

INTEGRATION ENGINEERING SAFETY MANAGEMENT

Crossrail Delivery Contracts Standard ESM Requirements Specification

Document Number: CRL1-XRL-O8-GPD-CRG03-50001

Current Document History:

Revision:	Effective Date:	Author(s) (‘Owner’ in eB *)	Reviewed by: (‘Checked by’ in eB *)	Approved by:	Reason for Issue:
4.0	14-07-16	S James	Chi Wong	J Bates	Legislation update. Additional contract details added in Section 6.

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ESM Requirements Specification
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Previous Document History:

Revision	Prepared Date:	Author:	Reviewed by:	Approved by:	Reason for Issue
1.0	22-06-11	K. Harvey	C Bloxsome	M. Kilby	Issued for Implementation
2.0	26-08-11	K. Harvey	C Bloxsome	M. Kilby	New Contract Part 32
3.0	16-05-12	K. Harvey	C Bloxsome	M. Kilby	C610 update/peer review

Revision Changes:

Revision	Status / Description of Changes
4.0	Legislation update. Additional contract details added in Section 6.

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1 Purpose

The purpose of this document is to define the strategy for assigning engineering safety management requirements to delivery contracts so as to assure the future operational safety of the Crossrail railway.

A principal aim is to ensure a suitable and sufficient depth of engineering safety management is applied to contracts depending on the scope of supply, the complexity of the design and safety significance of the delivered railway systems. Where practicable, reliance is to be placed on previous railway proven use of components, equipment and systems (i.e. use of “reference systems”).

2 Scope

Scope is limited to the specification of engineering safety management requirements for delivery contracts involved in the design, procurement and installation of railway systems on the central section of the Crossrail Project.

The engineering safety management requirements relate 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 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 Construction Design and Management (CDM) Regulations.

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

3 Definitions

CDM	Construction Design and Management Regulations
CRL	Crossrail Limited
CSM	Common Safety Method Regulation
ESM	Engineering Safety Management
LUL	London Underground Limited
M&E	Mechanical and Electrical
ORR	Office Of Rail and Road
RAMS	Reliability Availability Maintainability Safety
RIR 2011	Railways (Interoperability) Regulations 2011
ROGs	Railways and Other Guided Transport Systems (Safety) Regulations
SCADA	Supervisory Control and Data Acquisition

4 Background

The assurance of safety during design, procurement and project delivery is influenced by the particular design discipline, and the railway systems, equipment and components involved. Traditionally, the design disciplines may be characterised as either “passive” or “active” where:

- “passive” relates to systems which essentially remain static throughout their operational life. These systems are generally civil engineering orientated, for example:
 - Route civils (formation works, utilities, drainage etc.)
 - Structures (bridges, viaducts etc.)
 - Tunnels and shafts (civil works such as tunnel boring and linings etc.)
 - Ground engineering (embankments, cuttings etc.)
 - Stations civil works

For “passive” systems the assurance of safety is driven by the application of established design and construction techniques, implementation of appropriate design standards and validation of the as-built design through quality assurance and certification. Since “passive” systems are related principally to civil design elements, the safety assurance is generally facilitated through the application of the Construction Design and Management (CDM) Regulations.

- “active” relates to systems which may be in a state of change as part of their operation. These systems generally relate to electric, electronic, and programmable electronic equipment but also include railway mechanical systems, for example:
 - Signalling, control and communications
 - Permanent way track infrastructure
 - Traction power and overhead line equipment
 - Non-traction power
 - Tunnel systems
 - Station systems
 - Rolling Stock

For “active” systems the design and operational safety is more prone to random or systematic failures involving components or equipment, or through interactions with other systems. Consequently, safety is assured through the application of an engineering safety management approach throughout the project delivery lifecycle, such as is recommended in:

- BS EN 50126 -1: 1999, ‘Railway applications – The specification and demonstration of Reliability, Availability, Maintainability and Safety (RAMS)’

To secure safety approval from the Competent Authority the Crossrail Project will comply with the applicable railway safety legislation, where relevant:

- Railways (Interoperability) Regulations 2011 (RIR 2011) as amended by the
- Railways (Interoperability) (Amendment) Regulations 2013
- Railways and Other Guided Transport Systems (Safety) Regulations 2006 as amended (ROGs), including
- Railways and Other Guided Transport Systems (Miscellaneous Amendments) Regulations 2013.

The RIR 2011 is supported by the “Common Safety Method” approach for the evaluation of hazards on an interoperable railway as are described in the following:

- EU/402/2013 EU Commission Regulation – Common Safety Method for Risk Evaluation and Assessment;
- and EU/2015/1136 EU Commission Regulation – Amending Common Safety Method for Risk Evaluation and Assessment (collectively the CSM Regulation)
- ORR March 2015 Guidance on the Application of the Common Safety Method (CSM) on Risk Evaluation and Assessment (against EU/402/2013).

Where the RIR 2011 do not apply it is not mandatory to apply the CSM Regulation although it is recognised as a good practice but its use is voluntary. The alternative approach for non-RIR 2011 would be to apply the “Yellow Book”:

- RSSB, Engineering Safety Management Fundamentals and Guidance (Yellow Book), Issue 4, 2007

However, it is recognised that the “Yellow Book” has been withdrawn to account for the widespread implementation of the CSM Regulation as being the best practice in the UK. Therefore the Crossrail Project has implemented an engineering safety management system consistent with the CSM Regulation to all areas of the central section delivery, irrespective of whether or not the RIR 2011 applies.

The areas where the RIR 2011 do and do not apply are described in:

- CRL1-XRL-07-GST-CR001-00001 Engineering Safety Management – System Safety Plan

Noting the above, the withdrawn “Yellow Book” may be used as a reference source of accepted Engineering Safety Management methodologies to be applied in support of the CSM Regulation.

The CSM Regulation, and supporting ORR Guidance, advises that hazards can be analysed and evaluated by a combination of one or more basic principles:

- A. The application of Codes of Practice (including standards and specifications);
- B. Comparison with similar systems (reference system – with proven railway use);
- C. Explicit risk estimation (e.g. consistent with BS EN 50126).

For the majority of railway systems, having a proven railway use, it is envisaged that safety assurance will be demonstrated via the application of A & B. Only for more complex or high risk systems, and/or new/novel or bespoke design, should C require to be significantly applied.

5 Strategy

The strategy is to prepare a standard form of contract Works Information Volume 2B Part 32 of systemwide contracts, or equivalent section for other contracts, to outline the engineering safety management requirements. This can be found in Works Information Volume 2B – Part 32 Contractors Engineering Safety Management Requirements (Systemwide) (Ref 2).

The principal requirement is to comply with the Crossrail strategy for engineering safety management defined in:

- Engineering Safety Management – System Safety Plan (Ref 1)

How the CRL System Safety Plan is to be implemented on the Project is explained in the “Crossrail Engineering Safety Management Reference Manual” which will be provided for guidance to the Contractor by the Project Manager within 4 weeks of the contract starting date.

Other requirements relate to the preparation of a common set of engineering safety deliverables however the depth of engineering safety management, hence complexity of the documentation, will reflect the scope of supply of the contract and the railway system(s) involved.

Some safety deliverables may not be required where systems have proven railway use (i.e. a reference system), and the design is to agreed standards and relatively straightforward. A suitable and sufficient depth of engineering safety management is to be agreed between the Contractor and Project Manager/Employer through the preparation of a contract specific System Safety Plan.

At the tender stage a preliminary System Safety Plan is to be prepared by each of the Tenderers to evaluate their proposed approach to Engineering Safety Management and compliance with Part 32.

In addition to the standard form of contract, the following supporting information is to be provided in Works Information Volume 2C of the contract:

- Preliminary Project Wide Hazard Record (hazard log) relevant to the contract;
- Preliminary Safety Integrity Level Requirements relevant to the contract.

6 Conclusions

This document represents a pragmatic strategy for the implementation of suitable and sufficient engineering safety management requirements for Crossrail delivery contracts.

It is to be applied to the delivery of “active” railway systems comprising electric, electronic or programmable electronic equipment and railway mechanical systems.

Civil engineering “passive” systems are to be safety assured in accordance with application of the Construction Design and Management (CDM) Regulations.

The standard form of engineering safety management requirements in Works Information Volume 2B – Part 32 Contractors Engineering Safety Management Requirements (Systemwide) (Ref 2) shall be implemented into the Crossrail delivery contracts as listed below. The process shall be facilitated by the CRL Head of System Safety.

For delivery contracts not listed, these are essentially civil engineering orientated, and the assurance of safety will be delivered under the application of the CDM Regulations.

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Contract No	Delivery Contract Description	Comments
Tunnels Contract (other contracts principally civils & not included)		
C335	Shaft / Portal Finishing	<i>Apply Part 7 of Volume 2A of Standard Works Information supported by (Ref 2) – See note [1]</i>
Stations Fit Out contracts (applies to stations systems delivery only)		
C405	Paddington Station Main Works/Fitout / M&E (inc Bakerloo link)	<i>Apply Part 7 of Volume 2A of Standard Works Information supported by (Ref 2) – See note [1]</i>
C412	Bond St Station Main Works/Fitout / M&E	
C422	Tottenham Court Road Station Main Works /Fitout / M&E	
C435	Farringdon Station Main Works /Fitout / M&E	
C502	Liverpool St Station Main Works/Fitout / M&E	
C502	Liverpool St EDF Powerlink Substation	
C512	Whitechapel Station Main Works/Fitout / M&E	
C520	Custom House Main Works/Fitout / M&E	
T142	Canary Wharf Station Design & Build Contract	
C530	Woolwich Station Design & Build Contract	
Framework Contracts (applies to delivery of systems only & installed by Station Fit Contractor)		
C730	Lifts	<i>Apply Part 7 of Volume 2A of Standard Works Information supported by (Ref 2) – See note [1]</i>
C740	Escalators	
F943	Uninterruptable Power Supplies	
F944	Building Management System	
F945	DALI lighting Control	
Railway Systems (applies to all railway systems)		
C610	Systemwide Main Works (Track / OLE / Tunnel M&E / Trace Logistics)	<i>Apply (Ref 2)</i>
C620	Signalling System	
C625	Rail Control Centre	
C631	Platform Screen Doors	
C641	Kensal Green Traction Power Bulk Supply Point	
C643	Pudding Mill Lane Traction Power Bulk Supply Point	
C644	Traction Power Infrastructure	
C650	Non-Traction High Voltage Power Systems	
C660	Communications & Control Systems (inc SCADA & Radio)	
Other Contracts (managed by RfL on behalf of CRL)		
C828	Maintenance Depot/Sidings	<i>RfL will comply with the CRL SSP using approach consistent with (Ref 2) and provided CRL with the safety deliverables defined in the CRL SSP.</i>
X2235	Rolling Stock & Ilford Depot	

Notes

[1] It should be emphasised that Works Information Volume 2B – Part 32 Contractors Engineering Safety Management Requirements (Systemwide) (Ref 2) applies only to the railway/station systems, and not the civil engineering elements which are significant for stations (and shafts). For this reason it was decided by Procurement to include a minimal requirement in Part 7 of Volume 2B of the Standard Works Information of these essentially civil contracts and use information in Works Information Volume 2B – Part 32 Contractors Engineering Safety Management Requirements (Systemwide) (Ref 2) to advise the Contractor how the railway/station systems require to be safety assured.

In addition, where LUL is the IM then the application of Works Information Volume 2B – Part 32 Contractors Engineering Safety Management Requirements (Systemwide) (Ref 2) should be viewed in the context of the assurance requirements of the 1-538 (Ref 13). In the event of conflicting requirements, the safety assurance and acceptance requirements of the LUL standard shall take precedence.

7 Reference Documents

Ref:	Document Title	Document Number:
1.	Engineering Safety Management – System Safety Plan.	CRL1-XRL-O7-GST-CR001-00001
2.	Works Information Volume 2B – Part 32 Contractors Engineering Safety Management Requirements (Systemwide)	CRL1-XRL-O8-XWI-CRG03-50002
3.	'Railway applications – The specification and demonstration of Reliability, Availability, Maintainability and Safety (RAMS)	BS EN 50126 -1: 1999
4.	The Construction (Design and Management) Regulations 2015 (CDM 2015)	SI 2015 No 51
5.	Railways (Interoperability) Regulations 2011 (RIR 2011)	SI 2011 No 3066
6.	Railways (Interoperability) (Amendment) Regulations 2013	SI 2013 No 3023
7.	Railways and Other Guided Transport Systems (Safety) Regulations 2006 as amended (ROGs)	SI 2006 No 599
8.	Railways and Other Guided Transport Systems (Miscellaneous Amendments) Regulations 2013	SI 2013 No 984
9.	EU Commission Regulation – Common Safety Method for Risk Evaluation and Assessment	EU/402/2013
10.	EU Commission Regulation – Amending Common Safety Method for Risk Evaluation and Assessment	EU/2015/1136
11.	ORR March 2015 Guidance on the Application of the Common Safety Method (CSM) on Risk Evaluation and Assessment (against EU/402/2013).	(No number)
12.	RSSB, Engineering Safety Management Fundamentals and Guidance (Yellow Book), Issue 4, 2007	(Withdrawn but may be used for reference)
13.	LUL category 1 standard “Assurance”	1-538

8 Standard Forms / Templates

Ref:	Document Title	Document Number:
A.	None	
B.		