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The IET's New Guide: How to Do EMC to Achieve Functional Safety

Helping you solve your EMC problems

The IET's New Guide: How to Do EMC to Achieve Functional Safety

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This new (2008) Guide comprehensively describes practical and cost-effective procedures for both management and engineering, to help to save lives and reduce injuries, wherever electronic technologies are used in an “EFS”.

An “EFS” is product, equipment, system or installation in which malfunction or failure of Electrotechnology can increase Functional Safety risks.

The Guide can also be used to improve reliability, although some of its ‘fail-safe’ design techniques may not always be appropriate for this purpose.

The figure below shows the nine basic steps employed by the Guide's process, for a “Simple EFS”. The Guide has a figure applying the same process “Complex EFS” of any size or scale, having any number of subcontractors (e.g. a national railway network).

A comprehensive set of checklists are provided with the Guide – very useful aids in project management, design and compliance assessment.

Many EMC and safety engineers still think that all that is needed to control electromagnetic interference (EMI) for safety reasons, is to pass the normal EMC immunity tests. Some go further by increasing the test levels, which they say provides a “safety margin”.

But relying on EMC testing alone is much too simplistic for modern electronic control systems. It ignores most of the issues that arise over the lifecycle that can affect how EMI can increase safety risks.

To demonstrate that the design of a product, system or installation will be safe enough despite reasonably foreseeable EMI during its lifecycle, we must now use *Risk Management* methods as described by Edition 2 of IEC/TS 61000-1-2 [1].

IEC/TS 61000-1-2 Ed.2.0 has been written using the terminology of IEC 61508 – the IEC's basic standard on Functional Safety – so that it can be used as 61508's “missing EMC Annex”.

But there are other standards on functional safety, such as ISO 14971 (medical) and draft ISO 26262 (automotive), which describe the same basic functional safety principles but use different terminologies, making it difficult to apply 61000-1-2 directly to them.

For this reason, although the IET's Guide describes a practical series of steps to comply with IEC/TS 61000-1-2, it has been written in a way that is *universally applicable*, regardless of which functional safety standard, or none, is being used.

Interestingly, manufacturers who follow this new Guide should benefit from lower financial risks – because improved immunity to EMI should significantly reduce the number of warranty returns/repairs and product liability lawsuits.

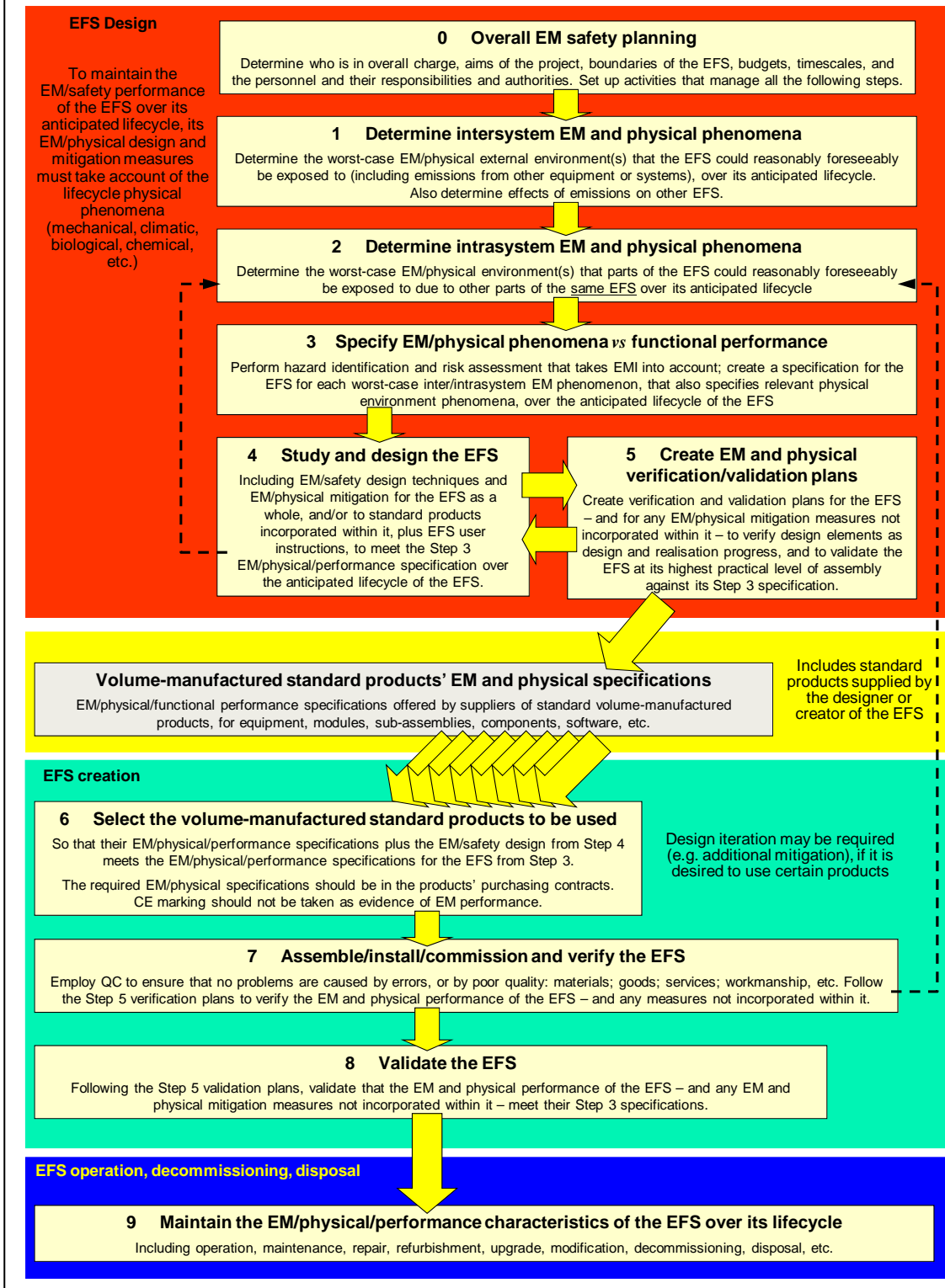
And because the Guide's procedures require the use of EMC expertise from project start, instead of the usual approach (design/assemble with little attention to EMC, then modify the design until EMC tests are passed) this will also help manufacturers get to market more quickly with lower overall manufacturing costs.

Here is a very brief overview of the Steps in the Guide's EMC for Functional Safety process:

Step 0 — Overall EM safety planning

This step determines who is in overall charge, the aims of the project, the physical boundaries of the EFS to be managed, budgets, timescales, and the personnel with their responsibilities and authorities. Having done all this, the appointed people then manage all the following steps.

Overview of the EMC for Functional Safety process for a 'Simple' EFS



Step 1 — Determine the *intersystem* EM and physical phenomena

Before the EFS can be designed, it is necessary to determine the *worst-case* external (i.e. intersystem) environment(s) that it could reasonably foreseeably be exposed to over its anticipated lifecycle.

Obviously, the electromagnetic (EM) environment must be determined, but it is also necessary to determine the physical, climatic and user environments because they can cause EM characteristics to be degraded over the lifecycle.

For example, exposure to liquids will hasten corrosion of EMC gaskets and ground bonds, and users might leave shielding doors open or remove shielding panels (functional safety has to take reasonably foreseeable misuse into account).

Step 2 — Determine *intrasystem* EM and physical phenomena

This is exactly the same as Step 1, except that it deals with the effects on the EM, physical, etc. environment *due to the EFS itself*. For example, a motor used in the EFS might cause problems due to vibration or its magnetic fields.

Because Step 2 depends on the design of the EFS (Step 4), it has to start out with a rough idea and be refined later as the other steps proceed.

Step 3 — Specify EM/physical phenomena versus functional performance

This step takes the inputs from Steps 1 and 2 and uses hazard identification and risk assessment techniques that take EMI possibilities into account.

The output of this step is a specification that guides the design, manufacture and verification/validation of the EFS, to ensure that EMI will not cause its safety risks to exceed the specified level over its lifecycle.

Step 4 — Study and design the EFS

This applies EM and safety design techniques, plus mitigation techniques to reduce the effects of the EM, physical, climatic and user environments (e.g. filters, surge suppressers, shock absorbers, anti-condensation heaters, etc.), to the entire EFS and/or to standard products incorporated within it. It also creates user instructions that specify necessary maintenance.

The goal of Step 4, as for all other steps in the process, is for the finished EFS to comply with the Step 3's EM/physical/performance specification, over its anticipated lifecycle.

Risk assessment techniques are applied to the design as it develops, with the final risk assessment only available at the end of the project, part of the validation that Step 3's specifications have been complied with.

Step 5 — Create EM and physical verification/validation plans

Because cost/time-effective verification and validation depend on the design, this step occurs in parallel with Step 4, at the same time.

Some of these verification plans are applied to elements of the EFS *during* Step 4 (e.g. calculations, simulations, experiments, design reviews, etc.).

Step 6 — Select the volume-manufactured standard products to be used

These are selected so that their EM/physical/performance specifications will – in conjunction with the EM/safety design of the EFS from Step 4 – meet Step 3's EM/physical/performance specifications for the finished EFS.

The required EM/physical specifications should be in the products' purchasing contracts. It is important to be aware that 'CE marking' or Declarations or Certificates of Conformity, should not be taken as evidence of actual performance.

Step 7 Assemble/install/commission and verify the EFS

During the manufacture installation and commissioning of the EFS, this step requires Quality Control techniques to be employed to ensure that no problems are caused by errors, or by poor quality materials, goods, services, workmanship, etc.

Also, the remainder of Step 5's verification plans are applied to verify that the EM and physical performance of the elements of the EFS – and of any necessary EM and physical mitigation measures not incorporated within it – are consistent with Step 3's specifications for the final, completed EFS.

Step 8 Validate the EFS

Step 5's validation plans are applied to the EFS at its highest practical level of assembly (ideally completed and finished).

This must demonstrate that the EM, physical, climatic and use/misuse performance of the *finished* EFS – including any necessary EM and physical mitigation measures that are not incorporated within the EFS itself – complies with Step 3's specifications.

Step 9 Maintain the EM/physical/performance characteristics of the EFS over its lifecycle

The users follow Step 4's User Instructions to maintain the EFS characteristics necessary for the achievement of Step 3's specified safety risks, during operation, maintenance, repair, refurbishment, upgrade, modification, decommissioning, disposal, etc.

The Guide is available as a free download from: www.theiet.org/factfiles/emc/index.cfm, and as a reasonably-priced colour-printed book from <http://www.emcademy.org/books.asp>.

[1] IEC TS 61000-1-2 Ed.2, December 2008: "*EMC – Part 1-2: General – Methodology for the achievement of functional safety of electrical and electronic systems including equipment with regard to electromagnetic phenomena*", purchase from <http://webstore.iec.ch/>.