Controls and Compliance to *pr*EN 12101-9 and ISO 21927-9

Presenter:
Alan Honeysett
Global Controls Manager
Novenco Building and Industry

This presentation discusses the requirements of the applicable standards for smoke control systems, equipment, and implication on system design

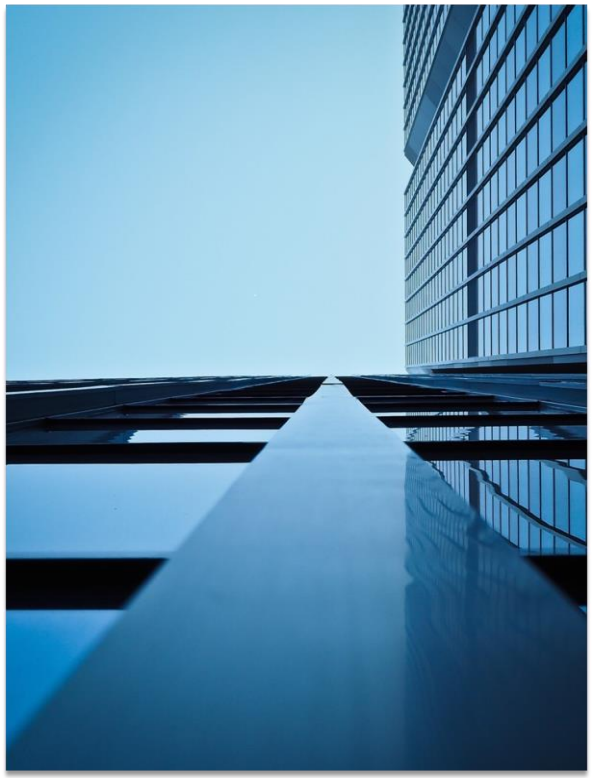
SMOKE CONTROL ASSOCIATION

Overview

1. About the SCA
2. Basic requirements
3. Why these Standards?
4. Snapshot of the Standard
5. Other relevant considerations

SMOKE CONTROL ASSOCIATION

1
About the SCA



The Smoke Control Association (SCA) is an independent body involved in various aspects of smoke control; including design, CFD, manufacturing, install, commissioning, service and maintenance.

Past projects include the publication of guides related to the design of smoke control systems and projects.

The SCA is an advocate for best practice within the industry.

SMOKE CONTROL ASSOCIATION

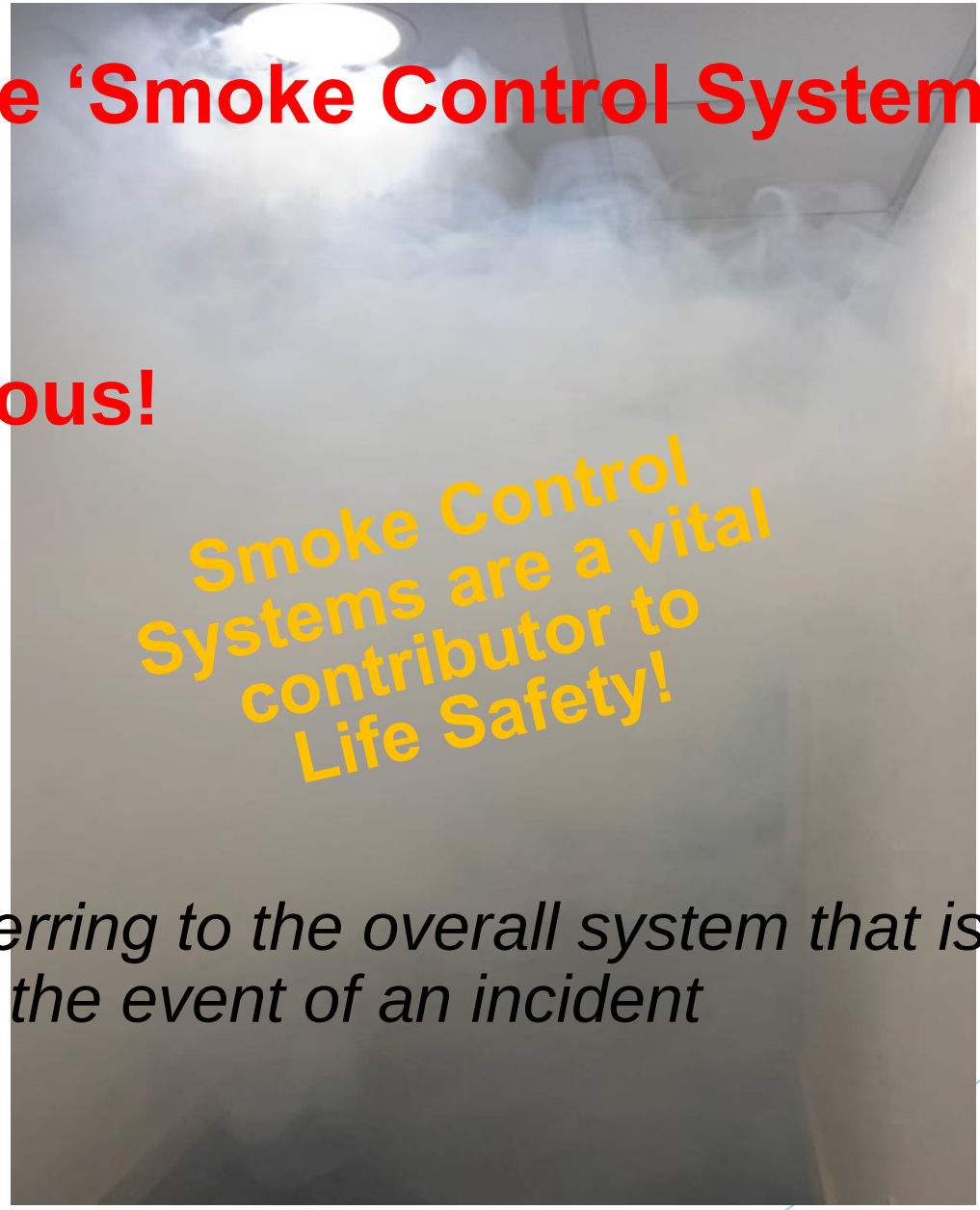
2
Basic Requirements for all Controls

This section considers why we have controls, and what are the essential characteristics of controls

SMOKE CONTROL ASSOCIATION

Firstly, why are there ‘Smoke Control Systems’?

Because life is precious!

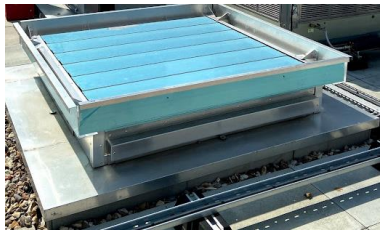


Here ‘smoke control’ is referring to the overall system that is used to ventilate smoke in the event of an incident

SMOKE CONTROL ASSOCIATION

Here are examples of equipment that may be found in typical Smoke Control Systems

Fans



Automatic Opening Ventilator

Smoke Control Damper

?

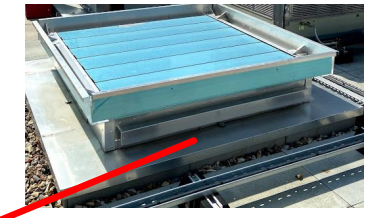
Manual Control Points

Smoke Detection

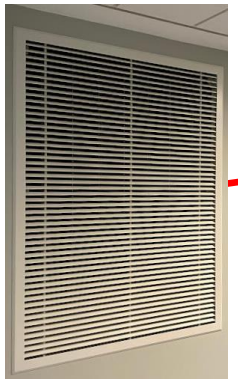
SMOKE CONTROL ASSOCIATION

But the *controls* join all the elements together, they are the ‘beating heart’ of the system – without controls the system will not be functional

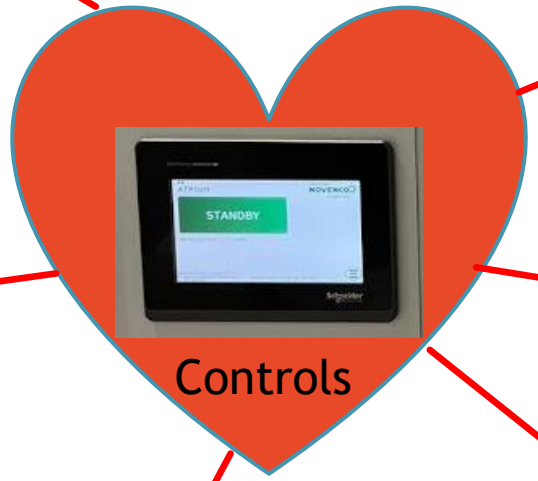
Fans



Automatic Opening Ventilator



Smoke Control Damper



Controls

Manual Control Points

Smoke Detection

SMOKE CONTROL ASSOCIATION

For now, we will consider just three essential characteristics of any controls:

1. Functionality

   Must do ‘what it says on the tin’
   Must give appropriate notifications

2. Reliability

   It must work when required

3. Resilience

   Check for & notify faults (before and/or during an event)
   Must operate sufficiently should something fail

SMOKE CONTROL ASSOCIATION

3
Why these Standards?

This section looks at why the ISO 21927-9 is relevant and important

SMOKE CONTROL ASSOCIATION

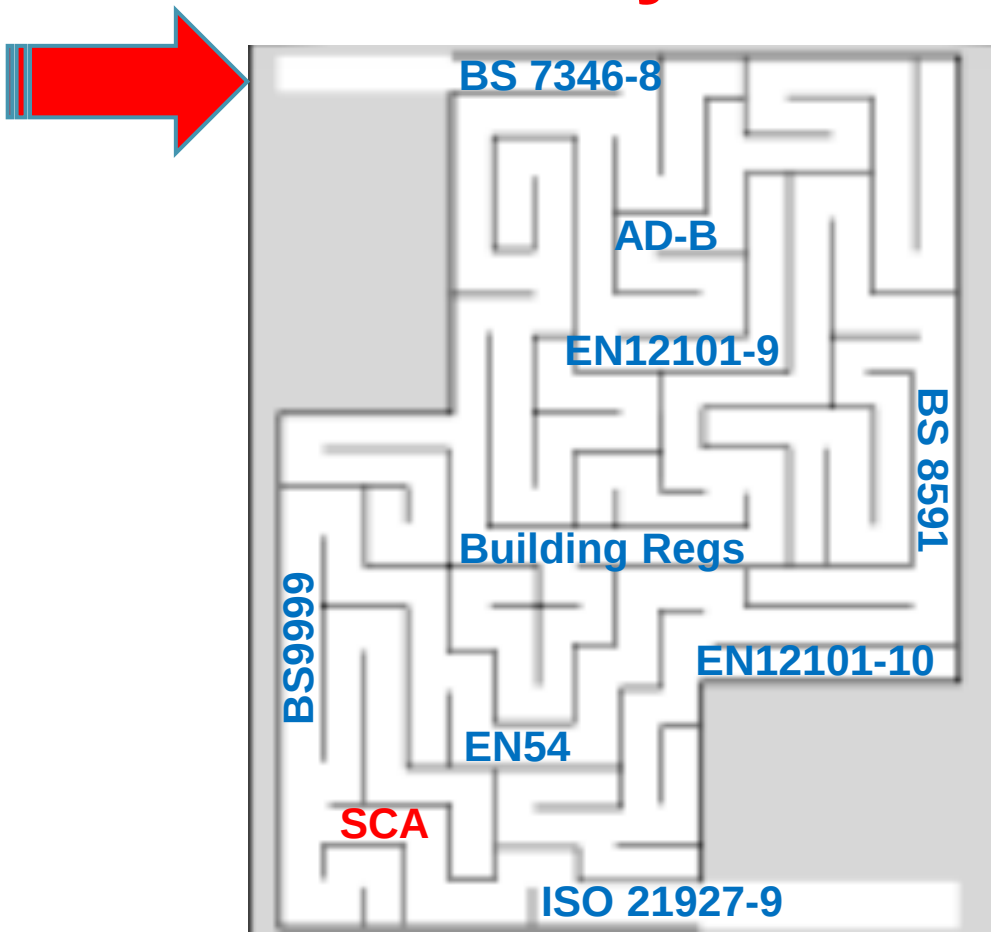
Q1. What are we trying to achieve?

A. Control of a Smoke Control System (a Life Safety System), that in the event of smoke detection will function as designed, reliably and with resilience

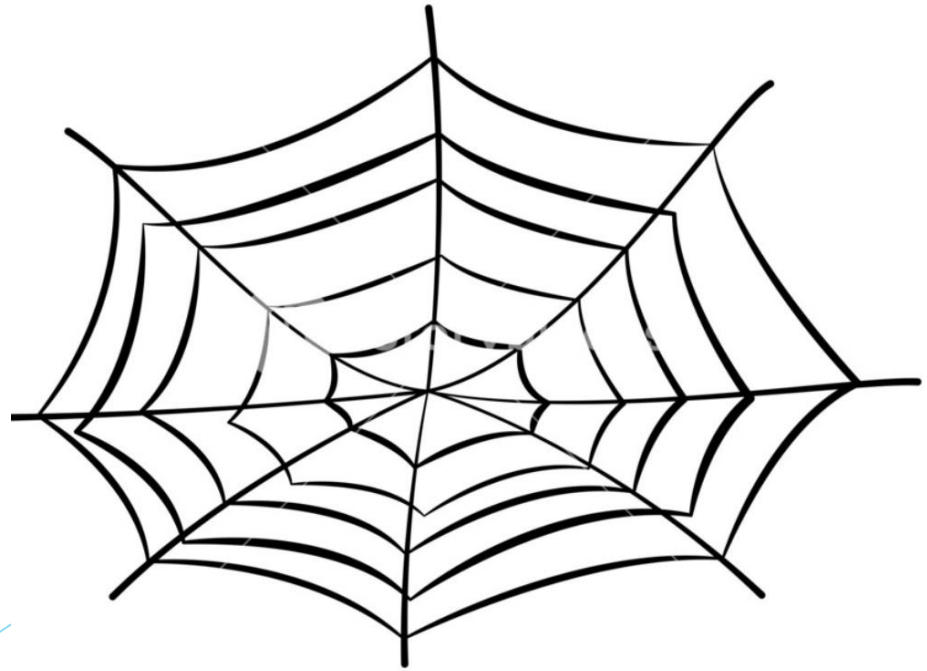
SMOKE CONTROL ASSOCIATION

Q2. How do we get there?

A. By following the Regulations, Codes of Practice and Standards – but they seem to be a maze…



or perhaps a spider's web!



SMOKE CONTROL ASSOCIATION

There is a hierarchy to the Regulations

The Building Act – Primary legislation

The Building Regulations (Statutory Instrument)

Approved Documents

Guidance on ways to meet the requirements of the Building Regulations

Approved Document B – Fire Safety

Guidance on ways to meet the requirements of the Building Regulations

Codes of Practice

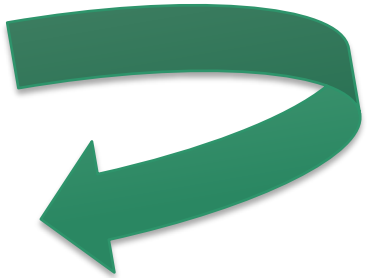
BS9999 – Fire Safety in the Design, Management and Use of Buildings

BS9991 – As above – for dwellings and other buildings not included in above

SMOKE CONTROL ASSOCIATION

Continuing the hierarchy of regulations

Clause 14.3 of BS9991 states: Design, installation, commissioning and maintenance of smoke control systems should be carried out in accordance with BS7346-8



BS7436-8 is the Code of Practice for design, installation, commissioning and maintenance of Smoke Control systems. The correlating clause in this regulation states "….in addition to the requirements of BS9999 and BS9991 the following recommendations should be followed……"

SMOKE CONTROL ASSOCIATION

Drilling into BS7346-8……

Clause 6.3 - Selection of Components stares:

"Suitable electrical and mechanical system components should be selected……..."

"……only products that have been tested to product standards should be selected".

On the following page are some examples:

SMOKE CONTROL ASSOCIATION

Continue drilling into BS7346-8……

Selection of products that have been tested to product standards

Examples are:

AOVs
Tested to
EN12101-2

Note requirement for AOVs and actuators to be tested together

Fans
EN12101-3

Note requirement for fans and inveters to be tested together

Smoke Control
Dampers
EN12101-8

See next page

SMOKE CONTROL ASSOCIATION

More drilling down into BS7346-8……

Clause 6.9.1 Power supplies should be provided in accordance with BS8591

Clause 6.10.1 All cables and cable management systems should be selected in accordance with BS8591

SMOKE CONTROL ASSOCIATION

What does BS7346-8 have to say about controls……

Clause 6.7.1 Suitable control equipment conforming to BS ISO 21927-9 should be selected to ensure correct operation of the smoke control system. Control of a system may be centralised or distributed, or a combination of both.

What about prEN12101-9?

SMOKE CONTROL ASSOCIATION

What about *pr*EN12101-9?

This was/is intended to be one of the EN12101 suite of standards, but Section 9 (controls) is still only provisional (*pr*) and has not been harmonized.

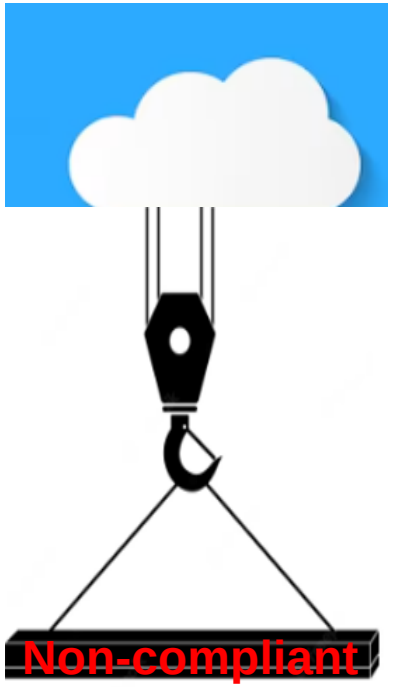
ISO 21927-9 is virtually identical, and as it is a published standard, this is the standard that is quoted as a reference in BS7346-8

SMOKE CONTROL ASSOCIATION

What are the options?

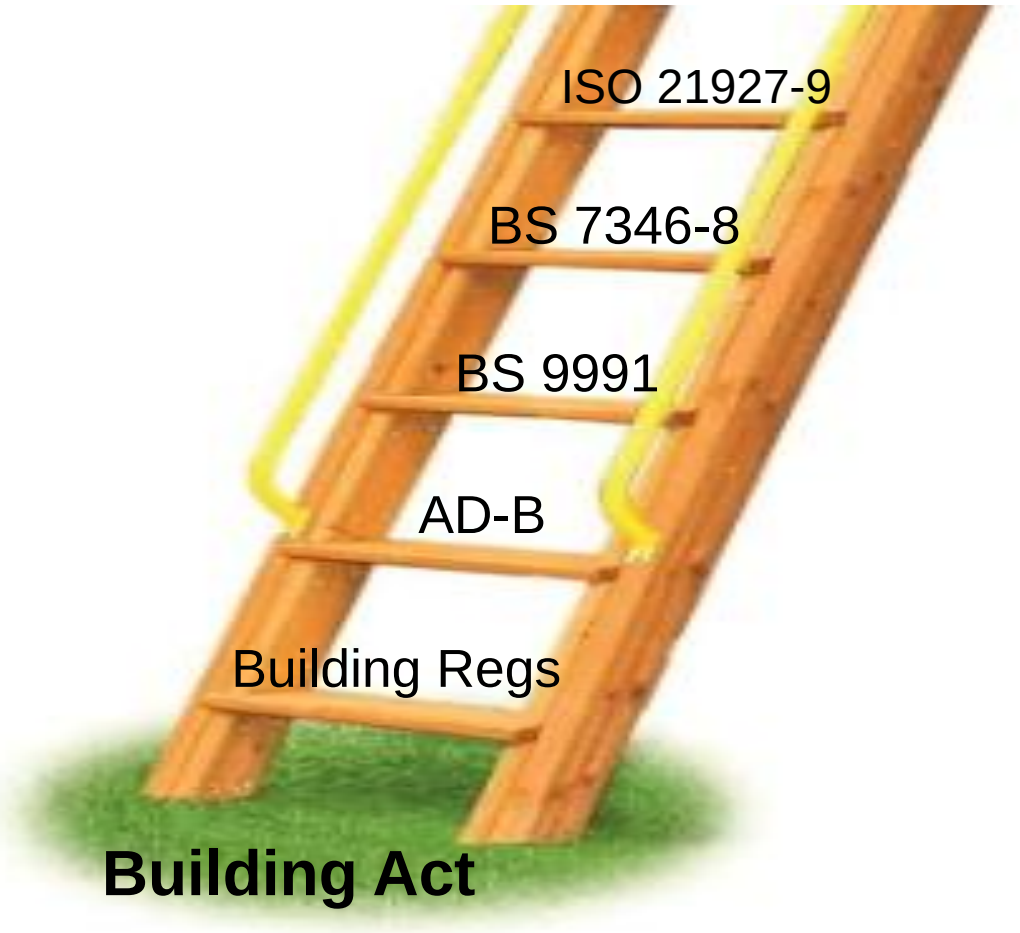
You use controls that not are compliant to ISO 21927-9, and provide your own justification that you are complying with your responsibilities in law

Alternative 1



SMOKE CONTROL ASSOCIATION

Or……..alternative 2



You use controls that are compliant to ISO 21927-9, as these are built on the hierarchy of standards previously referred to.

Compliance = Safe System

SMOKE CONTROL ASSOCIATION

4
Snapshot of the Standard

This section looks at some of the basic requirements in the ISO 21927-9

SMOKE CONTROL ASSOCIATION

ISO 21927-9
Specification for Control Equipment

Clause 1 defines the scope of the regulations

Scope: Specifies the product performance requirements, classifications and test methods for control equipment designed for use in smoke- and heat- control systems (SHCS) in buildings

SHCS = SHEVS (Smoke and Heat Exhaust Ventilation System)
SHCS is the term used in ISO 21927-9; the equivalent term used in prBS12101-9 is the more familiar SHEVS- they both refer to the same thing

SMOKE CONTROL ASSOCIATION

Types of Control Equipment

Clause 4.2.3

Four categories of controls equipment are identified

A – Mechanical Control Panels

B – Basic Control Panels and Pneumatic-only Control Panels

C – Control Panels without direct connection to detectors

D – Control Panels with direct connection to detectors

This presentation does not cover mechanical or pneumatic panels
An example of a Basic Control Panels is a stand-alone manual operator used to open an AOV window

Types C & D are both systems with multiple inputs and multiple outputs, operating in accordance with a defined Cause and Effect, and are what are considered in this presentation

SMOKE CONTROL ASSOCIATION

Let's look at how some of the essential characteristics of smoke controls are covered by this Standard:

1. Some Functional requirements

Primary function - Control equipment is required to control all components of a SHCS

Clause 4.2.6 – Use for other purposes

May be used for functions other than smoke control e.g. to provide comfort ventilation; however the primary purpose of the system should always be for control of smoke and heat

Clause 4.2.5 - Priority

The fire condition shall always have the highest priority

SMOKE CONTROL ASSOCIATION

Timings

Clause 5.1.4.1.2

The response to a fire signal shall not be more than 10s

Clause 5.1.5.1.1

The control panel shall enter the fault warning condition within 100s of receiving signals which are interpreted as a fault

SMOKE CONTROL ASSOCIATION

Indications

Clause 5.1.2.1

The control panel shall indicate the following functional conditions:

- Standby condition
- Fire condition
- Fault condition
- Disablement condition (if provided)
- Test condition (if provided)

** BS7646 – indicators should be located in the Control Centre, or at the Fire and Rescue Service access point

SMOKE CONTROL ASSOCIATION

Operational conditions

Clause 5.1.1.1

It is possible for the system to be in any of these conditions simultaneously:

- Fire condition
- Fault warning condition
- Disablement condition (if provided)
- Test condition (if provided)

SMOKE CONTROL ASSOCIATION

Manual control points

Clause 5.3

Two types of manual control points are permitted, both fairly similar, and in both cases their form and function are closely prescribed

Type 1 – Control and indication, with reset

Type 2 – Control only, optional reset, but still requires a ‘fire’ indication

SMOKE CONTROL ASSOCIATION

As an aside, what is the purpose of Zone Manual control points?

- Initiation?

  No, systems should be automatically initiated

- Fire service intervention?

  No, systems should be designed not to require fire fighter intervention, and in any case, smoke control dampers are not designed to *operate* after 90s, *unless* they are MA rated dampers

- Post-suppression smoke clearance?

  Not necessary, this can be managed from the main operator panel

- Maintenance testing?

  Absolutely not, testing from a manual control point is not valid – all tests must be carried out at the smoke head – this is the only way to test the integrated system

2. Some Reliability requirements

Clause 5.1.5.1.3 – Cable fault monitoring

This is to ensure that no damage has occurred to cables between maintenance tests, and that the system will operate when demanded. Any cable fault prescribed below must be reported within 100s

Table 1 — Monitoring of cable faults

Any line (if provided) between	Interruption	Short-circuit
c.p. <-> actuator / drive / motor / solenoid electromagnet	C	C**
c.p. <-> detector or c.i.e. (ISO 7240)	C	C*
c.p. <-> wind detector (if used in fire condition)	C***	C****
c.p. <-> manual control point	C	C*
c.p. <-> separate c.p. or b.c.p. or m.c.p.	C	C*
c.p. <-> separate p.s.e.	C	C
c.p.<-> SHCS component position indicating contact	C	C

C	Compulsory.
C*	Short-circuit between conductors for initiation of the SHCS only.
C**	Where the ventilators are partially open for day-to-day ventilation, monitoring is not required until they are in their closed or fully open position.
C***	Only the power supply conductors need to be monitored as long as any data conductors are included within the same cable, and data failure results in activating the relevant outputs in the fire condition.

SMOKE CONTROL ASSOCIATION

Cable Faults – points to note

5.1.5.1.3 – All cable faults in Table 1 shall initiate a fault condition unless the system goes automatically into fire mode in the event of failure

5.1.5.1.3 – Interruption is considered to be a break in any single conductor in a cable

5.1.5.1.4 – In the case of a single output to an actuator or motor with more than two terminals, interruption is considered to be a break in all conductors

SMOKE CONTROL ASSOCIATION

Software Reliability

These points are more specilaised, and relate to the system manufacturer, but they are included here to demonstrate the breadth of the regulations.

Clause 9.4

1. Program execution is to be monitored

This monitoring shall be by means of an additional device with a time base independent from the monitored device
or
By an external time base (eg crystal)

2. Memory content is to be monitored

SMOKE CONTROL ASSOCIATION

3. Some requirements to maximise Resilience

Clause 5.1.1.2 – Transmission faults

This section on transmission faults is very significant – in general terms a transmission path can be considered to be an electrical circuit connecting two items of equipment

This clause states that "A single short circuit or interruption in any individual transmission path…shall not prevent the correct operation of more than one of the following:

- Automatic detection of a fire (Type D)
- Operation of a Basic Control Panel
- Signal to or from and input or output device
- Initiation of ancillary equipment

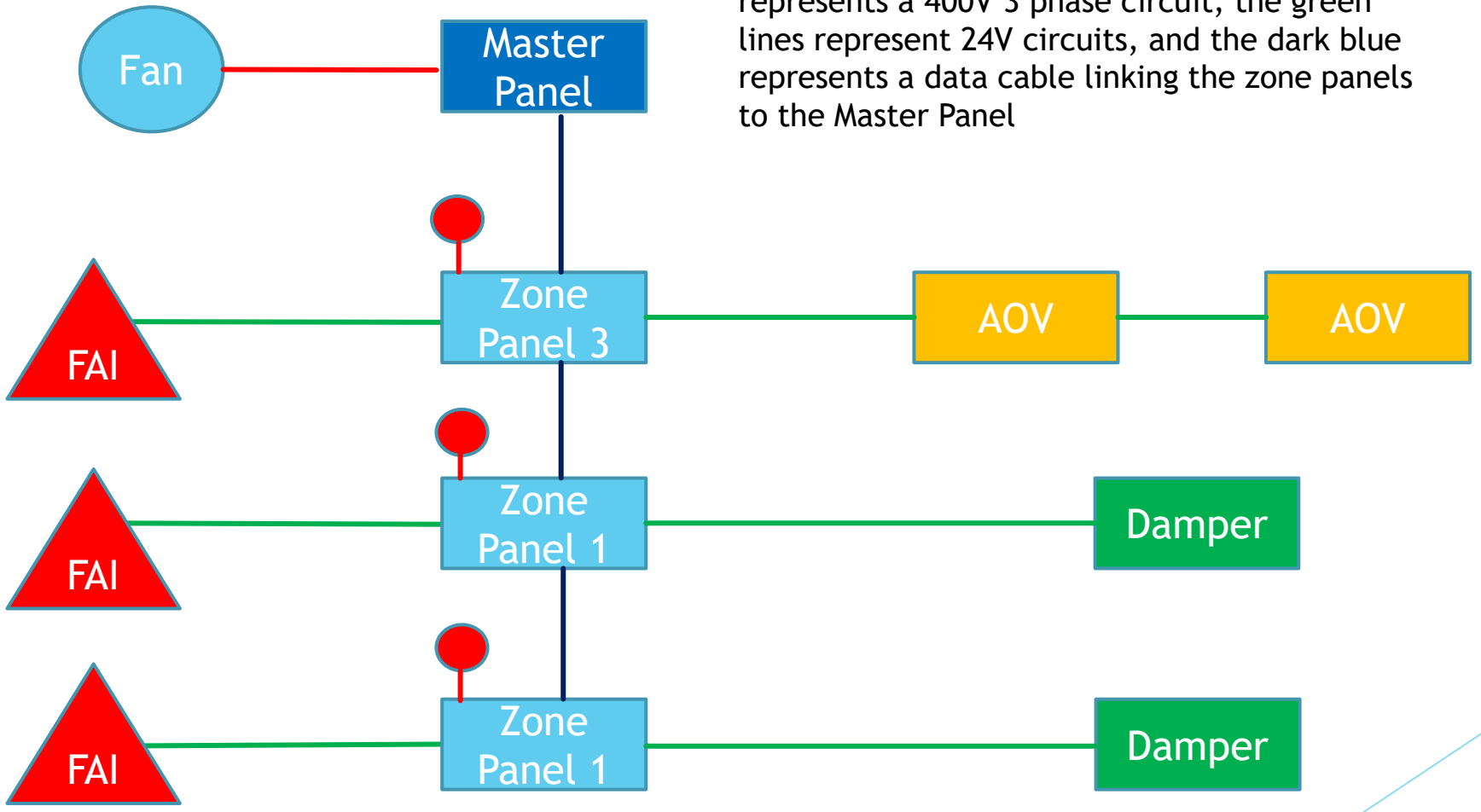
And also that

- All devices affected are intended operate together
- All devices affected fulfil the same function"

SMOKE CONTROL ASSOCIATION

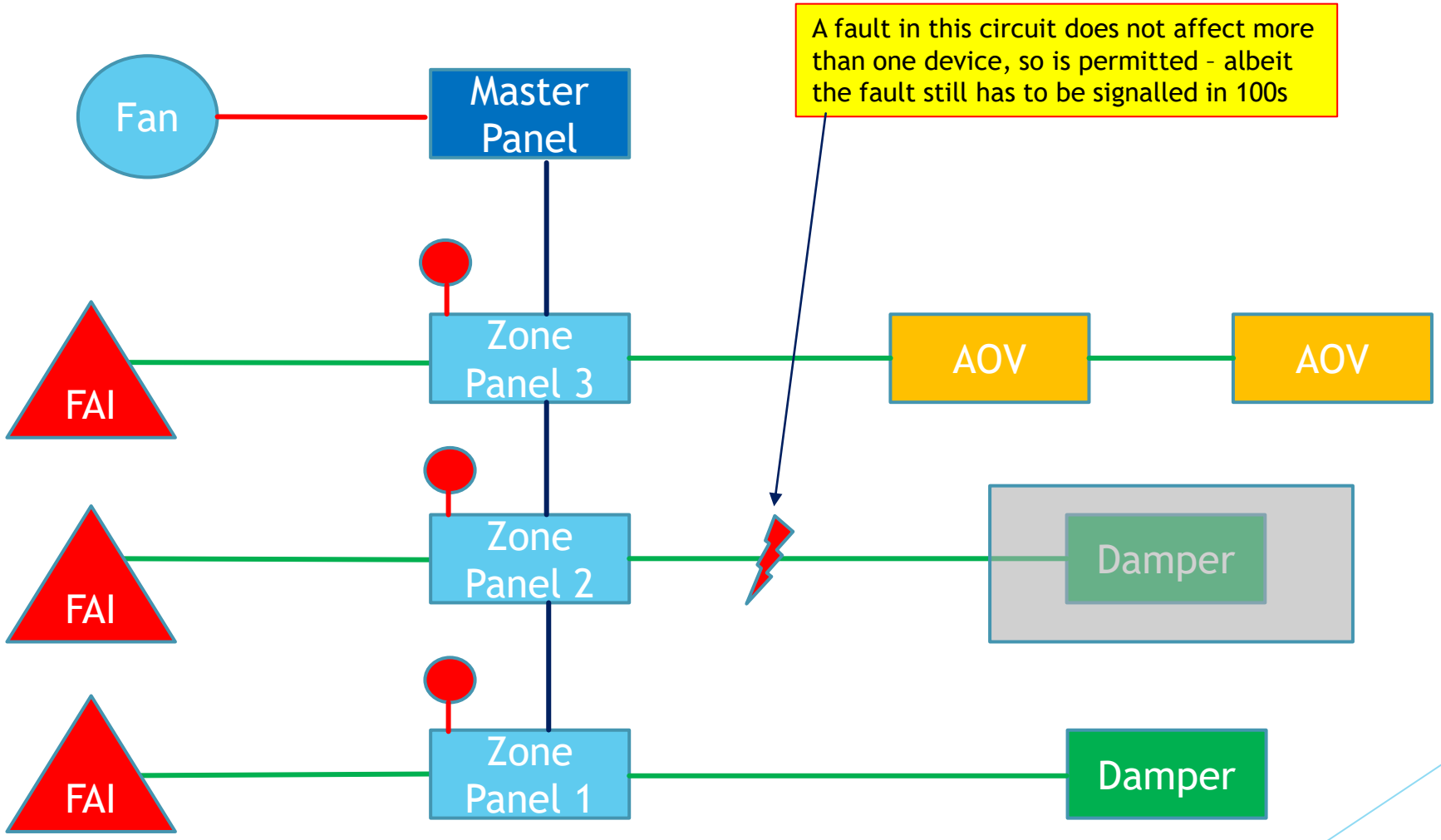
Demonstrating transmission paths

In this simple schematic, the red line represents a 400V 3 phase circuit, the green lines represent 24V circuits, and the dark blue represents a data cable linking the zone panels to the Master Panel



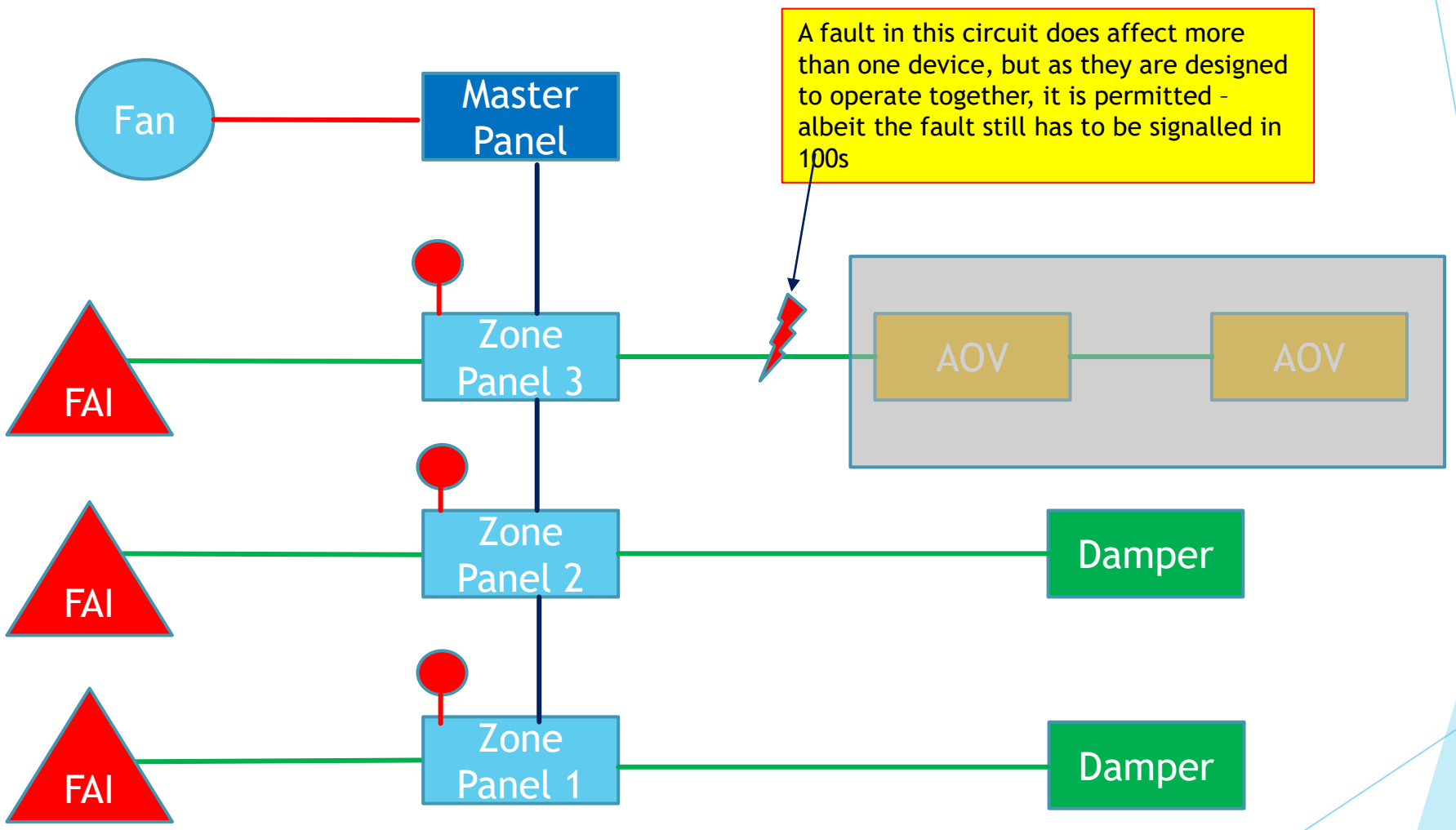
SMOKE CONTROL ASSOCIATION

Transmission path faults (1)



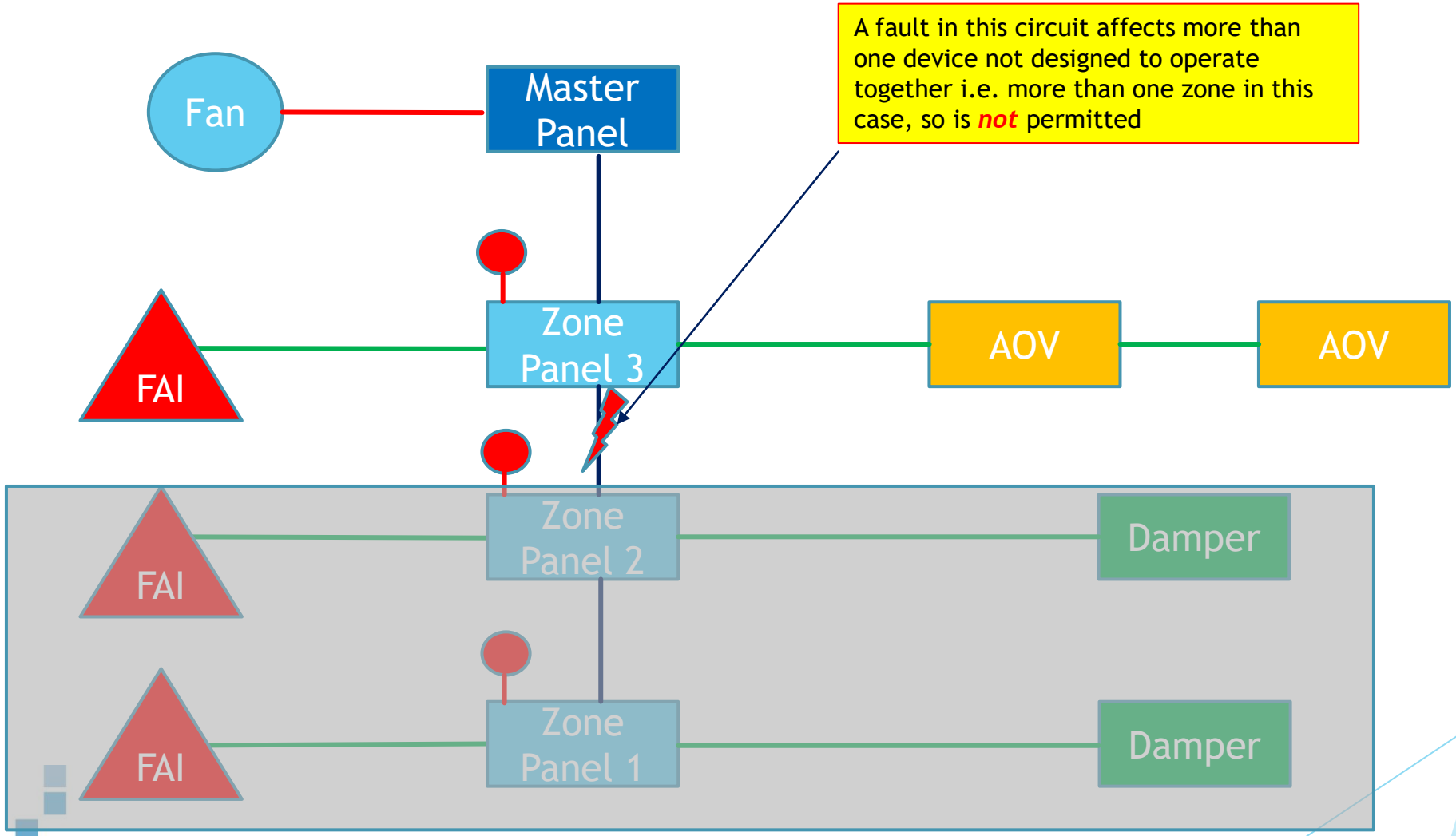
SMOKE CONTROL ASSOCIATION

Transmission path faults (2)



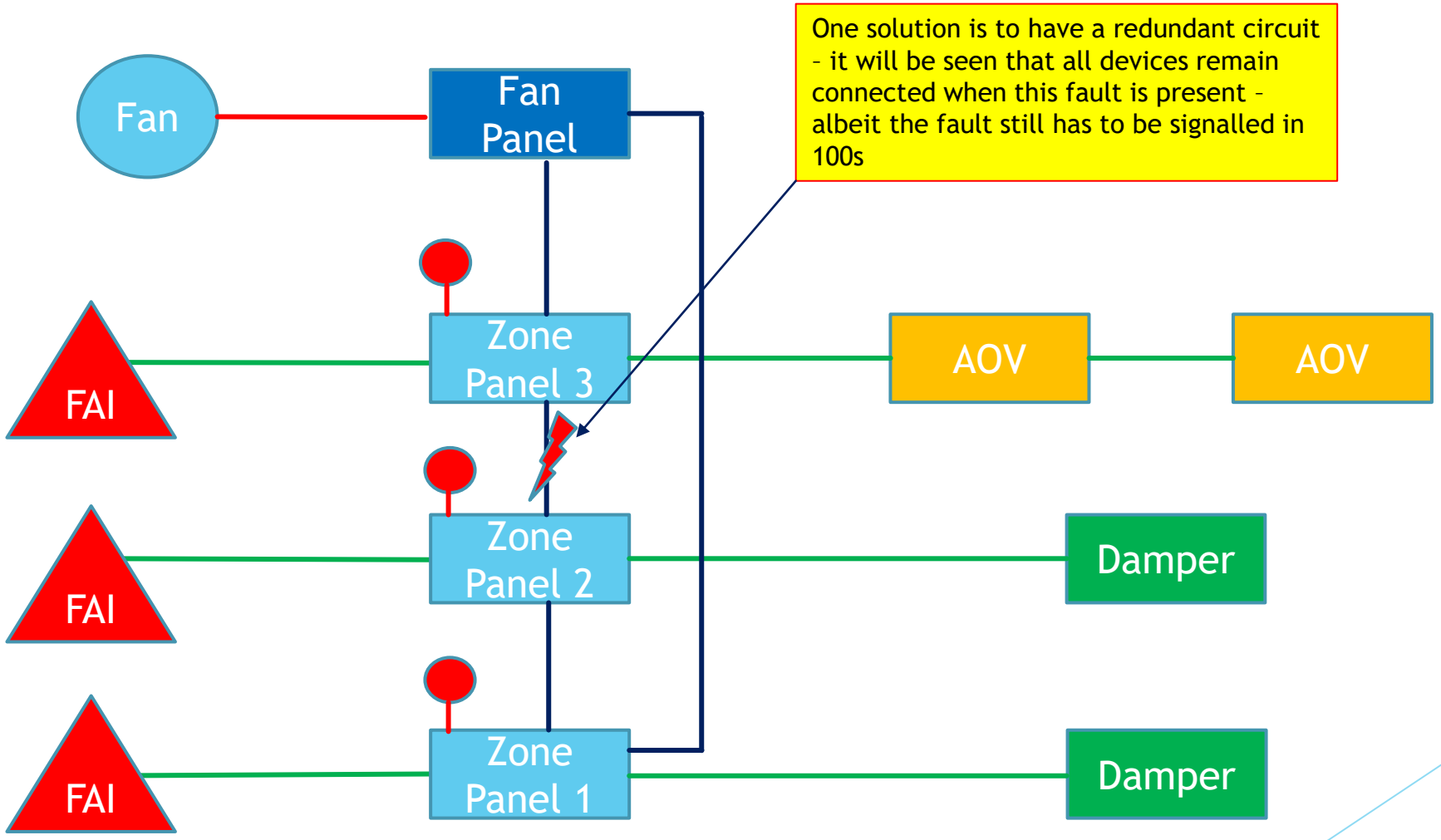
SMOKE CONTROL ASSOCIATION

Transmission path faults (3)



SMOKE CONTROL ASSOCIATION

Transmission path faults (4)



SMOKE CONTROL ASSOCIATION

Now just a few general clauses

Design and documentation

Clause 8.5

Interruption of a power supply shall not cause any change in indications or state of any outputs

Clause 8.6

Distributed control system, integrity of transmission paths, and integrity of power supplies

SMOKE CONTROL ASSOCIATION

Requirements for Environmental Testing

Test	Class of c.p.				Operational or endurance	Clause number
	1	2	3	4		
Cold	✓	✓	✓	✓	Operational	13.3
Damp heat, steady state	✓	✓	✓	✓	Operational	13.4
Impact	✓	✓	✓	✓	Operational	13.5
Vibration, sinusoidal	✓	✓	✓	✓	Operational	13.6
Damp heat, steady state	×	✓	✓	✓	Endurance	13.7
Vibration, sinusoidal	✓	✓	✓	✓	Endurance	13.8
Dry heat	×	✓	✓	✓	Operational	13.9
SO_2 corrosion	×	×	✓	✓	Endurance	13.10
Salt spray testing	×	×	×	✓	Endurance	13.11
Protection against water (IP rating)	×	✓	✓	✓	Operational	13.12
Protection against substance (IP rating)	×	✓	✓	✓	Operational	13.13
EMC	✓	✓	✓	✓	Operational	13.14

Key

✓ test required
× test not required

SMOKE CONTROL ASSOCIATION

Designated Access Levels
- access to higher levels must be protected by key or passcode

Appendix A

Level 1 – General access

Level 2 – Trained operatives only

Level 3 – Engineering & Maintenance functoions e.g. altering configuration, labelling

Level 4 – Software configuration

SMOKE CONTROL ASSOCIATION

The regulations permit various options

4.2.1 Options may be included, but…..
whenever an option is adopted, the associated conditions must be applied

Examples of options include:

5.1.2.2 – Incorrect operation indication

5.1.4.4 – Audible indications

5.1.4.5 – Fire condition output to other systems

5.1.4.7 – Deadlock

5.1.6 – Disablement condition (eg maintenance)

5.1.7 – Test condition

SMOKE CONTROL ASSOCIATION

5
Other relevant considerations

This section looks at some relevant aspects outside of ISO 21927-9, but which nevertheless need to be considered

SMOKE CONTROL ASSOCIATION

Outside of ISO 21927-9

1. EN12101-3: Note the requirement that inverters must be tested and certified with the fan

2. EN12101-10: Relates to output power supplies eg 24V power supplies

3. BS 8519: Covers cabling requirements and also acceptable input power supply arrangements

SMOKE CONTROL ASSOCIATION

More to consider outside of ISO 21927-9

4. Commissioning

Thorough commissioning of smoke control systems is critical, and a system should be finally tested when all doors are fitted with adjusted closers, risers closed, and floor finishes are final. A plea here to M&E Contractors and Principal Contractors to factor in sufficient time in the construction program for this to be carried out

5. Testing and recording

This is a requirement imposed on a building's responsible person. Smoke Control systems require:

- Weekly functional testing – initiated through the fire alarm, and properly checked for correct operation
- All equipment must feature in a test at least once every 3 months
- Annual maintenance by a competent engineer

6. Remote monitoring

This feature is becoming more generally available, and by enabling automatic reporting of faults it allows quicker diagnosis leading to faster repairs. It also provides a confirmatory record for the responsible person that testing is being carried out

SMOKE CONTROL ASSOCIATION

Thank you

Any questions?

www.smokecontrol.org.uk

SMOKE CONTROL ASSOCIATION