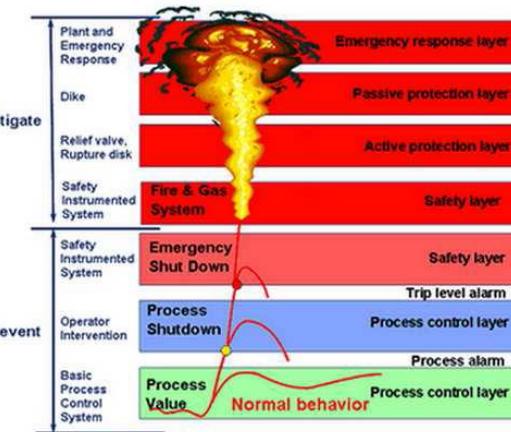
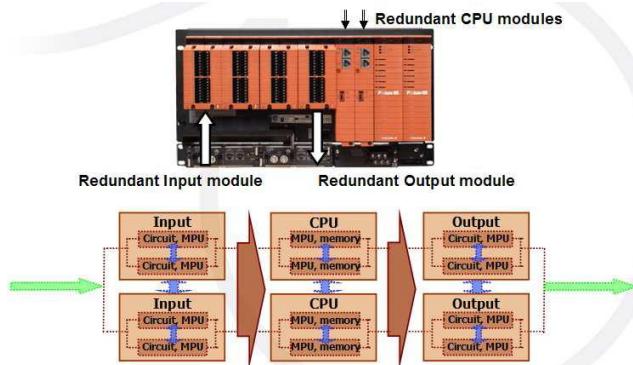
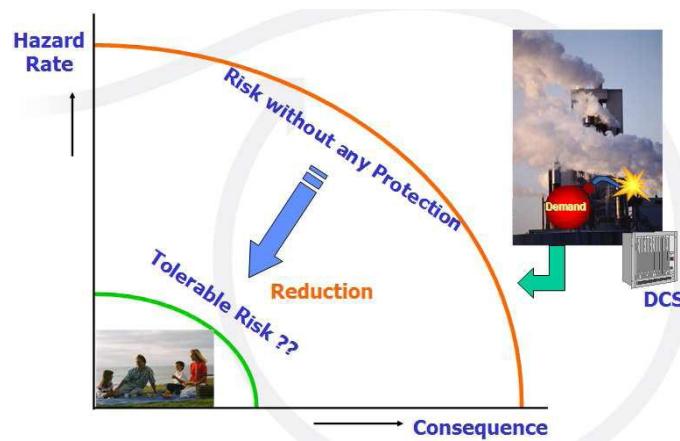


## C11: Safety process

### Cuprins:

- Introducere
- Standarde de siguranta
- Arhitecturi “Safety process”
- Exemple

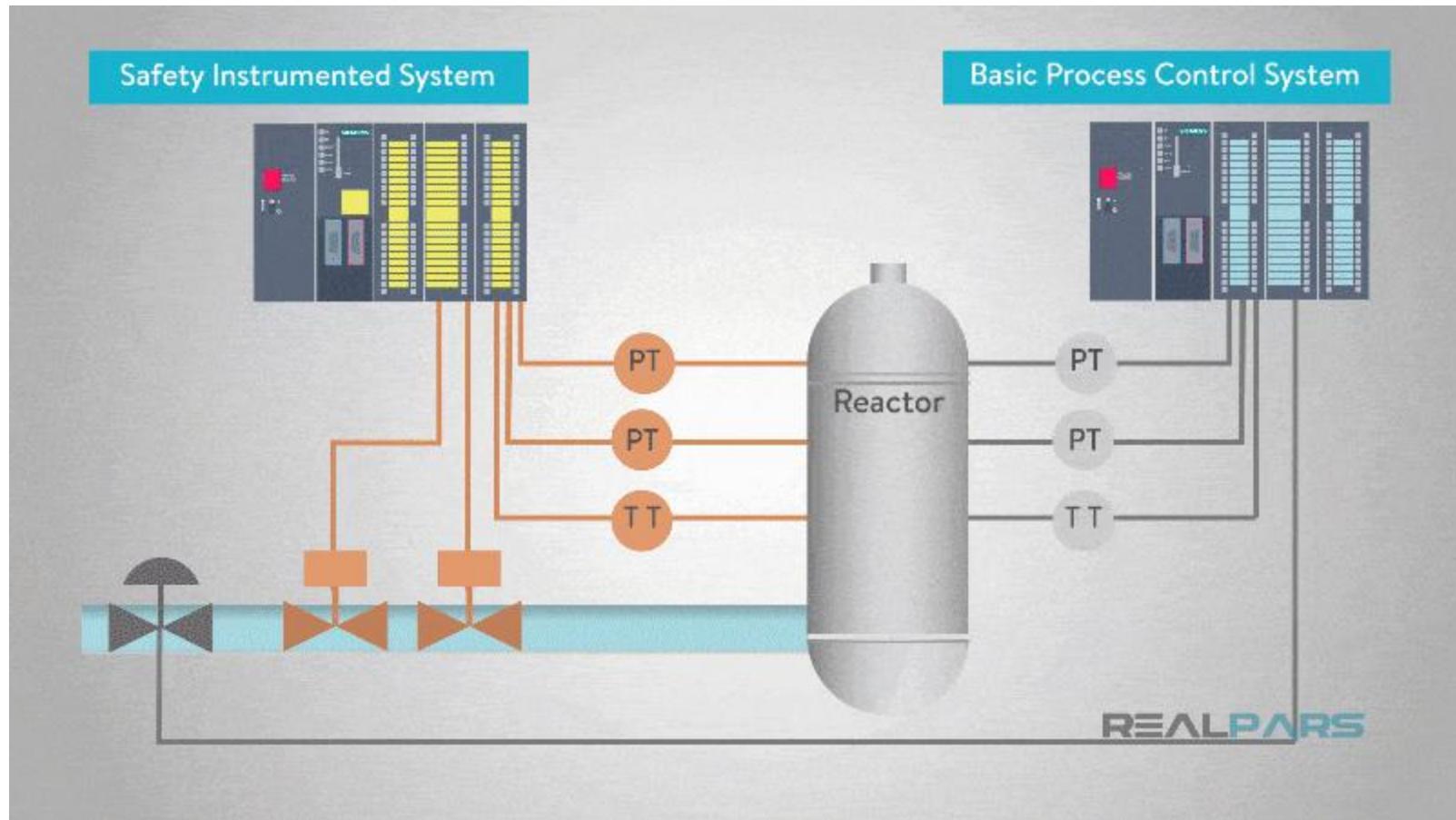
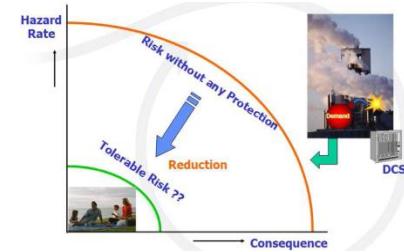


- Inspirat dupa Prosafe-RS training manual engineering - Yokogawa

# C11: Safety process

## 1. Introducere

### Sistem h-s independent

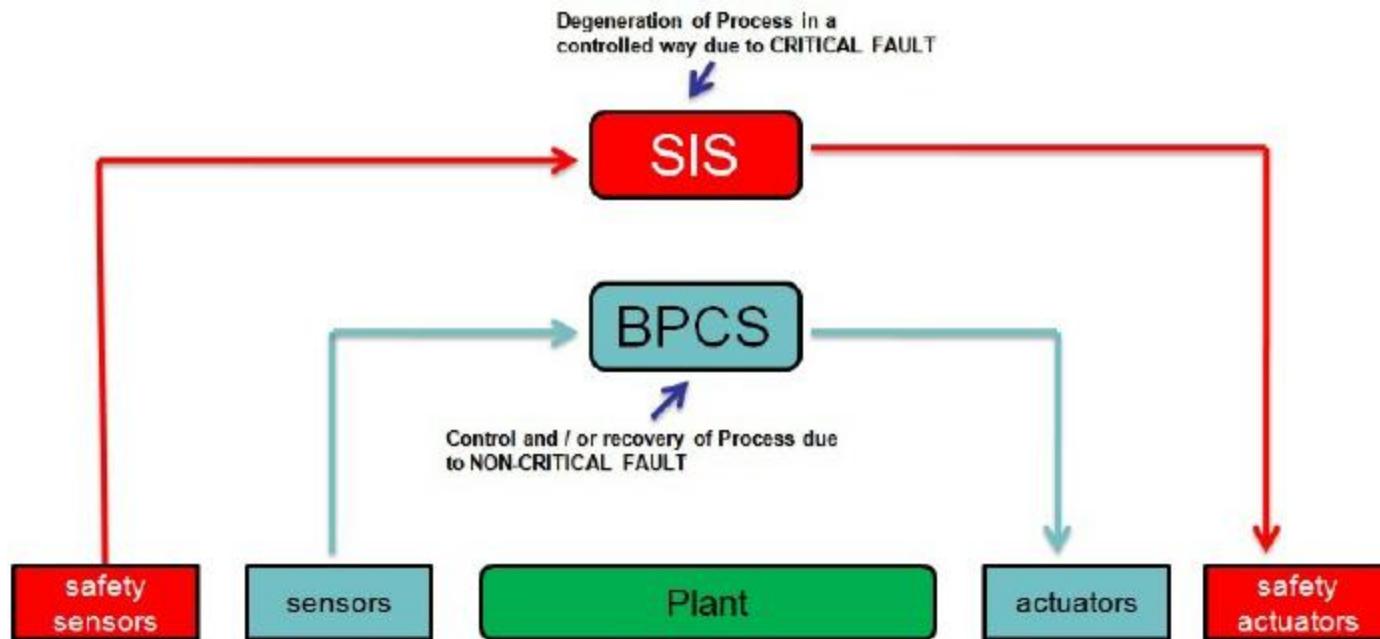
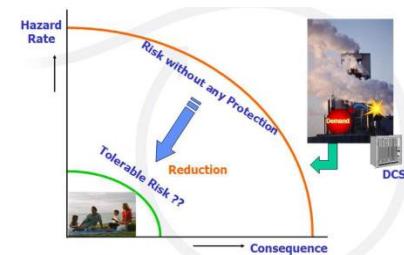


**Safety Instrumented Systems (SIS).** = **Sistemele de Control a Siguranței (SIS).**

# C11: Safety process

## 1. Introducere

### Sistem h-s independent

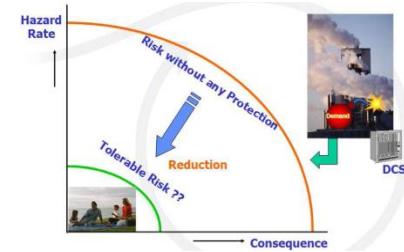


**Safety Instrumented Systems (SIS).** = **Sistemele de Control a Siguranței (SIS).**

# C11: Safety process

## 1. Introducere

### Risc –standarde moderne de siguranta



In standardele de siguranță moderne, "riscul" este definit ca un rău potențial pentru personal și/sau mediu.

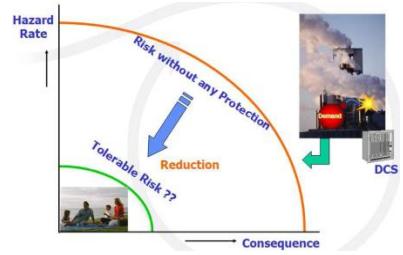
Cu toate acestea, cele mai multe companii extind **lista de risc(uri)** pentru a include următoarele categorii:

- Deteriorarea echipamentului și costurile de reparație
- Siguranță publică și sănătate
- Costurile de răspundere
- Întreruperi de producție și aspecte calitative

# C11: Safety process

## 1. Introducere

### Risc –standarde moderne de siguranta



Riscul este determinat atât de **probabilitatea** (sau frecvența, rata) cu care se întâmplă un eveniment periculos, precum și **consecințele** acestui eveniment.

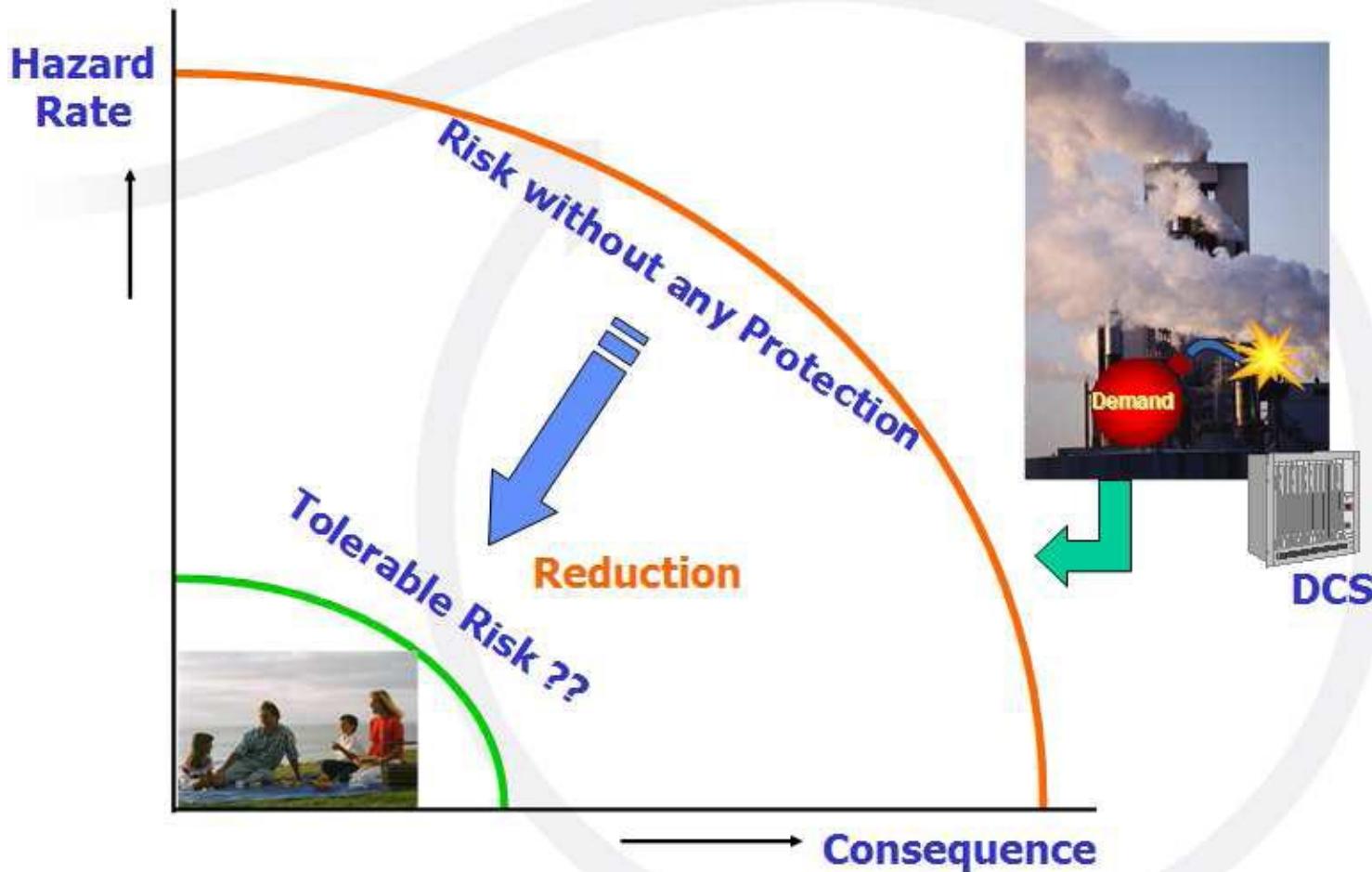
Majoritatea instalațiilor de procesare au multe piese și/sau echipamente și fiecare, contribuie la ceea ce se numește **riscului inițial** - cu alte cuvinte, **riscul care există din cauza naturii procesului**, inclusiv echipamentele și materialele prezente.

De exemplu, riscurile cititului într-o mașină includ accidentele cauzate de erori ale conducătorului auto, anvelope etc.

# C11: Safety process

## 1. Introducere

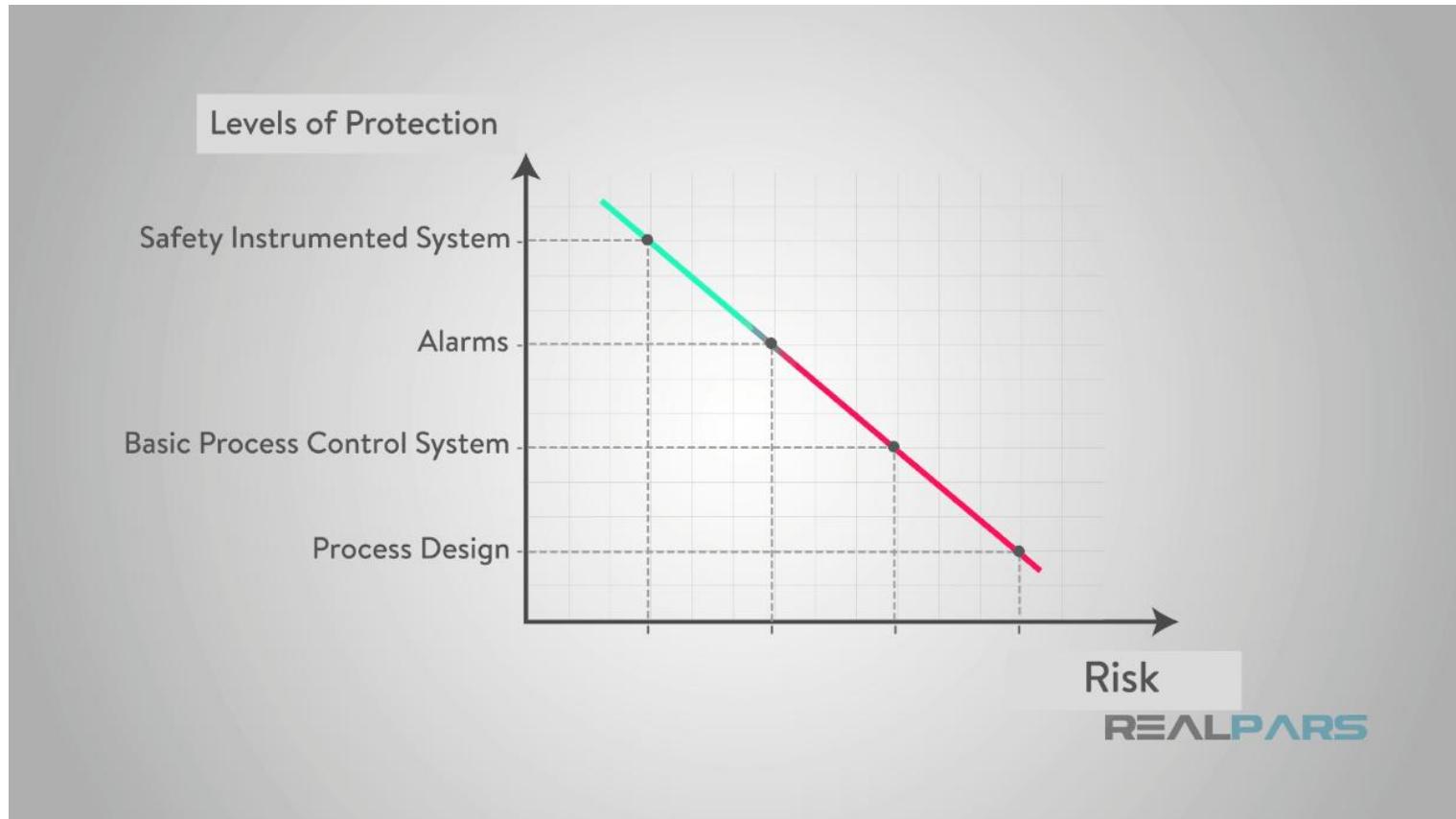
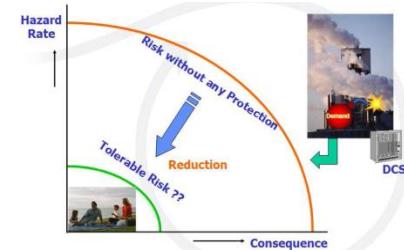
### Risc –standarde moderne de siguranta



# C11: Safety process

## 1. Introducere

### Risc –standarde moderne de siguranta



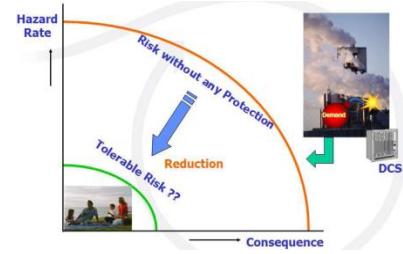
# C11: Safety process

## 1. Introducere

### Risc –prevenirea riscurilor

Un pas important în menținerea sau îmbunătățirea siguranței este capacitatea de a identifica risurile.

Provocarea este de **a identifica risurile în avans**, astfel încât acestea să poată fi reduse sau eliminate - de exemplu, prin schimbarea formulei unui produs, reducerea cantităților de materiale periculoase prezente, sau prin aplicarea unui sistem de siguranță. (safety system) (**Ex. Accident Mihalesti**)

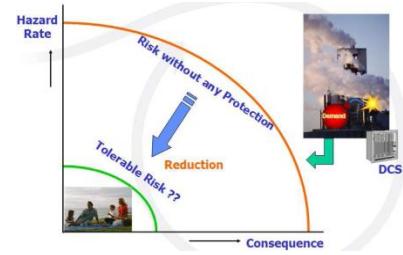


# C11: Safety process

## 1. Introducere

### Safety Integrity Level (SIL)

Fiecare nivel SIL este definit ca un interval de reducere riscului (aranjate în ordine de mărime).

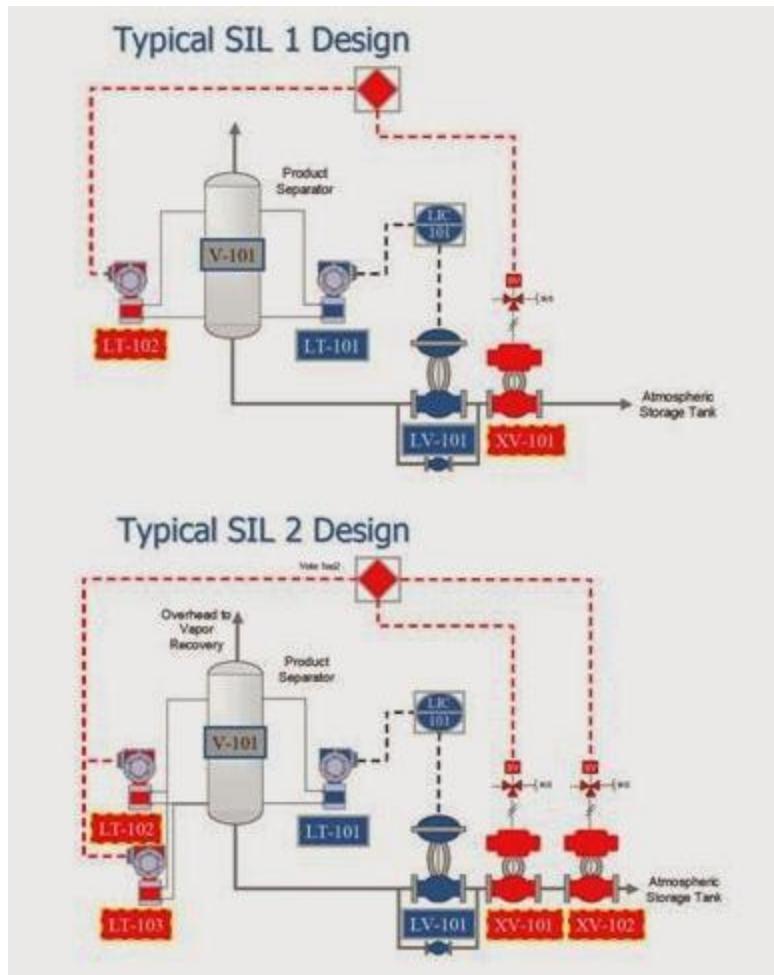
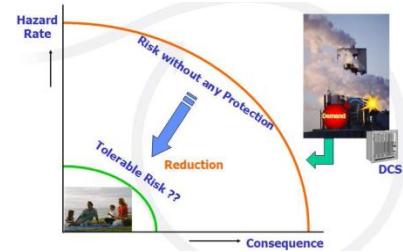


SIL Level	Probability of Failure on Demand (PFD)	Risk Reduction Factor (RRF)
4	$10^{-5}$ to $10^{-4}$	100,000 to 10,000
3	$10^{-4}$ to $10^{-3}$	10,000 to 1,000
2	$10^{-3}$ to $10^{-2}$	1000 to 100
1	$10^{-2}$ to $10^{-1}$	100 to 10

# C11: Safety process

## 1. Introducere

### Safety Integrity Level (SIL)



<http://ichzenk.blogspot.com/2014/02/>

# C11: Safety process

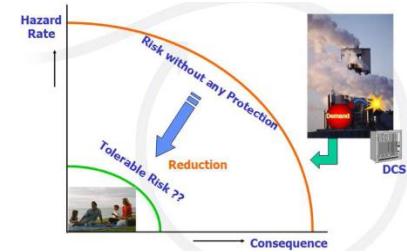
## 1. Introducere

Nivele de protectie (Protection Layers)

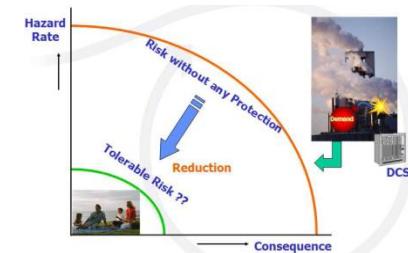
2 nivale:

Prevenire – Prevent

Diminuare - Mitigate

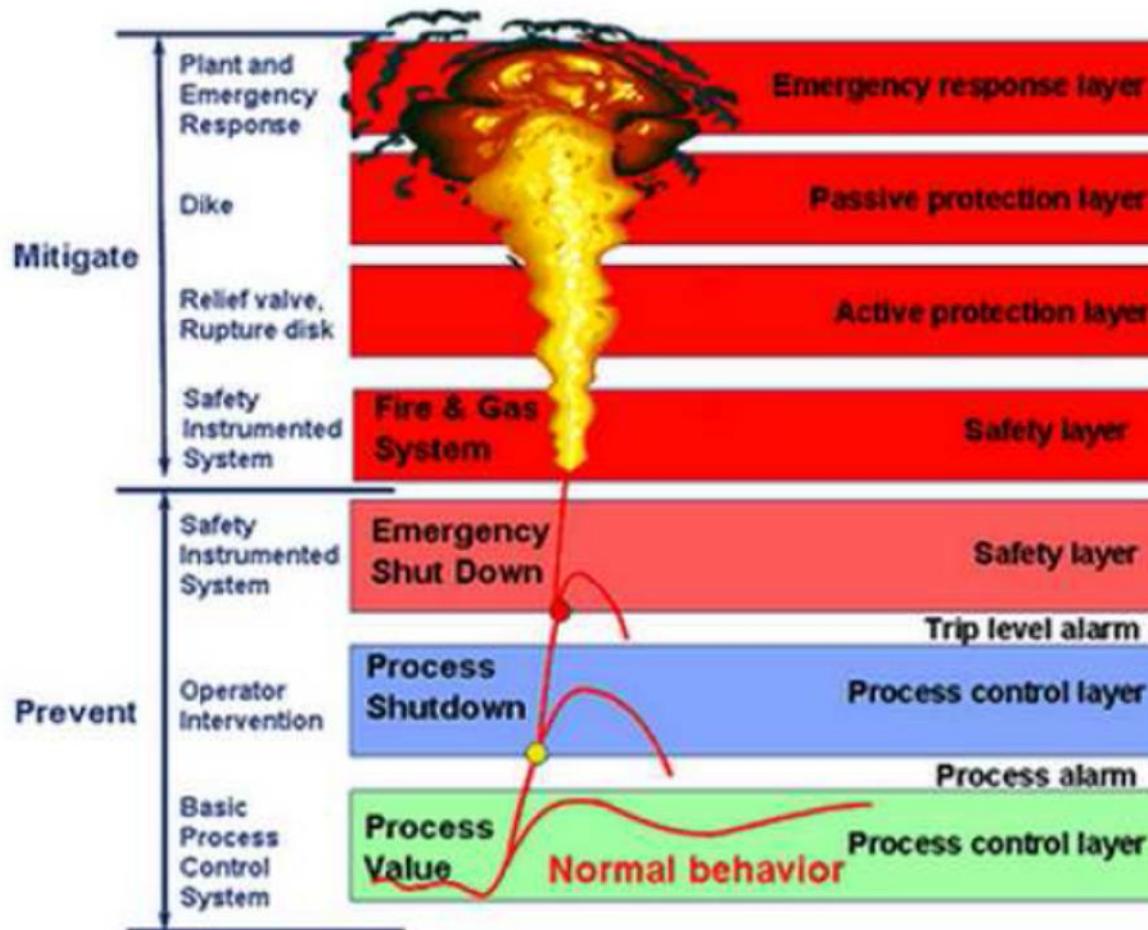


# C11: Safety process

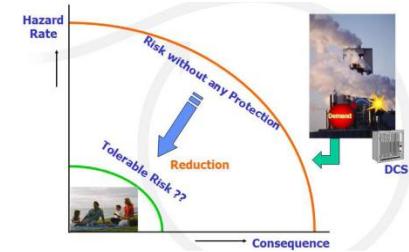


## 1. Introducere

### Nivele de protectie (Protection Layers)



# C11: Safety process



## 1. Introducere

### Exemple:

#### **Catastrofa de la Bhopal**

**Catastrofa de la Bhopal** este numele sub care este cunoscut unul dintre cele mai grave accidente industriale din lume și care s-a soldat cu peste 15.000 de victime și cu peste 500.000 de persoane afectate în mod direct. Evenimentul s-a petrecut în noaptea de 2 spre 3 decembrie 1984 în apropierea orașului Bhopal și a constat în eliberarea în atmosferă a peste 45 de tone de derivat gazos de cianură din incinta uzinei Union Carbide India.

Efectele catastrofei continuă să se manifeste la mulți ani după accident: s-au născut sute de copii cu deficiențe neuro-motorii, orbi sau cu alte dizabilități și malformații, mai ales la nivelul sistemului osos sau sistemului muscular.

**Golful Mexic;**

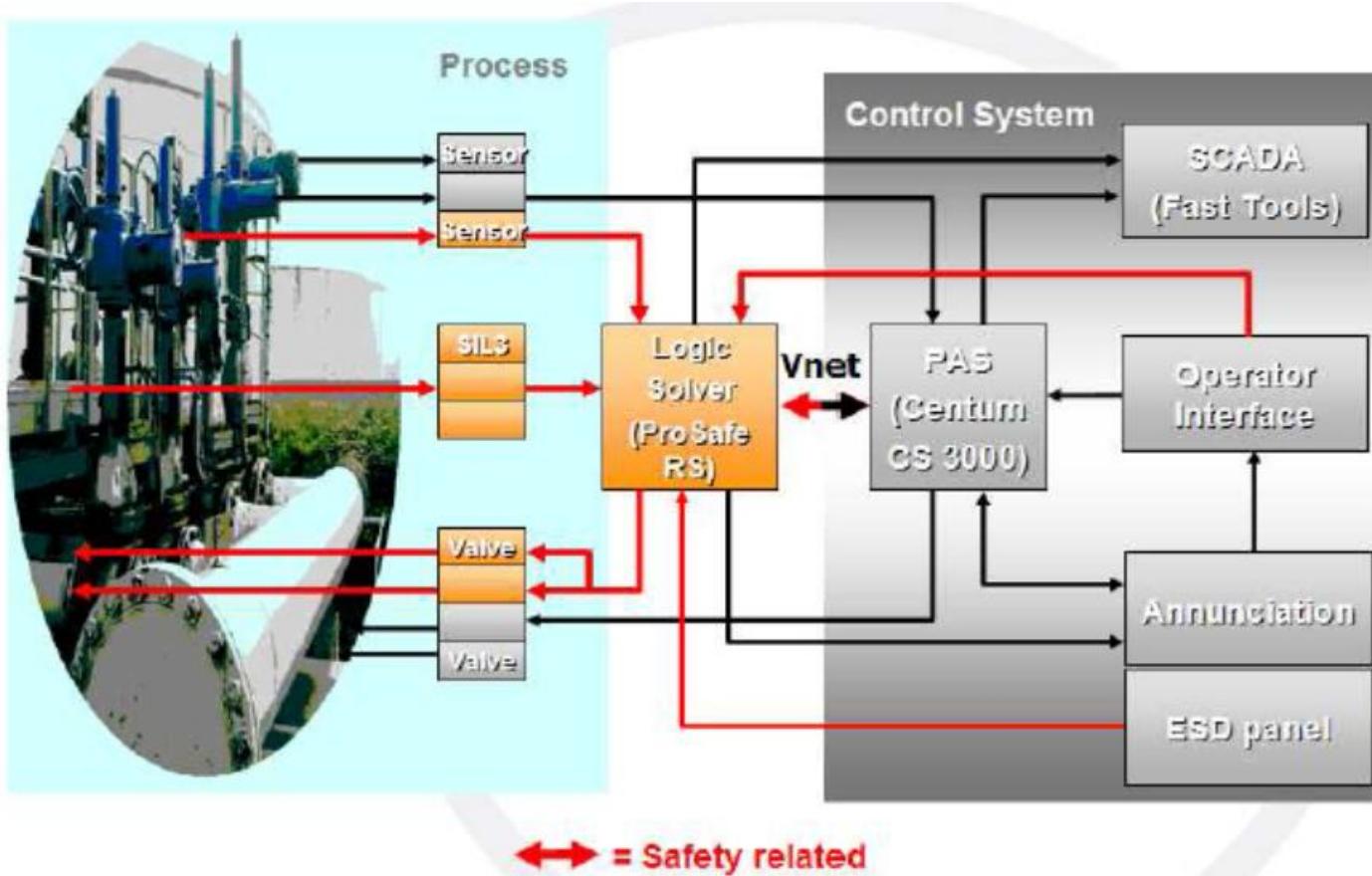
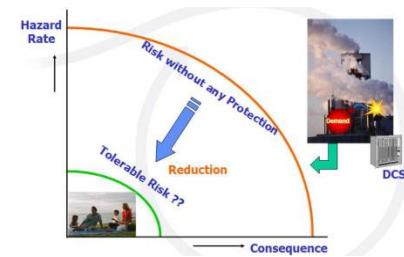
**Cernobal - tragedia nucleară;**

**etc.**

# C11: Safety process

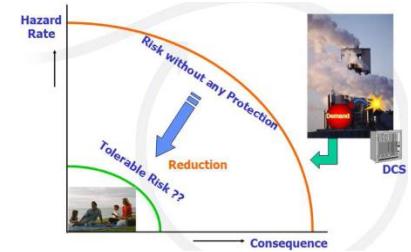
## 1. Introducere

### Nivele de protectie



# C11: Safety process

## 2. Standarde de siguranta Institutii



IEC – International Electrotechnical Commission

ANSI – American National Standards Institute

ISA – International Society of Automation

# C11: Safety process

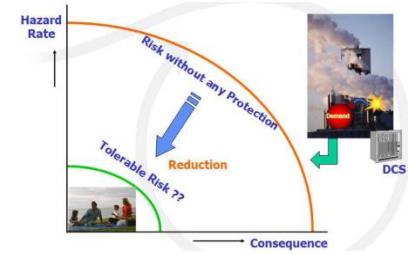
## 2. Standarde de siguranta

### Standarde tipice

IEC 61508, IEC 61511,

sau

ANSI/ISA S84.00.01-2004.

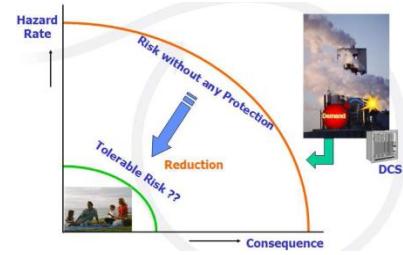


# C11: Safety process

## 2. Standarde de siguranta

### IEC 61508

**I E C 6 1 5 0 8, Functional safety of electrical/electronic/programmable electronic safety-related systems**

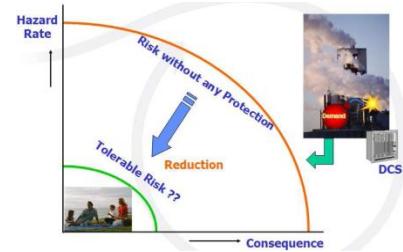


**Ex:** indicatori de sarcină în condiții de siguranță pentru o **macara**, sisteme de centralizare și controlul dozei de expunere de instalatii medicale de radioterapie, sau luminile de avertizare, de frânare antiblocare.

# C11: Safety process

## 2. Standarde de siguranta

IEC 61508



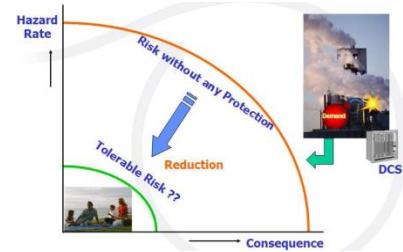
# C11: Safety process

## 2. Standarde de siguranta IEC 61508

### Parts framework of IEC 61508

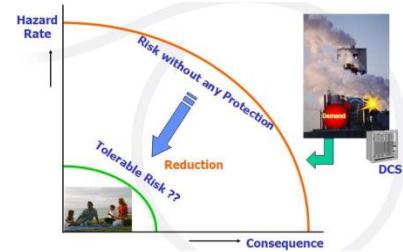
The standard consists of 7 parts:

- IEC 61508-1, General requirements;
- IEC 61508-2, Requirements for electrical/electronic/programmable electronic safety-related systems;
- IEC 61508-3, Software requirements;
- IEC 61508-4, Definitions and abbreviations;
- IEC 61508-5, Examples of methods for the determination of safety integrity levels;
- IEC 61508-6, Guidelines on the application of IEC 61508- 2 and IEC 61508-3;
- IEC 61508-7, Overview of measures and techniques.



# C11: Safety process

## 2. Standarde de siguranta IEC 61508



**Safety Instrumented Systems (SIS).**

=

**Sistemele de Control a Siguranței (SIS).**

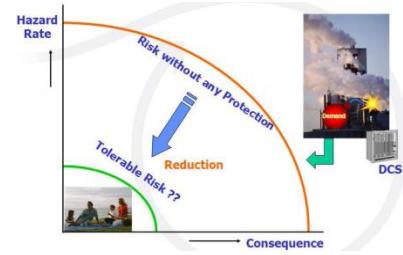
# C11: Safety process

## 2. Standarde de siguranta

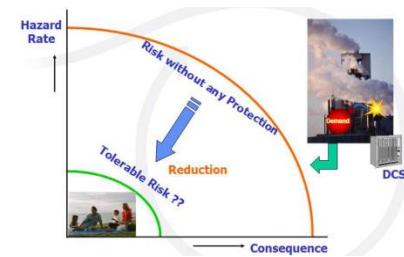
### IEC 61511 – dezvoltare a 61508

IEC 61511 identifica trei tipuri de aplicatii software:

1. **Application:** The software you develop specifically for your SIS solution – in other words, the system configuration.
2. **Utility:** The software tools used to develop, verify, and maintain the application software. In the ProSafe-RS it is referred to as SCS Manager (Workbench) software.
3. **Embedded:** The software (also called firmware) that is “built-in” to SIS products. In the ProSafe-RS, the dual circuitry within the CPUs and I/O modules is an example of the “built-in” firmware.

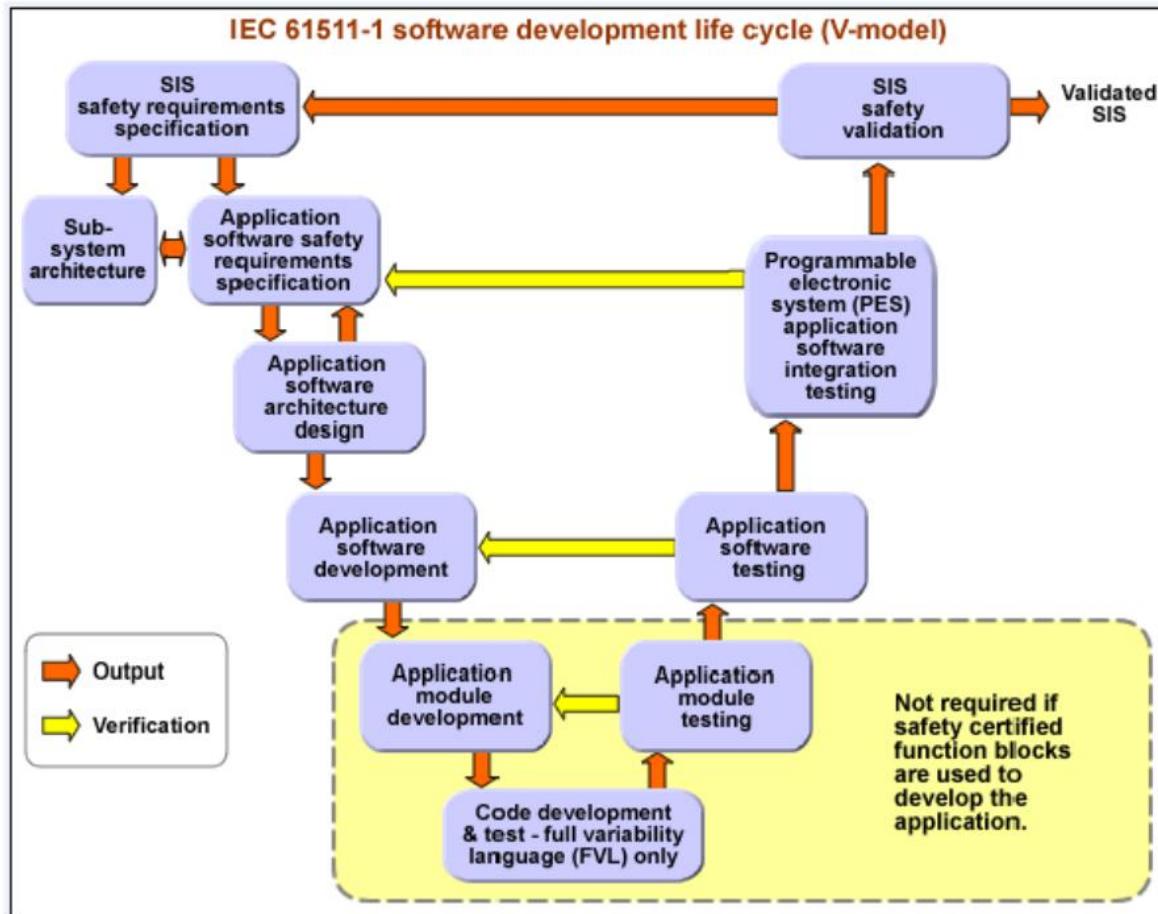


# C11: Safety process



## 2. Standarde de siguranta

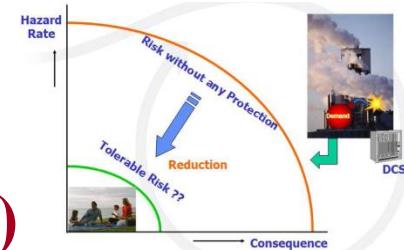
### IEC 61511 – dezvoltare software (in V)



# C11: Safety process

## 2. Standarde de siguranta

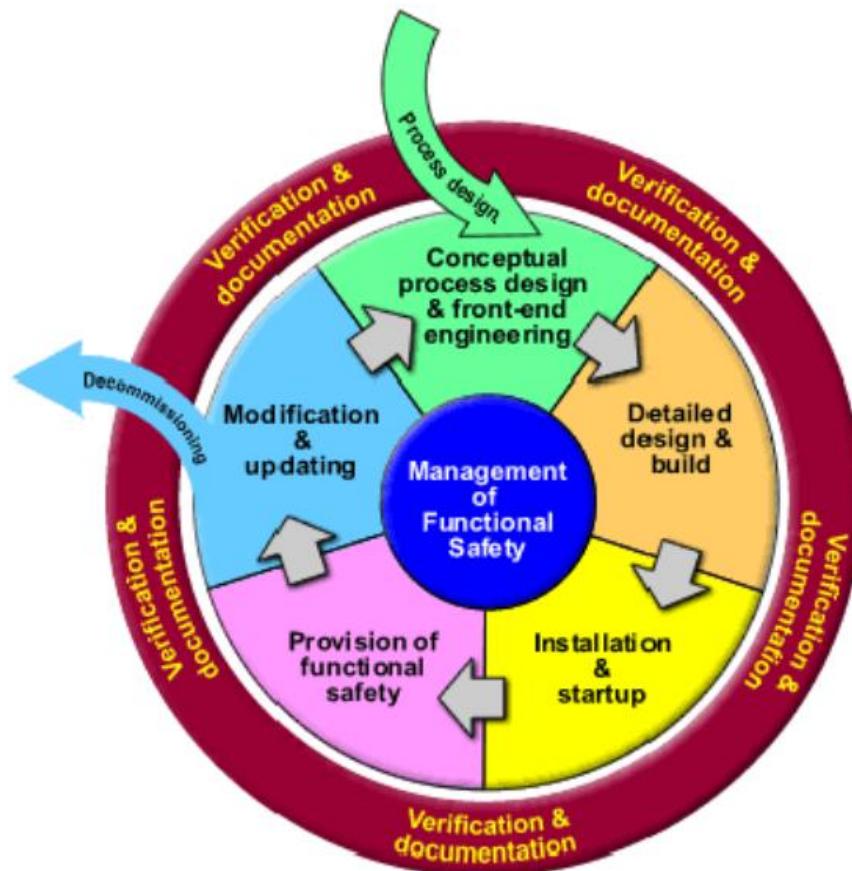
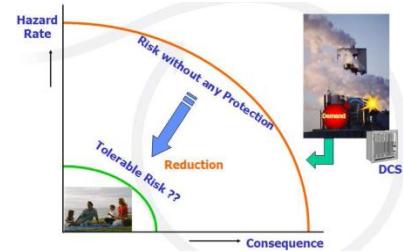
### Modele pentru ciclu de viata (Life-Cycle)



# C11: Safety process

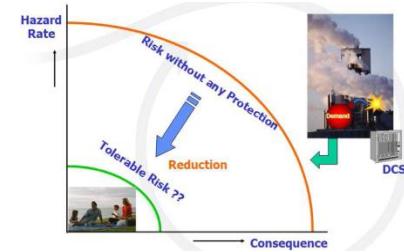
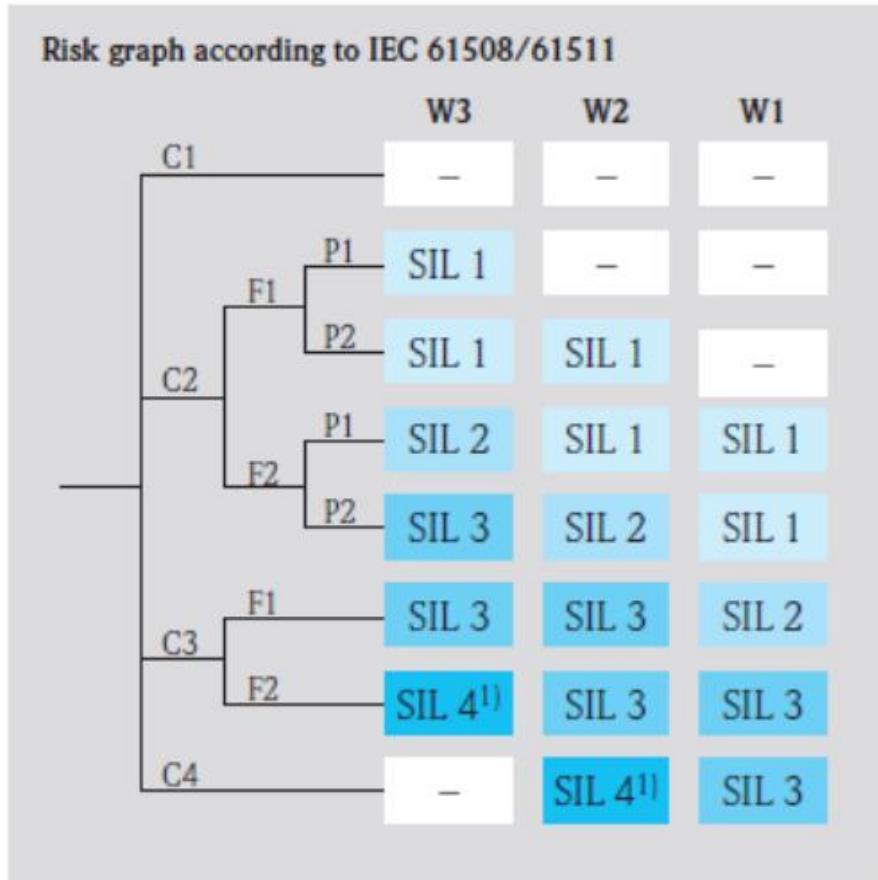
## 2. Standarde de siguranta

### IEC 61511 - ciclu de viata (Life-Cycle)



# C11: Safety process

## 2. Standarde de siguranta IEC 61511 / 61508



### Consequences

- C1 minor injury
- C2 serious permanent injury to one or more persons; death of one person.
- C3 death of several persons
- C4 very many people killed

### Exposure time

- F1 rare to more often
- F2 frequent to permanent

### Avoidance of hazard

- P1 possible under certain circumstances
- P2 almost impossible

### Probability of unwanted occurrence

- W1 very slight
- W2 slight
- W3 relatively high

# C11: Safety process

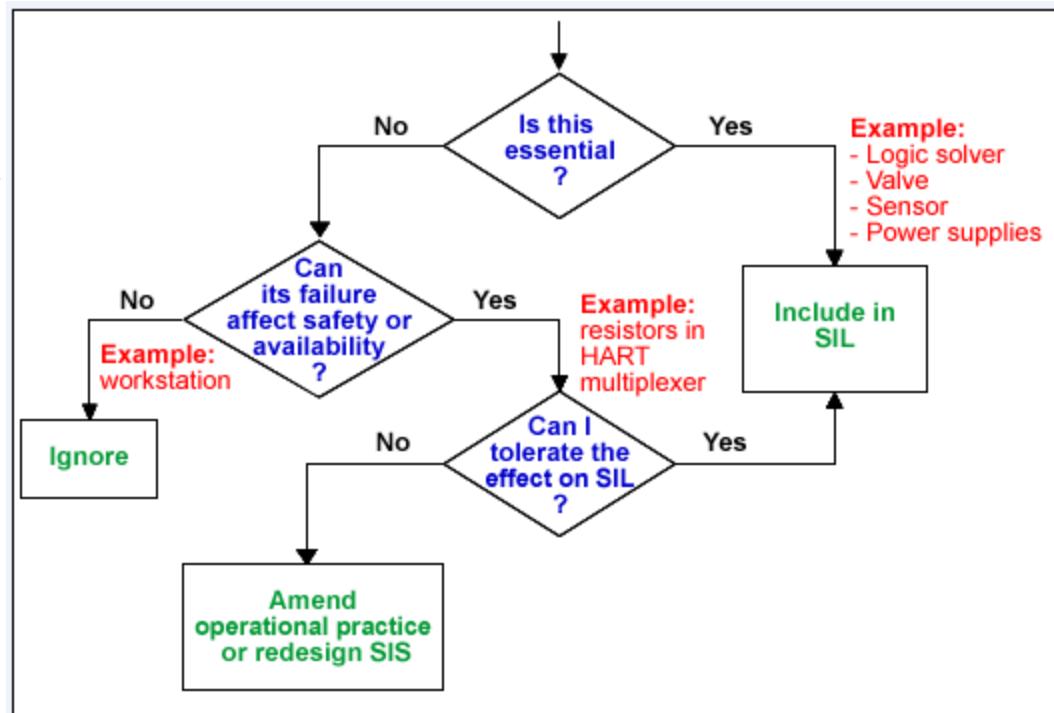
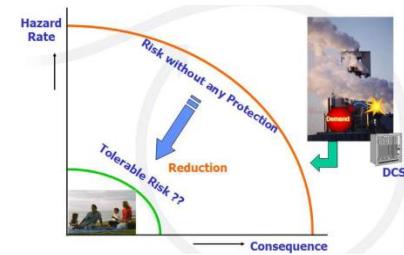
## 3. Arhitecturi Safety Process

### Strategie - Yokogawa

Elemente:

-Esentiale,

-Ne-esentiale.

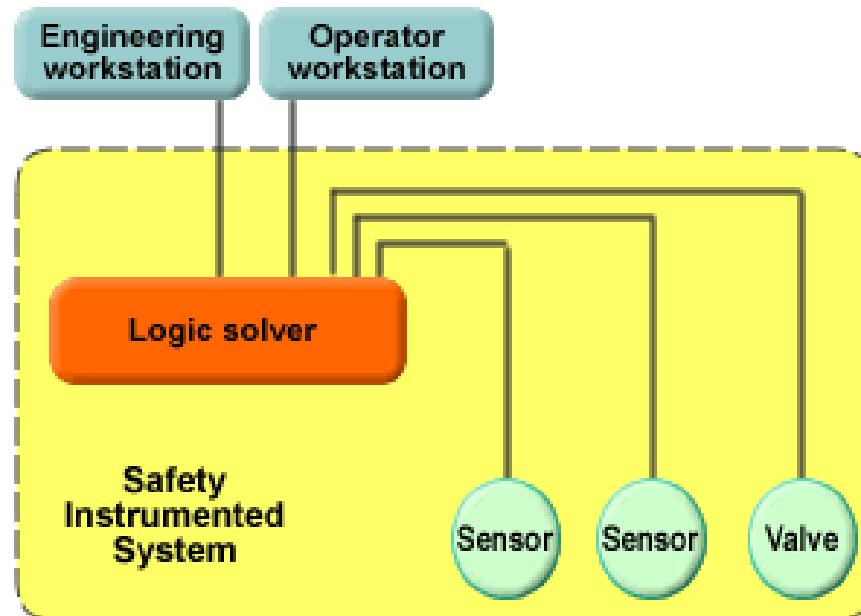
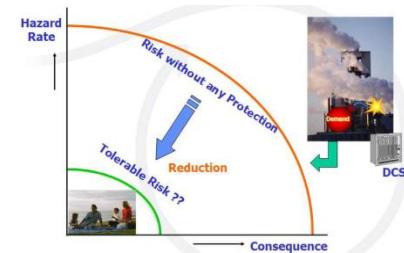


# C11: Safety process

## 3. Arhitecturi Safety Process Strategie - Yokogawa

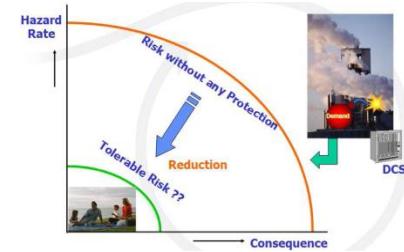
Elemente:

- Esentiale,
- Ne-esentiale.



# C11: Safety process

## 3. Arhitecturi Safety Process Strategie - Yokogawa



Elemente:

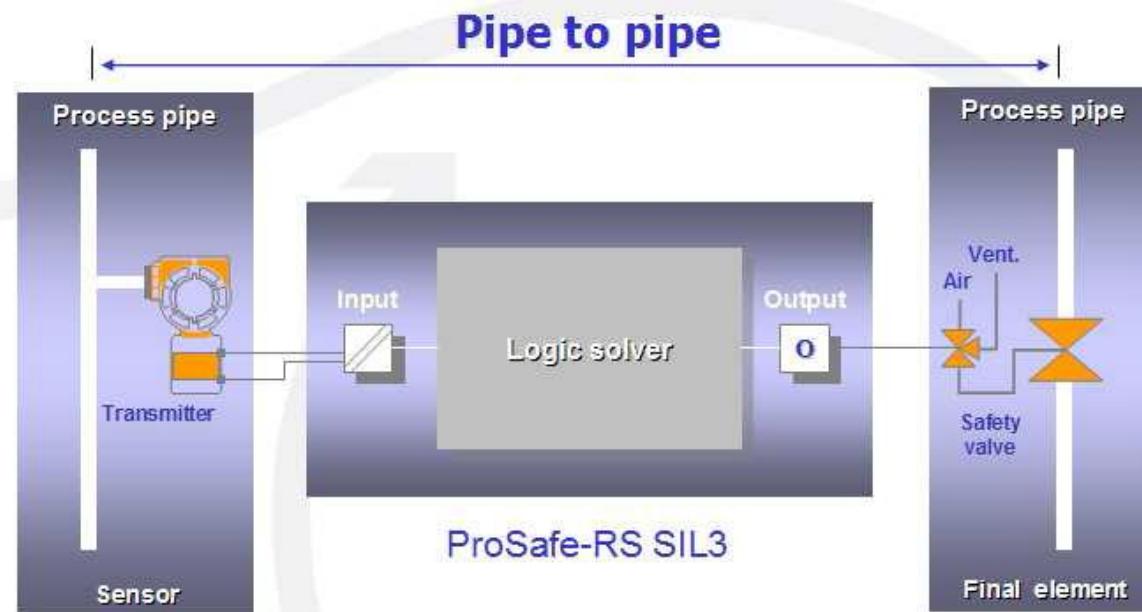
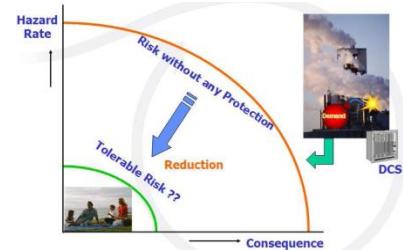
- Esentiale,
- Ne-esentiale.



# C11: Safety process

## 3. Arhitecturi Safety Process

Yokogawa



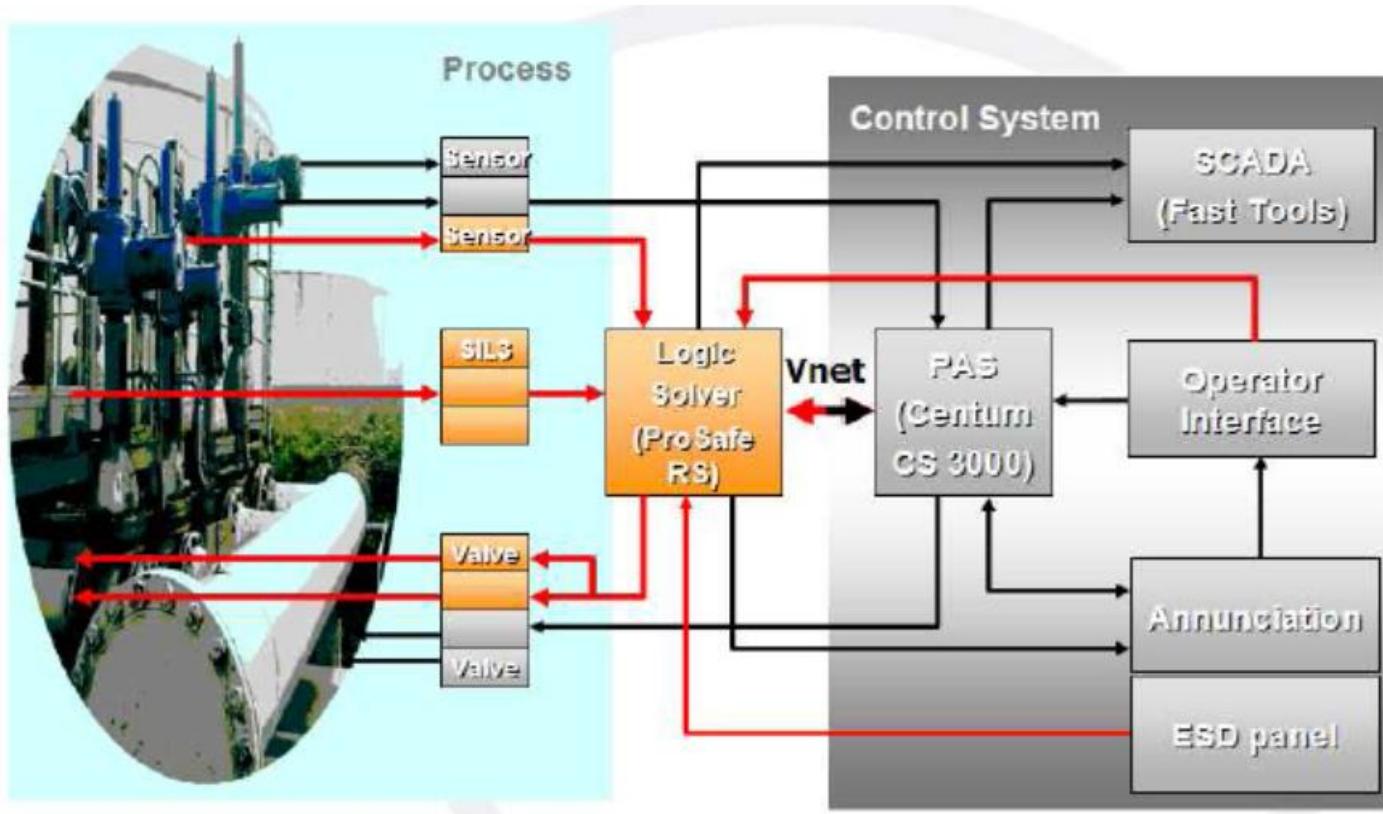
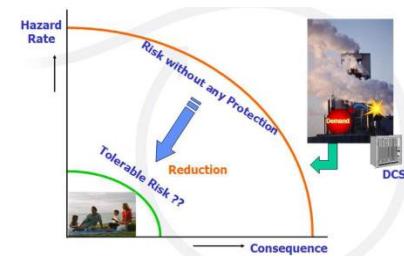
DPharp EJX  
Pressure Transmitter  
IEC-61508 Certified

Single remote  
actuated valve with  
the SVI II digital  
positioner

# C11: Safety process

## 3. Arhitecturi Safety Process

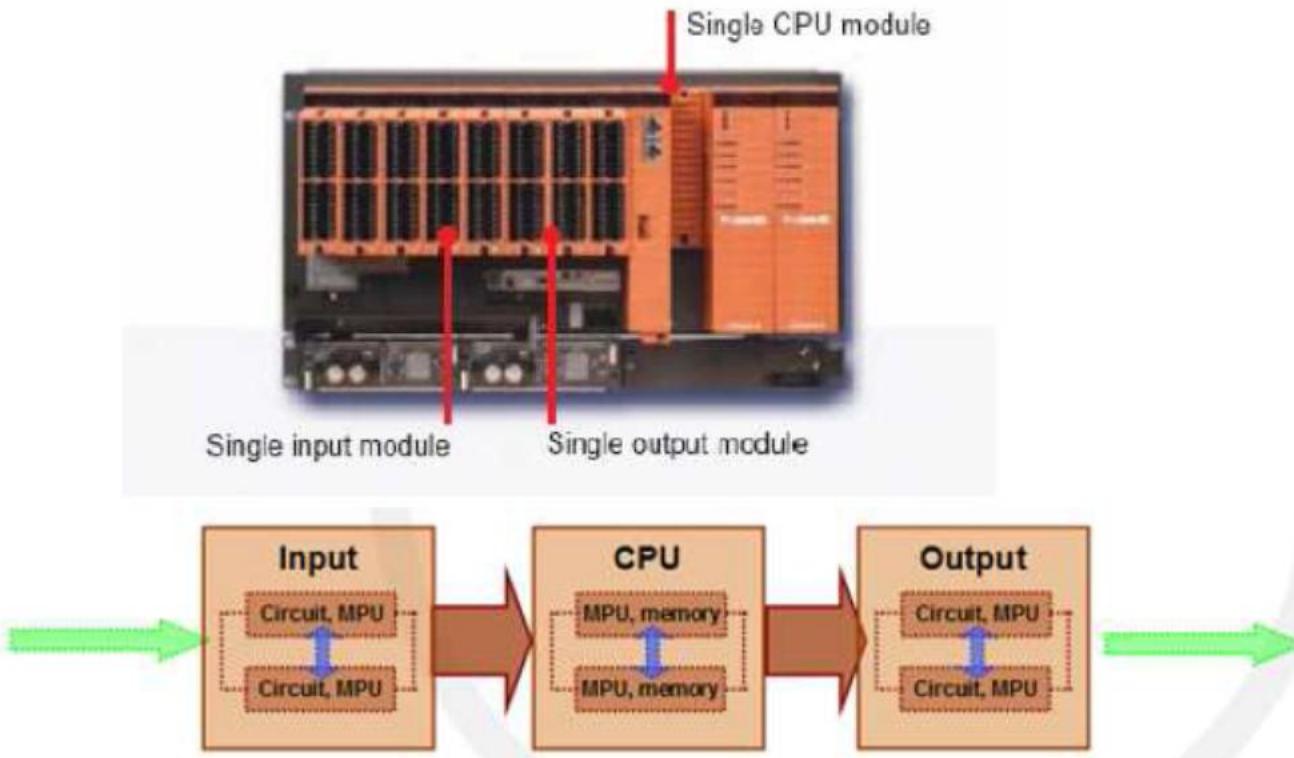
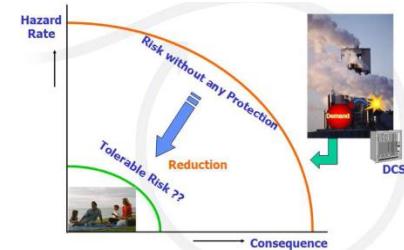
### Yokogawa



# C11: Safety process

## 3. Arhitecturi Safety Process

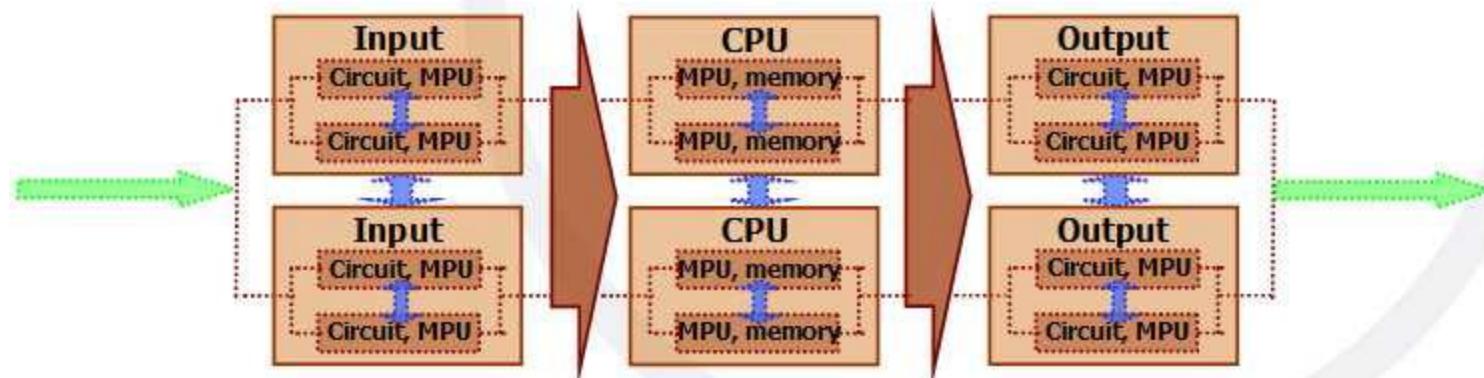
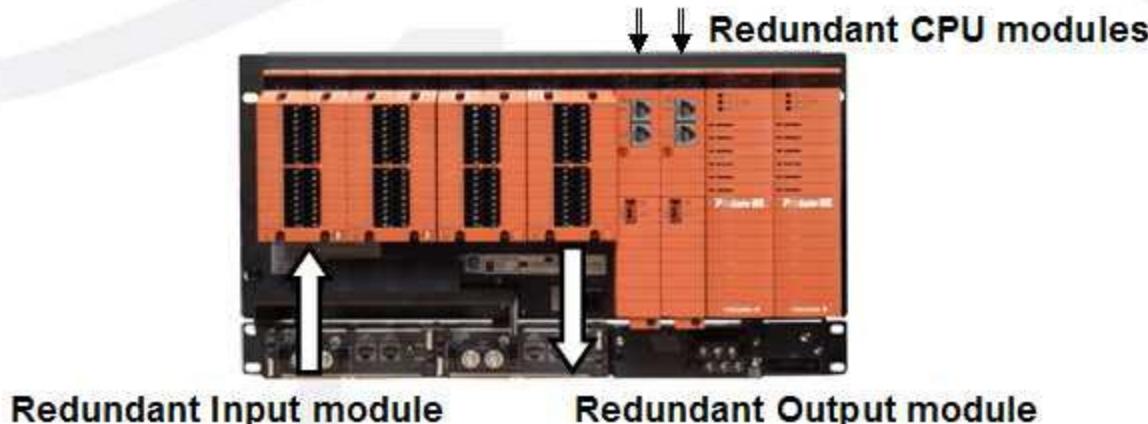
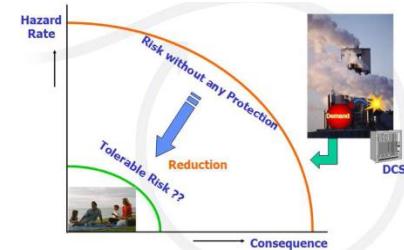
Yokogawa – ProSafe – SIL3



# C11: Safety process

## 3. Arhitecturi Safety Process

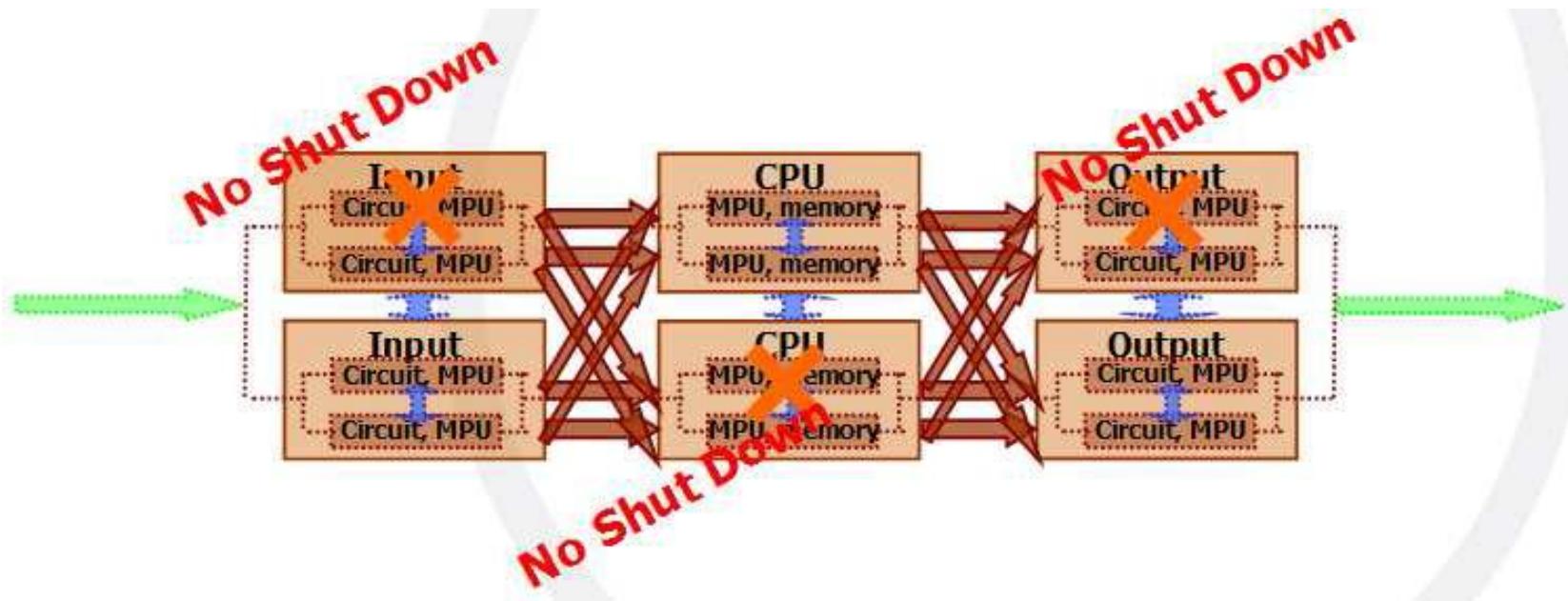
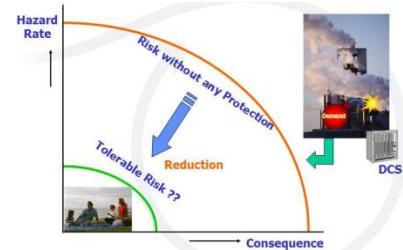
### Yokogawa – structura redundanta



# C11: Safety process

## 3. Arhitecturi Safety Process

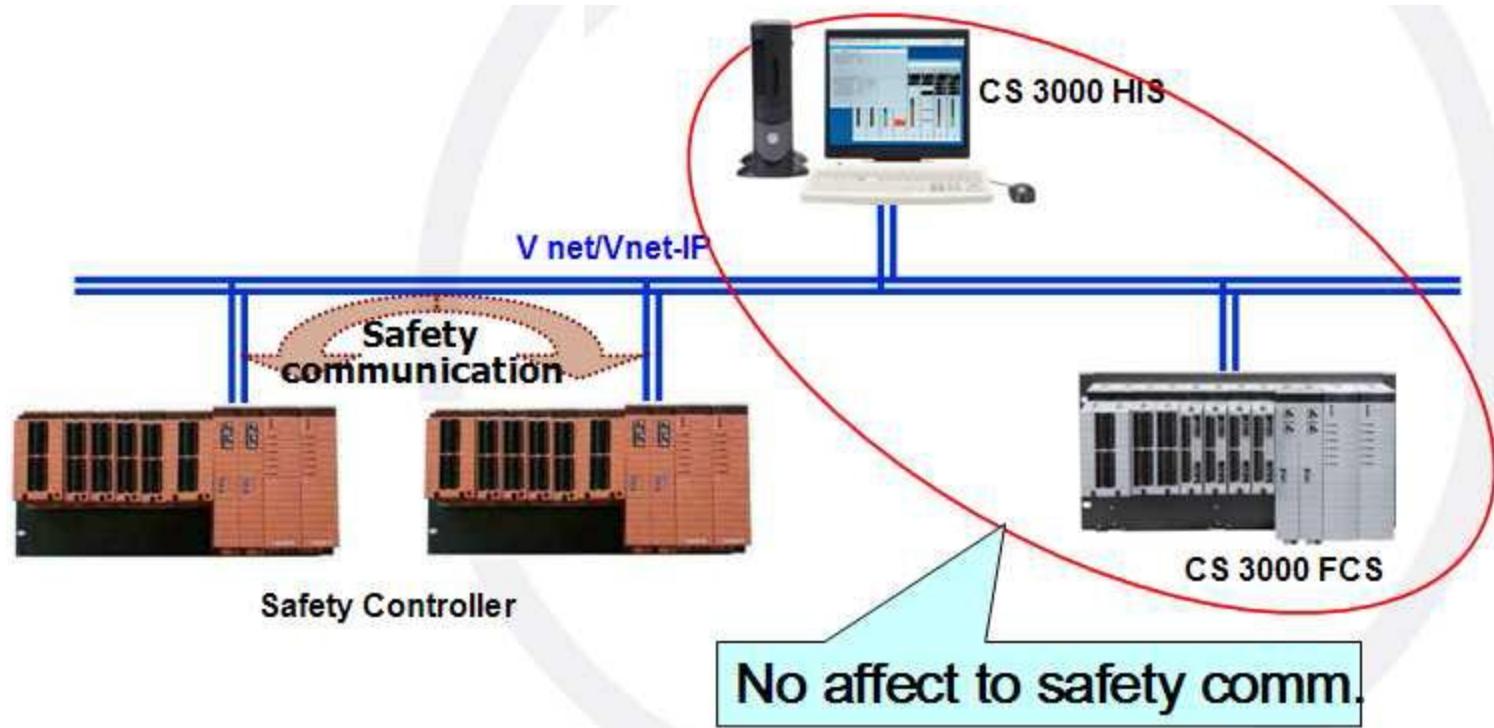
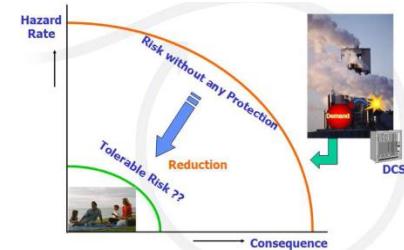
Yokogawa – structura redundanta



# C11: Safety process

## 3. Arhitecturi Safety Process

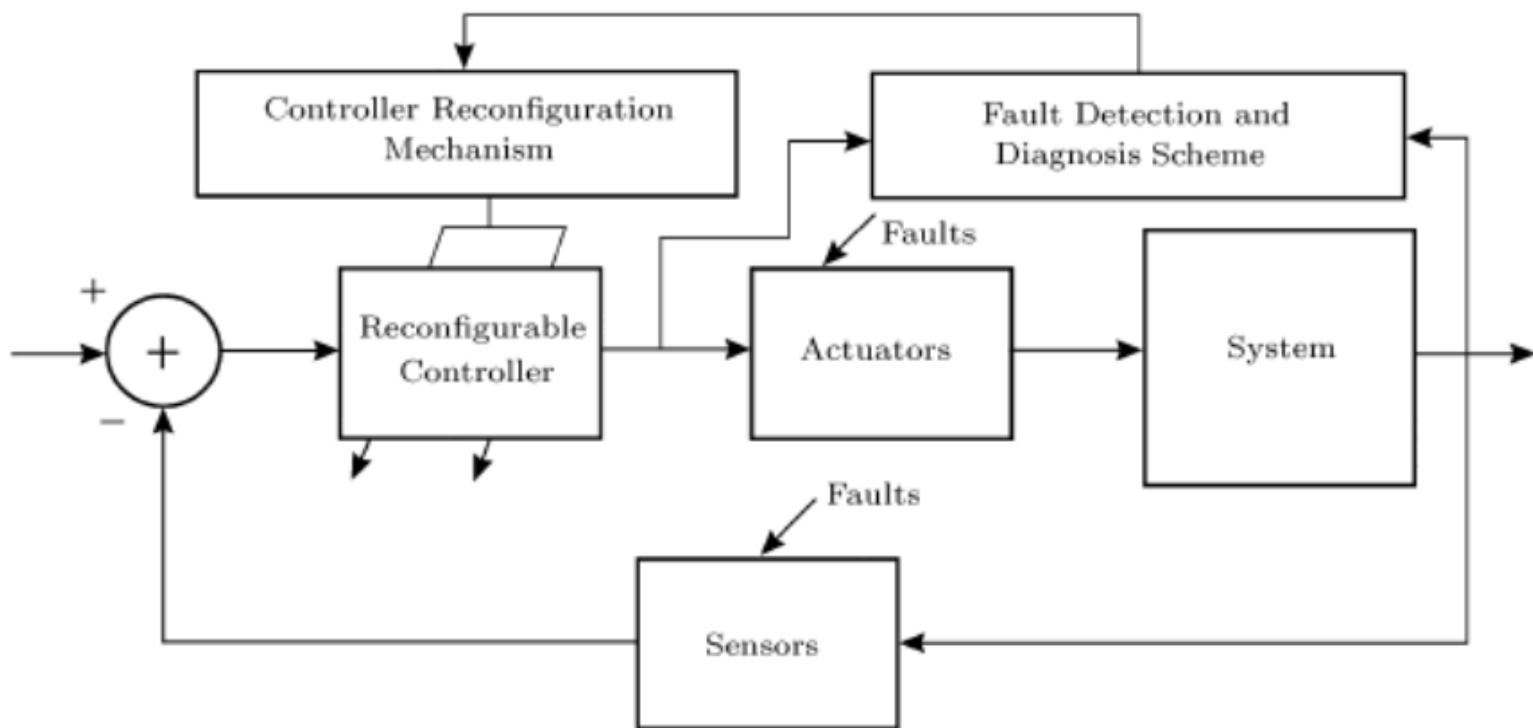
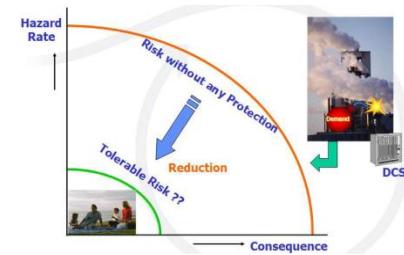
Yokogawa – structura redundanta



# C11: Safety process

## 3. Arhitecturi Safety Process

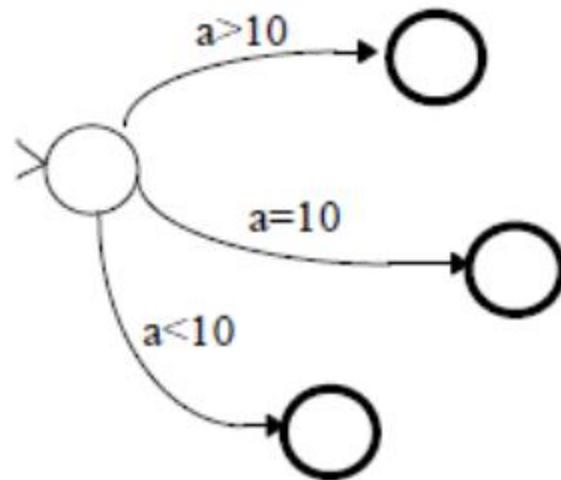
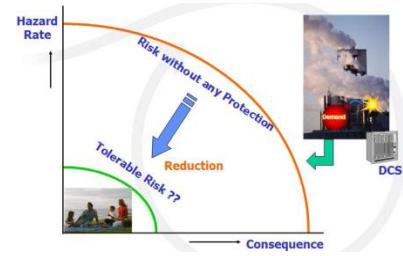
Alte exemple – sistem de reglare  
tolerabil la defecte



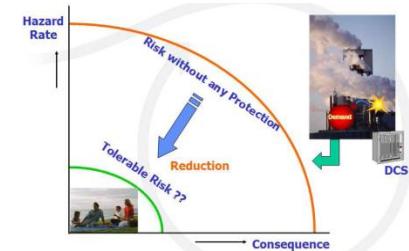
# C11: Safety process

## 3. Arhitecturi Safety Process

Alte exemple – acoperirea tuturor variantelor

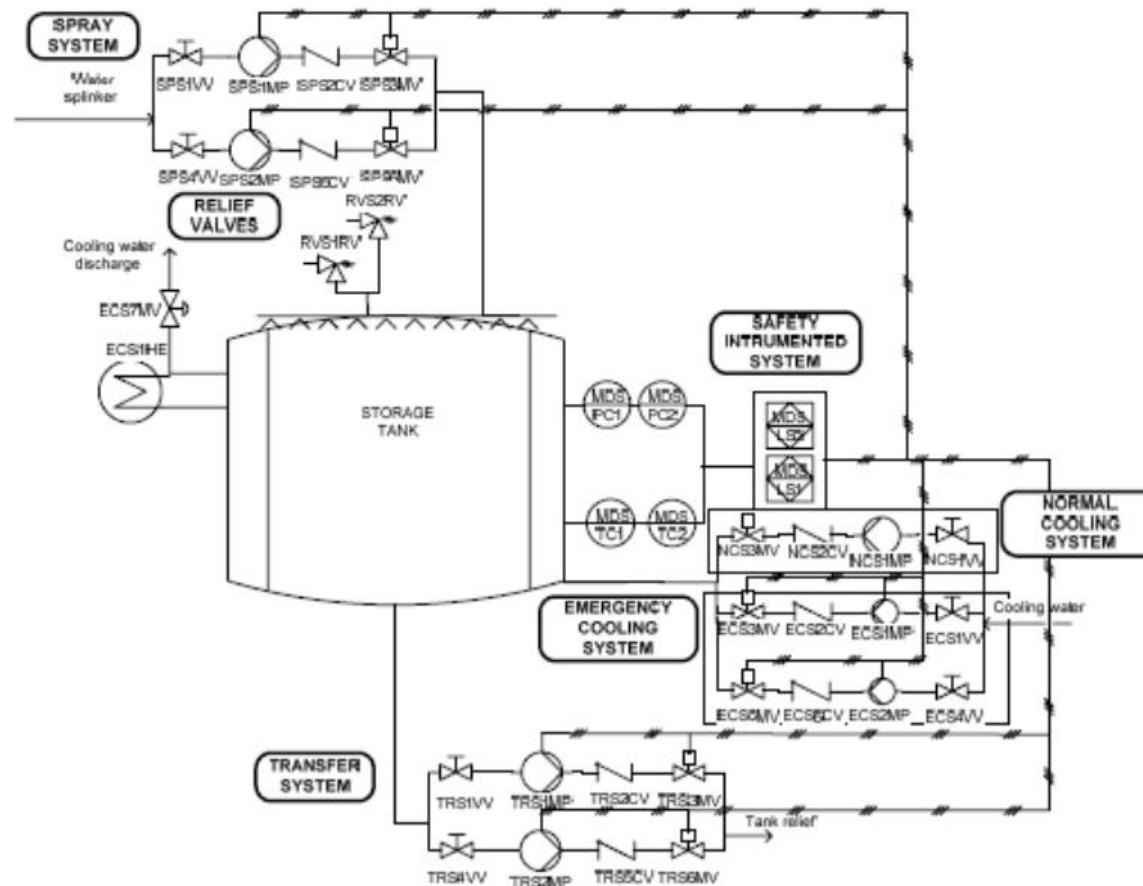


# C11: Safety process

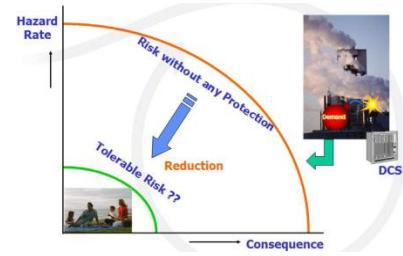


## 3. Arhitecturi Safety Process

### Alte exemple – rezervor pentru etilena

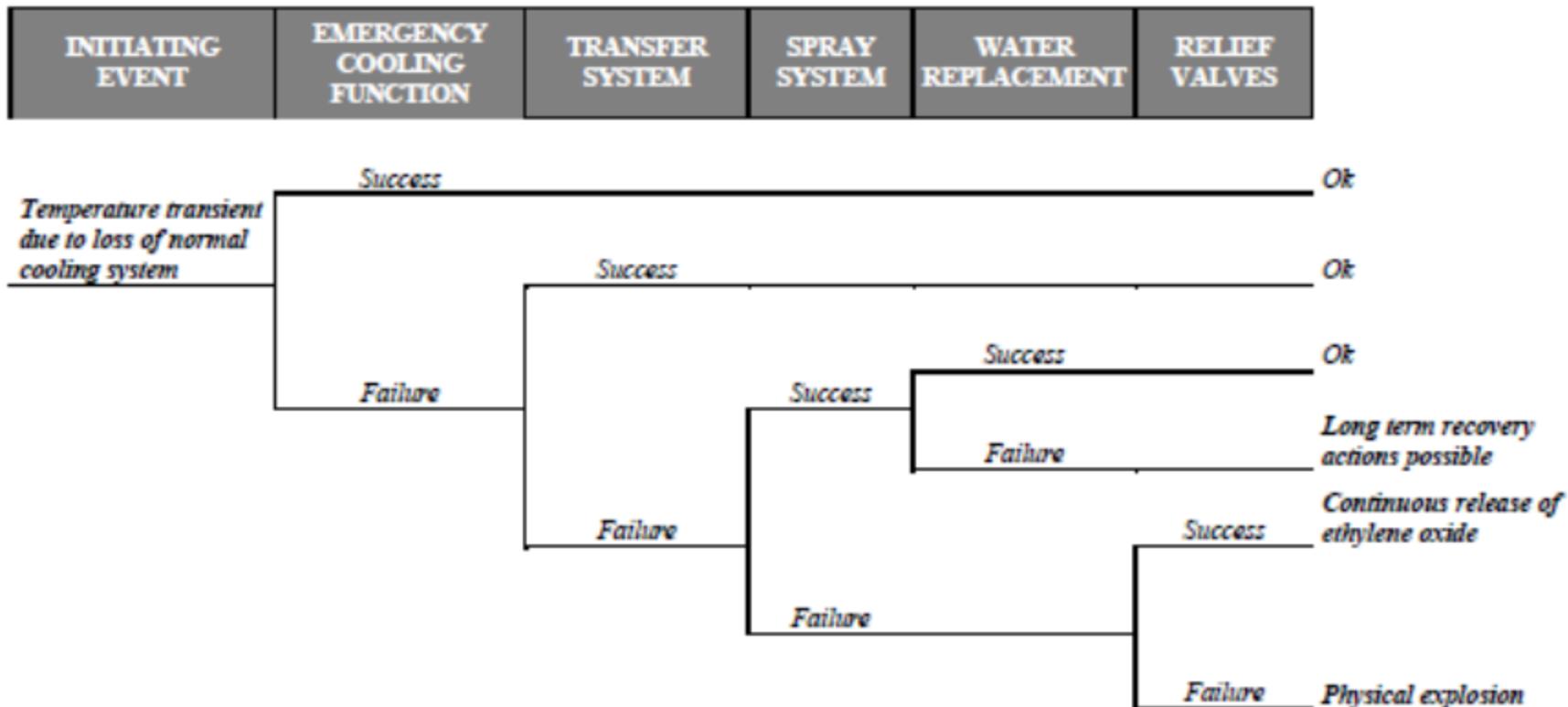


# C11: Safety process



## 3. Arhitecturi Safety Process

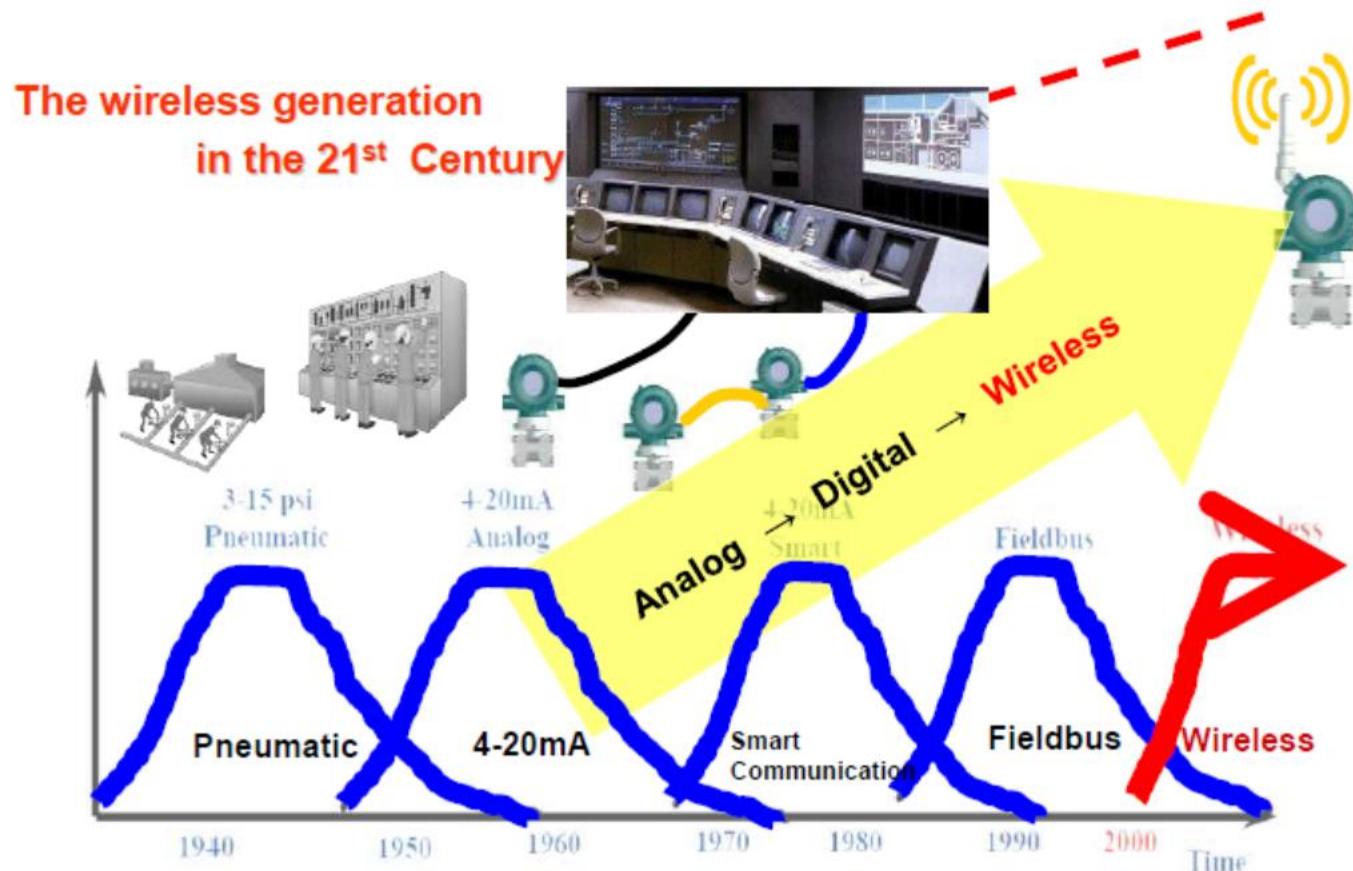
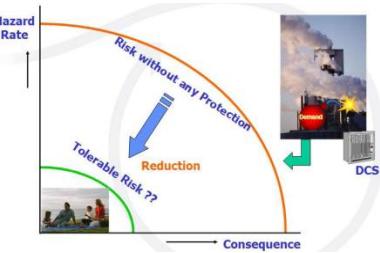
Alte exemple – rezervor pentru etilena – arbore evenimente



# C11: Safety process

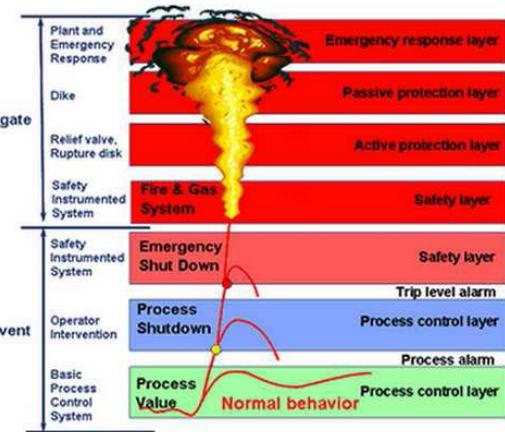
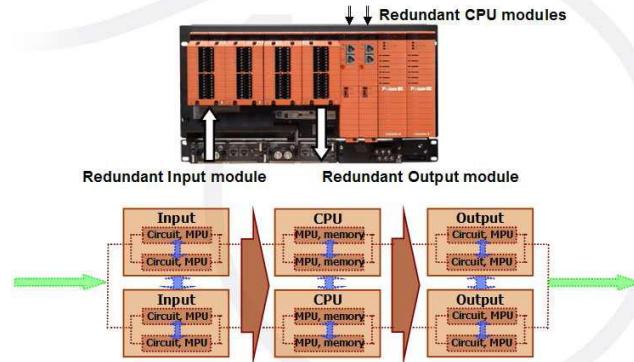
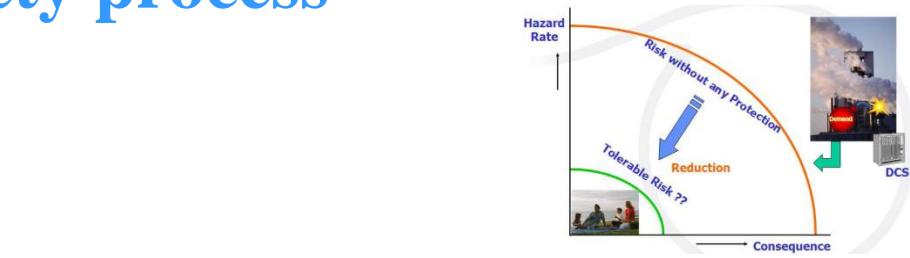
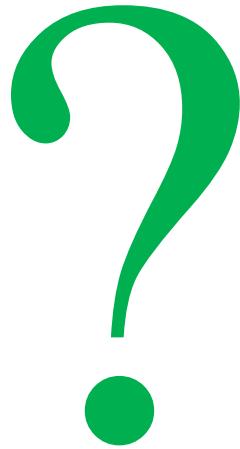
## 4. Alte exemple

### Alte exemple – standardul IEC 62734



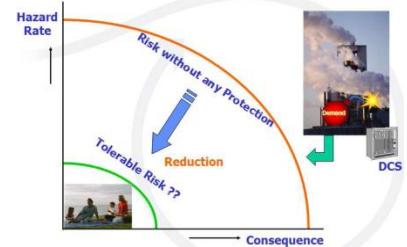
# C11: Safety process

Etc....



# C11: Safety process

Utile:



<https://www.yokogawa.com/library/videos/training-videos/process-control-and-safety-systems-w-yokogawas-jan-debreet-2015-arc-industry-forum/>

<https://realspars.com/safety-instrumented-system/>

<http://www.orioninstruments.com/Images/Interior/pdfs/sil.pdf>