



# INTEGRATION ENGINEERING SAFETY MANAGEMENT

## Crossrail Common Safety Method Hazard Assessment Process

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## **1 Purpose**

The purpose of this document is to define the process for applying the “Common Safety Method” Regulation for Risk Evaluation and Assessment (CSM Regulation) approach to engineering safety management hazard analyses on the Crossrail Project.

## **2 Scope**

Scope applies to all to hazard analyses carried out for the central operating section of the Crossrail railway, which includes CRL, its Delivery Contractors and Suppliers.

This hazard analysis relates to the future operational, maintenance and emergency safety of the Crossrail railway. It excludes installation and construction health & safety requirements which are facilitated via application of the Construction (Design and Management) (CDM) Regulations.

Also excluded are hazard analyses relating to the civil design elements of delivery contracts, or delivery contracts that are solely civil design, where operational, maintenance and emergency safety management is shown to be facilitated via the CDM Regulations. For this reason the CSM Regulation approach was not applied to a large part of the FDC contracts, which for example dealt with architectural design of stations. Similarly, any design of systems carried out by FDC contractors was at the concept level (up to RIBA Gate 2) hence low risk. The detailed design of the railway systems and supporting hazard analyses is undertaken by the subsequent Delivery Contractors who apply the CSM Regulation approach in full.

Adequacy of safety of railway systems during testing & commissioning activities are similarly excluded and are dealt with elsewhere in the contract requirements.

This document does not apply to adjacent On Network Works where Network Rail Infrastructure Limited is the Infrastructure Manager.

### **3 Definitions**

ALARP	As Low As Reasonably Practicable
BS	British Standards
CDM	Construction (Design and Management) Regulations
CRL	Crossrail Limited
CSM	Common Safety Method
EN	Euro Norm
ESM	Engineering Safety Management
FDC	Framework Design Consultant
LUL	London Underground Limited
NNTR	Notified National Technical Rule
NRIL	Network Rail Infrastructure Limited
ORR	Office of Rail and Road
PWHR	Project Wide Hazard Record
QRA	Quantitative Risk Assessment
RAMS	Reliability Availability Maintainability and Safety
RIR	The Railways (Interoperability) Regulations
ROGS	The Railways and Other Guided Transport Systems (Safety) Regulations (as amended)
SIF	Safety Issues File
SIL	Safety Integrity Level
TSIs	Technical Specifications for Interoperability

## **4 Background**

Where applicable, the Crossrail Project shall comply with the relevant railway safety legislation:

- The Railways (Interoperability) Regulations 2011 (RIR)
- The Railways and Other Guided Transport Systems (Safety) Regulations 2006 as amended [ROGS]

The requirements for Engineering Safety Management in support of the Regulations are defined in the following Crossrail Project documents:

- Crossrail ESM System Safety Plan [Ref 1]
- Crossrail ESM Hazard Management Procedure [Ref 2]

The RIRs mandate the “Common Safety Method” approach for the evaluation of hazards on an interoperable railway as are described in the following.

- 2015/1136/EU & 402/2013/EU - EU Commission Regulation – common safety method for risk evaluation and assessment; and
- ORR Mar 2015 Guidance on the application of the common safety method (CSM) for risk evaluation and assessment.

The “Common Safety Method” is mandated by EU law. In view of this the Crossrail Project has implemented the “Common Safety Method” for the central section delivery and irrespective of whether or not the RIR currently apply.

## **5 CSM Process**

The Common Safety Method for Risk Evaluation and Assessment Regulation, and supporting ORR Guidance, advise that hazards can be analysed and evaluated by a combination of one or more basic principles:

- the application of Codes of Practice;
- comparison with similar systems (reference system);
- explicit risk estimation (using a combination of qualitative and / or quantitative methods).

How this is to be applied to the Crossrail railway is shown diagrammatically in Attachment 1 and summarised below:

### **A: Application of Codes of Practice**

The aim is that the railway systems comply with the relevant codes of practice, standards and specifications (NRIL, LUL, BS, EN, CRL etc.), where applied. The justification is to be given by the normal engineering assurance process for the Crossrail Project:

- Technical Assurance Plan [Ref 3]  
Non-compliances are to be identified and safety justified by the Crossrail Delivery Contractors.

Where the RIRs apply, the various Technical Files and “Certificates of Conformity” will confirm the engineering design is compliant with relevant TSIs and NNTRs for Crossrail.

**B: Comparison with Similar Systems (Reference System)**

Where reasonably practicable, the preference for the Crossrail Project is to use railway proven, tried and tested components, equipment and systems (i.e. reference systems). For each system the pedigree of proven use and safety performance shall be evaluated in respect of previous relevant NRIL or LUL product approvals, or via cross-acceptance from another recognised railway authority. The safety implications of differences in application and environment of the Crossrail Project shall be analysed by the Crossrail Delivery Contractors.

In event of components, equipment or systems being proposed with no obvious justification of proven use (i.e. not a reference system) then this will be highlighted, and the necessary evidence provided to secure approval for use from the relevant acceptance bodies in advance of finalising the design. In certain circumstances, this may require the preparation of a Application Specific Product Safety Case by the Crossrail Delivery Contractors.

The evidence of previous proven use is to be recorded by the Crossrail delivery Contractors in the Product Breakdown Structure for each of the elementary systems.

**C: Explicit Risk Estimation**

This is to be carried out using a combination of qualitative and / or quantitative methods.

All engineering design shall be subject to a suitable and sufficient depth of hazard identification, risk estimation and evaluation depending on the magnitude of the perceived safety risk, whether the risk is new/novel and the complexity of the system design (e.g. bespoke design). The estimation and evaluation shall confirm that risks are either eliminated or managed/controlled to ALARP.

For the majority of systems the risk estimation and ALARP justification shall follow a recognised risk matrix approach in accordance with the Crossrail ESM Hazard Management Procedure [Ref 2]. However, for high risk (e.g. where the unavailability of the system safety function is judged immediately life threatening), new/novel and/or complex or bespoke systems this may require a full, in depth, engineering safety analysis.

The risk identification, estimation and evaluation will be recorded and monitored to successful resolution by the Crossrail Delivery Contractors in the Crossrail Project Wide Hazard Record (PWHR).

Preliminary examples of how the “Common Safety Method” approach may be applied to various railway systems are given in Attachment 1. These are informative and are to be confirmed by the relevant Delivery Contractors/Suppliers as part of the engineering safety management.

The overall justification of acceptable safety under the “Common Safety Method” is to be presented in Engineering Safety Justifications prepared by Crossrail Delivery Contractors at final design and post the successful completion of testing and commissioning.

## **6 ESF Deliverables**

The following documents outline the proposed format and/or approach for the document deliverables shown in Attachment 1:

### **Product Safety Case**

In conformance with:

- BS EN 50129: 2003, 'Railway applications – Communication, signalling and processing systems – Safety related electronic systems for signalling'

### **Product Breakdown Structure**

- Crossrail Process and Format for Product Breakdown Structures for Systems [Ref 4]

### **CRL Safety Issues File**

- Crossrail Safety Issues File (SIF) and Action Tracker Report [Ref 5]

### **Project Wide Hazard Record**

- Crossrail Project Wide Hazard Record Process [Ref 6]

### **Design and Final Engineering Safety Justifications**

- Crossrail Process and Format for Engineering Safety Justifications for Systems [Ref 7]

### **Safety Integrity Level Requirements**

- BS EN 50126 -1: 1999, 'Railway applications – The specification and demonstration of Reliability, Availability, Maintainability and Safety (RAMS)';
- BS EN 61508-1: 2010, 'Functional safety of electrical/electronic /programmable electronic safety-related systems – Part 1: General requirements'.

### **Risk Assessments**

To be carried out in accordance with Crossrail Delivery Contractors or Suppliers engineering safety management systems as defined in their respective System Safety Plans, or equivalent process documentation.



## 7 Reference Documents

Ref:	Document Title	Document Number:
1.	Crossrail ESM System Safety Plan	CRL1-XRL-O7-GST-CR001-00001
2.	Crossrail Engineering Safety Management Hazard Management Procedure	CRL1-XRL-O8-GPD-CR001-50002
3.	Technical Assurance Plan (TAP)	CRL1-XRL-O7-STP-CR001-50003
4.	Crossrail Process and Format for Product Breakdown Structures for Systems	CRL1-XRL-O8-GPS-CR001-50002
5.	Crossrail Safety Issues File (SIF) and Action Tracker Report	CRL1-XRL-O8-LLG-CR001-50001
6.	Crossrail Project Wide Hazard Record Process (draft)	CRL1-XRL-O8-GPS-CR001-50013
7.	Crossrail Format and Process for Engineering Safety Justifications for Systems	CRL1-XRL-O8-GPS-CR001-50004

## 8 Other References

Ref:	Document Title	Document Number:
N/A	BS EN 50129:2003 Railway applications – Communication, signalling and processing systems – Safety related electronic systems for signalling’	N/A
N/A	BS EN 50126 -1: 1999, ‘Railway applications – The specification and demonstration of Reliability, Availability, Maintainability and Safety (RAMS)’;	N/A
N/A	BS EN 61508-1: 2010, ‘Functional safety of electrical/electronic /programmable electronic safety-related systems – Part 1: General requirements’.	N/A

## 9 Standard Forms / Templates

Ref:	Document Title	Document Number:
A.	None	

## 10 Appendices

### Attachment 1: Application of Common Safety Method Flowchart

<https://eb.crossrail.co.uk/eB/Search/QuickLink.aspx?n=CRL1-XRL-O8-GPS-CR001-50003&t=3&d=Main%5ceBProd&sc=Global&state=LatestApproved&i=view>