meeting the requisite safety clearance, tec.nicum experts can make proposals for solutions and even carry out installation work where safety components need to be retrofitted.

The customer's aim is to have stop time measurements carried out on its machines every two years. If the next measurements show a difference over the first measurements, it could be an indicator of mechanical problems. Measurement results are therefore a useful set of data for wider maintenance management.

The customer is an international concern and intends to have stop time measurements carried out at all of its production plants. Each plant is able to independently determine whether or not it wishes to engage external support. With a global network of tec.nicum experts on hand, the customer is able to avail of tec.nicum's services in every country in which it operates. tec.nicum experts are all familiar with local requirements and have many years of experience dealing with the practical implementation of directives and standards.

Fault tolerance in machine safety

White paper from ZVEI points to new pathways

In machine safety, the maxim has long been that when an error in the machine's safety function is detected, the machine must be transferred to a safe state as quickly as possible. Typically, this means a machine stop brought about by immediate isolation from the energy supply.

Within Industry 4.0 and the increased networking of machinery and, in some cases geographically distant, production plants, the uncontrolled shutdown of complex manufacturing systems is no longer tolerable due to the potential for high productivity losses. There is, therefore, ongoing consideration to the further development of safety concepts. The 'Fault tolerance editorial committee' at ZVEI – switchgear, switching systems, industrial controls division – presented a white paper in summer 2019, outlining a new approach to how fault-tolerant safety functions could be implemented without neglecting personal safety ('Fault tolerance in machine safety ,part 1 – basic research, version 1.0).

The paper was a collaboration between representatives of the German Institute for Occupational Health and Safety (IFA), the German Social Accident Insurance (DGUV) and the German Wood and Metal Trade Association (BGHM) as well as companies operating in automation and safety technology, including Schmersal. The following text briefly summarises the white paper and provides an overview of the new approach developed by the editorial committee.

'Degraded operation'

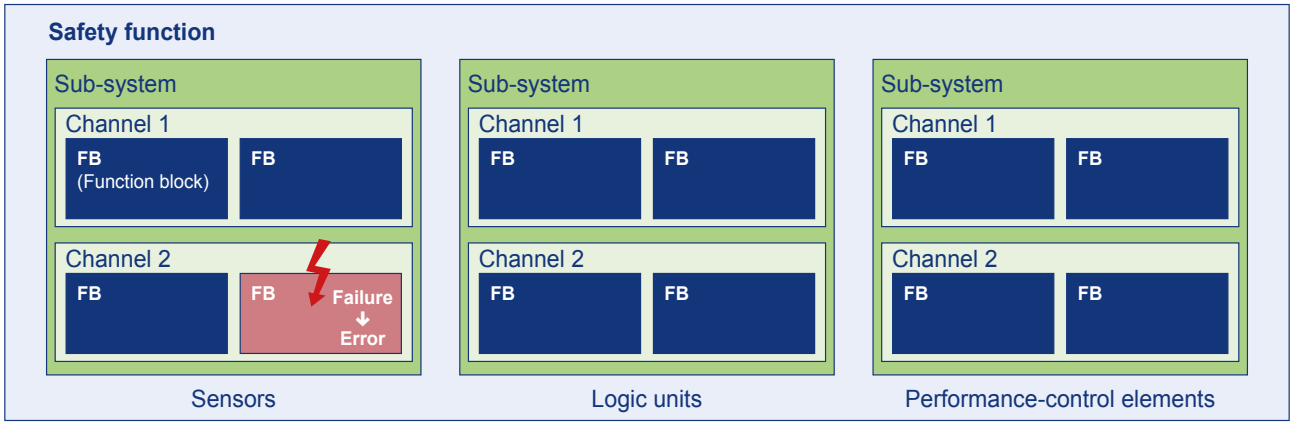
In the foreground, options are available to maintain the availability of machinery or sub-systems in the event of faults so as to be able to terminate the ongoing processing stage in an orderly fashion without the need to abruptly and completely disrupt production. This will involve harnessing the ever-increasing intelligence of state-of-the-art safety technology.

The editorial committee has added the term 'degraded operation', whereby a machine's operation is continued after the detection of an error in its safety function. The white paper defines three different types of degraded operation and outlines their respective boundaries and limitations.

The prerequisite for maintaining operation is enhanced (or 'qualified') fault diagnostics that permit unequivocal evaluation of errors and their potential effects. The diagnostics system must be able to distinguish between intolerable faults, where the machine must be transferred to a safe shutdown state immediately, and tolerable faults. In the event of the latter, machine functions can be permitted within defined boundaries with a sufficient level of safety, e.g. time limited, allowing a work step to be completed. Another option is limited operation, e.g. at low speed. Ultimately, a machine shutdown must always follow at the end so that repairs can be carried out.

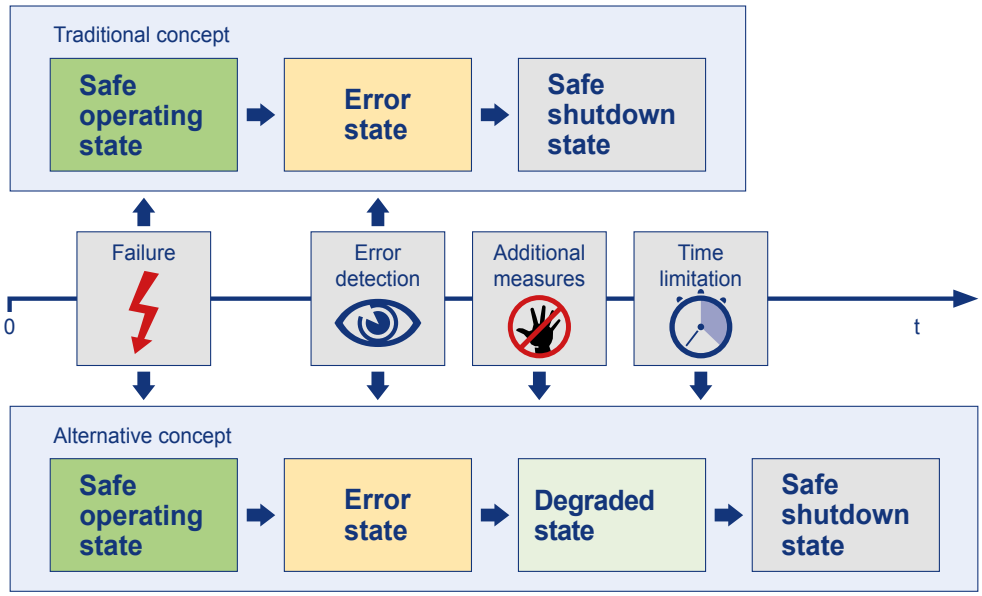
To be able to carry out an fault evaluation, a decision maker or decision logic must be implemented within that part of the machine's safety chain – e.g. in the control system or in the sensor system. This decision maker must influence the other operating conditions for the machine and regulate further operation. Moreover, the decision maker must report the degraded operation to the operator, so that he or she can initiate the machine's shutdown after a defined period of time, thus allowing for repair.

An example of this particular concept functioning in practice exists in another area of technology – car tyres.



Source: ZVEI

Comparison of concepts



Source: ZVEI

Run-flat tyres are designed to resist the effects of deflation in the event of a puncture, allowing the car to continue for a limited distance at limited speed. Here too, safe continued operation is possible after a fault occurs (diagnosed via the car's tyre pressure management system), so that something akin to 'uncontrolled shutdown' can be avoided and the tyre can be taken for repair in an orderly manner.

Higher productivity, less incentive for manipulation

The benefit of 'degraded operation' is clear – machine operators can increase machine availability and in turn, the productivity of their manufacturing processes, without neglecting employee safety. Networked, modular systems allow different scenarios to be defined so that in the event of a fault that causes sub-systems to fail, the system can be operated under certain conditions.

In addition, the incentive for manipulation on the part of the machine operator is also reduced, avoiding the need for potentially hazardous and unauthorised intervention in the event of a machine shutdown.

Degraded operation can also lower the reject rate by bringing process steps to a conclusion in an orderly manner, which in the production of high-value manufactured parts can help to minimise losses caused by rejection.

The white paper concludes that the concept of degraded operation is consistent with the protection objectives of the Machinery Directive and does not conflict with the harmonised standards EN ISO 13849 and IEC 62061.

To be able to implement degraded operation in practice, there remain a number of technical issues that require clarification. The safety-related functionalities required for operation in a degraded state, such as enhanced fault diagnostics, enhanced fault evaluation and decision logic, still need to be developed and implemented into the safety architectures by machinery manufacturers and integrators. The editorial committee intends to further discuss with potential users in order to determine the needs and requirements. The working group plans to address further issues relating to the implementation of fault-tolerant safety functions in a supplementary document ('Fault tolerance in machine safety, part 2 – requirements'). Ideally, normative formalisation will begin at a later stage, in order to establish a normative basis for the procedure.

It will be some time before the complex issues and practical problems relating to fault tolerance in machine safety can be properly clarified. But, the first steps have been taken...

The complete white paper can be found here:
https://bit.ly/37b4XOJ

Things to consider when compiling instructions for use

Tips on structure and design

The Machinery Directive stipulates that machine manufacturers must prioritise the elimination or reduction of potential risks in the design of their machines through 'inherently safe design'. Risks that cannot be eliminated by design must be suppressed by additional technical precautions. The third measure is user information: manufacturers are obliged to warn users of the residual risks by providing warning information and warning equipment on the machine itself and warning information in the instructions for use.

Legal classification

In Germany, the 9th Ordinance to the Product Safety Act (Machine Ordinance – 9th ProdSV) transposes the requirements of the Machinery Directive into domestic legislation. Under the ordinance, a machine may only be sold if it satisfies the stipulations of the ordinance. Amongst other things, the ordinance stipulates that 'in particular, necessary information such as the instructions for use within the sense of Appendix I to Directive 2006/42/EC shall be made available.'

Content, structure and design

Appendix I, Section 1.7.4 of the Machinery Directive sets out the general principles for the composition of and minimum information that instructions for use must contain. Further content may be derived from product standards and the risk assessment.

The structure of instructions for use should be designed according to the life phases of a machine, and contain the following at a minimum:

- Machine and manufacturer identification
- Safety information that relates to the different life phases of the machine; intended use; misuse; reasonably foreseeable misuse; remaining residual risks; target audience
- Technical data, general functional description
- Transport, storage, setup, assembly, installation and commissioning
- Operation, workflows and equipment
- Maintenance, service, disassembly and disposal
- EC Declaration of Conformity

The Machinery Directive does not stipulate how the information should be structured or designed. Thus far, standard DIN EN 82079-1 'Preparation of instructions for use – Structuring, content and presentation – Part 1: General principles and detailed requirements' was the sole reference. The standard outlines the basics for the compilation and presentation of 'instructions for use' of all kinds (including children's toys), but specific writing rules and proposals for structure are only treated normatively.

The new standard DIN EN ISO 20607 'Safety of machinery – Instruction handbook – General drafting principles' is, however, tailored specifically to instructions for use for machines. This standard is classed as a 'type B' standard, and is harmonised with the Machinery Directive. Like DIN EN 82079, DIN EN ISO 20607 contains general guidelines that must be followed in order to comply with the Machinery Directive.

Language

The instructions for use must be included in the official language(s) of the community or Member State in which the machine is to be marketed and/or operated.

It must also be available in the original language of the country of manufacture. These operating instructions must be labeled with “Original operating instructions”. Only maintenance instructions intended for use by specialist personnel designated by the manufacturer may be compiled in one language of the community that is understood by those specialist personnel.

Paper format or electronic preparation

The Machinery Directive itself is silent on the form that instruction for use can take – paper or digital, and the Guide to Application of the Machinery Directive is often consulted for advice. On this, Article 255 of that guide states the following: ‘...It is generally agreed that all health and safety related instructions must be supplied in paper form, since it cannot be assumed that the user has access to the means of reading instructions supplied in electronic form or made available on an Internet site...

Conclusion

The Machinery Directive requires instructions for use to be compiled as an integral part of the machine and has clear stipulations on the content that must be included.

The label on this product guarantees responsible treatment of the world‘s forests.

The greenhouse gas emissions released during the production of this catalogue have been offset through investment in the „LAYA energy-efficient wood stoves“ project in India.

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