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TÜV Rheinland Group Overview

TÜV Rheinland Group is a leading provider of technical services for independent testing and assessment services worldwide.

Cologne

Newtown

Hong Kong

Toronto

Mexico City

Shin-Yokohama

Founded in **1872** and headquartered in Germany, the Group employs more than **12,500** people in over **360** locations in **62** countries and generates annual revenues of **$ 1.5** billion.

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Facts & figures.
Locations worldwide.

- 79 associated companies overseas. At 360 locations in 62 countries around the world.

- Wherever your market is:
  we are already there.
  And ready to help you with advice and assistance

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TÜV Rheinland Group - North American Overview



Established: 1978, Incorporated 1983
HQ in Newtown, CT

Offices in the USA, Canada & Mexico
Approx. 400 employees

Locations :

United States - *Newtown, CT, Boxborough, MA, Rochester, NY, Raleigh, NC, Detroit, MI, Chicago, IL, Pleasanton, CA, San Diego, CA, Austin, TX, Houston, TX, Portland, OR, Birmingham, AL.*

Mexico - Monterrey, Guadalajara, Mexico City

Canada - Toronto

Divisions at the TÜV Rheinland.
Where the Whole Is Much More than the Sum of its Parts.

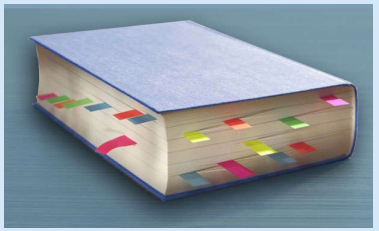
Industrial Services

Mobility

Products

Life Care

Training and Consulting



Systems

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Why does safety matter?

“… avoiding accidents should not be understood as regulation by law, but should be an imperative of human responsibility and economic rationality.”

Werner von Siemens (yes, that Siemens)

Why pursue safety certification?

Independent verification of your safety implementation provides an objective rating/grade to satisfy:

- Insurance and liability exposure
- Local government codes
- End user (internal) standards

"… measures to reduce risks can only be ruled out if the sacrifice involved, in terms of money, time and trouble, are grossly disproportionate to the benefits to be gained."

Ron Bell Consulting Ltd, IEC January 2008

The safety challenge has evolved…

In the past:

- Electro-Mechanical safety products
- Separate control and safety task
- “Hard-wired” Safety
- Centralized safety architecture
- Simple shut-down functionality

Situation today and in the future:

- Electronic Safety Systems + High Level Design Tools
- Integration of safety relevant and non safety relevant tasks
- Safety Networks
- Distributed safety implementation (e.g. remote safety I/O’s)
- Systems capable of different modes, Diagnostic features

Risk Analysis

Hazards arise in virtually all technology applications that can put human life and the environment in jeopardy.

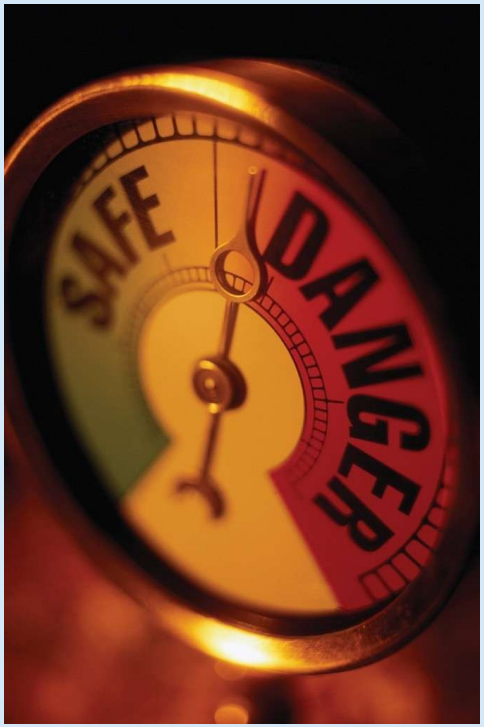
How do we handle this?

- Detection of hazards
- Evaluation of hazards
- Reduction of hazards (risk) to an acceptable level
- Use of technical and organizational measures
- Complete elimination of risk not possible

Risk … (R)

… is the combination of the probability of occurrence of harm (H) and the severity of that harm (S)

$$R = H \times S$$



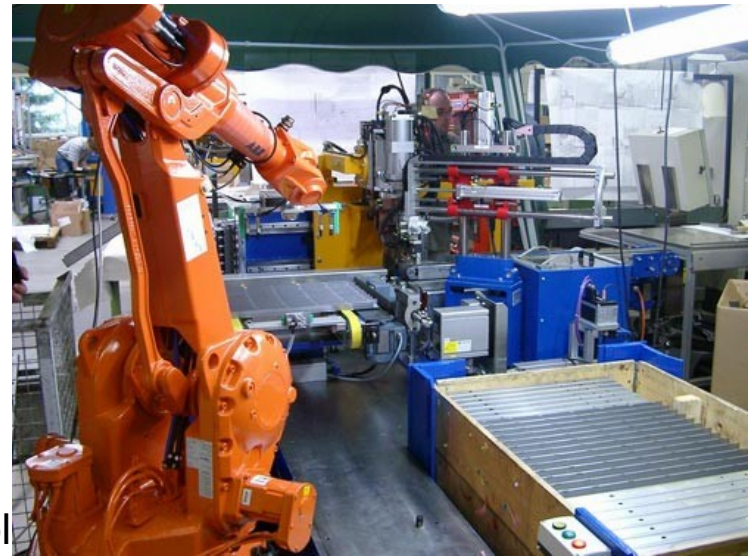
What does Functional Safety have to do with risk?

Functional Safety defines protection against hazards caused by incorrect functioning of components or systems

- Technical definition: A safety system is functionaly safe if -
  - *Random*, *systematic* and *common cause* failures ***do not*** lead to a loss of the safety system and ***do not*** result in:
    - Injury or death to people
    - Spills to the environment
    - Loss of equipment or production

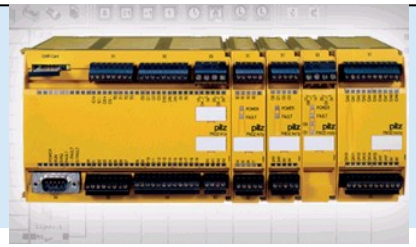
Who should be interested?

- **Developer** of safety related controls systems (e.g. PLC) and safeguards



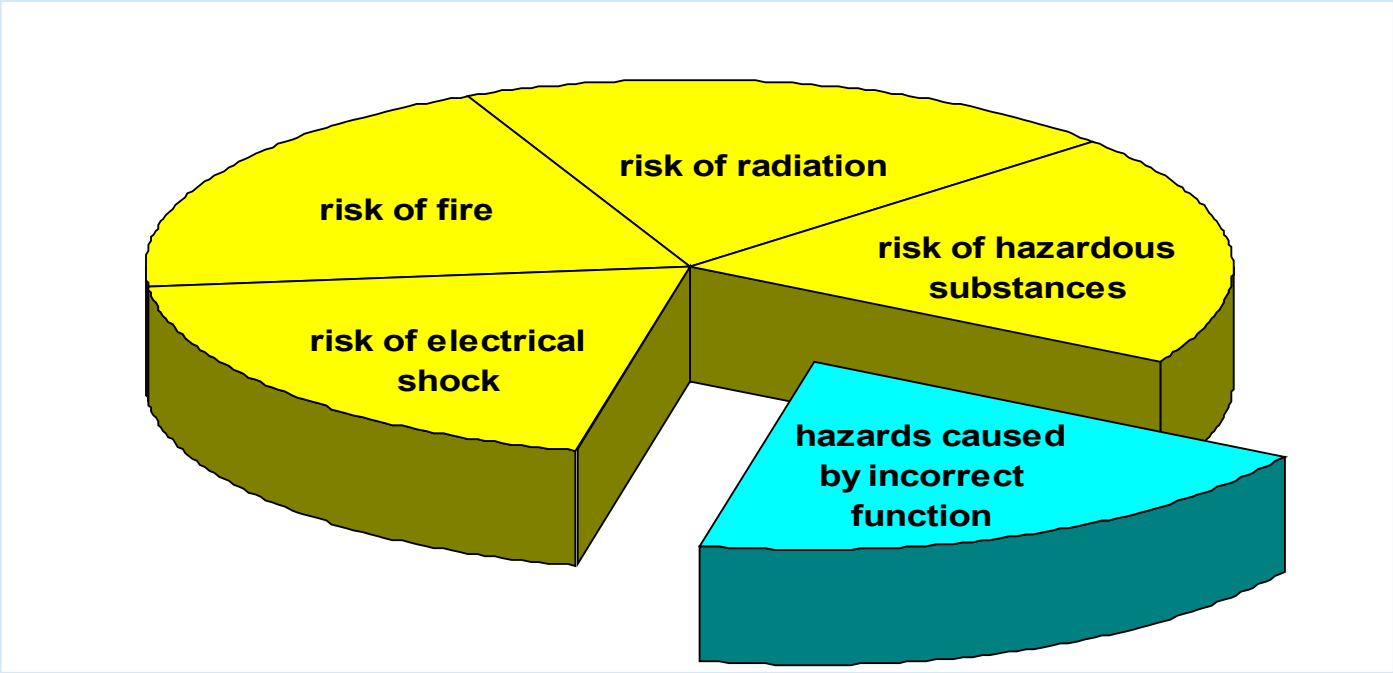
- **Machine builder**, who has to ensure safety at his machine (risk analysis, implementation of measures for risk reduction/elimination, validation of the safety functions)

- **System integrator**, integration of availabl complex and complex electronics) with and without Application SW



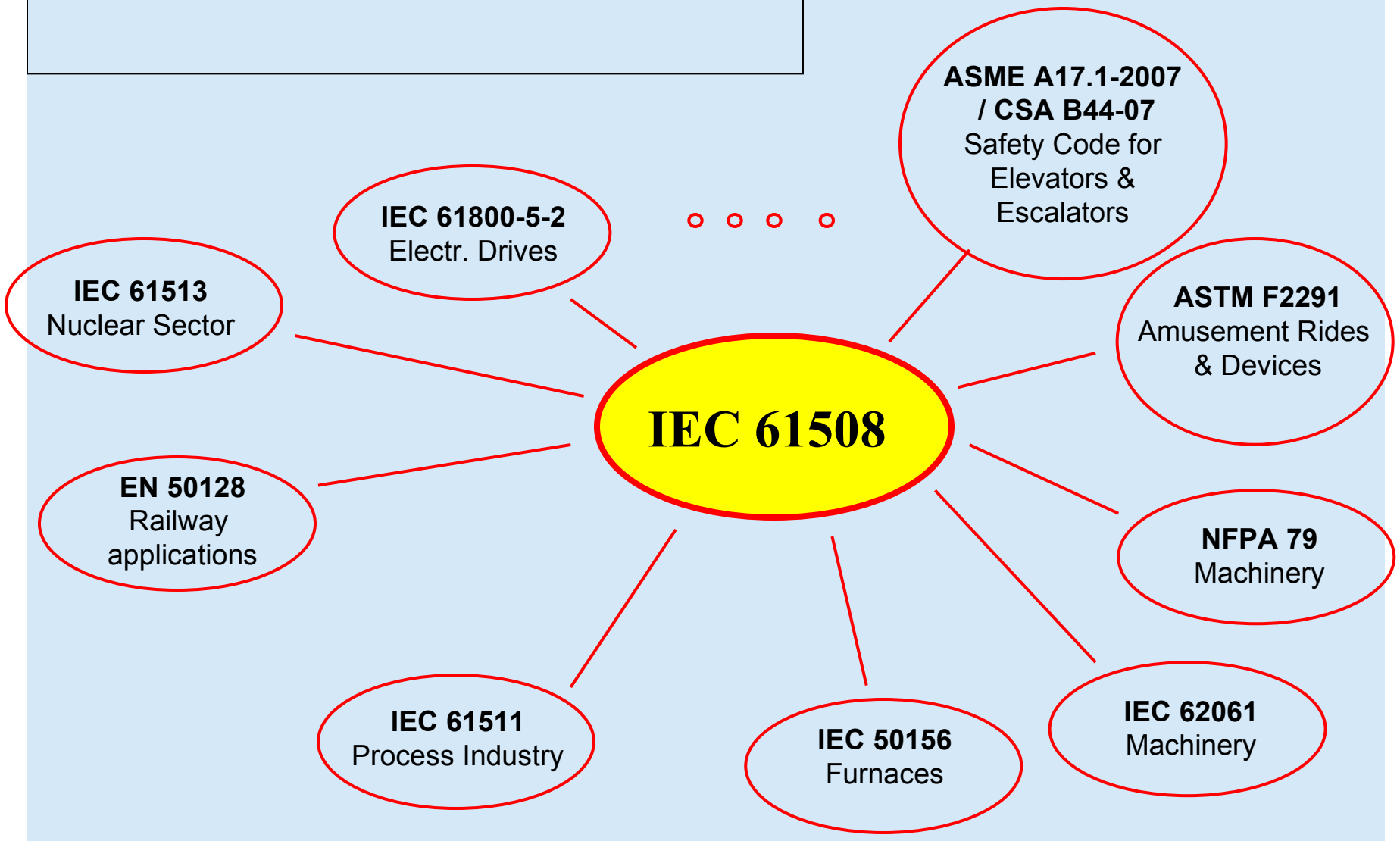
Functional safety is just one part of the overall safety strategy

Safety (in general) means protection against ALL hazards (movement, heat, radiation, electrical shock, etc.)



“Functional Safety” means protection against hazards caused by incorrect function.

International standards framework



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Safety classifications

- Safety rated systems are identified by **S**afety **I**ntegrity **L**evel (SIL)
  - As detailed in IEC 61508
    - SIL1 is the lowest level (highest risk)
    - SIL4 is the highest level (least risk)

- Related standards include ISO 13849-1 and EN 954-1 (machinery stds)
    - PL a is the lowest level, PL e is the highest level
    - CAT 1 is the lowest level, CAT 4 is the highest level

Safety classifications, cont

Low Demand Mode

Definition: Safety Demand is placed upon the system ≤ 1 occurrence per year

Safety Integrity Level	Probability of Failure on Demand
SIL 4	$>= 10^{-5}$ to $< 10^{-4}$
SIL 3	$>= 10^{-4}$ to $< 10^{-3}$
SIL 2	$>= 10^{-3}$ to $< 10^{-2}$
SIL 1	$>= 10^{-2}$ to $< 10^{-1}$

Continuous Mode

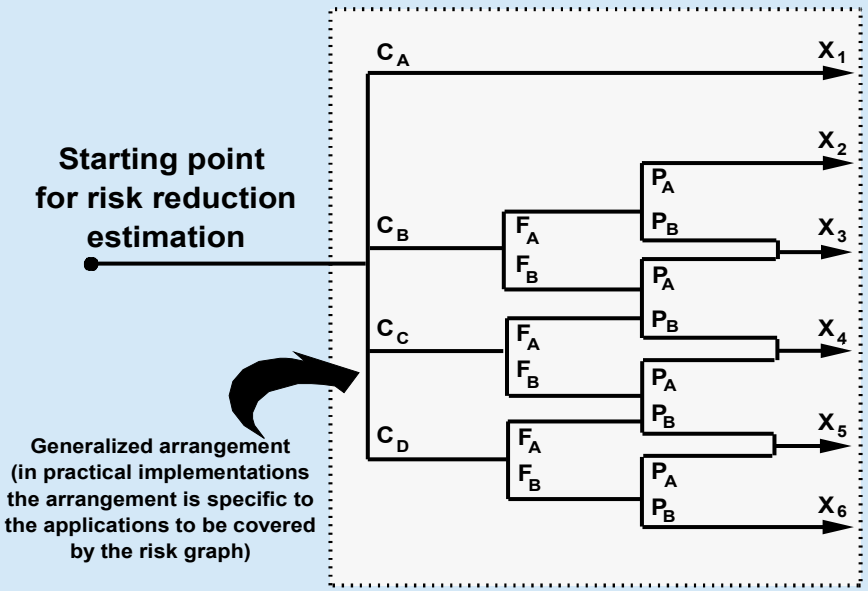
Definition: Safety Demand is placed upon the system > 1 occurrence per year

Safety Integrity Level	Probability of Dangerous Failure per Hour
SIL 4	$>= 10^{-9}$ to $< 10^{-8}$
SIL 3	$>= 10^{-8}$ to $< 10^{-7}$
SIL 2	$>= 10^{-7}$ to $< 10^{-6}$
SIL 1	$>= 10^{-6}$ to $< 10^{-5}$

Determination of the Safety Integrity Level

Risk parameter		Classification
Consequence (C)	C_1 C_2 C_3 C_4	Minor injury Serious permanent injury to one or more persons; death to one person Death to several people Very many people killed
Frequency of, and exposure time in, the hazardous zone (F)	F_1 F_2	Rare to more often exposure in the hazardous zone Frequent to permanent exposure in the hazardous zone
Possibility of avoiding the hazardous event (P)	P_1 P_2	Possible under certain conditions Almost impossible
Probability of the unwanted occurrence (W)	W_1 W_2 W_3	A very slight probability that the unwanted occurrences will come to pass and only a few unwanted occurrences are likely A slight probability that the unwanted occurrences will come to pass and few unwanted occurrences are likely A relatively high probability that the unwanted occurrences will come to pass and frequent unwanted occurrences are likely

Determination of the Safety Integrity Level, cont.



W3	W2	W1
a	---	---
1	a	---
2	1	a
3	2	1
4	3	2
b	4	3

C = Consequence risk parameter

F = Frequency and exposure time risk parameter

P = Possibility of failing to avoid hazard risk parameter

W = Probability of the unwanted occurrence

--- = No safety requirements

a = No special safety requirements

b = A single E/E/PES is not sufficient

1, **2**, **3**, **4** = Safety integrity level

How do I begin???

Training and workshops offered

Single day, onsite

Overview of IEC 61508 standard for functional safety

Core concepts of safety integrity levels (SIL) and safety lifecycle

Requirements needed to achieve a functional safety certificate

Documentation requirements

Functional safety design methodology.

Four day, onsite, optional FSE certification

Application of the international standard IEC 61508

Examples concerning management of functional safety

Requirements of E/E/PES

* Recent customer satisfaction survey

Determination and evaluation of safety-related parameter (practical examples)

Software requirements

Requirements of tools for configuration and specification of safety systems

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Functional Safety Project Steps

Concept Review

Management of FS

HW Assessment

SW Assessment

Verification Testing

Certification

* Recent customer satisfaction survey

Certificates and test marks

Functional Safety Type Approved

TÜVRheinland® FS

The test mark "Functional Safety FS" is applied to products, which - according to the product standards - require functional safety (failsafe behaviour) and which are used in safety related applications. The safety design of the products according to the relevant standards, including the EN 954 and/or the IEC 61508, has to be proved.

TÜV TÜV Rheinland Group

TÜV Industrie Service GmbH
Automation, Software und Informationstechnologie

ZERTIFIKAT
CERTIFICATE

No. 968/EZ 196.00/05

Product tested	Safety Control system ProSafe -RS	**Manufacturer**	Yokogawa Electric Corporation 2-9-32 Nakacho Musashino - shi Tok yo 180-8750 Japan
Type designation	ProSafe -RS, R1.01 The actual revision and official list of the product documentation, hardware components and software modules have to be considered. Please refer to the "List of type approved PES" published on: http://www.tuvasi.com/	**Intended application**	Safety related and high availability applications such as: Emergency Shutdown System (ESD), Process Shutdown System (PSD), Burner Management System (BMS), Fire And Gas System (F&G), where the safe state is the de -energized state or the energized state.
Codes and standards forming the basis of testing	IEC 61508, Part 1 - 7:2000 IEC 61511:2004 IEC 61131 -2:Feb. 2003		EN 298:October 2004 EN 50156 -1:2004 NFPA 85:2001 EN 54 -2:2004 NFPA 72:2002
Test results	The system is suita ble for safety related applications up to and including SIL 3 (IEC 61508), considering the results of the test report -no. 968/EZ 196.00/05 dated 2005 -03-10.		
Specific requirements	For the use of the system the test report mentioned above, the Safety Manual and the user documents referenced in the "ProSafe -RS Document Map" released by the system manufacturer and approved by TÜV Rheinland have to be considered.		

TÜV Rheinland FS

The test report -no. 968/EZ 196.00/05 dated 2005 -03-10 is an integral part of this certifica te.
The holder of a valid licence certificate for the product tested is authorized to affix the test mark shown opposite to products, which are identical with the product tested.

TÜV Industrie Service GmbH
Geschäftsfeld ASI
Automation, Software und Informationstechnologie
Am Grauen Stein, 51105 Köln
Postfach 91 09 51, 51101 Köln

2005-03-10
Date | Company seal | Signature

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Global Demand for Functional Safety

10 years ago:

One gas detector was SIL certified, Rockwell had several products

5 yrs ago:

Ten gas detectors, 20 smart valves, Rockwell had approx 200 part#‘s

Today:

Dozens of items from all top-tier vendors;

Rockwell, GE, Siemens, others have 1000‘s of items

Services provided by TUV

- **Expert Services** - Guidance on Functional Safety standards
- **Tests / Analysis**
  - Type approvals with optional certification
  - Software tests (application software, compiler)
  - Environmental tests (temperature, climatic, mechanical, EMC, etc.)
  - Calculation of safety related parameters
  - Failure mode and effect analysis (FMEA)
- **Certifications**
  - Certification and Marking
  - Functional Safety Management
- **Training/Workshops**
  - Customized and public training
  - TÜV Functional Safety Program

ID: 607/07 FS Engineer TÜVRheinland

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Sample TÜV Rheinland Clients

Industrial Machinery

Seagate

Teradyne

Ingersol Rand

Johnson Controls

John Deere

Process Industry

Rockwell Automation
Siemens
Eaton Corporation
Honeywell
GE (Energy, Fanuc, others)

Computing, Storage & Office

Hewlett-Packard
IBM
Dell
Sun Microsystems

Communications

Cisco Systems
Motorola
Alcatel-Lucent
Nortel

Scientific Instrumentation

Agilent
Varian
Thermo-Fisher
Bio-Rad

Transportation

Ford, GM, Chrysler, Polaris
Victory Motorcycles,
GE Transportation
Bombardier

Functional Safety

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