



Technical Directorate

Crossrail Format and Process for Overall Safety Justifications

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1 Purpose

The purpose of this document is to define the format and contents of Overall Safety Justifications prepared to support the safety approval and acceptance of the Crossrail railway under the applicable railway safety legislation.

2 Scope

Scope is limited to Safety Justifications prepared for the central section of the Crossrail Project which are the responsibility of Crossrail Limited (CRL) to deliver as defined in the CRL System Safety Plan.

Such Safety Justifications shall be in compliance with the Safety Management Systems of the relevant Infrastructure Managers (RfL for infrastructure & relevant stations, LU for relevant stations) and the future Railway Undertakings (for rolling stock and depot). They confirm the as-built railway can be safely operated and maintained when considered against the proposed operating concepts of the assets concerned.

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

3 Definitions

ALARP	As Low As Reasonably Practicable
BS	British Standards
CDM	Construction and Design Management (Regulations)
CRL	Crossrail Limited
CSM	Common Safety Methods
DeBo	Designated Body
EMC	Electromagnetic Compatibility
EN	Euro Norm
ESM	Engineering Safety Management
FDC	Framework Design Contractor
HAZOP	Hazard and Operability study
HRP	Hazard Review Panel
HV	High Voltage
LU	London Underground
MEP	Mechanical Electrical Power

NNTR	Notified National Technical Rule
NoBo	Notified Body
NR	Network Rail (Infrastructure Limited)
OLE	Overhead Line Equipment
PRM	Persons with Reduced Mobility (TSI)
PSD	Platform Screen Doors
PWHR	Project Wide Hazard Log
RAM	Reliability Availability Maintainability
RCC	Rail Control Centre
RfL	Rail for London
RIBA	Royal Institute of Building Architects
RfR	Railway Interoperability Regulations (2011)
SfF	Safety Issues File
SIRP	System Integration Review Panel
SRT	Safety in Railway Tunnels (TSI)
TCR	Tottenham Court Road
TSI	Technical Specification for Interoperability

4 Background

The approach to safety approval and authorisation of the central section of the Crossrail railway is defined in:

- CRL1-XRL-07-GST-CR001-00001 Crossrail Technical Directorate - Engineering Safety Management – System Safety Plan.

The System Safety Plan presents the evidence in support of safety approval and authorisation by the Safety Authority in a series of "Overall" Safety Justifications:

- Systemwide (integrated "line of route" railway systems - signalling, track, power etc.);
- Stations (one for each station);
- Tunnels (safety in Central and Connaught Crossrail tunnels);
- Rolling Stock;
- Depot.

These Safety Justifications are structured in such a way that when considered together they represent the holistic case for safety for the integrated railway.

A major input to the Safety Justifications are the subordinate Engineering Safety Justifications prepared by the Crossrail Delivery Contracts for each of the elementary systems, as are explained in:

- CRL1-XRL-08-GPD-CR003-50001 Crossrail Delivery Contracts Standard Engineering Safety Management Requirements Specification;
- CRL1-XRL-08-GPS-CR001-50004 Crossrail Format and Process for Engineering Safety Justifications for Systems.

5 Contents of Safety Justifications

5.1 Generic Content of Safety Justification

Overall Safety Justification(s) shall include, but not limited to, the following:

Part 1 – Introduction

- Scope (including asset name & geographic/battery limits), definitions, abbreviations and references.

Part 2 - System Description

- An overview of the key systems considered within the scope of the Safety Justification, with reference to the relevant design assurance documentation;
- Statement of the Contractual breakdown of the scope of works (i.e. which systems have been delivered by the various Contracts).

Part 3 –Safety Management System

- Explanation of the key principles of the CRL Safety Management System, with reference to the CRL System Safety Plan, and how these principles have been applied to the scope of works considered by the Safety Justification;
- To confirm the adequacy of implementation of the CRL System Safety Plan via reference to internal/external safety reviews and audits of design, including Delivery Contractors and their Suppliers;
- Description of how Operational, Maintenance and Emergency preparedness have been addressed throughout the Project delivery;
- Overview of System Integration activities:
 - Safety adequacy of the physical (design engineering safety management) integration of the component equipment, sub-systems and systems;
 - Project Management of other assurance activities integrated with engineering safety (eg CDM, EMC, RAM).

Part 4 – Overall Safety Analysis

This section comprises the main evidence demonstrating the adequacy of safety of the assets within the scope of the Safety Justification. Safety evidence presented will vary depending on the involved Delivery Contractors and the assets being considered as is explained in sections 5.2 to 5.6 for each specific safety justification. The referred to safety evidence is traced to
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successful resolution (including endorsement by the CRL Technical Approval Body) in the overall ESM deliverables schedule:

- CRL1-XRL-08-TSC-CR001-50001 Crossrail Overall Engineering Safety Management Deliverables Schedule.

In compliance with the CRL System Safety Plan, a main aim of this part is to provide the assurance that engineering safety management has been carried out in conformance with the Regulation on Common Safety Method (CSM) for Risk Assessment and Evaluation. It shall also be demonstrated that associated safety risks have been correctly assessed and controlled to be tolerable and as low as reasonably practicable (ALARP).

In addition to the evidence described in sections 5.2 to 5.6 for each specific safety justification the following shall be addressed:

Part 4a - Application of Codes of Practice

- Confirmation the design is in compliance with the relevant codes of practice, standards and specifications (LU, NR, BS, EN, TSIs, NNTRs etc.). With reference to design assurance documentation, or other design deliverables generated by the Contract¹.
- Identification of any non-compliances to the applicable codes of practice, standards or specifications and evidence the safety implications have been assessed and judged to be acceptable (i.e. ALARP).
- Confirmation significant assumptions in support of the design have been identified, the safety implications assessed and judged acceptable (i.e. ALARP).
- Evidence that the safety requirements have been achieved, non-compliances identified, safety implications assessed and judged acceptable (i.e. ALARP).

Part 4b - Comparison with Similar Systems

- Evidence of relevant, previous and proven use, and safety approvals of components, equipment and systems used in the design.

¹ Where the scope of the Safety Justification is covered, or partly covered by the relevant TSIs/NNTR(s) then the evidence of compliance of these parts will be provided by the NoBo/DeBo appointed by CRL:

- Intermediate Statement of Verification to the relevant TSIs & NNTRs
- Technical File containing the evidence specified in RIR Schedule 6

For example, a significant input to the Safety Justification for Tunnels will be the conformity assessment against the Safety in Railway Tunnels (SRT) TSI. Similarly, for stations the Persons with Reduced Mobility (PRM) TSI.

- Confirmation that components, equipment and systems have been procured from reputable Suppliers/Manufacturers and with reference to the evidence of this provided by the Delivery Contractors;
- Reference to safety analyses of any claims made for cross-acceptance where the Crossrail application and/or environment may be fundamentally different to the claimed reference system(s);
- Reference to any CRL approved Product Safety Cases prepared by the Delivery Contractor where cross-acceptance has not been feasible and use on Crossrail has needed to be pre-authorised.

Part 4c – Explicit Risk Estimation

- Provides, or makes reference to, any explicit risk estimations (detailed safety analyses) which have been undertaken;
- Summary and discussion of the main safety risks associated with the design and how these risks are mitigated. With reference to the Project Wide Hazard Record which is the principle Project hazard management tool (i.e hazard log);
- Highlight any particular safety issues or concerns and how these risk have been managed.

Part 5 - Supporting Safety Evidence

- List of relevant safety documentation prepared and issued², and giving their approval status. Including, but not limited to:
 - Details of safety related workshops (e.g. HAZOPs, SIRP) carried out;
 - Details of any safety analyses and assessments undertaken;
 - Engineering Safety Justifications, of elementary systems;
 - Other relevant documentation.

Part 6 – Safety Constraints and Assumptions

To list and explain any identified:

- safety operating constraints relevant to the as-built design (e.g. functional, operational, physical parameters which are vital to safe operation);

² Hyperlinks to these documents held on the Crossrail document control system (eB) will be provided within the text of the Safety Justification.

- minimum operating requirements which must be met to assure the safety of the continuing operation of the as-built design (e.g. level of degraded operation with failed components/equipment; redundant equipment allowed out of service for maintenance);
- safety related assumptions, or other safety issues, to be brought to the attention of future operators and maintainers of the elementary system(s) and previously advised through the Safety Issues File and CRL Hazard Review Panel.

Part 7 - Conclusions

The overall judgement that:

- design has been carried out in accordance with good engineering safety practice and the specified functional, technical and safety requirements;
- safety requirements have been met, or, if not, safety risks managed and controlled to ALARP;
- the as-built design may be operated and maintained such that the risks are managed and controlled to ALARP.

5.2 Systemwide Safety Justification

The specific safety evidence to be represented in Part 4 of the Safety Justification is explained diagrammatically in Appendix A.

5.3 Station Safety Justification

These are to be prepared for each of the following central section stations:

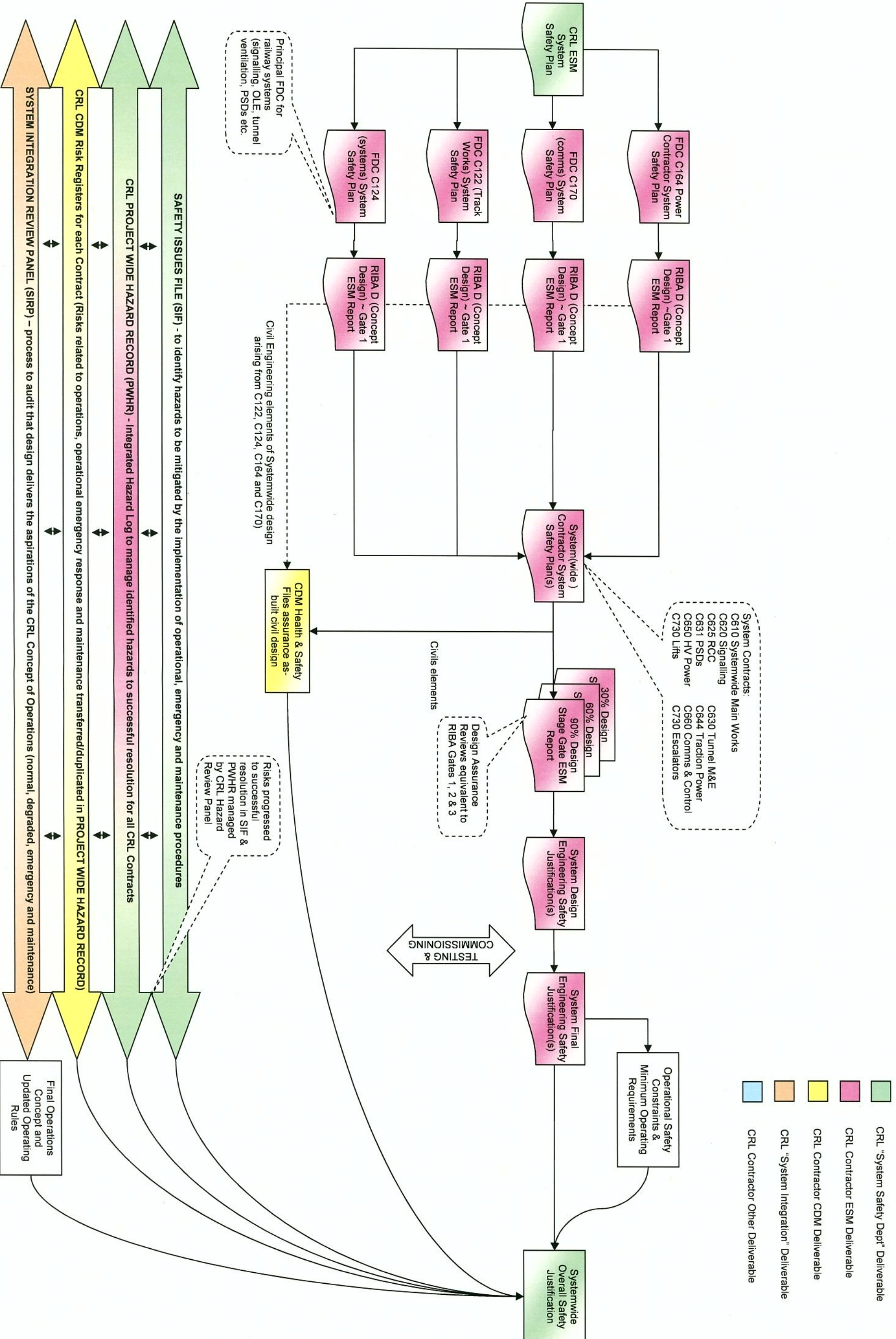
- LU Managed Stations:
 - Whitechapel Station
 - Bond Street Station
 - Tottenham Court Road Station
 - Farringdon Station
 - Liverpool Street Station
- RfL Managed Stations:
 - Paddington Station
 - Canary Wharf Station
 - Custom House Station
 - Woolwich Station

The specific safety evidence to be represented in Part 4 of the Safety Justification is explained diagrammatically in Appendix B.



Appendix A: Systemwide Overall Safety Justification

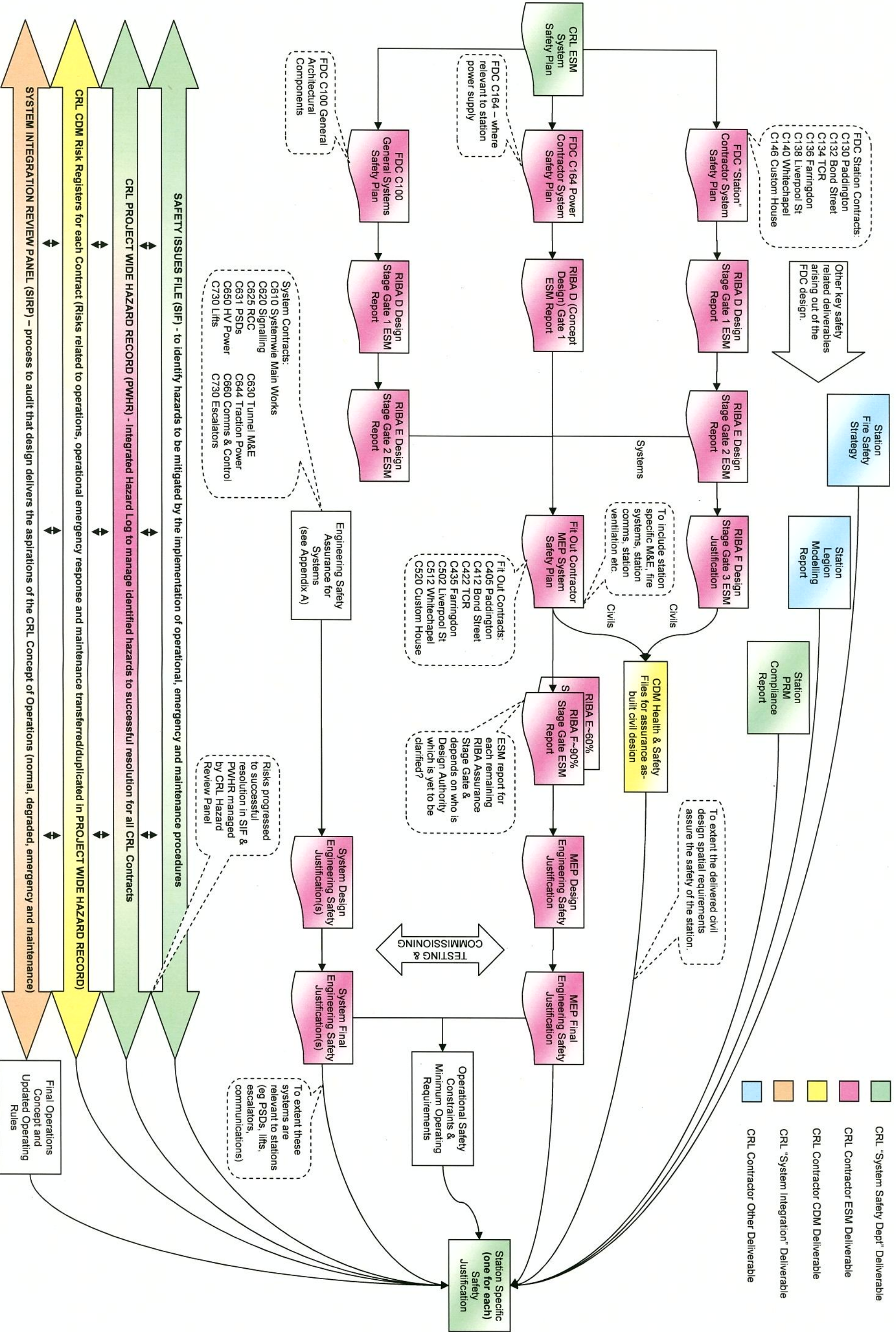
APPENDIX A: PROGRESSIVE ENGINEERING SAFETY ASSURANCE EVIDENCE IN SUPPORT OF OVERALL SYSTEMWIDE SAFETY JUSTIFICATION





Appendix B: Stations Overall Safety Justifications

APPENDIX B: PROGRESSIVE ENGINEERING SAFETY ASSURANCE EVIDENCE FOR STATION OVERALL SAFETY JUSTIFICATIONS (excluding Canary Warf)





Appendix C: Tunnels Overall Safety Justification

APPENDIX C: PROGRESSIVE ENGINEERING SAFETY ASSURANCE EVIDENCE FOR TUNNELS OVERALL SAFETY JUSTIFICATION

