Another EMC resource
from EMC Standards

Managing EMC for Functional Safety

Helping you solve your EMC problems

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How should EMC be controlled for acceptable functional safety?

- The new IEE Guidelines recommend using a hazards and risk assessment, as follows:

A) What EM threats could the apparatus possibly be exposed to?

B) What could possibly happen as a result of these EM threats?

C) Could EM disturbances emitted by the apparatus possibly affect other apparatus?

Hazard and risk assessment continued...

D) What are the reasonably foreseeable functional safety implications?

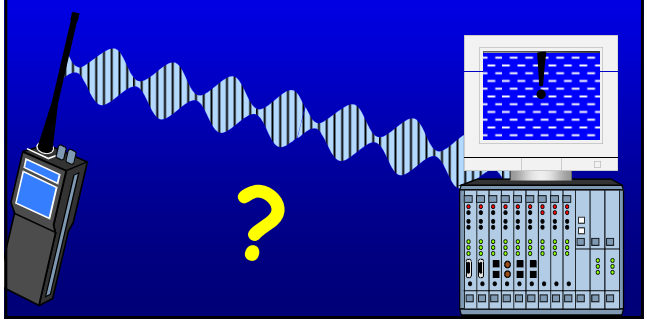
E) What actions are needed to achieve the required level of safety?

F) What documentation is required to show that the apparatus is safe enough?

A) What EM disturbances, however infrequent, might the apparatus be exposed to?

- Requires an assessment of the *possible* EM environment
  - for example, an increasingly common EMC problem is proximity to mobile radio transmitters, such as walkie-talkies and cellphones
    - these emit radio-frequency (RF) power
  - although they are not very powerful (a few watts)
  - they can be in close proximity, and so expose apparatus to quite strong RF fields.

What distance from a hand-held is equivalent to the EMC immunity tests for CE marking ?



What distance from a hand-held is equivalent to CE marking immunity tests?

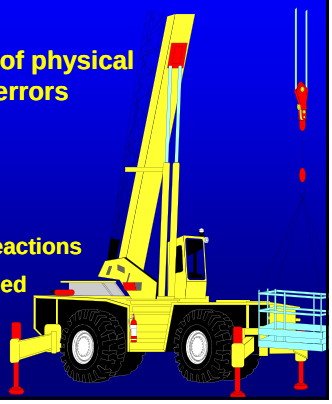
continued...

Type of transmitter	3V/m Commercial, and light industrial standards	10V/m Industrial immunity standards
Cellphone in strong signal area, 'intrinsically safe' walkie-talkie RF power = 0.8 Watts	1.7 metres (5½ feet)	0.5 metres (1½ feet)
Cellphone in weak signal area, or in standby mode RF power = 2 Watts	2.5 metres (8 feet)	0.76 metres (2½ feet)
Typical walkie-talkie handset RF power = 4 watts (note: some can go up to 10W)	3.7 metres (12 feet)	1.1 metres (3½ feet)
Typical vehicle-mobile (e.g. taxicab) or fixed base-station RF power = 100 Watts	18 metres (59 feet)	5.5 metres (18 feet)

Multiply distances by √2 for one constructive reflection from a metal surface, by √3 for two reflections, etc.

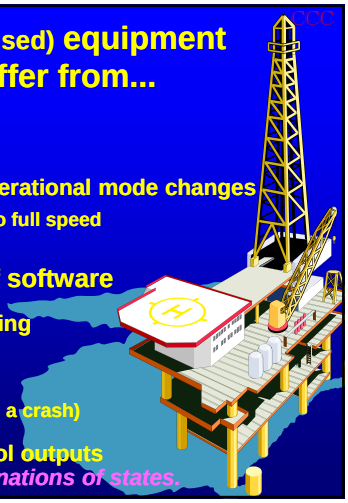
B) What are the foreseeable effects of EM disturbances on the apparatus?

- Measurement / control of physical parameters can suffer errors of up to ± 100%
  - not good news for...
    - safe load indicators
    - control of chemical reactions
    - control of vehicle speed
    - control of flow, temperature, pressure, etc..



Computer(-ised) equipment can suffer from...

- False key-presses
  - possibly leading to operational mode changes
    - e.g. from crawl speed to full speed
- Incorrect operation of software
  - e.g. continually repeating a subroutine
- Total failure (often called a crash)
  - which can leave control outputs in *any possible combinations of states.*



C) How might the emissions of EM disturbances affect other apparatus?

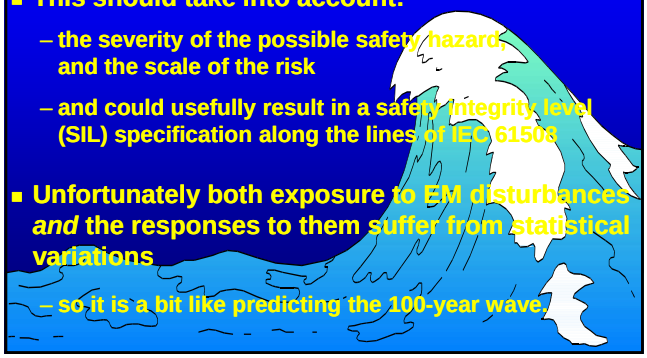
- Some types of equipment generate a great deal of electrical noise
  - can significantly worsen the EM environment they are going into
  - possibly causing interference problems for existing equipment / systems
    - which may have operated perfectly well and safely for decades.

How might emissions affect other apparatus
continued...

- Interference with telephones and radio systems is not uncommon
  - they are very sensitive
  - but even ordinary telephones can be safety-critical,
    - e.g. when you need to phone the emergency services
  - example of a North Sea Gas pumping station in Scotland that made ordinary wired telephones unusable up to 33km away.

D) What could be the reasonably foreseeable safety implications ?

- This should take into account:
  - the severity of the possible safety hazard, and the scale of the risk
  - and could usefully result in a safety integrity level (SIL) specification along the lines of IEC 61508
- Unfortunately both exposure to EM disturbances *and* the responses to them suffer from statistical variations
  - so it is a bit like predicting the 100-year wave.



E) What actions are needed to achieve the desired level of safety?

- EMC 'proof' testing seems an obvious choice
  - but can be very difficult (even illegal) to do on-site
- Where products in serial manufacture are poorly designed for EMC, EMC type tests mean *nothing*
  - appropriate EMC performance must be determined and 'designed-in' for all critical areas, from the start
- Duplicated or triplicated channels must use different technologies to avoid common-cause EMC problems.

What actions are needed? continued...

- A procedure similar to IEC 61508 is recommended for managing the safety lifecycle
  - because it employs a quantitative risk-based approach
  - now believed by most safety professionals to be the best way to control safety issues.

F) What documentation is required to show the apparatus is safe enough?

- The Low Voltage and Machinery Directives require documented safety arguments
- Some construction projects often require approval by a Regulator of a 'safety argument' or a 'safety case'
- These safety arguments (cases) should now include EMC-related functional safety
  - for some projects they can be slender documents.

Documentation continued...

- All the EMC-related safety work that is done should be documented, including:
  - assessing the foreseeable EM environment
  - assessing the foreseeable hazards and risks
  - design / construction / installation / commissioning / testing and verification / manuals / maintenance / repair / refurbishment.

Installation instructions

- Installation requirements could include:
  - a specification for the electromagnetic environment in which the apparatus will function safely
  - the location of the apparatus with respect to other equipment and their cables
    - i.e. segregation
  - the cable types to be used and their routing
  - the common bonding networks to be used
    - i.e. earthing
  - lightning / surge protection requirements.

Maintenance and repair instructions

- Maintenance or repair operations often involve...
  - opening the doors of shielded cabinets
  - using mobile phones in very close proximity
- So instructions on how to ensure safety during maintenance or repair might be necessary
  - the hazards and risk assessment should have identified any such issues early on
    - so they can be designed-out as far as possible.

Limitations to use and warnings

- Could include (for e.g.) banning mobile phones from a defined area
  - although this might not be adequate in some very hazardous situations
- Publishing limitations to use and warnings can help avoid 'failure to warn' claims
  - e.g. manufacturer of equipment that emitted chlorine gas into the workplace found guilty (1999) of 'failing to warn' of susceptibility to transients.

Documentation continued...

- Documented safety arguments should also be valuable in reducing exposure to liability claims
  - liability laws generally place the burden of proof on the manufacturers
  - who have to show that their products were not likely to have caused the damage, injury, or financial loss.

Competency issues

- Many company EMC and safety engineers merely follow the relevant test standards
  - and don't know how to assess the reasonably foreseeable EM disturbances in an environment
  - or their functional effects on circuits or software
- EMC and Functional safety falls into a gap in the knowledge of many EMC and Safety experts too
- Little statistical information on EM disturbances, or their effects, has been published.

Competency in EMC-related functional safety includes...

- An understanding of low-probability EM disturbances, including those due to:
  - mobile or fixed radio, radar, TV transmitters and radio-energy equipment (e.g. EN 55011)
  - lightning and electro-static discharge
  - electrical or electronic faults
  - human error or misuse
  - heavy power use, overhead lines, HV switchgear, etc.
  - power supply quality.

Competency also includes...

- In-depth understanding:
  - of electrical and electronic devices, circuits, software
    - and how they can be upset by EM disturbances
  - of the application-related safety-related functions
    - and the implications of any failures
- Plus the means to keep knowledge and understanding up to date
- Plus sufficient authority and resources to ensure that what needs to be done, is done.

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the end

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