

Safety Industry Automation for Realizing Safe and Secure Manufacturing

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ABSTRACT

Fuji Electric aims to supply proprietary safety solutions not only that provides the traditionally requested safety technology such as higher reliability and higher quality but also that meet international safety standards. The safety solutions encompass the three fields of energy automation, industry automation and socio-automation, and customer manufacturing facilities and systems are constructed and maintained by them so as to operate safely throughout their lifecycle. The safety solutions consist of consulting, safety control solutions, safety components, after-sales service and the like, and support the realization of a safety industry for “safe and secure manufacturing.”

1. Introduction

Recently, there has been an increase in serious accidents involving equipment and machinery at plants, and public concern regarding safety and security has heightened throughout the world.

Also, “corporate social responsibility” is being emphasized in corporate activities, requests for safety and security have intensified, and demand for safety industry automation technology has increased for plants, equipment and machinery. This paper describes the new safety industry and Fuji Electric’s efforts therein.

2. Present Status of the Safety Industry

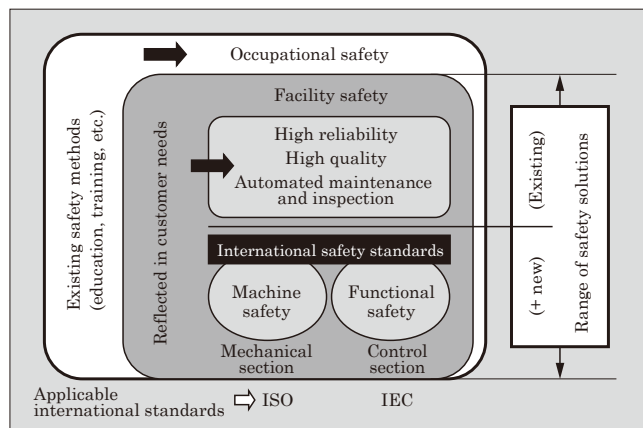
Safety technology is established internationally with ISO and IEC standards. In Europe, an EU directive obligating compliance with ISO and IEC standards for all products has been issued, and the markets for safety-related goods and services are growing rapidly. In accordance with international standards, JIS standards (JIS C 0508, issued in 2000, and JIS C 0511, issued in 2008) have been established in Japan, and GB standards have been implemented in China. The safety-related market is expanding even in Asia. In 2008, the size of the machine safety and functional safety-related market was approximately 800 billion yen in Europe and US, and approximately 50 billion yen in China and Asia (excluding Japan), and globally, the portion of the market for safety instrumented systems, relating to functional safety, exceeded 150 billion yen⁽¹⁾. Moreover, Fuji Electric estimates the machine safety and functional safety market in Japan to be approximately 180 billion yen, and in the future, expects

all safety-related markets to grow rapidly. Future growth will be driven by the following 3 factors.

- As automation advances, compliance will be difficult to achieve unless methods to ensure safety are changed (accidents will be on a large scale, and predicting their occurrence will be difficult).
- Technology to ensure safety has continued to be developed.
- As a consequence of (a) and (b), global safety standards have been established.

At a manufacturing site, previously, safety (occupational safety) had been ensured by instructing the operators with accident prevention measures. Recently, however, a new technique known as safety technology that halts the operation of machinery and minimizes harm to people and damage to equipment has been developed. This safety technology is categorized as “machine safety,” which applies to the mechanical parts of a drive system, and “functional safety,” which applies to the control section that governs the central part of the drive and control systems.

Fig.1 Range of Fuji Electric’s safety solutions



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Fig.2 Applicable fields for safety solutions

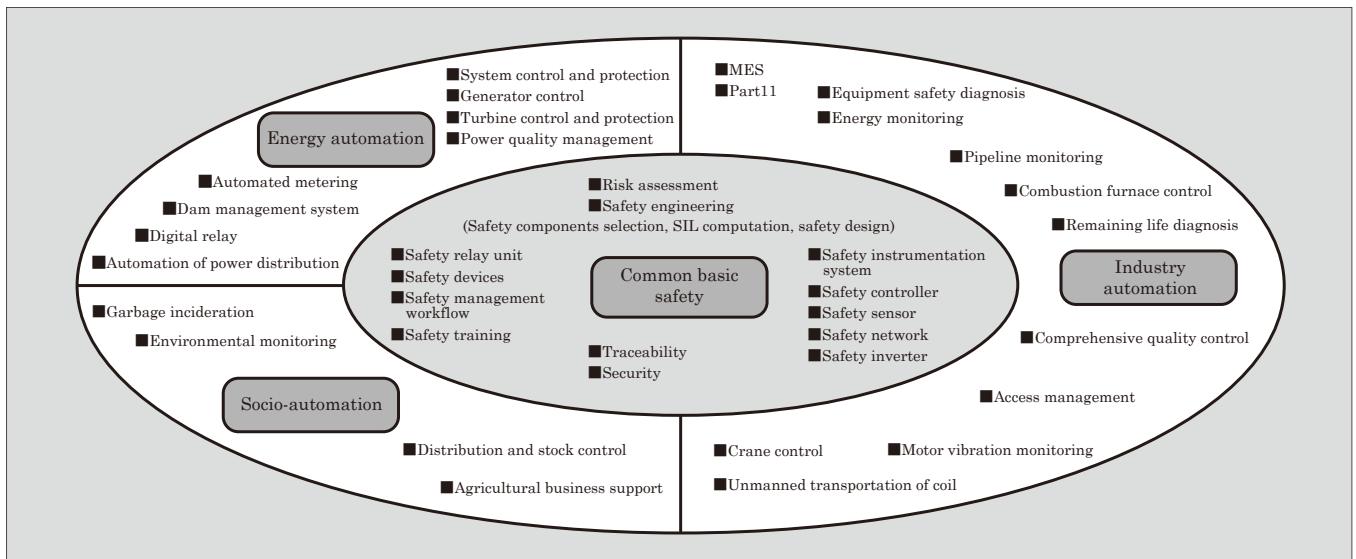


Fig.3 Concept of safety industry realized by combining IT, control, and equipment technology

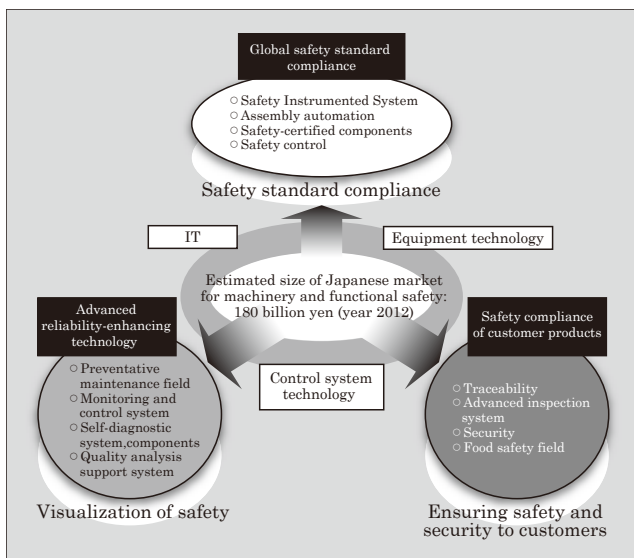


Figure 1 shows the range of safety solutions that Fuji Electric provides.

Japan is about to enter a critical period as most plant facilities are approaching their time for renewal, while at the same time, onsite maintenance workers who possess a high level of maintenance technology expertise are retiring. For the maintenance task of regularly repairing old facilities, there is a growing need for safety industry automation. In other words, safety is being addressed by quantitatively estimating the opportunity loss involved in a sudden plant shut-down, and making a corresponding capital investment in safety, and because the facilities are old, counter-measures for preventing human accidents and product defects are obtained from a comprehensive risk analysis of the entire facility.

On the other hand, safety for this type of manufac-

turing site is often under the control of the occupational health and safety management department, and the application and advancement of new safety standards remain as challenges for the future.

3. Fuji Electric's Efforts to Advance Safety Industry Automation

3.1 Efforts in regard to the safety industry

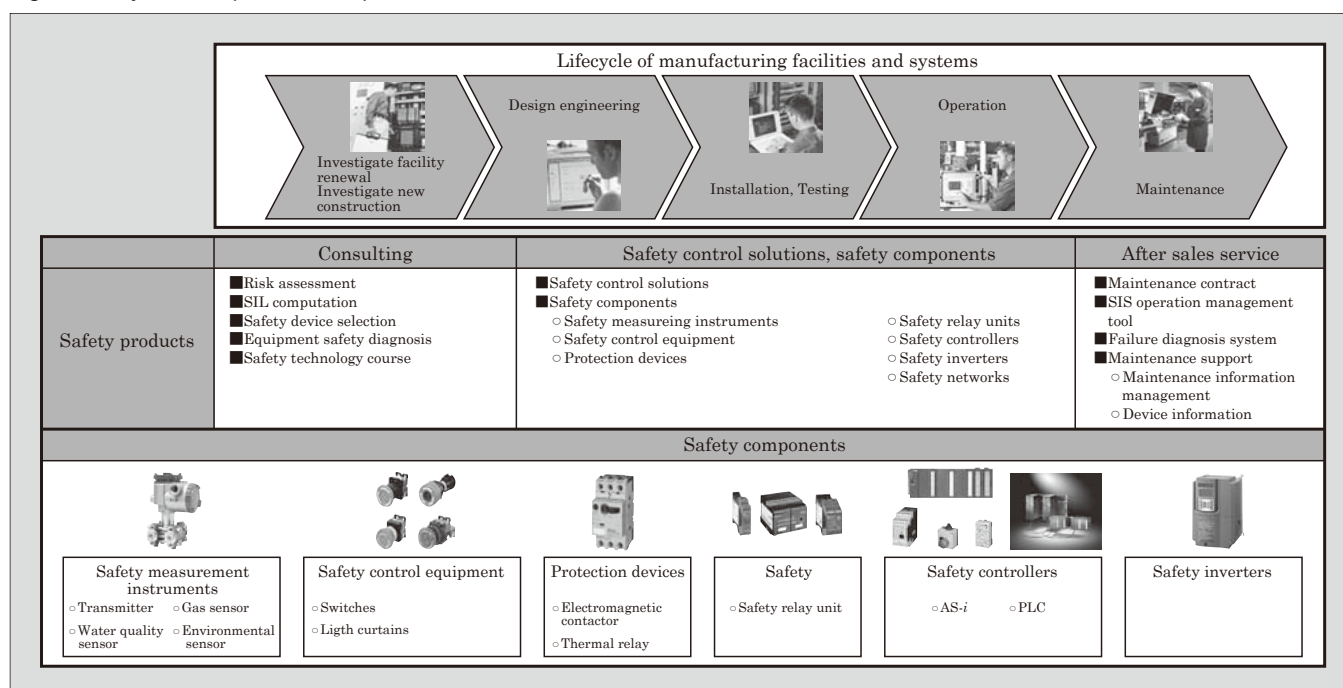
The fields of application of Fuji Electric's safety solutions are shown in Fig. 2. Fuji Electric is working in the industrial automation sector to develop next generation processes, components for machinery and equipment, and automation systems. Figure 3 illustrates the concept of the "safety industry," which is an important theme. In order to provide compliance with global safety standards for Safety Instrumented System and factory automation, to advance the performance of reliability-enhancing technology, such as preventative maintenance and self-diagnostic systems, and to ensure the safety compliance of customer products, safety industry automation combines IT, control platforms and plant engineering.

By offering comprehensive consulting services concerning machine safety and functional safety, and by supporting "safe and secure manufacturing," Fuji Electric aims to become a comprehensive safety solution supplier.

3.2 Safety solution product lineup

Figure 4 shows Fuji Electric's lineup of safety solution products. A lineup of various safety components is provided for realizing safety industry automation. Specifically, this lineup comprises safety instruments (push-button switches, door switches, light curtains), protection devices (electromagnetic contactors, thermal relays), safety relay units, safety controllers (PLC (SIL3), MICREX-NX Safety (SIL3)), safety pressure

Fig.4 Safety solution product lineup



transmitters (FCX-A III (SIL2)), safety inverters, safety networks and so on, conforming to a diverse range of safety standards.

Moreover, in addition to providing safety components, throughout the lifecycle of customer manufacturing facilities and systems, Fuji Electric also provides safety consulting (risk assessment, maintenance support, operations support, replacement support, safety technology lecture hosting), safety engineering (safety machine selection, SIL computation, safety system design) and safety control solutions. A safety control solution aims to combine safety technology acquired in the energy sector with international safety standards based on new concepts.

For further details, refer to the paper titled “Safety Control Solution that Protects Onsite Safety” in this edition.

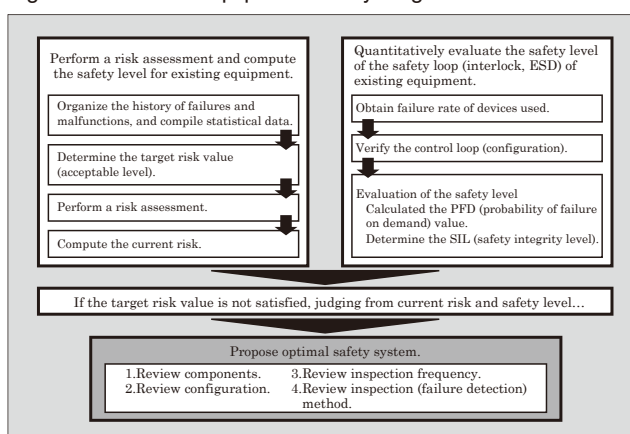
4. Safety Consulting

In the industrial sector, the construction of a “safe and secure system” requires a wide range of technologies for risk assessment, machine safety, functional safety, security, electronic recording of data, preventative maintenance of equipment, and so on. Fuji Electric provides safety consulting and safety control solutions as a comprehensive engineering-oriented approach to these technologies. A portion of Fuji Electric’s safety consulting service is described below.

4.1 Equipment safety diagnosis

Fuji Electric provides an “equipment safety diagnosis” service to support the replacement of existing equipment. Figure 5 shows an overview of this service. In cases where it would be difficult to renew or make

Fig.5 Overview of equipment safety diagnosis



major repairs on plant equipment, the safety of the existing equipment must be enhanced. As one such method, it is effective to diagnose the safety level of existing equipment from the perspective of maintenance. The current risk is computed from a risk assessment based on compiled statistical data and the history of past failures and malfunctions. Next, the safety level is quantitatively computed from the system configuration, failure rate, proof test period and the like for the devices used. If the risk, as determined from the above two results, does not meet the targeted level, the machinery, configuration, proof test period, inspection method (failure detection method) and the like will be reevaluated so that an optimal safety system can be proposed.

4.2 Risk assessment

Fuji Electric provides risk assessment as a part of

its safety consulting service. The international standard IEC 61508 prescribes that safety be managed over the safety lifecycle. Within the lifecycle, the “hazard and risk analysis” phase is positioned as the most important phase. To clarify hazards and hazardous events that occur in plants and control systems, Fuji Electric uses a risk analysis method such as HAZOP (Hazard and Operability Study) and a risk graph to evaluate methods for eliminating hazards, assess the frequency of occurrence of hazardous events, clarify the severity of occurrence relating to a hazardous event, and to estimate and assess plant risk (perform a risk assessment).

4.3 Safety engineering

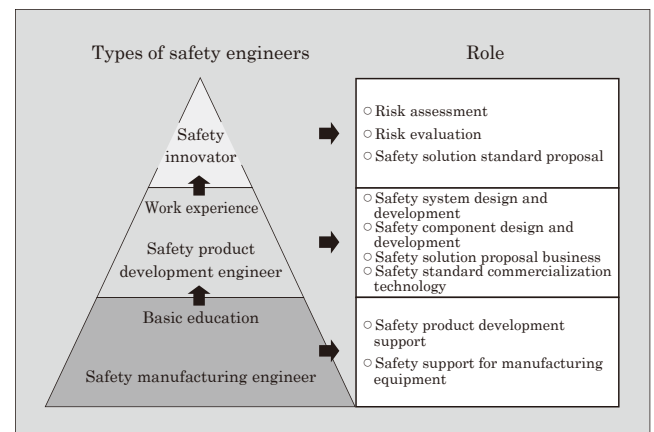
IEC 61508 was established as an international standard for control system safety (functional safety). The establishment of guidelines and standards for each industrial field, such as international standard IEC 61511 for the process industry, is progressing. The concept of functional safety is to maintain a certain level of safety by adding safety devices and systems, rather than by removing hazards. This is a reasonable method for situations in which intrinsic safety cannot be realized due to costs or other reasons. Fuji Electric provides safety engineering based on such international standards. For example, in the design of a SIS (Safety Instrumented System), after the SIS satisfies the requested safety specifications (i.e., provides the requested SIFs (Safety Instrumented Functions)), engineering services (safety device selection, safety system design, and SIL computation) can be provided to satisfy the requested safety integrity level (SIL) of each SIS function loop. The SIL (Safety Integrity Level) is a scale for measuring the failure of a safety function, having been assigned to an electronic safety device and/or system, with respect to its targeted function. SIL is defined as four levels (1 to 4) of safety. With this definition, the PFDavg (average probability of failure on demand) for safety devices and systems is once per 10, 100, 1,000 or 10,000 years, respectively.

4.4 Support of equipment maintenance

Fuji Electric also supports equipment maintenance work. The following four items relating to maintenance management are prescribed as functional safety standards.

- (a) Creation of plans for operation and maintenance with the goal of ensuring that functional safety will be maintained
- (b) Maintenance and repair so as to maintain the functional safety implied by the design
- (c) Ensuring that the functional safety is sufficient while improvements and modifications are being implemented
- (d) Training of safety personnel in order to maintain functional safety level

Fig.6 Safety engineers that support safety solutions



Thus, for safety devices or systems with which the safety level is evaluated quantitatively, proper installation, proper usage, and proper maintenance management are vital in order to maintain and ensure the assumed safety level. Consequently, constant assessment of the failure status of the devices being used, and the storage and management of this data are important for maintaining and ensuring the safety level.

4.5 Cultivation of safety engineers

Fuji Electric is also focusing on educating safety engineers to become capable of proposing the various safety solutions introduced in paragraph 3.2 in a timely manner with specific content. Figure 6 shows the types and roles of safety engineers. This education is being advanced with the goal of establishing “all engineers as safety engineers,” with “safety innovators” capable of safety consulting about risk analysis, risk evaluation and the like, “safety product development engineers” capable of designing safety systems, and “safety manufacturing engineers” for providing safety product development support and safety support of manufacturing equipment.

5. Postscript

An overview of Fuji Electric’s entire safety industry automation technology, as well as Fuji’s product lineup and product technology for safety solutions and safety components, has been presented. These safety technologies incorporate both machine safety and functional safety, since the safety of plants and equipment must be maintained comprehensively. Fuji Electric intends to continue to provide solutions that lend support to the realization of “safe and secure manufacturing” environments for our customers.

References

- (1) ARC, Process Safety System Worldwide Outlook-Market Analysis and Forecast Through 2012, 2008.



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