Safety Categories and there Characteristics.

Part 1501 of AS4024.1-2006 Design of the safety related parts of the control system.

AS 4024 New titles

Some recent changes have occurred to Australian Standards relating to machine guarding. This article provides a quick summary of those changes.

New standards titles

- **AS4024.2601-2006,** *Design of controls, interlocks and guarding - two-hand control devices – functional aspects and design principles*
- **AS4024.2801-2006,** *Safety distances and safety gaps-Positioning protective equipment with respect to the approach speed of parts of the human body (superseded in part AS4024.2-1998)*
- **AS4024.3101-2006,** *Materials cutting – Milling machines (including boring machines) – Safety requirements*

Withdrawn Standard titles

- **AS4024.2-1998,** *Safeguarding of Machinery Part 2: Installation and commissioning requirements for electro-sensitive systems-Optoelectronic devices*

AS 4024.1-2006

AS4024.1-2006 Safety of Machinery.

Made up of 26 commonsense sections on,

1. Safety Principles,

2. Design Parameters,

3. Ergonomics,

The Process relating to AS4024-1501-2006 Design of the Safety related parts of the control system.

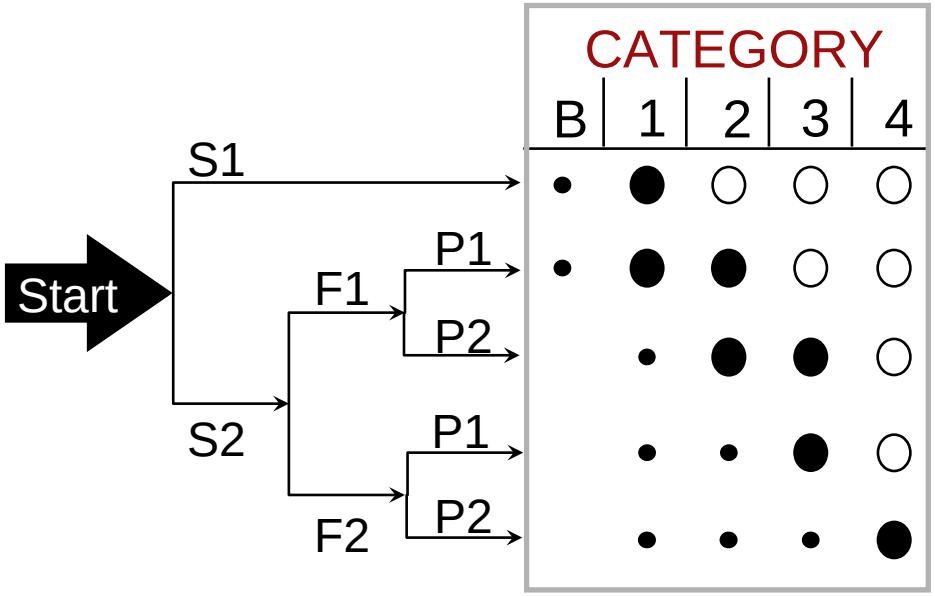
AS 4024 / EN 954-1

- EN 954-1 is a European standard entitled “Safety-related parts of control systems- Part 1: General principles for design”, we use that information in AS 4024.
- Parts of control systems are frequently assigned to provide safety functions. This standard gives requirements for how these parts behave should a fault develop within them. The behaviour is placed into one of five categories
- The categories are determined by following a risk estimation procedure. If a fault occurred which led to a hazard being generated, would an accident result?

  If so, how bad?

AS 4024 Categories

- The first question we ask is how severe would an injury be if an accident occurred
  - S1 = Slight, normally reversible
  - S2 = Severe, normally irreversible



AS 4024 Categories

- The first question we ask is how severe would an injury be if an accident occurred
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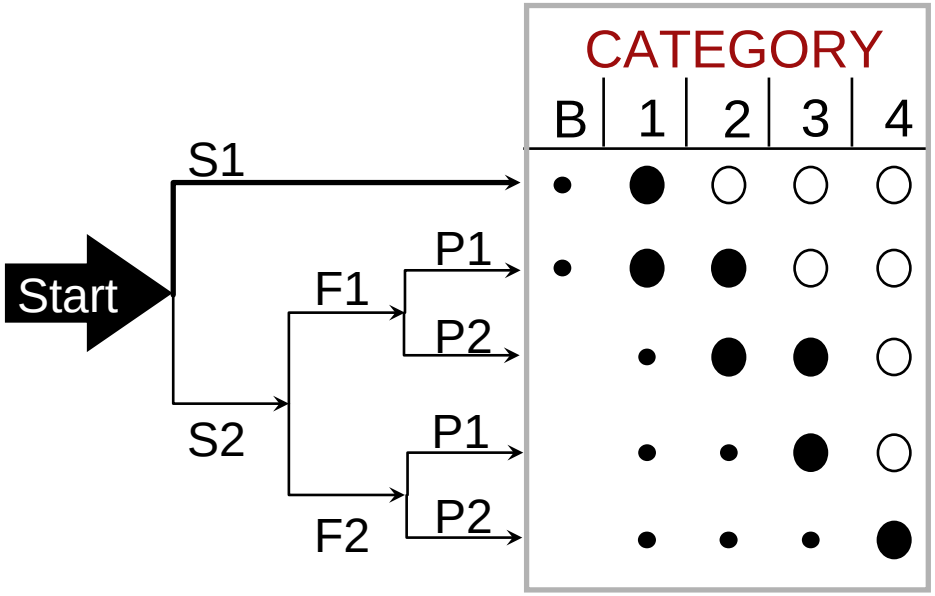
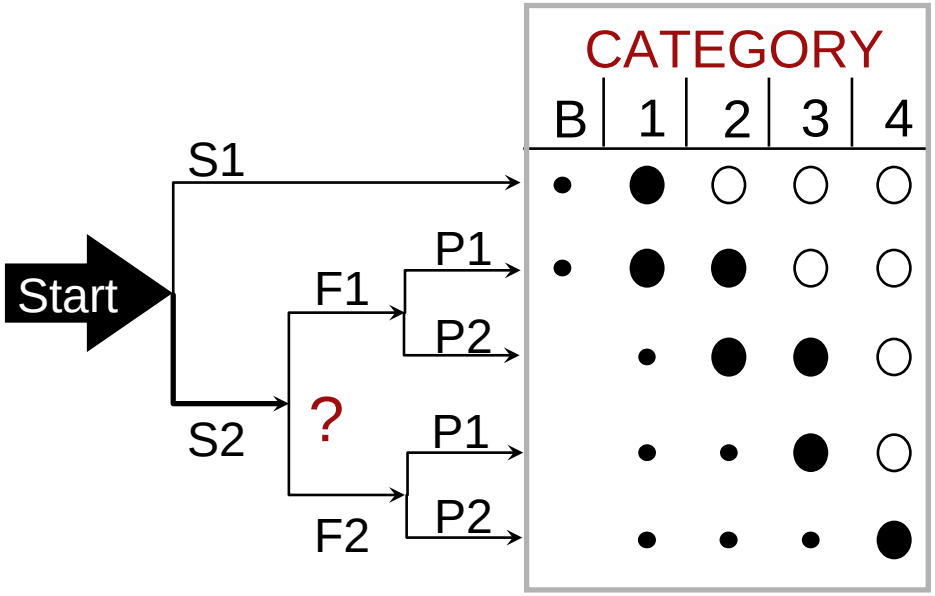
- If it is S1 we can select our category.



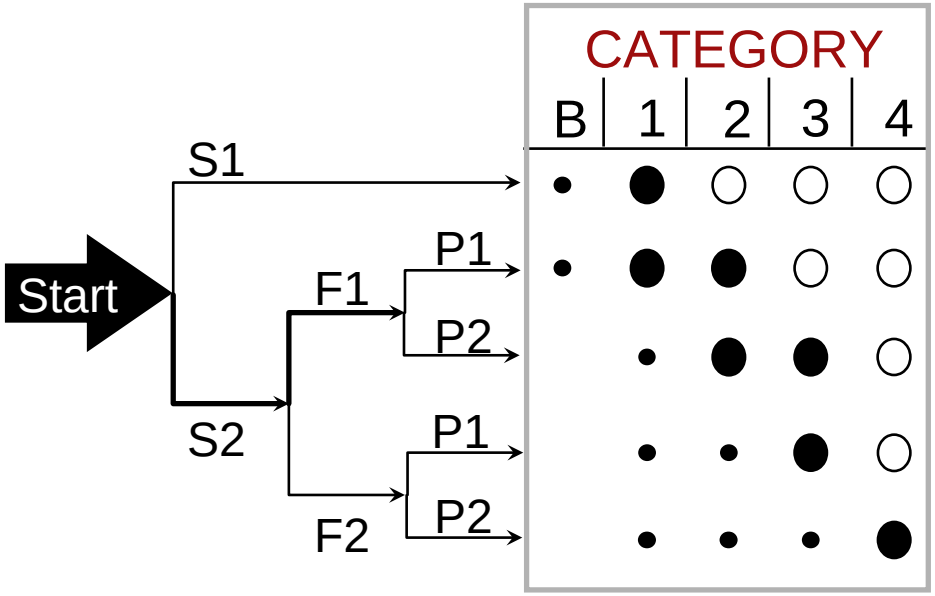
AS 4024 Categories

- The first question we ask is how severe would an injury be if an accident occurred
  - S1 = Slight, normally reversible
  - S2 = Severe, normally irreversible
- If it is S1 we can select our category.
- If it is S2 we have to ask the next question



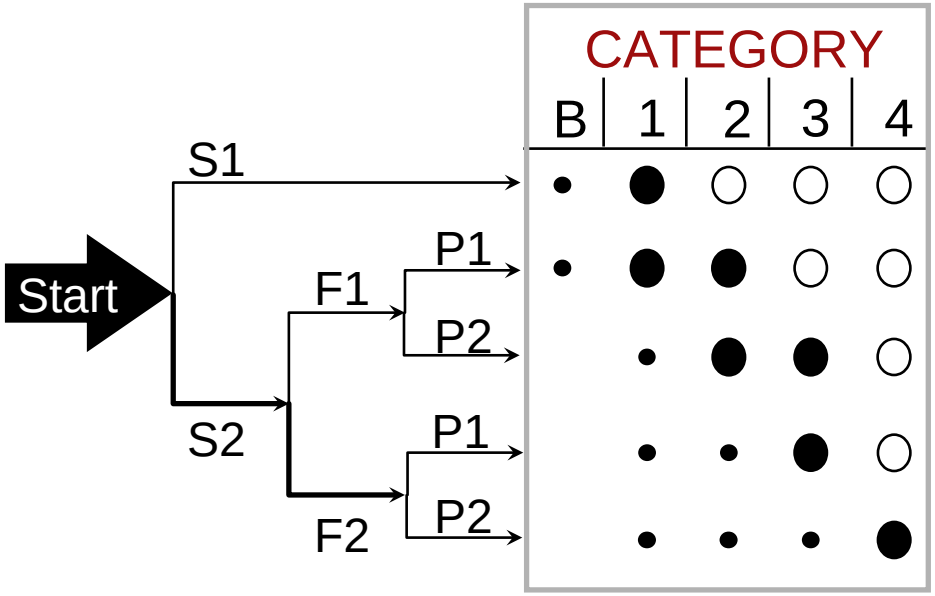
AS 4024 Categories

- For S2 next consider the frequency of exposure to the hazard
  - F1 = Seldom to quite often and/or the time of exposure is short



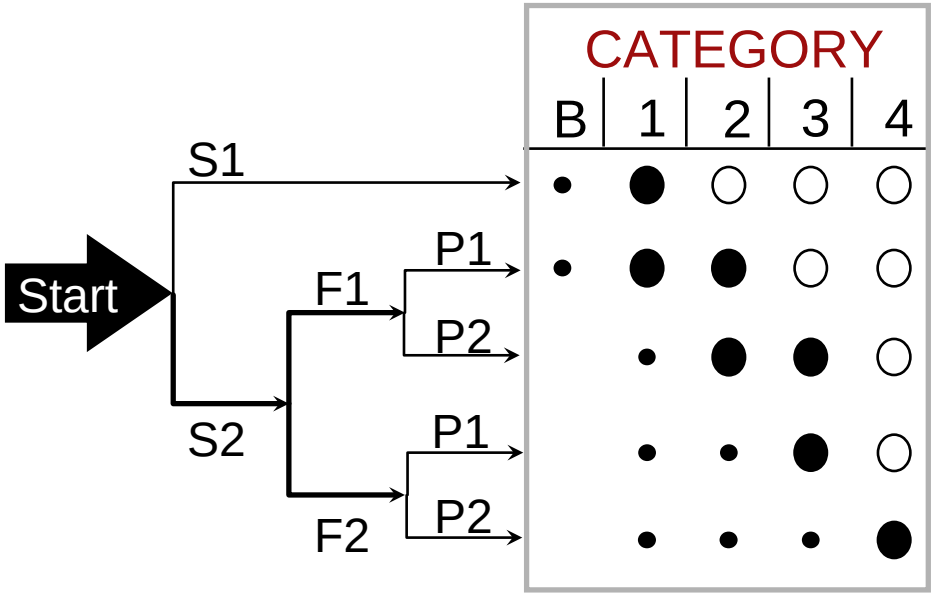
AS 4024 Categories

- For S2 next consider the frequency of exposure to the hazard
  - F1 = Seldom to quite often and/or the time of exposure is short
  - F2 = Frequent to continuous and/or the exposure time is long



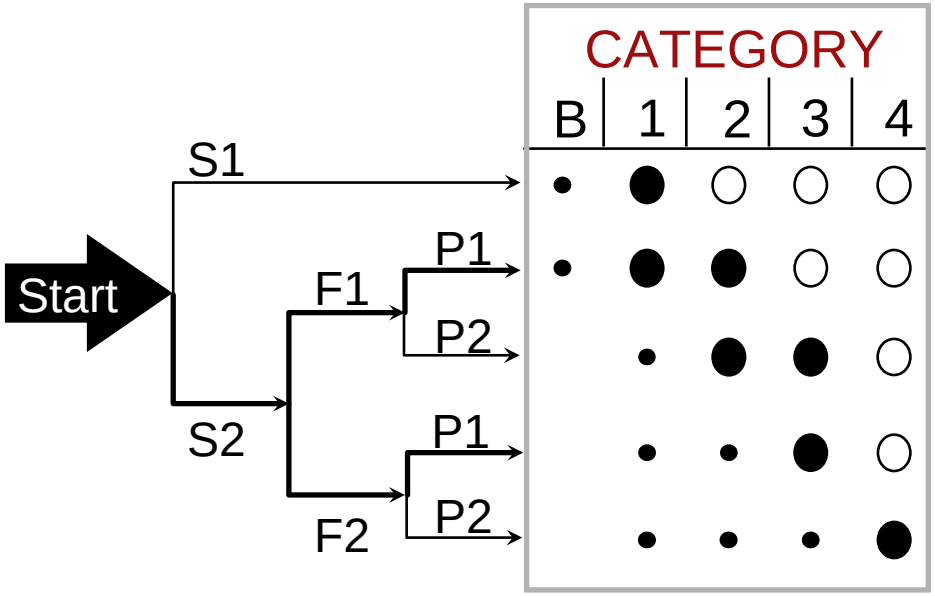
AS 4024 Categories

- For S2 next consider the frequency of exposure to the hazard
  - F1 = Seldom to quite often and/or the time of exposure is short
  - F2 = Frequent to continuous and/or the exposure time is long
- With either F1 or F2 next consider the possibility of avoiding the hazard



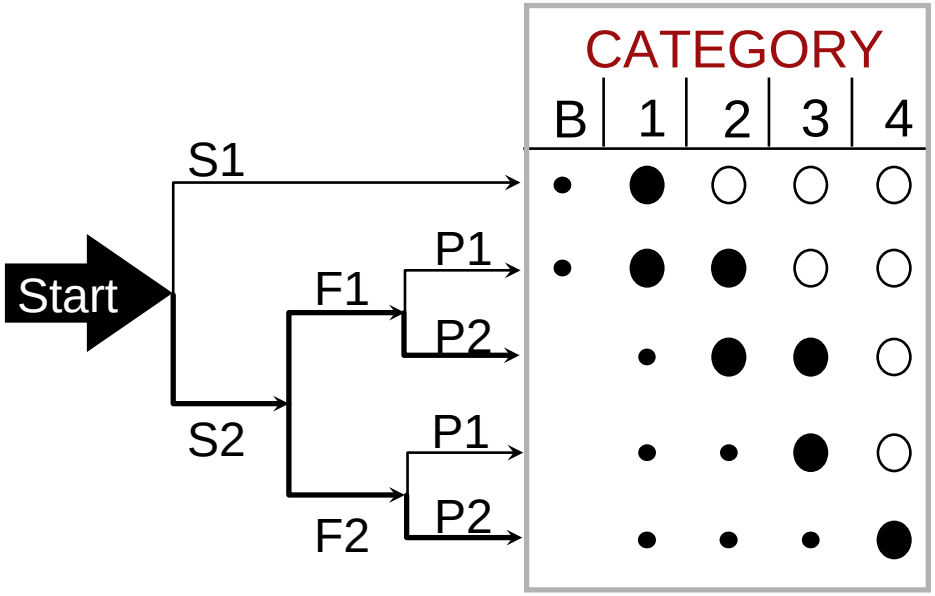
AS 4024 Categories

- The possibility of avoiding the hazard
  - P1 = Possible under specific conditions. i.e. the hazard is slow, highly visible etc.



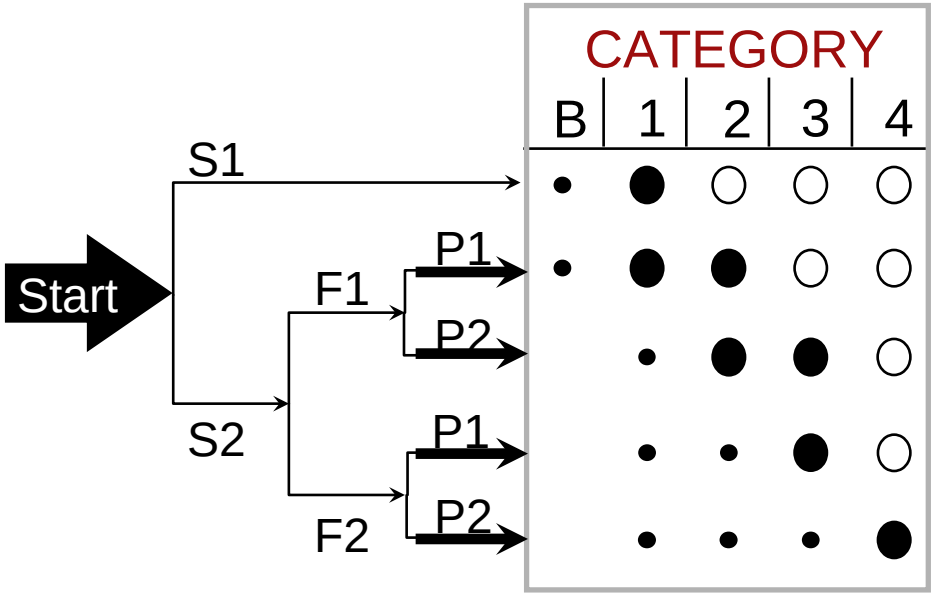
AS 4024 Categories

- The possibility of avoiding the hazard
  - P1 = Possible under specific conditions. i.e. the hazard is slow, highly visible etc.
  - P2 = Scarcely possible. i.e. the hazard occurs too fast to react in time



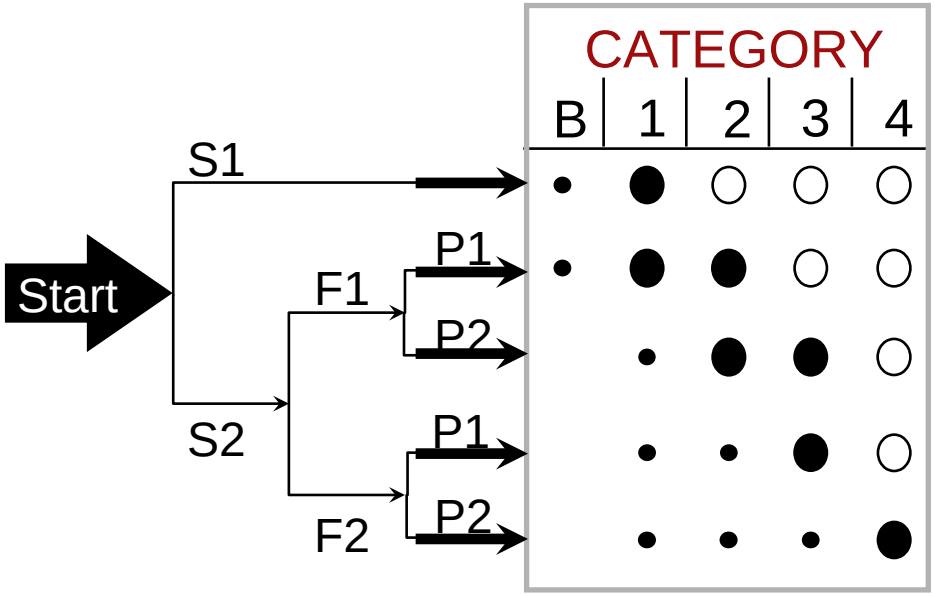
AS 4024 Categories

- The possibility of avoiding the hazard
  - P1 = Possible under specific conditions. i.e. the hazard is slow, highly visible etc.
  - P2 = Scarcely possible. i.e. the hazard occurs too fast to react in time
- We can then select an appropriate category



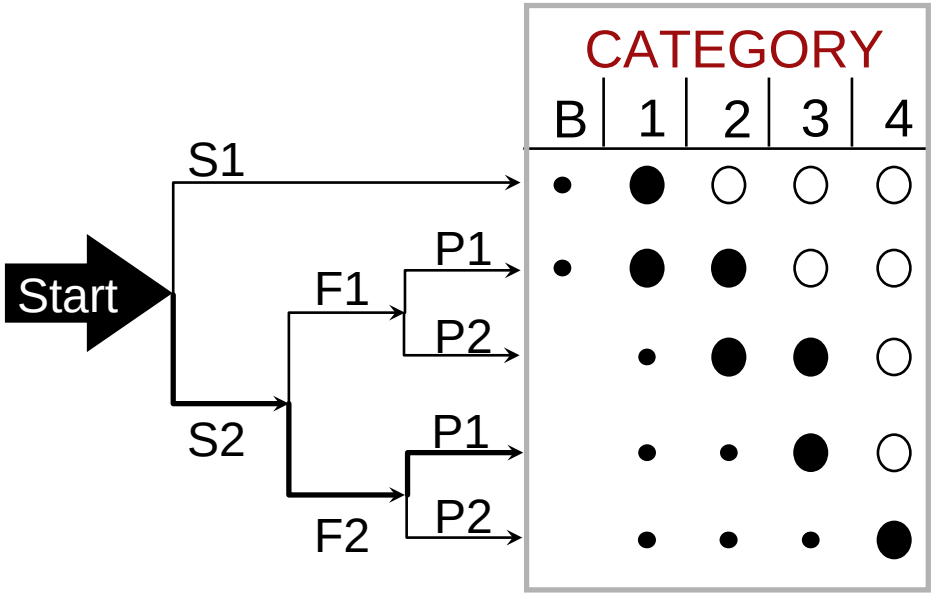
AS 4024 Categories

- By asking these questions we will arrive at one of five rows on the left side of our block
- The selection of the category is now relatively straight forward



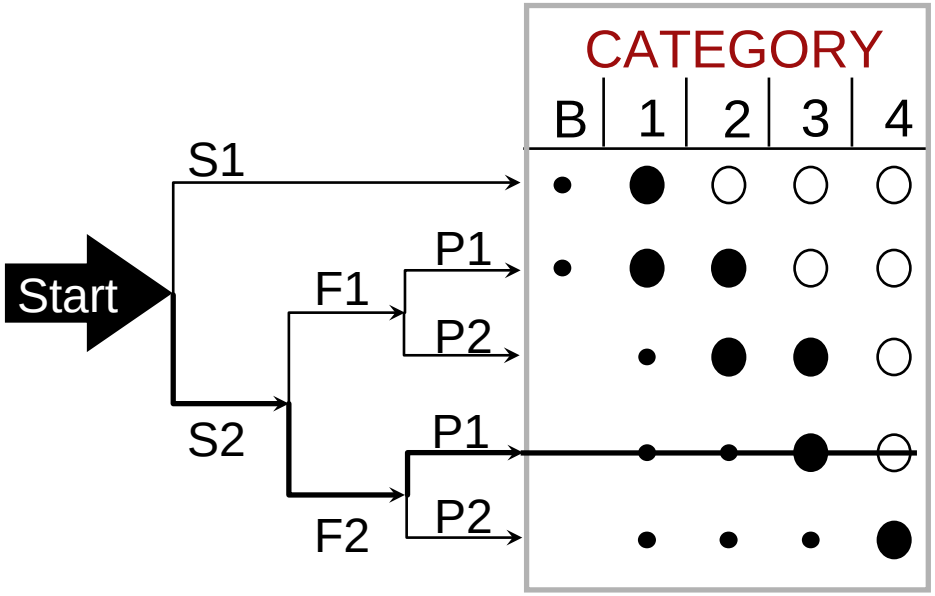
Selecting a category

- Meaning of the symbols in the table
  - needs additional measures
  - ● preferred category
  - ○ more than required
- As an example, let's assume the answers to the questions were S2, F2 and P1



Selecting a category

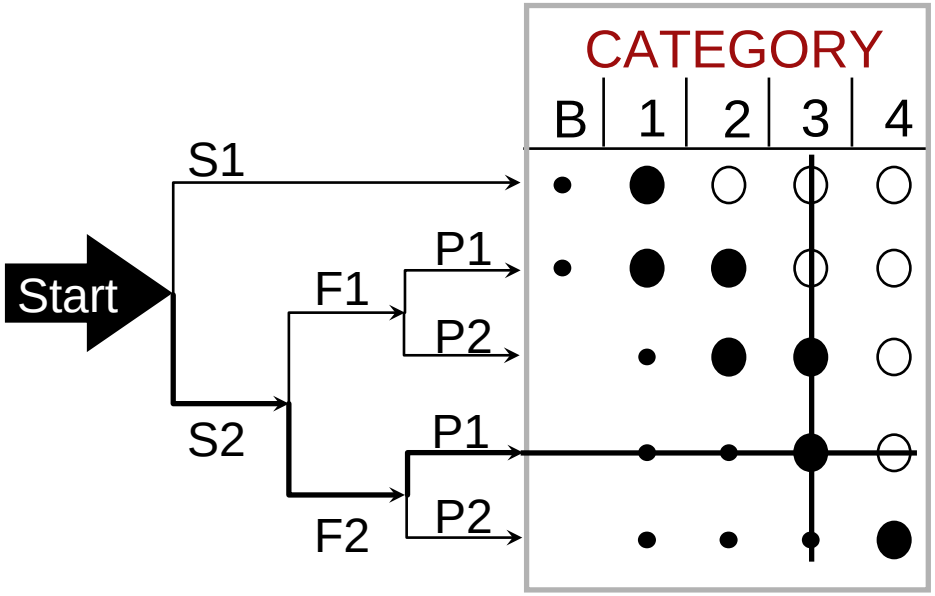
- Read across from the left hand point to find the preferred category



- needs additional measures
- preferred category
- more than required

Selecting a category

- Read across from the left hand point to find the preferred category
- Then read vertically up to find the category number
- The category is 3



● needs additional measures

● preferred category

○ more than required

Whats Next?????

When considering an installation using Safety Switches with separate actuators.

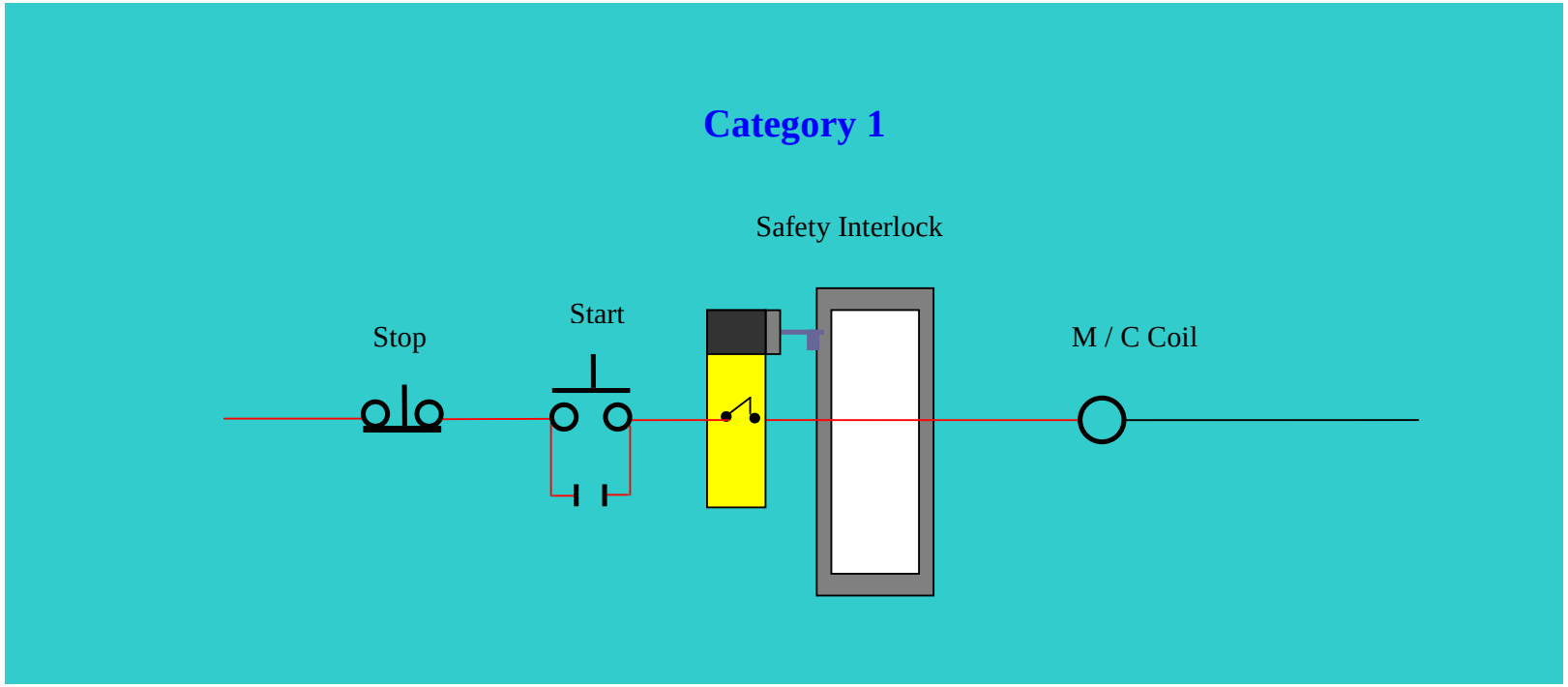
AS 4024 Categories

Category	Requirements	Behaviour
B	The safety related parts of the control system shall be designed, constructed and selected so that they are suitable for the job you want them to do	A fault may lead to the loss of the safety function

AS 4024 Categories

Category	Requirements	Behaviour
1	The requirements of B still apply plus well tried components and well tried safety principles shall be used	A fault may lead to the loss of the safety function but the likelihood is reduced

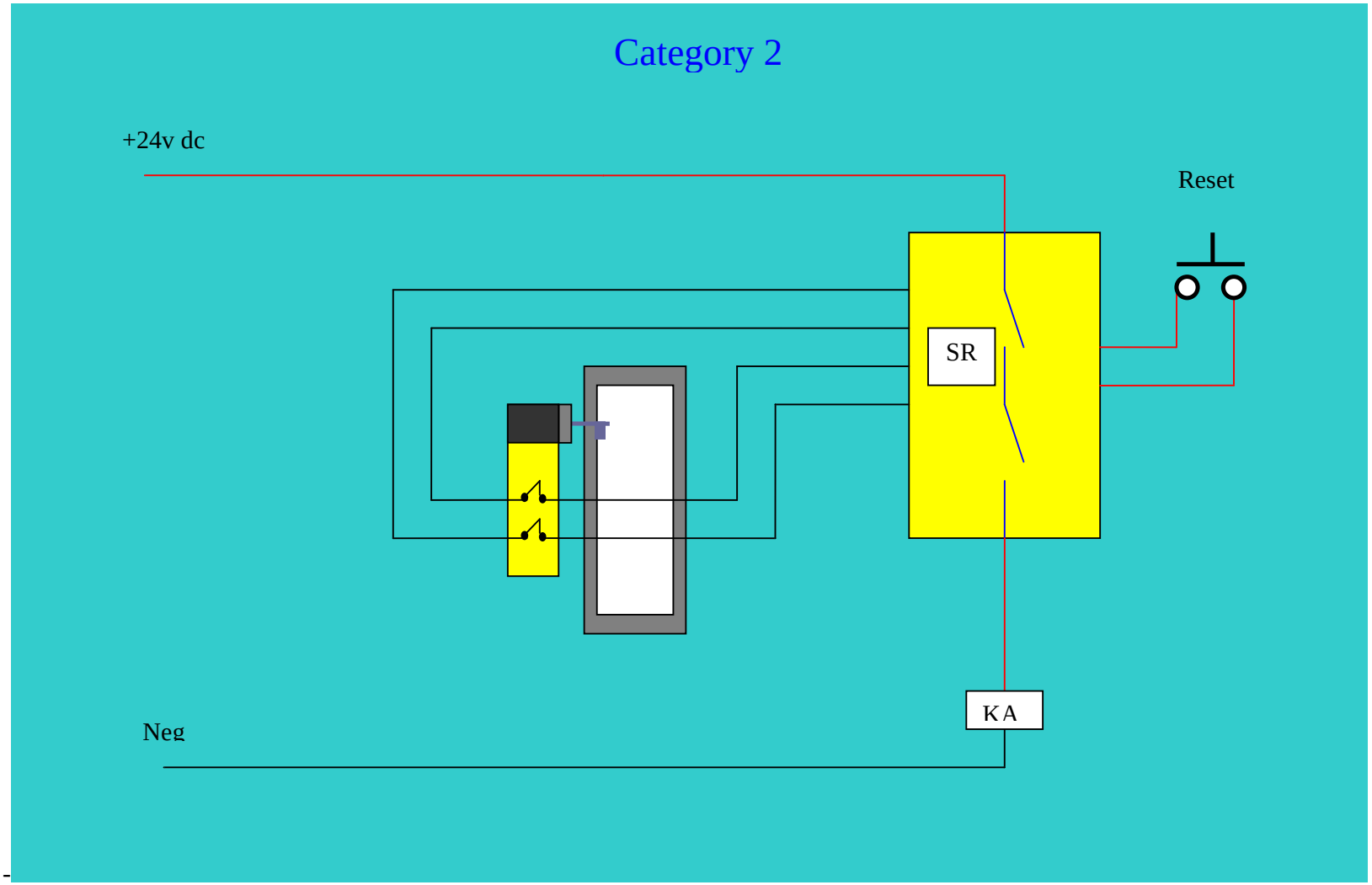
Category 1



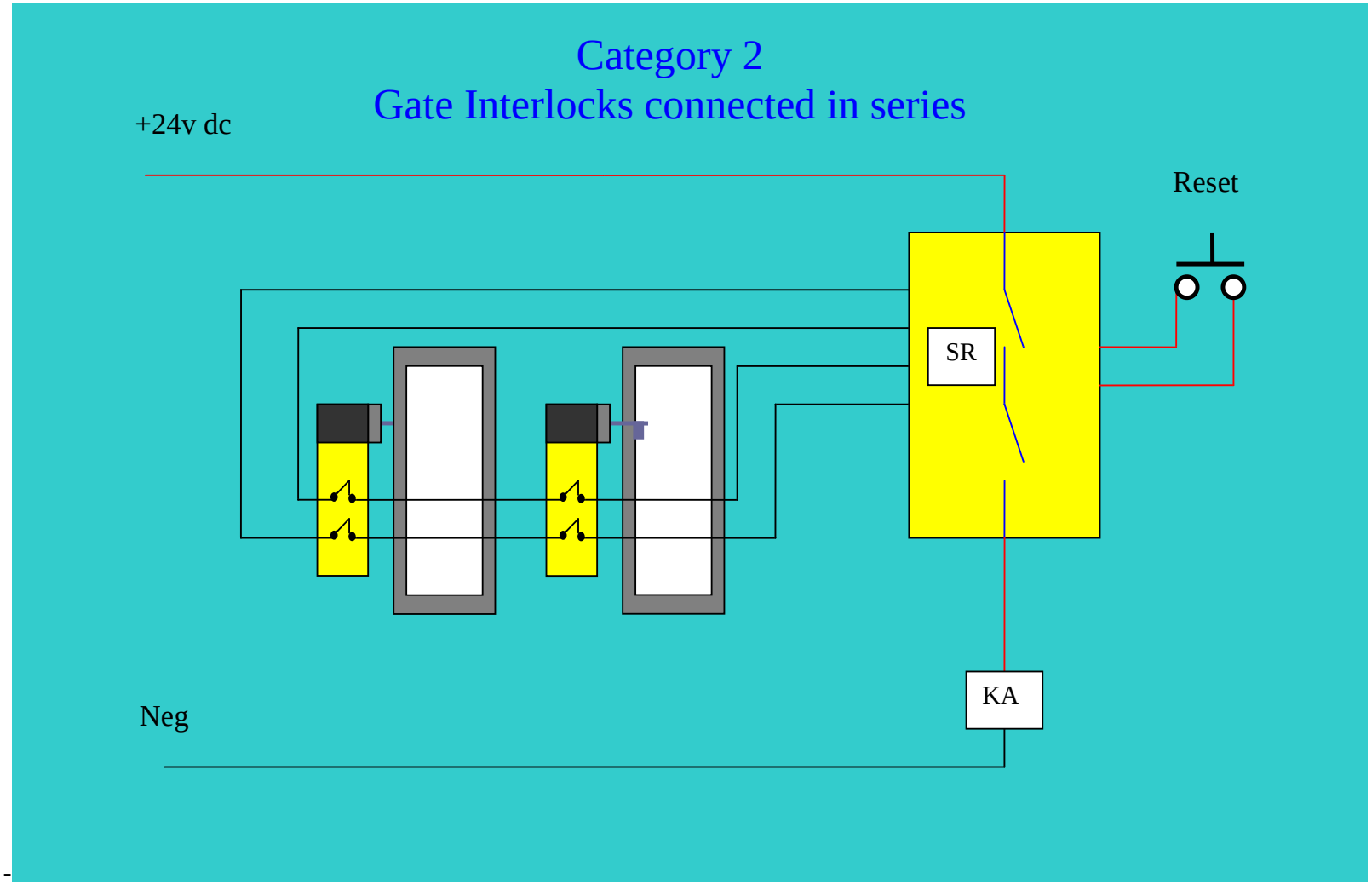
AS 4024 Categories

Category	Requirements	Behaviour
2	The requirements of B and 1 apply plus the safety function shall be checked at suitable intervals by the control system	A fault may lead to the loss of the safety function if it occurred between checks

Category 2



Category 2 in Series



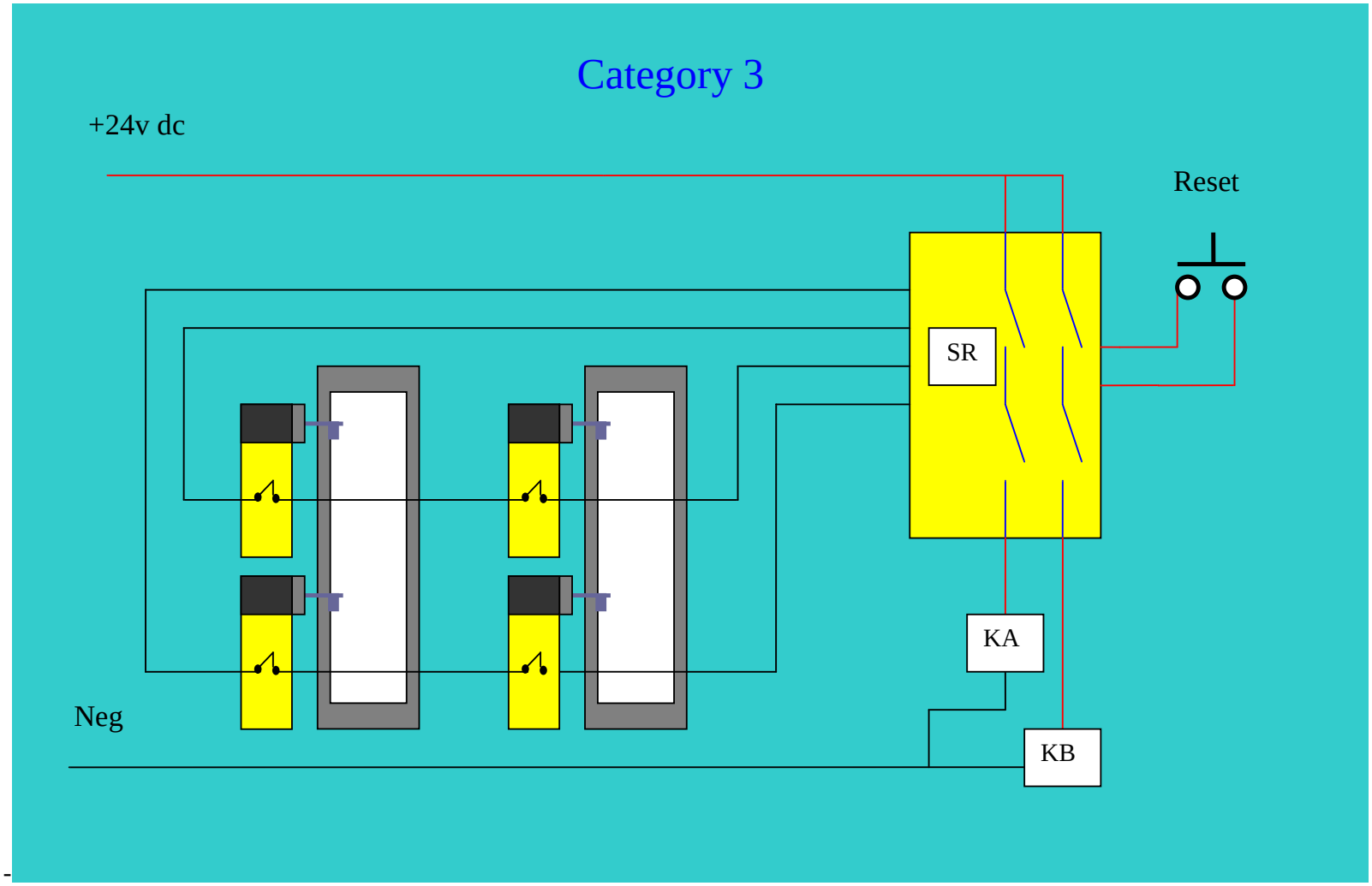
AS 4024 Categories

Category	Requirements	Behaviour
3	The requirements of B and 1 apply plus any single fault in the safety related parts shall not lead to the loss of the safety function and where reasonably practicable that fault shall be detected	The safety function is not lost if a fault occurs but not all faults may be detected. Accumulation of undetected faults may lead to the loss of the safety function.

AS 4024 Categories

- One way of achieving category 3 behaviour is by employing a technique called redundancy.
- Redundancy means you have two of something doing the same job. If one fails, the other will carry on.

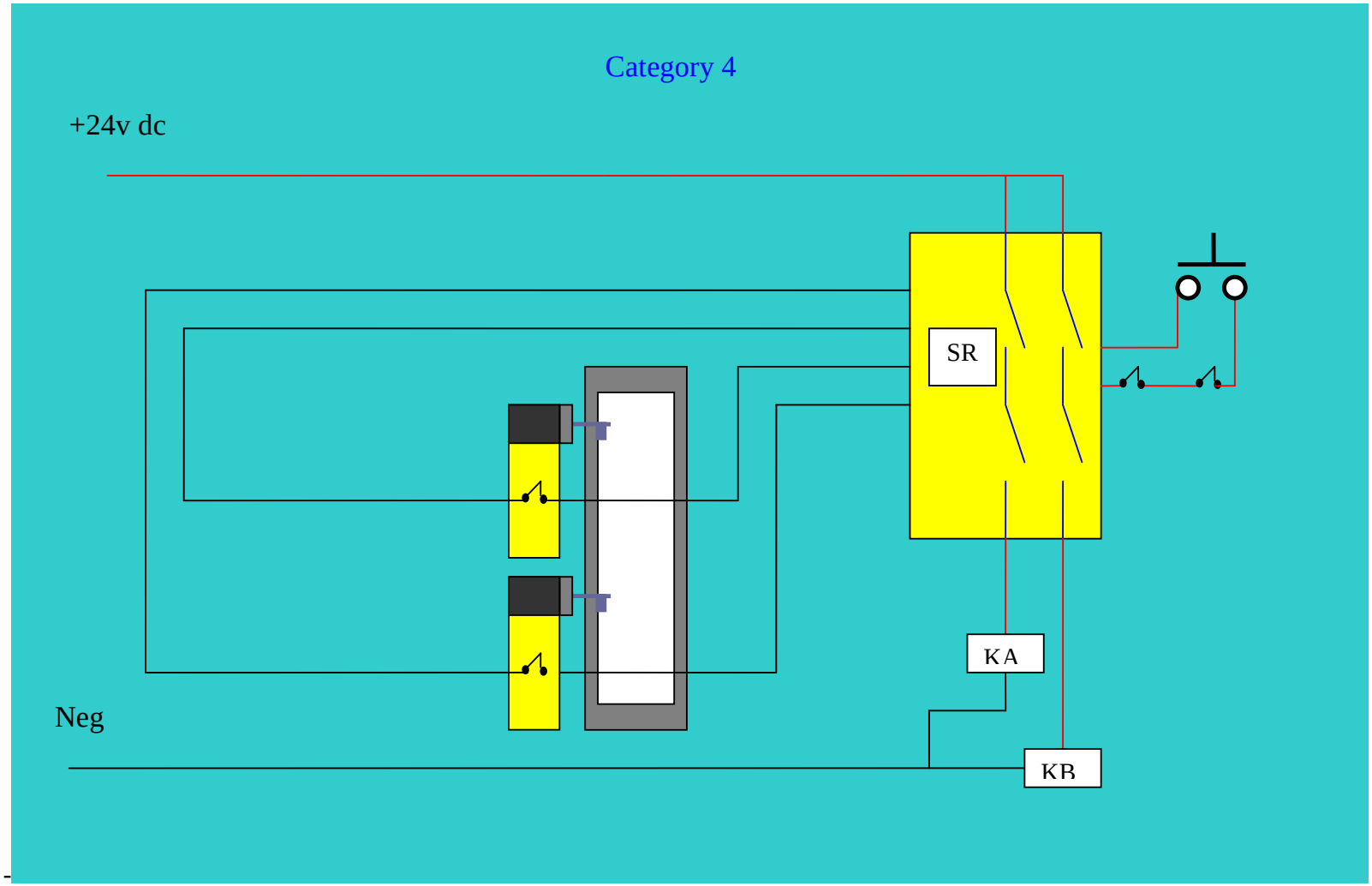
Category 3



AS 4024 Categories

Category	Requirements	Behaviour
4	The requirements of B and 1 apply plus any single fault in the safety related parts shall not lead to the loss of the safety function and where reasonably practicable that fault shall be detected. If this is not possible then an accumulation of faults shall not lead to the loss of the safety function	The safety function is not lost if a fault occurs but not all faults may be detected. Accumulation of undetected faults will not lead to the loss of the safety function.

Category 4

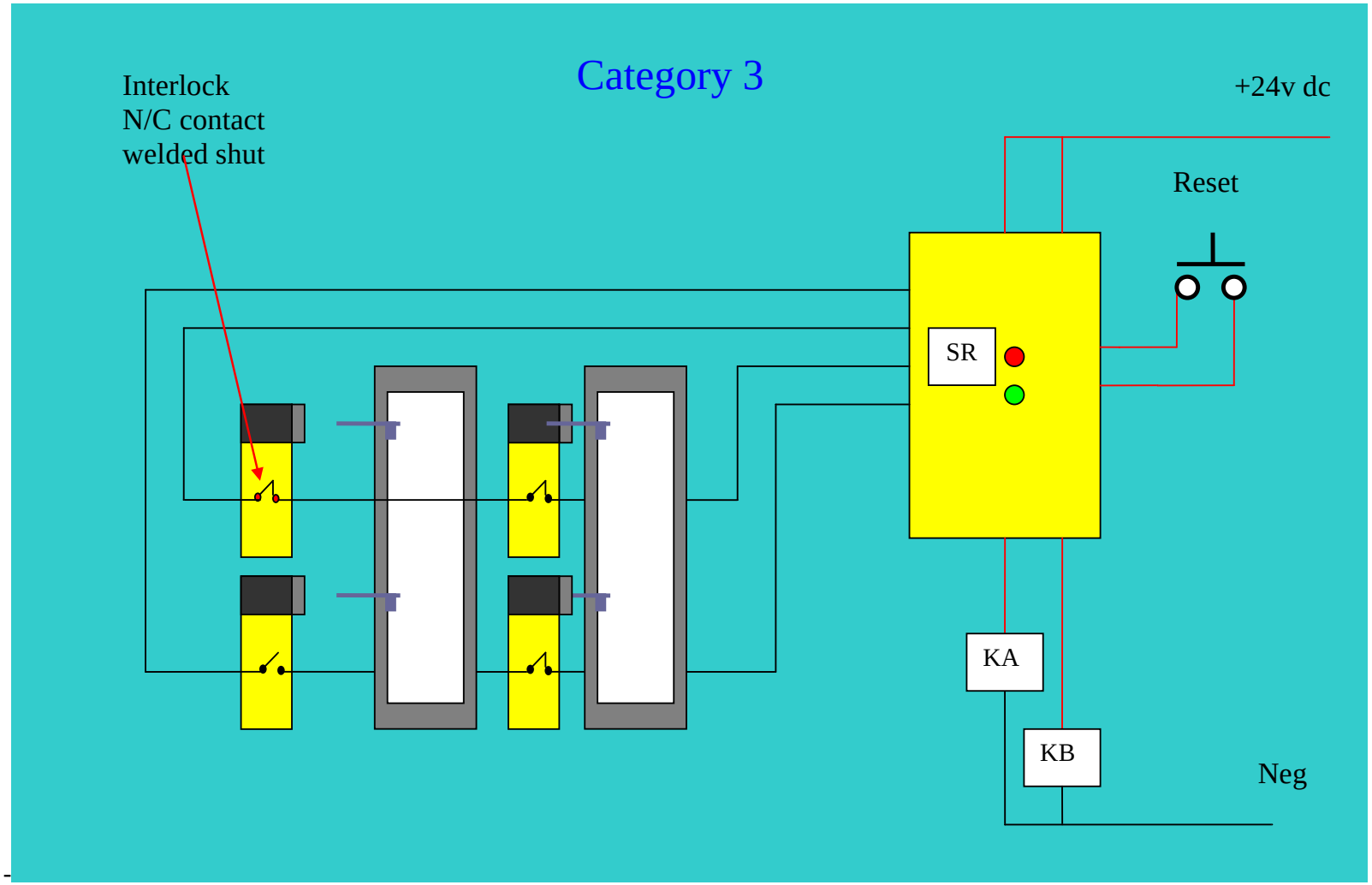


Series connections of interlocks

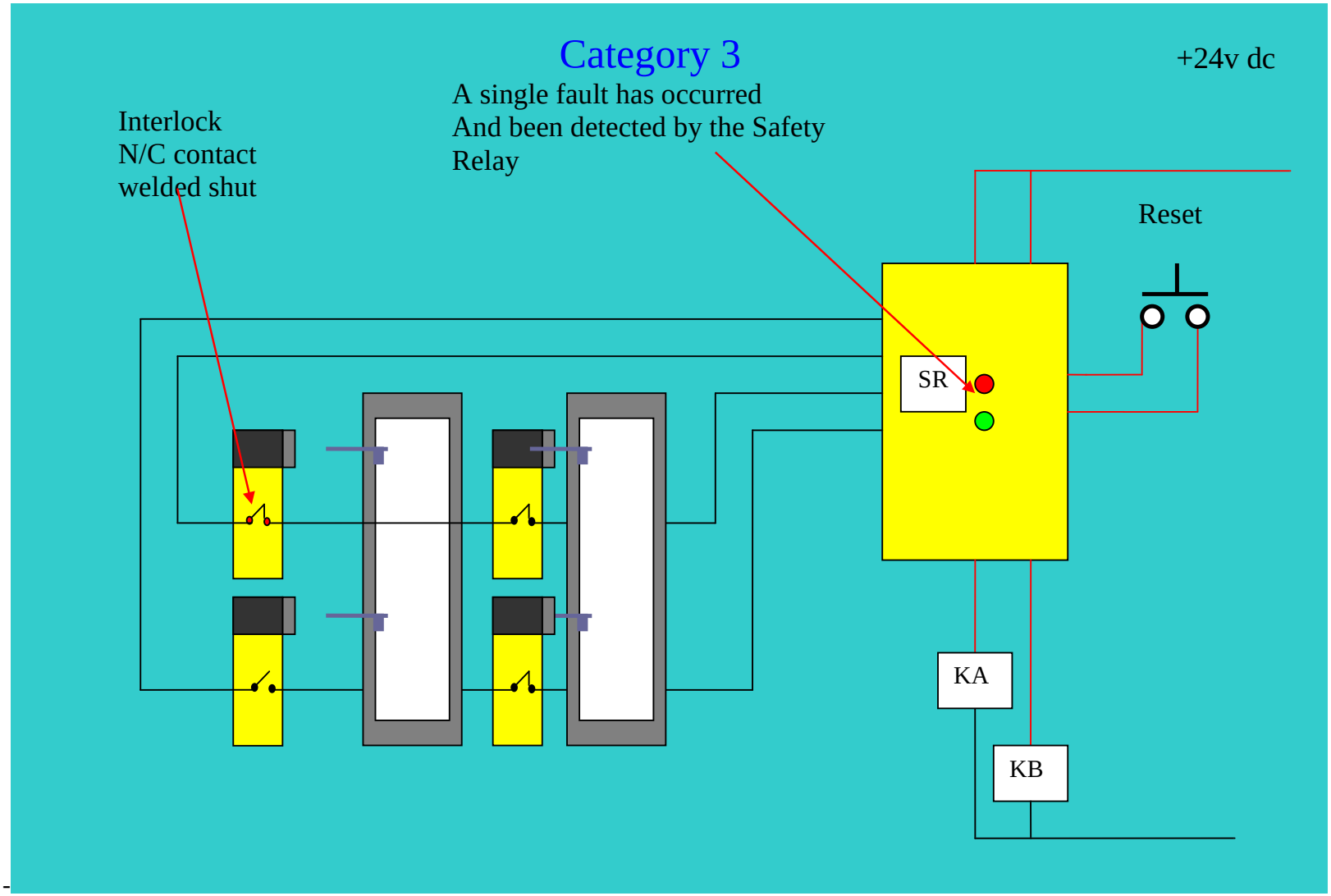
- In Category 3 we saw that interlocks can be connected in series, this is not allowed in category 4 installations.

  We can look at the following fault conditions for an example of why this is so.

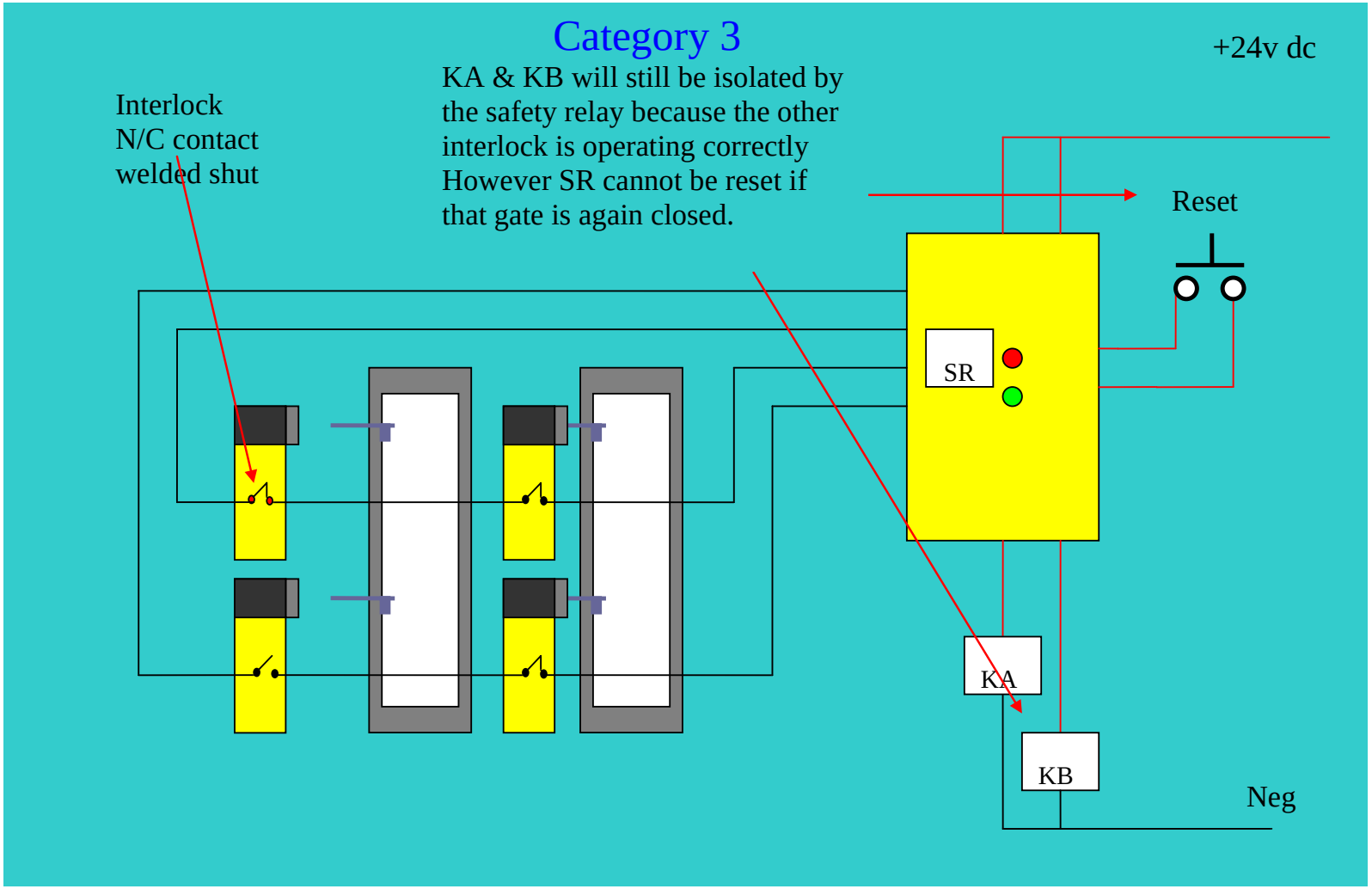
Category 3 in Series



Category 3 in Series



Category 3 in Series



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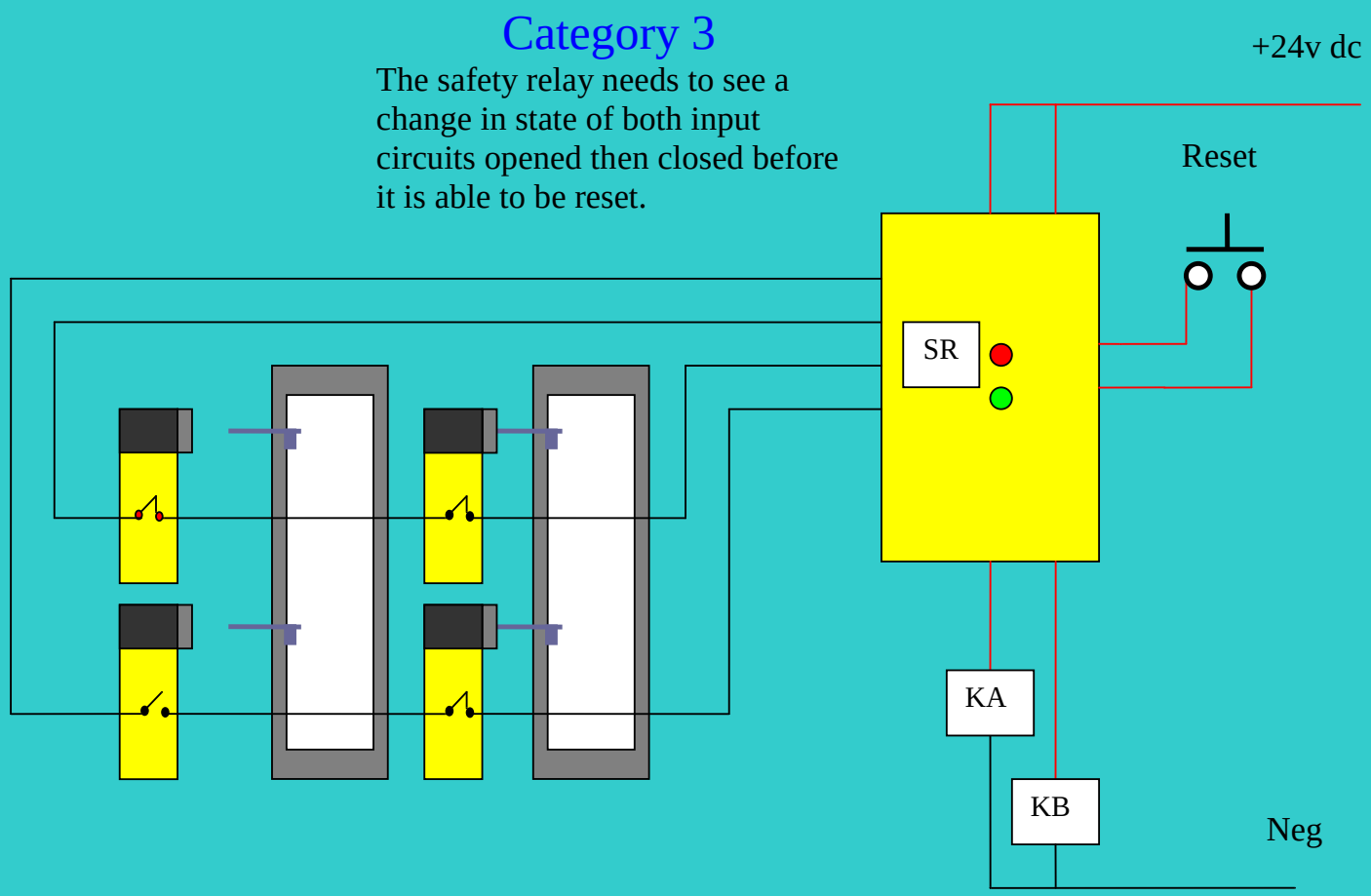
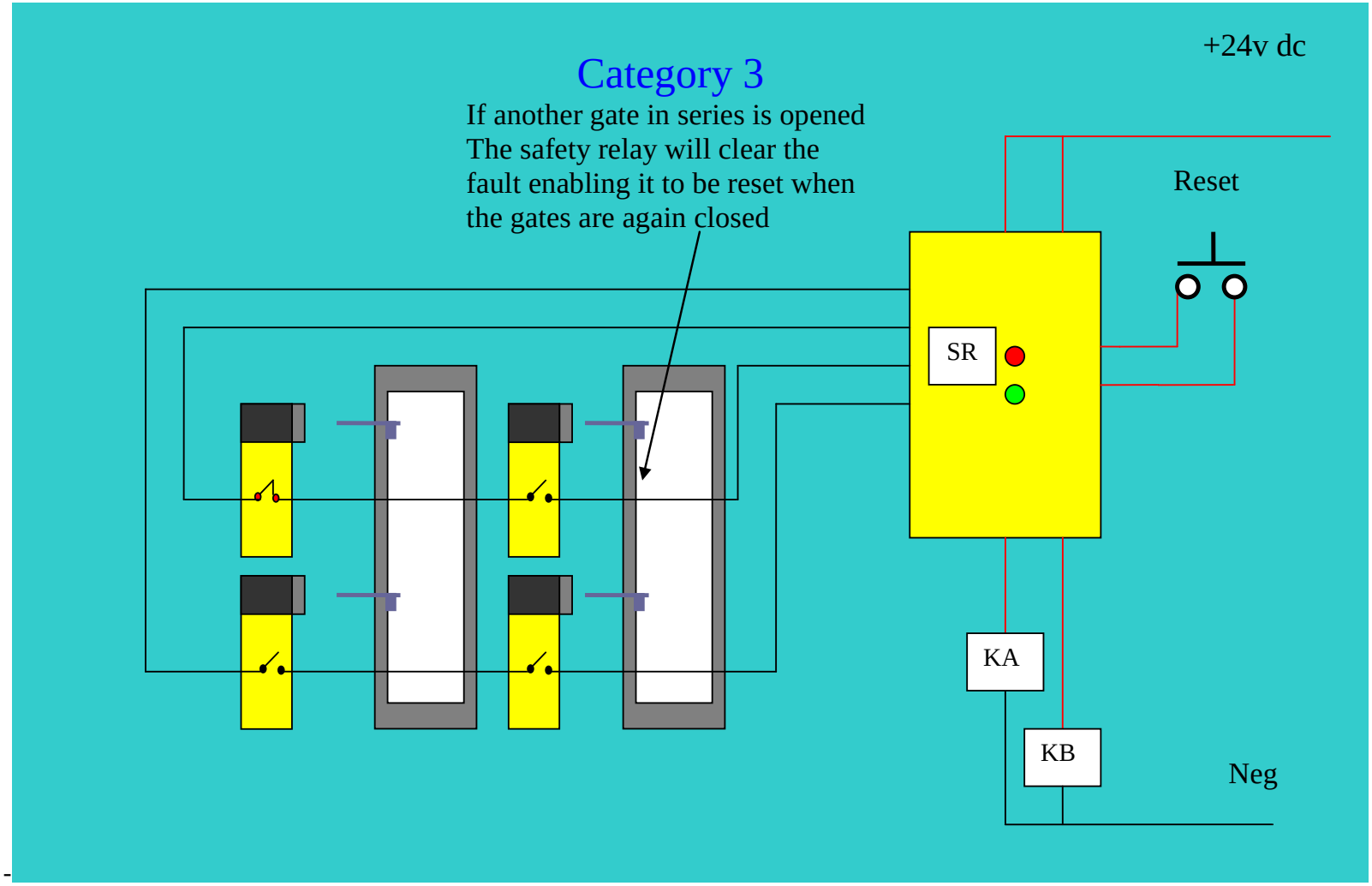
Category 3 in Series

Category 3

The safety relay needs to see a change in state of both input circuits opened then closed before it is able to be reset.



Category 3 in Series



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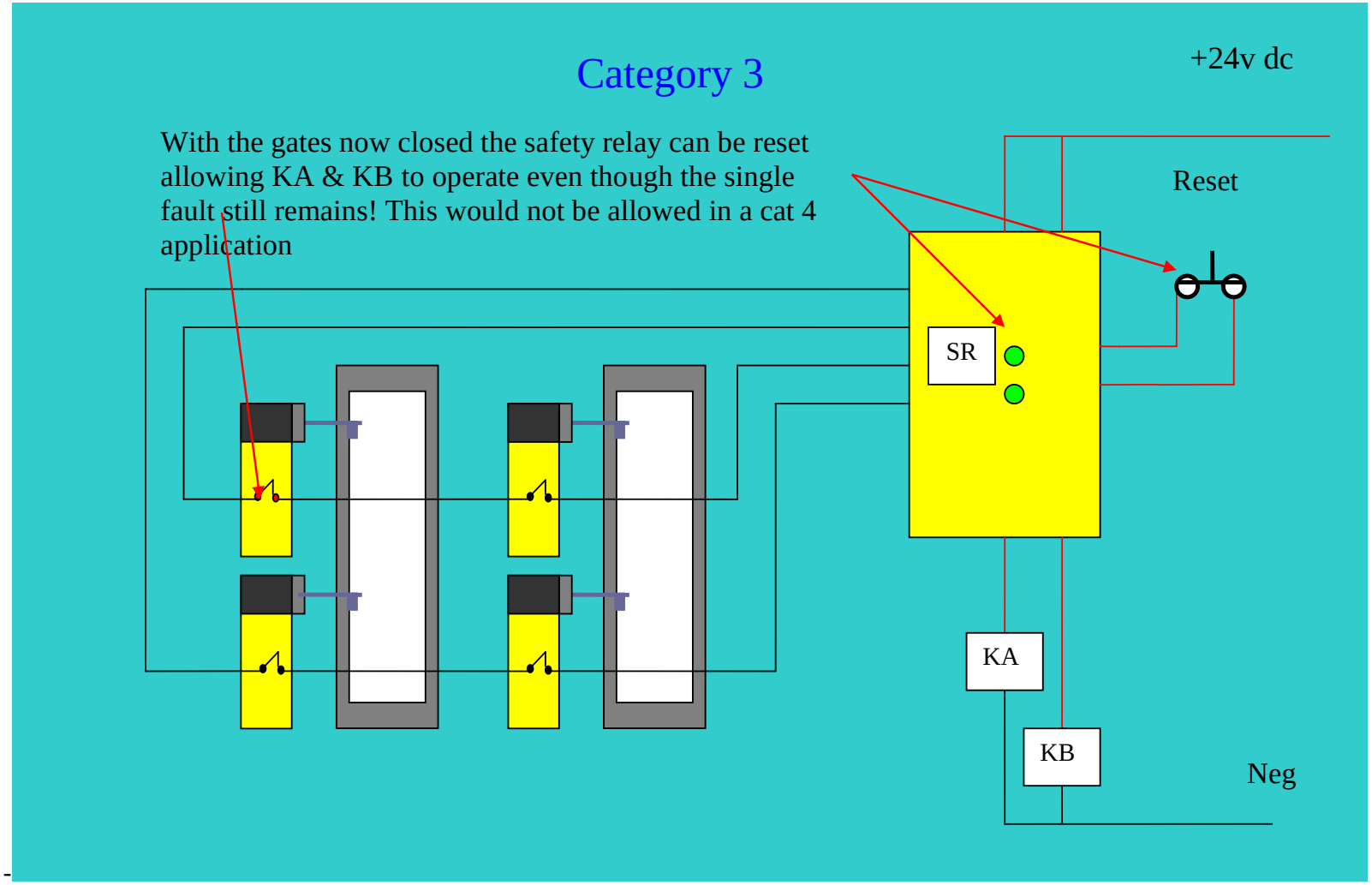
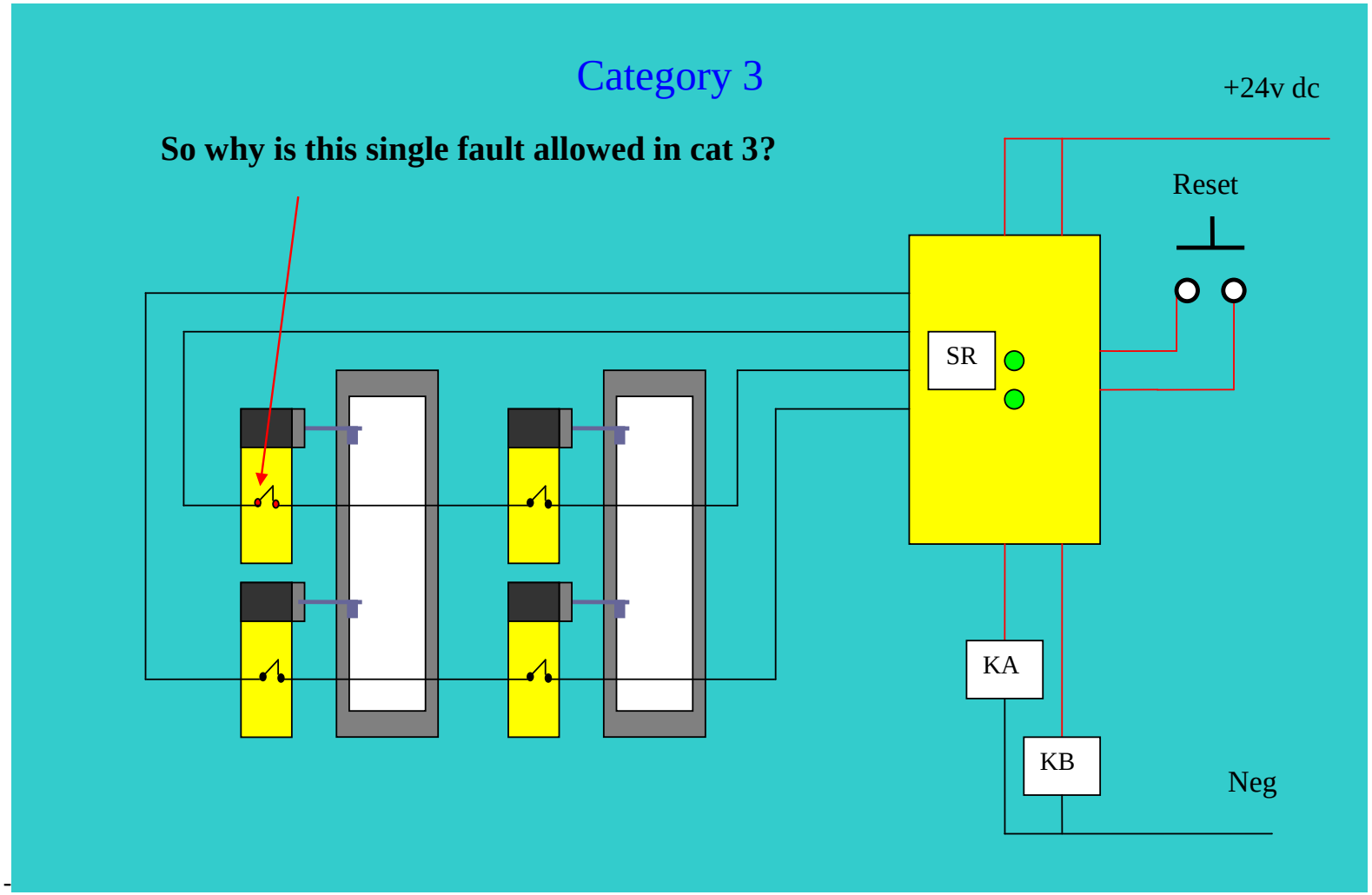


Category 3 in Series



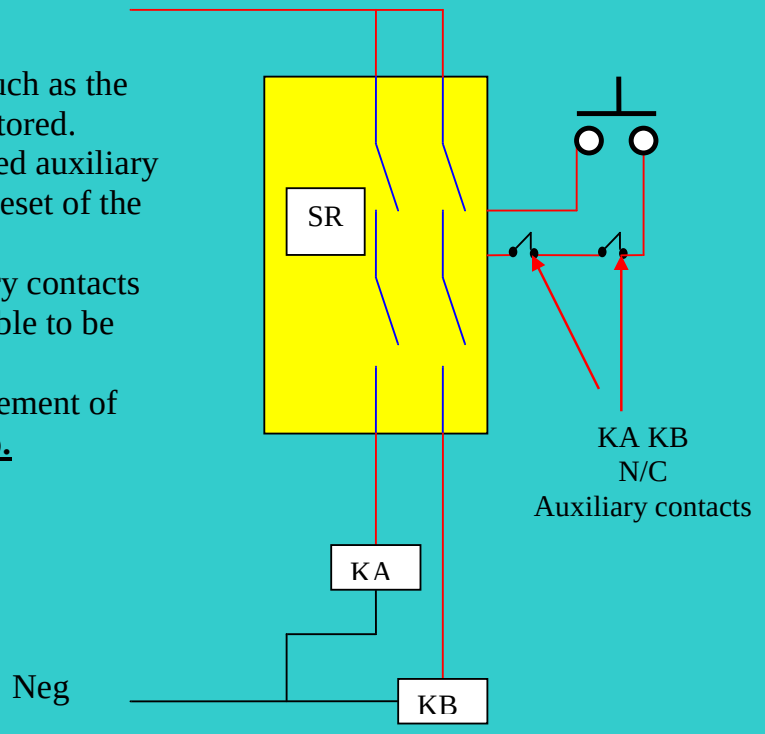
AS 4024 Categories

As mentioned previously the category 3 requirement states that any single fault that develops in that particular part of the control system being assessed shall not lead to the loss of the safety function it is controlling. Plus where reasonably practicable the fault is detected.

External Device Monitoring

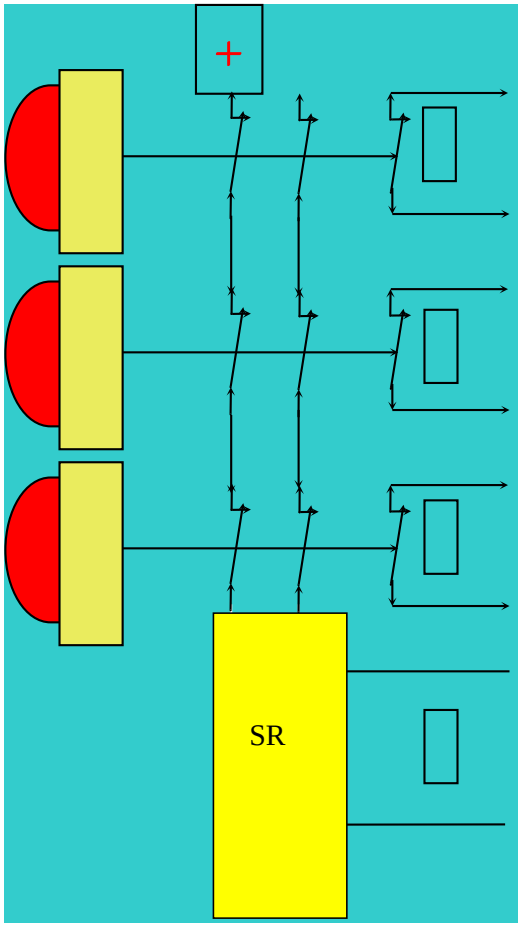
EDM External Device Monitoring

It is a requirement of Cat 4 that external devices such as the positively guided contactors KA and KB are monitored.
This is achieved by connecting the Normally Closed auxiliary contacts of the external devices in series with the reset of the Safety Relay.
If then ,one of the contacts welds shut, the auxiliary contacts will remain open and the safety relay will not be able to be reset.
Monitoring of the External devices is not a requirement of category 3 but **it is highly recommended to do so.**



Emergency Stop Principles of Design.

E Stops in series



This is allowable even in Cat 4 Why?

E-stops are activated when a hazardous situation has occurred or is about to occur.

After one is activated you don't need to activate any others.

E Stops Principles of Design

- Emergency Stops are to be installed as a separate system overriding all other activities.
- Emergency Stops are to be used only in the event of an emergency THEY ARE NOT TO BE USED FOR CONTROL STOP or ISOLATION.
- Emergency Stops shall be located on all operator station’s.
- Emergency Stops when activated shall be maintained by engagement of the actuation (latching in/rotate to release).

E Stops Principles of Design

- Emergency Stops are to be positively driven open 2x N/Closed contacts.
- The Emergency Stop once activated will need to be, on release re-set by a separate operation (Manual Reset button).

Summary

- AS 4024 deals with those parts of a control system that have a safety related function.
- It specifies the behaviour of those parts if a fault develops within them.
- The behaviour of those parts is placed into a category by following a hazard assessment.
- A typical control system may have a mix of categories depending on the functions of the various parts and their contribution to the reduction of risk.

Thankyou for your attention