



# INTEGRATION ENGINEERING SAFETY MANAGEMENT

## Project Wide Hazard Record Process

Document Number: CRL1-XRL-O8-GPS-CR001-50013

### Current Document History:

Revision:	Effective Date:	Author(s) (‘Owner’ in eB *)	Reviewed by: (‘Checked by’ in eB *)	Approved by:	Reason for Issue:
2.0	14-07-2016	S James	Chi Wong	J Bates	Review. Update to incorporate new PWHR metrics area and also to include new Safety Requirements module

**Previous Document History:**

<b>Revision</b>	<b>Prepared Date:</b>	<b>Author:</b>	<b>Reviewed by:</b>	<b>Approved by:</b>	<b>Reason for Issue</b>
1.0	06-03-2012	C Bloxsome	S Archbold	M Kilby	Issued For Use

**Revision Changes:**

<b>Revision</b>	<b>Status / Description of Changes</b>
2.0	Review. Update to incorporate new PWHR metrics area and also to include new Safety Requirements module

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## **1 Purpose**

- 1.1.1 The Project Wide Hazard Record (PWHR) has been developed to record and manage all identified hazards for the Crossrail Railway. It provides the central control and electronic reference document providing traceability of the hazard management activities for this.
- 1.1.2 The PWHR is a 'live' database managed through the use of a Database Object-Oriented Requirements System (DOORS) database.
- 1.1.3 The PWHR functions include:
- Detailing hazards;
  - Maintaining a list of safety records and a chronological journal of entries
  - Providing traceability to other safety documentation (e.g. FMECA, FTA, CBA, CPFR);
  - Collating evidence to justify that the design can be operated and maintained to a level that is tolerable and ALARP.
- 1.1.4 The purpose of this document is to define the process by which the hazards identified on the Crossrail Project are recorded, reviewed, accepted, referenced, mitigated, resolved and ultimately closed out or transferred to another stakeholder.
- 1.1.5 The hazard management procedure is defined in the Crossrail Engineering Safety Management (ESM) Hazard Management Procedure [1].
- 1.1.6 The PWHR meets the requirements of the Common Safety Method (CSM) Regulation [2], for the document in which identified hazards, their related measures, their origin and the reference to the organisation which has to manage them are recorded and referenced.

## **2 Scope**

- 2.1.1 This process shall apply to the management of all safety hazards identified at any stage of the Crossrail Project and by all the Design and Delivery Contracts covering the central section, the rolling stock and depot contracts, and Crossrail Ltd (CRL) (See Figure 1 – Section 7). It applies to all safety hazards relating to the operation and maintenance of the Central Operating Section of the Crossrail Railway and of adjacent operating railways. The scope is the same as those defined in the Crossrail ESM System Safety Plan [3].
- 2.1.2 The PWHR is maintained separately from the Project Risk Register and CDM Risk Registers.

### **3 Definitions**

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#### **Definitions**

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Accident	An unintended event or series of events that results in harm.
Accident Sequence	A potential series of events leading from a hazard(s) to an accident. Typically there will be more than one accident sequence resulting from a given hazard.
Cause	System failure, sub-system failure, component failure, human error or operational conditions which could individually or in combinations result in the occurrence of a hazardous event.
Consequence	Outcome that could arise following the hazard being realised.
Contractor	For the purposes of this document only, any organisation contracted to CRL which is required to, or carries out Design or Design and Build (Delivery) activity on behalf of the project.
Control Measures	The measures (hardware systems and equipment or procedural) that are put in place to prevent or minimise the frequency at which the causes occur or to mitigate the consequences following the occurrence of a hazardous event.
Comply Pro 2 (CP2)	User friendly interface which provides access to DOORS without the need for Users to be familiar with the DOORS system.
Designer	For the purposes of this document only, any organisation contracted to CRL which undertakes Design activity on behalf of the project.
Hazard	A hazard is a condition that could lead to an accident.
Hazard Analysis	Analyses potential lines of cause and effect that might lead from an event to a hazard. The aim is to provide the best approach to control or eliminate the risk.
Hazard Identification	A process used to identify all potential lines of cause and effect that might lead from a hazard to an accident.
Hazard Record	The string of fields in a database that describes a hazard and the associated actions .
Incident	An unplanned, uncontrolled event, which under different circumstances could have resulted in an accident.
Inherent Consequence	The evaluated severity (1-5) of the accident before consequence control measures are considered. Consequence definitions are given in Appendix C, Table C2.
Inherent Frequency	The evaluated likelihood (1-5) that the hazard will result in an accident before cause control measures are considered. Frequency definitions are given in Appendix C, Table C1.
Inherent Risk	Combination of the inherent frequency and consequence. Risk classifications are given in Appendix C, Table C3.

Project Wide Hazard Record	The DOORS database in which all hazards identified, together with all related safety measures and system assumptions identified during the risk assessment process are recorded. In particular, it shall contain a clear reference to the origin and to the selected risk acceptance principles and shall clearly identify those in charge of controlling each hazard.
Requirements	Something that governs what, how well, and under what conditions a product will achieve a given purpose.
Residual Consequence	The evaluated severity (1-5) of the accident after consequence control measures are considered. Consequence definitions are given in Appendix C, Table C2.
Residual Frequency	The evaluated likelihood (1-5) that the hazard will result in an accident after cause control measures are considered. Frequency definitions are given in Appendix C, Table C1.
Residual Risk	Combination of the residual frequency and consequence. Risk classifications are given in Appendix C, Table C3.
Risk Control Action (RCA)	A risk reducing action on the Designer or the future infrastructure manager or maintainer.

## 4 Abbreviations

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### Abbreviations

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ALARP	As Low As Reasonably Practicable
CBA	Cost Benefit Analysis
HRP	Hazard Review Panel
CaCM Id	Cause Control Measure Id
CDM	Construction (Design & Management) Regulations 2007
CM	Control Measure
CoCM Id	Consequence Control Measure Id
CP2	Comply Pro 2
CPFR	Crossrail Programme Functional Requirements
CRL	Crossrail Ltd
DOORS	Database Object-Oriented Requirements System
DSRM	Derived Safety Requirements Module
CSM	Common Safety Method Regulation
ESM	Engineering Safety Management
FDC	Framework Design Consultant
FMECA	Failure Modes Effects and Criticality Analysis
FTA	Fault Tree Analysis
HAZID	Hazard Identification Study
HAZOP	Hazard and Operability Study
HE	Hazardous Event (refers to the codes used in the SRM)

HRP	Crossrail Hazard Review Panel
Hz Id	Hazard Id
IC	Inherent Consequence
IF	Inherent Frequency
IR	Inherent Risk
NRP	Nominated Responsible Person
PHA	Preliminary Hazard Analysis
PWHR	Project Wide Hazard Record
PS	Performance Specification (Systemwide)
RC	Residual Consequence
RCA	Risk Control Action
RF	Residual Frequency
RR	Residual Risk
RSSB	Rail Safety & Standards Board
SRM	Safety Risk Model (by RSSB)

## **5 Roles and Responsibilities**

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### **Roles and Responsibilities**

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**Hazard Review Panel (HRP)** The HRP has the responsibility of reviewing and determining the appropriate action for i) hazards that cannot be mitigated by design and require a future infrastructure manager or train operator to manage via operational rules and regulations and/or maintenance; and ii) hazards that remain intolerable after the hazard mitigations have been implemented.

**CRL Systems Safety Manager** The CRL System Safety Manager is the person responsible for managing the PWHR. They will arrange access to the PWHR database for the designers, confirm new hazards are valid and check for duplication. They will also liaise with the designer and HRP.

**Design & Delivery Contracts Engineering Safety Managers** The Design & Delivery Contracts Engineering Safety Managers are responsible and accountable to their respective Project Directors. Responsibilities include undertaking hazard assessments of the elements of the design and interfaces that are the responsibility of their organisation.

**Hazard Owner** The person and organisation responsible for the management of a particular hazard. This will normally be one of the Design & Delivery Contracts Engineering Safety Managers. It is the Hazard Owner's responsibility to ensure that the risk information for their allocated risks is up to date and accurate.

**Risk Control Action (RCA) Owner** The RCA Owner is the person who has been selected to take ownership of a specific RCA for a risk; this allocation is generally carried out as part of the risk identification process. The RCA Owner is the person who is best suited to implement the RCA most effectively e.g. a specific suppliers' Design Engineer. It is the RCA Owner's responsibility to ensure that specific RCAs are completed and reported on time.

Note: Some hazards will not be controlled by reasonably practicable changes to the design e.g. maintenance, procedures, etc. In these instances, the RCA Owner is likely to be one of the Infrastructure Managers or Railway Undertakings. Hazards can only be passed to an Infrastructure Manager or Railway Undertakings with their agreement. Evidence that the appropriate Infrastructure Manager or Railway Undertakings has accepted the control will be required before a hazard can be closed/transferred. This process is managed by the HRP.



## **6 Project Wide Hazard Record**

### **6.1 DOORS**

- 6.1.1 The PWHR is managed in the web based DOORS database system hosted by the company Comply Serve Ltd [4].
- 6.1.2 The DOORS system is accessed via the Comply Pro 2 (CP2) interface by logging onto the Comply Serve website, via Citrix. (Citrix will need to be installed to access DOORS.)
- 6.1.3 To use the PWHR there is no requirement for the Users to be familiar with DOORS. The structure and user interface of the PWHR is self explanatory.
- 6.1.4 PWHR users requiring training will have a half day's training provided by CRL (see Section 6.5).
- 6.1.5 The Crossrail Requirements and Assumptions are also recorded in the same DOORS database and administered by the CRL Requirements Team.

### **6.2 Access to the PWHR**

- 6.2.1 Read only access of the whole of the PWHR is granted to all individuals on the Crossrail Project who have PWHR access.
- 6.2.2 Restricted write access for the PWHR will be given to those individuals who have been allocated the responsibility to input the hazards into the database for their particular Contract known as the Nominated Responsible Person (NRP). This will typically be the Design & Delivery Contracts Engineering Safety Managers and hazard owners.
- 6.2.3 Full editorial rights will be limited to the CRL System Safety Manager and nominated representatives.

### **6.3 Request for Access to the PWHR**

- 6.3.1 A request for CP2 PWHR access can be made via e-mail to the Crossrail System Safety Team<sup>1</sup>. The request should be made by the CRL Project Manager, CRL Engineering Manager or Contractor Engineering Safety Manager, providing the following information:
  - Name
  - Title
  - Company
  - E-mail address
  - Type of access required (i.e. read only or NRP with restricted write access)
  - Contract(s) covered
- 6.3.2 Access to PWHR should take a maximum of 3 working days to arrange. Individuals will be notified by e-mail of their User login, password and confirmation of the type of access granted.

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<sup>1</sup> The Crossrail System Safety Team e-mail is [systemsafetyteam@crossrail.co.uk](mailto:systemsafetyteam@crossrail.co.uk).

## **6.4 Logging-On**

- 6.4.1 Once the PWHR User login has been set up, the User will be able to access the PWHR by going to the Complyserve website <http://www.complyserve.com/> and clicking “ComplyPro Login”.
- 6.4.2 After the User has logged in through the Complyserve website they will be able to access the PWHR by clicking on the **50180 Crossrail ComplyPro** icon in the Applications webscreen.

## **6.5 PWHR Training**

- 6.5.1 A PWHR training video has been prepared which describes how PWHR users can:
- add a new hazard record into the PWHR
  - enter the data
  - use the search function
  - print information
  - move between different screens
- 6.5.2 The training video is available on request to the Crossrail System Safety Team.
- 6.5.3 In addition to the training video, Crossrail will run a half day training session for Users requiring further training. These will be arranged by the CRL System Safety Manager.

## 7 Structure of the PWHR

### 7.1 PWHR Structure

7.1.1 The PWHR is divided into two areas as shown in Figure 1:

- 1 The **Design Contracts** – for Framework Design Consultants (FDC) responsible for developing the systemwide mechanical and electric reference designs, and the rail systems designs for the stations, shafts and portals
- 2 The **Delivery Contracts** –for Contractors responsible for the detailed design, build, testing and commissioning

7.1.2 It should be noted that this structure will be amended as additional contracts are let.

Design Contracts:

C100 Architectural Component Design
C121 Sprayed Concrete Lining
C122 Bored Tunnels
C122 Connaught Tunnel
C122 Plumstead Sidings
C123 Intermediate Shafts
C124 Tunnels and Shafts
C130 Paddington Station
C130 Bakerloo Link
C132 Bond Street Station
C134 Tottenham Court Road Station
C136 Farringdon Station design
C138 Liverpool street Station
C140 Whitechapel Station
C146 Custom House Station
C150 Royal Oak Portal
C152 Pudding Mill Lane Portal
C154 Victoria Dock Portal
C156 North Woolwich Portal
C156 Plumstead Portal
C158 Woolwich Station
C160 Depot
C160 Rolling Stock
C161 Iford Yard
C164 Bulk Power Distribution and HV System
C166 Rail Control Centre
C170 Comms and Control Systems

Figure 1 – PWHR Directory Structure

Delivery Contracts:

C335 Shaft / Portal Finishing
C336 Royal Oak Portal
C340 Victoria Dock Portal
C350 Pudding Mill Lane Portal
C360 Eleanor St and Mile End Shafts
C360 Fisher Street
C360 Limmo
C360 Stepney Green
C405 Paddington Advanced Piling and Lain Station / Fitout / M&E
C405 Bakerloo Link Paddington
C412 Bond St Main station / Fitout / M&E
C422 Tottenham Court Road St main station / Fitout / M&E
C435 Farringdon Main Station / Fitout / M&E
C502 Liverpool St Main station / Fitout / M&E
C512 Whitechapel Main Station / Fitout / M&E
C520 Custom House
C530 Woolwich Station
C610 Systemwide Main Works
C620 Signalling System
C625 Rail Control Centre
C631 Platform Screen Doors
C641 Kensai 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
C660 Communication & Control Systems
C730 Lifts
C740 Escalators
C828 Iford Yard
T142 Canary Wharf Station
RSPA Depot
RSPA Rolling Stock
NR On-Network
NR South East Spur
CRL Miscellaneous
RSSB
PWHR Training

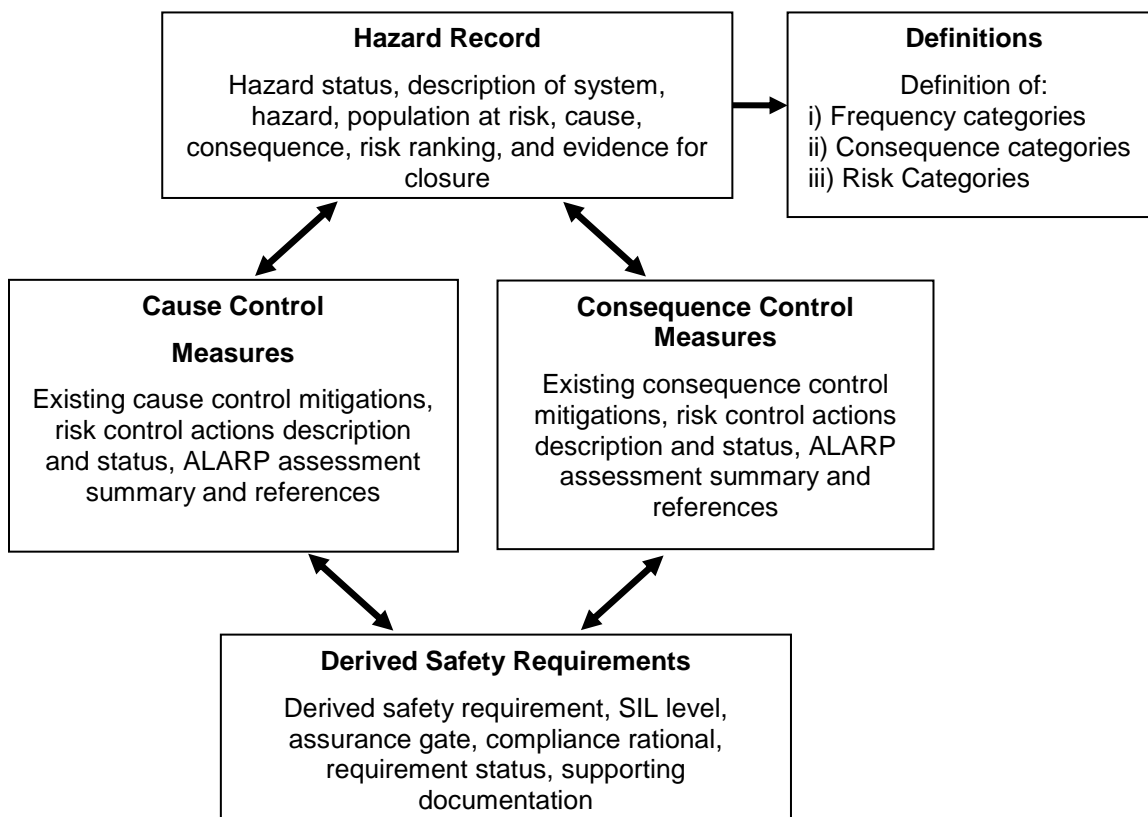
Figure 1 – PWHR Directory Structure

## 7.2 PWHR Sub-directory Structure

7.2.1 Each contract directory is further broken down into 4 sub-areas:

- **Hazard Record:** contains the hazards identified, details of each hazard record and risk information. Hazard records are linked to the Cause Control measures and Consequence Control Measures where appropriate. It is also linked to the definitions panel.
- **Cause Control Measures:** contains the cause mitigations. It is linked to the Hazard Record and Crossrail Requirements.
- **Consequence Control Measures:** contains the consequences mitigations. It is linked to the Hazard Record and Crossrail Requirements.
- **Derived Safety Requirements:** contains the derived safety requirements. It is linked to the Hazard Record, Cause Control Measures and Consequence Control Measures.

7.2.2 From the Control Measures directories (pages) there is an option to link to the project requirements in the performance specification.

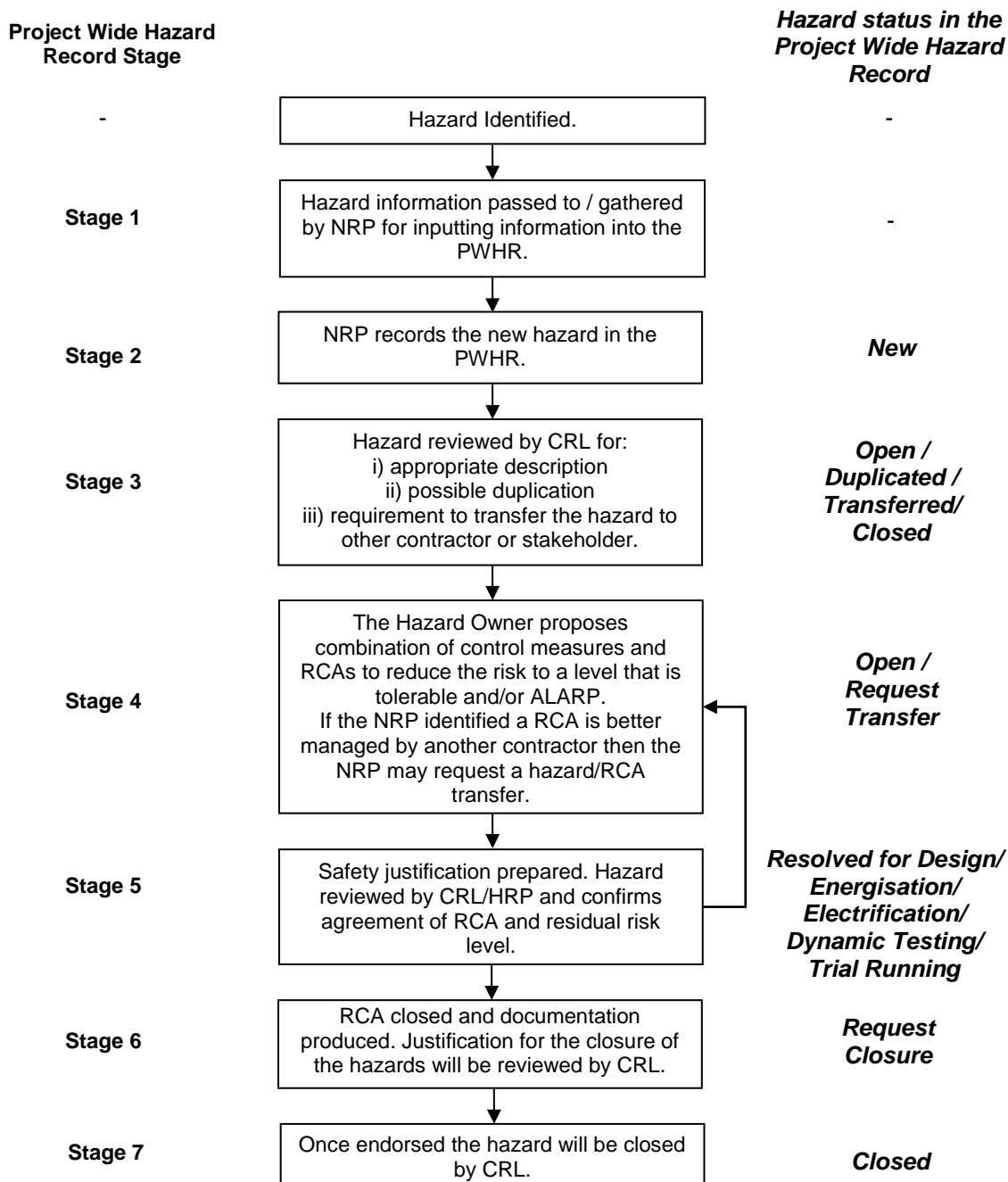


**Figure 2 – PWHR Sub-directory Structure**

## 8 PWHR Process

### 8.1 PWHR Process Stages

8.1.1 The management of the hazards within the PWHR has been divided into seven stages as detailed in the flowchart in Figure 3 below. These stages are addressed in more detail in the following sections.



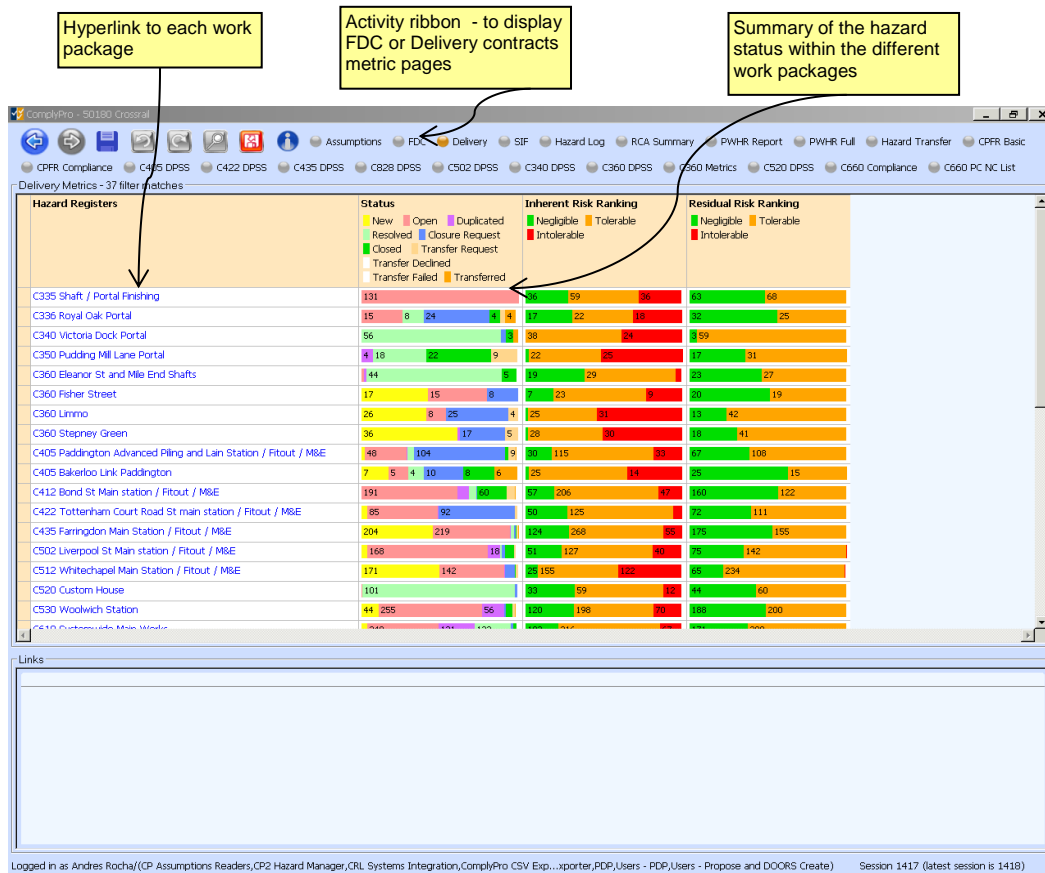
**Figure 3 - PWHR Process Stages**

## 8.2 Hazard Identification and Collation (Stage 1)

- 8.2.1 Hazards will be typically identified through the usual processes such as HAZIDs, HAZOPs and structured brainstorming workshops as described in the designer’s system safety plans.
- 8.2.2 Once a hazard has been identified it will be necessary to record the hazard within the PWHR. Within each of the contracts it will be the responsibility of the hazard owner to gather all the information together.
- 8.2.3 All information shall be passed to the NRP in charge of entering the information into the PWHR for each Design & Delivery Contract.
- 8.2.4 Delivery Contracts must check that all inherited hazards from the Design Contracts are relevant in the design taken forward.

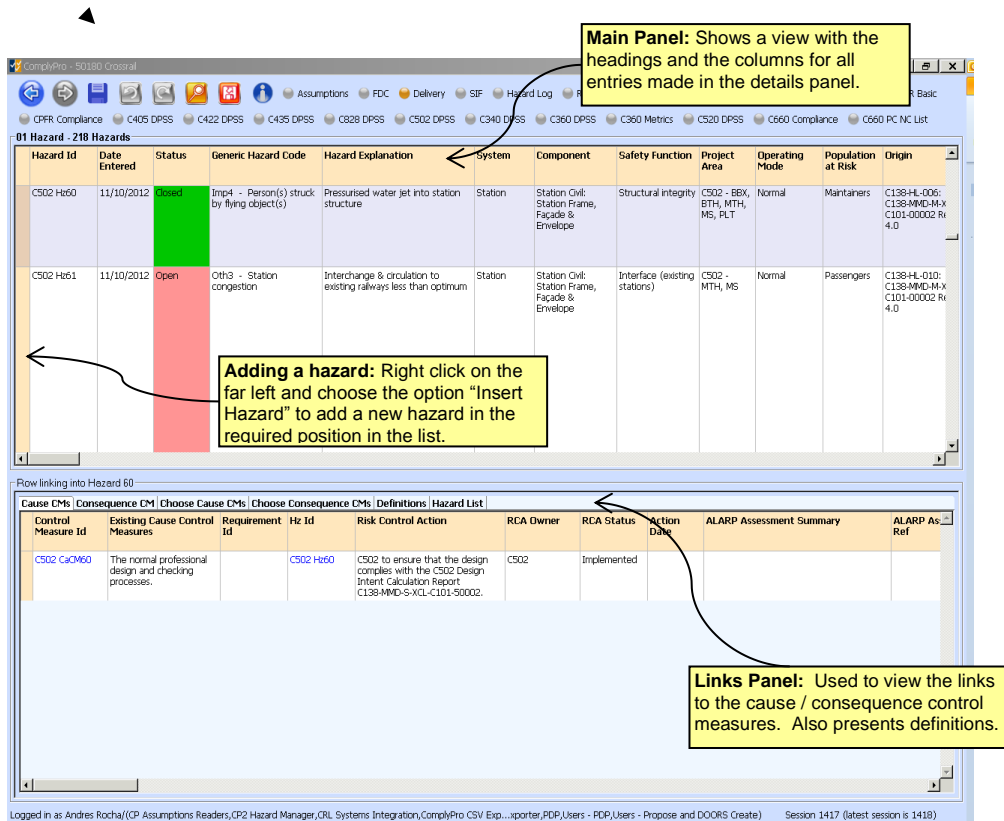
## 8.3 Creating a ‘New’ Hazard Record in DOORS (Stage 2)

- 8.3.1 Once the user is logged onto the DOORS Crossrail System, a PWHR metrics area will be displayed for most Users. Otherwise the User should click the **FDC** activity on the ribbon at the top of the screen to display the FDC metric area or the **Delivery** activity to display the Design & Build metric area. This will also ensure the relevant Links panel will be visible. The FDC metrics area is shown in Figure 4.



**Figure 4 - Snap Shot of the PWHR Metrics Area**

- 8.3.2 The FDC and Delivery metrics areas are effectively content pages of the hazard records within each contract and a summary of their status. By clicking on the contract the appropriate hazard area can be chosen.
- 8.3.3 The information required for a new hazard is listed in Table 1 overleaf. As can be seen some of the information is generated automatically by the DOORS system. This is denoted by *italics* in Table 1. The NRP should complete all the fields detailed using the instructions given in Table 1.
- 8.3.4 Figure 5 provides a snap shot of the typical PWHR screen indicating the locations of the panels. To create a new hazard, right click on the left of the main panel and choose “Insert Hazard After” or “Insert Hazard Before”.



**Figure 5 – Snap Shot of a Typical PWHR Screen Annotated with Different Panels**



**Table 1 creating a new hazard record in the PWHR**

<b>Creating a New Hazard Record in PWHR</b>		
<b>PWHR Field</b>	<b>Description</b>	<b>Entering data</b>
<b>Hazard ID</b>	An internal reference number is generated automatically by the system. The hazard prefix will indicate the contract the hazard has been identified by( or transferred to). For example those hazards identified by C124 will have the prefix "C124-".	-
<b>Date Entered</b>	The date the Hazard Record was entered is created automatically by the system <b>once the data is saved</b>	-
<b>Status</b>	The current status of the hazard is given. All new hazards will be allocated a new status. <b>The status can only be changed from New to Open by the CRL System Safety Team</b>	-
<b>Generic Hazard Code</b>	These are finite groups of hazards where the contractor hazards can be grouped into similar types. Appendix A presents the list of the Generic Hazards. More than one Generic Hazard can be linked to each hazard.	<b>Drop Down List</b> Double click in the cell for the drop down list to appear. Select the generic hazard(s) by clicking on the appropriate tick box(es).
<b>Hazard Explanation</b>	Detailed description of the hazard and explaining its cause which, if realised, has the potential to cause an accident.	<b>Free Text</b> Double click in the cell for the text box to appear. Once finished, click onto another cell to close the text box
<b>System</b>	The system to which the hazard relates. Only one system may be chosen.	<b>Drop Down List</b> Double click in the cell for the drop down list to appear. Select one of the systems by clicking on it.
<b>Component</b>	The sub-system /component to which the safety function applies.	<b>Free Text</b> Double click in the cell for the text box to appear. Once finished, click onto another cell to close the text box
<b>Safety Function</b>	The safety function which is not achieved in the event of realisation of the hazard.	<b>Free Text</b> Double click in the cell for the text box to appear. Once finished, click onto another cell to close the text box
<b>Project Area</b>	Identification of which Consultant/ Contractor's area of the Project is/are subject to the hazard.	<b>Free Text</b> Double click in the cell for the text box to appear. Once finished, click onto another cell to close the text box
<b>Operating Mode</b>	Operating modes relevant to the hazard e.g. normal, emergency, degraded or maintenance.	<b>Drop Down List</b> Double click in the cell for the drop down list to appear. Select the relevant operating mode(s) by clicking on the appropriate tick box(es).
<b>Population at Risk</b>	Population at risk from the hazard e.g. Passengers, driver, staff, maintainers, members of the public, emergency services.	<b>Drop Down List</b> Double click in the cell for the drop down list to appear. Select the relevant population at risk by clicking on the appropriate tick box(es).
<b>Origin</b>	The origin of the hazard e.g. PHA, HAZOP studies, Meeting.	<b>Free Text</b> Double click in the cell for the text box to appear. Once finished, click onto another cell to close the text box
<b>CDM Cross-Reference</b>	Cross – reference to CDM Risk Register. The corresponding hazard(s) in the CDM risk register should be recorded where appropriate.	<b>Free Text</b> Double click in the cell for the text box to appear. Once finished, click onto another cell to close the text box
<b>Cause</b>	Description of the causes of the hazard being realised (e.g. system failure, sub-system failure, component failure, human error).	<b>Free Text</b> Double click in the cell for the text box to appear. Once finished, click onto another cell to close the text box
<b>Cause Comments</b>	General comments can be added here.	<b>Free Text</b> Double click in the cell for the text box to appear. Once finished, click onto

<b>Creating a New Hazard Record in PWHR</b>		
<b>PWHR Field</b>	<b>Description</b>	<b>Entering data</b>
		another cell to close the text box
<b>CaCM Id(s)</b>	See stage 4 (Section 6.5) below.	-
<b>Consequence</b>	Description of the consequences of the hazard being realised.	<b>Free Text</b> Double click in the cell for the text box to appear. Once finished, click onto another cell to close the text box
<b>Consequence Comments</b>	General comments can be added here.	<b>Free Text</b> Double click in the cell for the text box to appear. Once finished, click onto another cell to close the text box
<b>CoCM Id(s)</b>	See stage 4 (Section 6.5) below.	-
<b>RSSB HE Code</b>	The RSSB Safety Risk Model Hazardous Event Codes are used to help describe the hazard. A full list of RSSB Hazardous Events (HE) is given in Appendix B. <b>This field is not mandatory</b> and has a default "Not assessed".	<b>Drop Down List</b> Double click in the cell for the drop down list to appear. Select the relevant RSSB HE codes by clicking on the appropriate tick box(es).
<b>IF</b>	<b>IF is the inherent frequency</b> , the evaluated likelihood that the hazard will result in an accident before all existing control measures and Risk Control Actions (RCA) are considered, in accordance with the frequency definition given in the Engineering Safety Management Hazard Management Procedure (see Appendix C).  Note: The definitions are also given by clicking on the "Definitions" tab in the Links Panel.	<b>Drop Down List</b> Double click in the cell for the drop down list to appear. Select one of the numbers from 1 to 5 by clicking on it.
<b>IC</b>	<b>IC is the inherent consequence</b> , the evaluated severity of the accident before all existing control measures and Risk Control Actions (RCA) are considered, in accordance with the severity definition given in the Engineering Safety Management Hazard Management Procedure (see Appendix C).  Note: The definitions are also given by clicking on the "Definitions" tab in the Links Panel.	<b>Drop Down List</b> Double click in the cell for the drop down list to appear. Select one of the numbers from 1 to 5 by clicking on it.
<b>IR</b>	<i>The Inherent Risk (IR) is based on the inherent frequency and consequence. The evaluated inherent risk is generated automatically by the system.</i>	-
<b>Hazard Owner</b>	The organisation and safety manager responsible for the management of the hazard.	<b>Free Text</b> Double click in the cell for the text box to appear. Once finished, click onto another cell to close the text box
<b>Last Review Date</b>	<i>This is an automatic indication of when the hazard record was last updated.</i>	-
<b>Transfer Target</b>	Target contract/ stakeholder responsible to close the hazard	<b>Drop Down List</b> Double click in the cell for the drop down list to appear. Select the relevant target contract for transfer by clicking on the appropriate tick box(es).
<b>Linked Hazard</b>	<i>When the hazard is transferred to another entity, this field will show the link to the hazard in the target module</i>	

## **8.4 Change of Hazard Record Status (Stage 3)**

- 8.4.1 All new hazard records entered into the PWHR are given a 'new' status. All 'new' hazards will be reviewed by a CRL System Safety Manager (or nominated representative) to confirm that the hazard is appropriate. Once the hazard record has been confirmed as valid, the hazard record status will be change from 'new' to 'open' by the CRL System Safety Manager.
- 8.4.2 Should the hazard be identified as being duplicated the hazard will be recorded as "duplicated" and no further action will be required.
- 8.4.3 There may be a requirement to transfer the hazard to another designer or stakeholder. This may occur when an identified hazard is better dealt with by an interfacing designer or stakeholder. This will be managed via the CRL System Safety Team working with the relevant design hazard owners.
- 8.4.4 If the hazard is not deemed to be valid, the hazard record status will be changed to "closed", with a justification for closure given in the CRL Comments field.
- 8.4.5 Hazard records may not be deleted once saved in the PWHR.
- 8.4.6 Should it be considered that a hazard is better managed by another party then the NRP may request a hazard transfer. This request is made by changing the hazard record Status to "Transfer Request" from the dropdown list. The transfer will be managed by the CRL System Safety Manager and agreed with the appropriate parties before being transferred. This agreement will be confirmed and recorded. To make the hazard record transfer, the hazard record Status to be changed to "Transferred" by the CRL System Safety Manager.

## **8.5 Control Measures (Stage 4)**

- 8.5.1 In accordance with the Engineering Safety Management Hazard Management Procedure [1], the hazards shall be addressed to either eliminate them or reduced them tolerable and/or as low as reasonably practicable (ALARP).
- 8.5.2 A record of how the hazard is to be mitigated will be recorded by the NRP, both the cause control measures and the consequences control measures requires the same information.
- 8.5.3 To create a new cause control measure, first click on the Cause CMs tab in the Links Panel, this results in the causes being shown. Then right click on the relevant hazard record and select the option "Create new Cause CM for this hazard". A new Cause CM reference is created. To create a second cause control measure repeat this process.
- 8.5.4 To create a new consequence control measure, the Consequence CM tab in the Links Panel must first be selected and then follow the same process as described above.
- 8.5.5 The information required for a new cause mitigation measure is listed in Table 2.

**Table 2 creating a new cause control measure in the PWHR.**

<b>Creating New Cause Control Measure</b> (The following also applies to creating new consequence control measure)		
<b>PWHR Field</b>	<b>Description</b>	<b>Entering data</b>
<b>Control Measure Id</b>	<i>An internal id number is generated automatically by the system</i>	-
<b>Existing Cause Control Measures</b>	The cause control measures which exist or have already been specified.	<b>Free Text</b> Double click in the cell for the text box to appear. Once finished, click onto another cell to close the text box
<b>Requirement Id</b>	<p>Reference to existing or derived safety requirement which will mitigate the hazard.</p> <p>Systemwide only - Existing safety requirements should link to the requirement in the Contractor Performance Specification which will mitigate the hazard.</p> <p>Derived safety requirements will need to be created in the Derived Safety Requirements Module and linked.</p> <p>Note: Each Control Measure entry should be either an existing CM or an RCA, do not group them on to the same line to ensure clarity of Control Measure evidence.</p>	<p><b>Cause CM in Main Panel &amp; PS Tab in Links Panel (systemwide only)</b></p> <p>Highlight the Control Measure record to be linked. Choose the appropriate Performance Specification tab and select the requirement by Right clicking and choosing the "Link Objects".</p>
<b>Hazard Id</b>	<i>The hazard Id is generated automatically to reference back to the appropriate hazard.</i>	-
<b>Risk Control Action</b>	<p>Description of further risk control actions (RCA) that could be implemented to reduce the risk to a level that is tolerable and ALARP.</p> <p>Note: this field should be used independently/ exclusively of an "existing control measure" not together, this will ensure clarity of Control Measure evidence.</p>	<b>Free Text</b> Double click in the cell for the text box to appear. Once finished, click onto another cell to close the text box
<b>RCA Owner</b>	The RCA Owner who is responsible for ensuring that the RCA is actioned and that the hazard owner and NRP are aware of the status of the RCA.	<b>Free Text</b> Double click in the cell for the text box to appear. Once finished, click onto another cell to close the text box
<b>RCA/ CM Status</b>	<p>The status of the RCA or Existing Control Measure.</p> <p>This includes open, reassign request, rejected, transferred etc. RCA/CM Status will only be "implemented" when the compliance evidence against the linked existing safety requirements (performance specification) has been verified or the derived safety requirement status is resolved.</p>	<b>Drop Down List</b> Double click in the cell for the drop down list to appear. Select one of the status options by clicking on it.
<b>Action Date</b>	<p>An action date by which the RCA owner should address the RCA can be specified.</p> <p><i>There is an automatic indication of whether the Action Date is due.</i></p> <ul style="list-style-type: none"> <li>• Red signifies the due date has expired</li> <li>• Orange signifies the due date is in the next 7 days</li> </ul>	<b>Date Text</b> Double click in the cell for the text box to appear. Type in the date, then press return

<b>Creating New Cause Control Measure (The following also applies to creating new consequence control measure)</b>		
<b>PWHR Field</b>	<b>Description</b>	<b>Entering data</b>
<b>Implementation rationale</b> (former ALARP assessment Summary)	RCA/CM implementation rationale  Note: Justification for ALARP should be made at the hazard level in the evidence of closure column.	<b>Free Text</b> Double click in the cell for the text box to appear. Once finished, click onto another cell to close the text box
<b>Implementation evidence</b> (former ALARP assessment Ref)	RCA/CM implementation evidence  Note: Justification for ALARP should be made at the hazard level in the evidence of closure column.	<b>Reference Text</b> Double click in the cell for the text box to appear. Type description and reference link, then press return
<b>General Comments</b>	General comments can be added here.	<b>Free Text</b> Double click in the cell for the text box to appear. Once finished, click onto another cell to close the text box
<b>Last Modified On</b>	<i>This is an automatic indication of when the hazard record was last updated.</i>	-
<b>Last Modified By</b>	<i>This is an automatic indication of who updated the hazard record last.</i>	-
<b>Reassigned ID</b> (former SIF Action Id)	<i>Link to the Action ID on the SIF file or the RCA ID on the RCA Owner PWHR</i>	
<b>Reassigned Status</b> (former SIF Issue Accepted)	<i>Status of the action or RCA after reassignment.</i>	

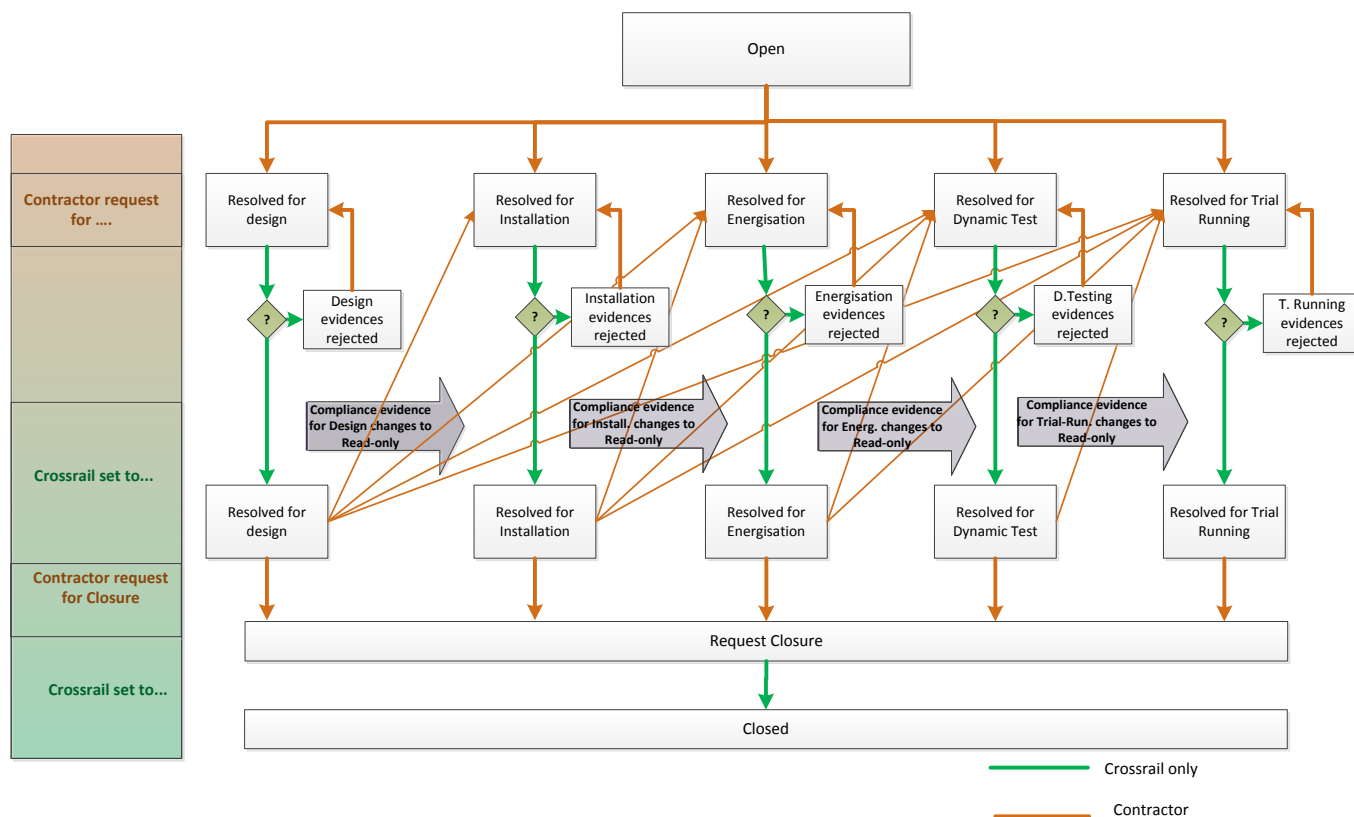
- 8.5.6 Should it be considered that the proposed RCA is better managed by another party then the NRP may request an RCA transfer by indicating the proposed recipient in the “Target Template” box. This request is made by changing the RCA Status to “Reassign Request” from the dropdown list and specifying the 3<sup>rd</sup> party to which it is believed the RCA belongs. The transfer will be reviewed by the CRL System Safety Manager and the 3<sup>rd</sup> party to ensure its relevance. If the 3<sup>rd</sup> party is RfL this will be reviewed by the HRP and recorded in the SiF, see section 6 of the Crossrail Hazard Management Procedure [1]. If the 3<sup>rd</sup> party is another contractor, the review will confirm whether the RCA already exists in the 3<sup>rd</sup> party PWHR as either an RCA or Existing Control Measure, to which it can be linked. Or if the RCA does not currently exist, an Orphan Control Measure can be generated in the 3<sup>rd</sup> parties PWHR for management until closure evidence has been obtained. Once the transfer has been validated and completed, the RCA Status will be changed to “Reassigned” by the CRL System Safety Manager. The agreement between the relevant parties will be documented.
- 8.5.7 The resulting residual risk should then be updated in any linked hazard record.

**Table 3 hazard residual risk in the PWHR.**

<b>Hazard Residual Risk</b>		
<b>PWHR Field</b>	<b>Description</b>	<b>Entering data</b>
<b>RF</b>	<p><b>RF is the residual frequency</b>, the evaluated likelihood that the hazard will result in an accident after all existing control measures and Risk Control Actions (RCA) are considered, in accordance with the frequency definition given in the Engineering Safety Management Hazard Management Procedure (see Appendix C).</p> <p>Following any changes to the RCAs, such as rejection or addition of further RCAs, the residual frequency must be reviewed and re-ranked where necessary.</p> <p>Note: The definitions are also given by clicking on the "Definitions" tab in the Links Panel.</p>	<p align="center"><b>Drop Down List</b></p> <p>Double click in the cell for the drop down list to appear. Select one of the numbers from 1 to 5 by clicking on it.</p>
<b>RC</b>	<p><b>RC is the residual consequence</b>, the evaluated severity of the accident after all existing control measures and Risk Control Measures (RCA) are considered, in accordance with the severity definition given in the Engineering Safety Management Hazard Management Procedure (see Appendix C).</p> <p>Following any changes to the RCAs, such as rejection or addition of further RCAs, the residual consequence must be reviewed and re-ranked where necessary.</p> <p>Note: The definitions are also given by clicking on the "Definitions" tab in the Links Panel.</p>	<p align="center"><b>Drop Down List</b></p> <p>Double click in the cell for the drop down list to appear. Select one of the numbers from 1 to 5 by clicking on it.</p>
<b>RR</b>	<p><i>The Residual Risk (RR) is based on the residual frequency and consequence. The evaluated residual risk is generated automatically by the system.</i></p>	-

## **8.6 Resolving Hazards (Stage 5)**

- 8.6.1 When the Hazard Owner has proposed a suitable package of planned risk mitigation measures and any other risk control actions (which may include transfer to others), with all the justification prepared in the evidence for closure column (i.e. planned Risk Acceptance Criteria, justification for resolution, etc. – See Table 5 below), the hazard will be reviewed by the CRL System Safety Manager. Once the CRL System Safety Manager accepts the hazard mitigation proposals, the hazard record status will be revised from 'Open' to 'Resolved for Design/Installation/Energisation/Dynamic Testing/Trial Running'.
- 8.6.2 Should the CRL System Safety Manager not agree with the planned risk mitigation measures or justification, they will provide details of their reasons within the CRL Comments section (located at the far right of the hazard record).
- 8.6.3 Table 4 below details the resolved hazard statuses in the PWHR. Note that some resolved statuses may not be relevant to all Contractors.



**Figure 6: Changing Hazard Status in PWHR**

**Table 4 resolving hazards in the PWHR**

Resolved Hazard Status in PWHR		
Hazard Status	Description	Status to be updated by
Request Resolve for Design	Contractor requests resolved for design once they have completed evidence of closure to confirm that all existing control measures and design related RCAs have been identified, and has declared the risk acceptance criteria for the hazard.	Contractor
Resolved for Design	Crossrail have reviewed the existing control measures and design related RCAs and are happy with the evidence for this design stage and accept the new resolved status.	Crossrail
Request Resolve for Installation	Contractor requests resolved for installation once they have completed evidence of closure to confirm that all existing control measures and design related RCAs have been “implemented”, and has declared the risk acceptance criteria for the hazard.	Contractor
Resolved for Installation	Crossrail have reviewed the implementation of existing control measures and design related RCAs and are happy with the evidence for this stage and accept the new resolved status.	Crossrail
Request Resolve for Energisation	Contractor requests resolved for energisation once they have completed evidence of closure to confirm that all outstanding energisation related RCAs have been “implemented”, and as necessary updated the risk acceptance criteria for the hazard.	Contractor
Resolved for Energisation	Crossrail have reviewed the implementation of energisation related RCAs and are happy with the evidence for this stage and accept the new resolved status.	Crossrail

Request Resolve for Dynamic Testing	Contractor requests resolved for dynamic testing once they have completed evidence of closure to confirm that all outstanding testing related RCAs have been “implemented”, and as necessary updated the risk acceptance criteria for the hazard.	Contractor
Resolved for Dynamic Testing	Crossrail have reviewed the implementation of testing related RCAs and are happy with the evidence for this design stage and accept the new resolved status.	Crossrail
Request Resolve for Trial Running	Contractor requests resolved for trial running once they have completed evidence of closure to confirm that all outstanding trial running related RCAs have been “implemented”, and as necessary updated the risk acceptance criteria for the hazard.	Contractor
Resolved for Trial Running	Crossrail have reviewed the implementation of trial running related RCAs and are happy with the evidence for this design stage and accept the new resolved status.	Crossrail

## 8.7 Request Hazard Closure (Stage 6)

- 8.7.1 When all identified risk mitigation measures and risk control actions within the Contractor’s control have been “implemented” (i.e. the linked safety requirements have compliance evidence) and the RCAs outside of the Contractor’s control have been Transferred AND Accepted by the 3<sup>rd</sup> party (i.e. another contractor, Crossrail or RfL), the NRP should update the “Evidence for Closure” and request closure.

**Table 5 evidence for hazard closure in the PWHR**

Evidence for Hazard Closure		
PWHR Field	Description	Entering data
<b>Evidence for Closure</b>	<p>Area for the NRP to provide details on why the hazard is considered resolved or closed for this lifecycle stage.</p> <p>Confirmation of the risk acceptance principles used to evaluate the risk acceptability (see Crossrail Hazard Management Procedure [1]) as required by the CSM.</p> <p>Summary confirmation that the Existing Control Measures and RCAs have been implemented and that the associated safety requirements have compliance evidence against them, this could then refer to a verification report or equivalent.</p> <p>Declaration of any derogations to safety requirements related to this hazard.</p> <p>Where Explicit Risk Estimation has been used, a summary statement that the hazard risk has been reduced to a level that is tolerable and ALARP. Complex arguments should be made in a separate document and reference to these documents made.</p> <p>Note: This information should be kept concise, any commentary information that is not directly relevant should be relocated to the appropriate column within the PWHR.</p>	<p align="center"><b>Free Text</b></p> <p>Double click in the cell for the text box to appear. Once finished, click onto another cell to close the text box</p>



8.7.2 The CSM 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 and evaluation.

Which risk acceptance principle(s) have been used should be specified in the Evidence for Closure. Further details of these three principles can be found in the Crossrail CSM Hazard Assessment Process [5].

8.7.3 Once completed, the NRP should change the hazard record Status to 'Closure Request'. The Evidence for Closure will be reviewed by the CRL System Safety Manager. The CRL System Safety Manager will require evidence that all risk control actions have been completed by reference to appropriate documents, drawings, etc. Where a control measure relies upon future testing, inspection, maintenance, procedure, etc., evidence that the appropriate IM / operator has accepted the mitigation measure will be required. This will help to ensure that mitigation measures are not unacceptably onerous on the future operators and/or maintainers.

## **8.8 Hazard Closure (Stage 7)**

8.8.1 If the CRL System Safety Manager accepts the Evidence for Closure has been completed satisfactorily, and the justification that the hazard risk has been reduced to a level that is tolerable and / or ALARP, then the hazard record status will be revised from 'Closure Request' to 'Closed'.

8.8.2 There should be no hazards which remain Intolerable after implementation of control measures or risk control actions. In the event a risk remains Intolerable then the appropriate cause of action will be advised by the CRL Hazard Review Panel (HRP). In the event of dispute regarding the closure of a hazard the CRL HRP will be the sole means of arbitration.

## 9 Derived Safety Requirements Module

9.1.1 Where a contractor identifies a derived safety requirement, an entry shall be created by the Contractor in the Derived Safety Requirements Module (DSRM) of the PWHR. The information required for a derived requirement is listed in Table 6 below. As can be seen some of the information is generated automatically by the DOORS system. This is denoted by *italics* in Table 6. The NRP should complete all the fields detailed using the instructions given in Table 6. Please see Figure 6 for a screenshot of this module.

**Table 6 creating a derived Safety requirement in DSRM of the PWHR**

<b>Creating a New Derived Safety Requirement in PWHR</b>		
<b>PWHR Field</b>	<b>Description</b>	<b>Entering Data</b>
<b>Id</b>	<i>An internal reference number is generated automatically by the system. The prefix will indicate the contract the derived safety requirement has been identified by. For example those requirements identified by C124 will have the prefix "C124-".</i>	-
<b>Safety Requirement Text</b>	A description of the Derived Safety Requirement	<b>Free Text</b> Double click in the cell for the text box to appear. Once finished, click onto another cell to close the text box
<b>Required SIL</b>	The Safety Integrity Level (SIL) level of the relevant component/system	<b>Drop Down List</b> Double click in the cell for the drop down list to appear. Select a SIL level by clicking on it.
<b>Hazard Id</b>	<i>A link to the Hazard Id is automatically generated by the system.</i>	-
<b>CM Id</b>	<i>A link to the Control Measure Id is automatically generated by the system.</i>	-
<b>Document Ref/ CCM/ PMI</b>	Specific reference documents providing details about the safety requirement as applicable.	<b>Free Text</b> Double click in the cell for the text box to appear. Once finished, click onto another cell to close the text box
<b>System</b>	<i>A link to the relevant system is automatically generated by the system.</i>	-
<b>Sub-System/Functions</b>	<i>The specific component/sub-system related to the derived safety requirement</i>	-
<b>Stage</b>	The stage at which the derived safety requirement will be reviewed	<b>Drop Down List</b> Double click in the cell for the drop down list to appear. Select an assurance gate by clicking on it.
<b>Compliance Status</b>	Whether the derived safety requirement complies with the existing safety requirements as defined by Crossrail	<b>Drop Down List</b> Double click in the cell for the drop down list to appear. Select a compliance status by clicking on it.
<b>Compliance</b>	A justification as to why the	<b>Free Text</b>

<b>Rational/Comments</b>	derived safety requirement is compliant/partially compliant/ non-compliant with the existing safety requirements as defined by Crossrail	Double click in the cell for the text box to appear. Once finished, click onto another cell to close the text box
<b>Requirement Status</b>	<i>The current status of the derived safety requirement is given. See Sections 6.6 and 6.7 above.</i>	<b>Drop Down List</b> Double click in the cell for the drop down list to appear. Select a requirement status by clicking on it.
<b>Evidence Design</b>	Documentation numbers and titles which support the compliance of the derived safety requirement during design stage <b>Note</b> that some evidences fields may not be relevant to all Contractors.	<b>Free Text</b> Double click in the cell for the text box to appear. Once finished, click onto another cell to close the text box
<b>Evidence Installation</b>	Documentation numbers and titles which support the compliance of the derived safety requirement during Installation stage <b>Note</b> that some evidences fields may not be relevant to all Contractors.	<b>Free Text</b> Double click in the cell for the text box to appear. Once finished, click onto another cell to close the text box
<b>Evidence Energisation</b>	Documentation numbers and titles which support the compliance of the derived safety requirement during energisation stage <b>Note</b> that some evidences fields may not be relevant to all Contractors.	<b>Free Text</b> Double click in the cell for the text box to appear. Once finished, click onto another cell to close the text box
<b>Evidence Dynamic test</b>	Documentation numbers and titles which support the compliance of the derived safety requirement at dynamic test stage <b>Note</b> that some evidences fields may not be relevant to all Contractors.	<b>Free Text</b> Double click in the cell for the text box to appear. Once finished, click onto another cell to close the text box
<b>Evidence Trail running</b>	Documentation numbers and titles which support the compliance of the derived safety requirement during trial running stage <b>Note</b> that some evidences fields may not be relevant to all Contractors.	<b>Free Text</b> Double click in the cell for the text box to appear. Once finished, click onto another cell to close the text box
<b>Requirement Status Set By</b>	<i>The member of the Crossrail System Safety Team who has reviewed the status of the derived safety requirement.</i>	-
<b>CRL Review Comments</b>	<i>Additional comments added by the Crossrail System Safety Team</i>	-

**Main Panel:** Shows a view with the headings and the columns for all Derived Safety Requirements.

**Adding a derived safety requirement:** Right click on the far left and choose the option "Insert row after" to add a new derived safety requirement in the required position in the list.

**Links Panel:** Used to view the links to the cause / consequence

Id	Requirement Text	Required SIL	Contractor Comment	Hazard Id (Link)	CM Id (Link)	Document Ref / CCM / PMI	System (Link)	Sub-System / Functions (Link)	Stage	Compliance Status	Compliance
DSR-C660.19		N/A	CMS269, SMS234, SMS235, SMS326	C660 Hz26 C660 Hz137	C660 CaCM74	C660-SMN-R3-R GN-CR001-5011 Rev 3.0	Portal Comms & Data	Portal Evacuation Strategy : Operations Procedures CDN		TBD	
DSR-C660.20		N/A	CMS319, CMS321, SMS326, SMS234, SMS235, SMS242							TBD	
DSR-C660.21		N/A				GN-CR001-5010 9 Rev 2.0				TBD	
DSR-C660.22		N/A	CIS Reliability (requirements CIS136 and CIS138)	C660 Hz54 C660 Hz55	C660 CaCM37	C660-SMN-R3-R GN-CR001-5010 9 Rev 2.0	Comms & Data Systems Comms & Data	CIS CIS		TBD	

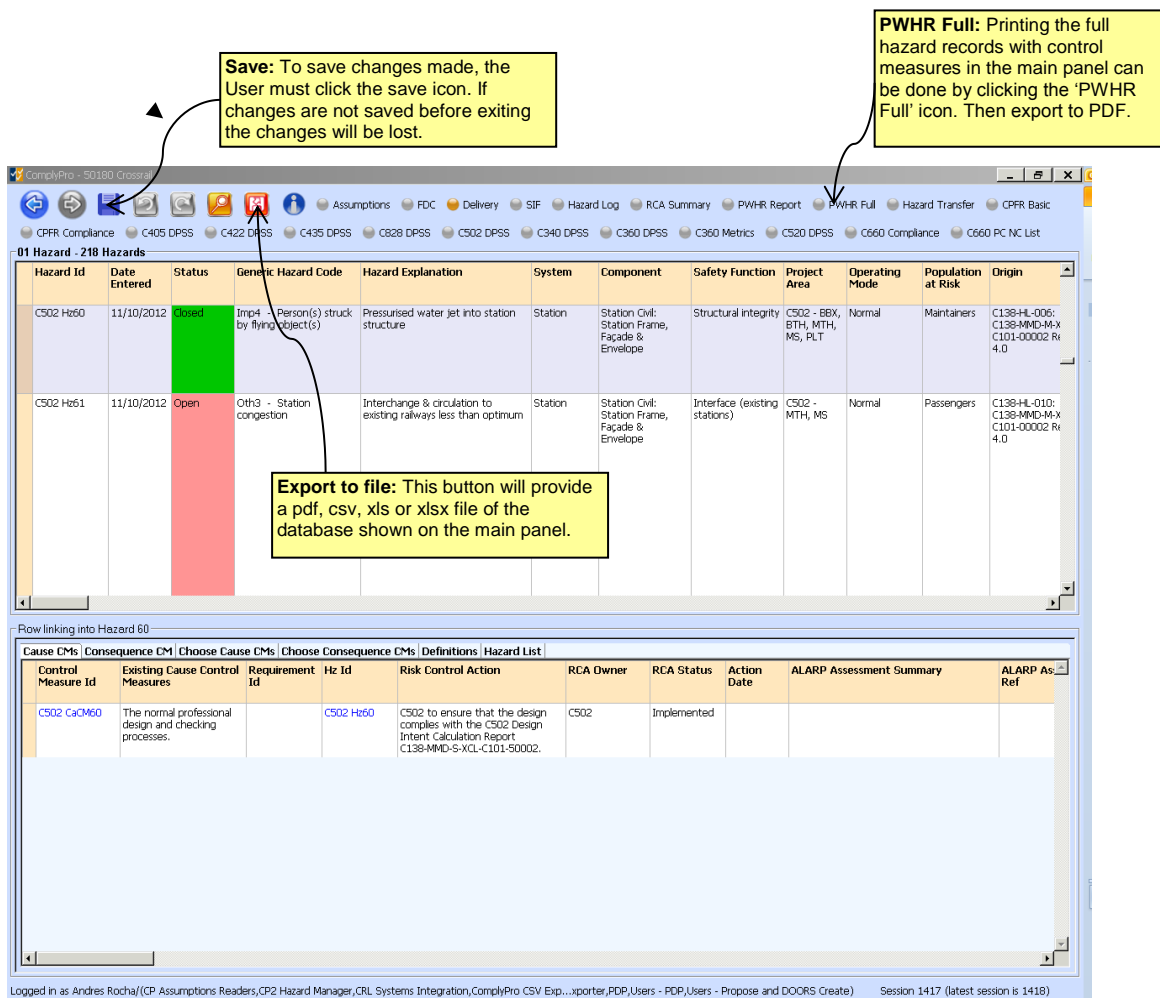
Control Measure Id	Existing Cause Control Measures	Requirement Id	Hz Id	Risk Control Action	RCA Owner	RCA Status	Action Date	ALARP Assessment Summary	ALARP As-Ref
C660 CaCM37		DSR-C660.22	C660 Hz54 C660 Hz55 C660 Hz56 C660 Hz57		C660x	Open			

**Figure 6 – Derived Safety Requirements Module screenshot**

## 10 PWHR Facilities

### 10.1 Saving Information in CP2

- 10.1.1 In order to save changes made to PWHR the User must click on the save button at the top of the screen (see Figure 7). This action will also retrieve any changes made by other Users since the PWHR was opened/last saved.
- 10.1.2 If the changes are not saved before exiting CP2 the changes will be lost.
- 10.1.3 Once a hazard record has been saved, the hazard record cannot be deleted. Should a hazard record no longer be valid, for example due to redesign, a comment may be added in the Evidence for Closure and the hazard Status changed to close, in line with the process described in Section 6.



**Figure 7 – Save, Export to File, Search and Filter Options Illustrated**

### 10.2 Updating Information in CP2

- 10.2.1 The information contained within each hazard record can be updated at anytime by the appropriate person. CP2 records all changes saved.
- 10.2.2 Updates and progress made should be added to the existing text to preserve the developing evidence, rather than overwriting the existing text.

### **10.3 Resizing CP2 Panels and Column Widths**

- 10.3.1 The main and links panels can be resized to accommodate working requirements. The resizing is achieved by placing the cursor over the bars between the panels and using the left button to drag the panel to the size required.
- 10.3.2 It is also possible to resize the column widths within the panels. Again the resizing is achieved by placing the cursor over the bars between the column headings and using the left button to drag the column to the size required.
- 10.3.3 The resizing will not be permanent. Once the User logs off and on again the column widths and panel sizes will return to their default sizes.

### **10.4 Switching Between Panels**

- 10.4.1 The CaCM Id(s), the CoCM Id(s) and the Hz Id have a blue font. These are links used to change the main focus within CP2. For example, by clicking on the blue font of a Ca CM Id the Cause Control Measures are then listed in the main panel rather than the links panel. The hazard record can then be restored in the main panel by clicking on the blue font Hz Id.

### **10.5 Printing from CP2**

- 10.5.1 A file in pdf, csv, xls or xlsx formats can be created containing data viewed in the main panel, at any time. This is achieved by clicking the export icon at the top of the screen (see Figure 7). A file in the appropriate format will be generated which can be saved to disk or printed in the usual way.
- 10.5.2 The “**PWHR Full**” activity in the ribbon at the top of the screen (see Figure 7) gives a more detailed view, which includes hazard, cause, consequence and control measure information on a single screen for the contract that is currently selected in the main panel. This information can then be exported to file as detailed above in Section 8.5.1.

## **11 Reference Documents**

<b>Ref:</b>	<b>Document Title</b>	<b>Document Number:</b>
1.	Engineering Safety Management Hazard Management Procedure	CRL1-XRL-O8-GPD-CR001-50002
2.	Common Safety Method on Risk Evaluation and Assessment	Commission Regulations (EC) No EU/402/2013 as amended by EU/2015/1136
3.	Engineering Safety Management System Safety Plan.	CRL1-XRL-O7-GST-CR001-00001
4.	DOORS database system by the hosting company Comply Serve Ltd	<a href="http://www.complyserve.com/">http://www.complyserve.com/</a>
5.	Crossrail Common Safety Methods Hazard Assessment Process	CRL1-XRL-O8-GPS-CR001-50003

## **12 Standard Forms / Templates**

<b>Ref:</b>	<b>Document Title</b>	<b>Document Number:</b>
A.	None	
B.		

## **13 Appendices**

**Appendix A - Generic Hazard List**

**Appendix B RSB Hazardous Event Codes**

**Appendix C Frequency, Consequence and Risk Categorisation**

## Appendix A Generic Hazard List

The initial generic list of hazards is presented in the following table.

<b>Derailment Hazards</b>	
Der1	Potential vehicle derailment due to fault/ failure of rolling stock
Der2	Potential vehicle derailment due to fault/ failure of infrastructure
Der3	Potential vehicle derailment due to overspeed
Der4	Potential vehicle derailment due to object on track
<b>Collision Hazards</b>	
Col1	Potential collision between rail vehicles
Col2	Potential collision between vehicle and object dropped/ left on the track
Col3	Potential collision between vehicle and rail structure
Col4	Potential impact between vehicle and object falling from vehicle
<b>Fire Hazards</b>	
Fir1	Potential fire in vehicle/station/trackside/depot etc
Fir2	Person(s) exposed to smoke in vehicle/ station/ depot etc
<b>Explosion Hazards</b>	
Exp1	Explosive device
Exp2	Potential for explosion exists
<b>Impact Hazards</b>	
Imp1	Potential impact between rail vehicle and person(s)
Imp2	Potential impact between vehicle and person(s) falling from or being dragged/ crushed by vehicle
Imp3	Impacts of person(s) with heavy object(s)
Imp4	Person(s) struck by flying object(s)
Imp5	Person(s) exposed to pointed or sharp objects
<b>Entrapment Hazards</b>	
Ent1	Person(s) become trapped
Ent2	Potential for person(s) to become trapped by/ caught in equipment/ machinery
<b>Electrical Hazards</b>	
Ele1	Person(s) exposed to hazardous voltages on vehicle / track / station
Ele2	Person(s) exposed to arcing
<b>Trip/ fall Hazards</b>	
Stf1	Person(s) fall from height
Stf2	Slip/ trip/ fall hazard present
<b>Other Hazards</b>	
Oth1	Flooding
Oth2	Evacuation
Oth3	Station congestion
Oth4	Unauthorised access
Oth5	Lack of communication
Oth6	Structural Failure
Oth7	Manual handling
Oth8	Exposure to noise
Oth9	Potential heat exhaustion due to exposure to abnormally high temperatures
Oth10	Person(s) exposed to hazardous materials
Oth11	Person(s) exposed to hot object/ surface/ fluid
Oth12	Trespass and illegal acts
Oth13	Road Traffic Accident
Oth14	Asphyxiation



## **Appendix B RSSB Hazardous Event Codes**

The RSSB hazardous event codes and their descriptions are given in the table below. The hazardous events are divided between train accidents (HETs), movement accidents (HEMs) and non-movement accidents (HENs).

It should be noted that the RSSB HE Codes are not mandatory fields in the PWHR.

<b>H. E. Code</b>	<b>Hazardous Event Description</b>
<b>Train Accidents</b>	
HET-01	Collision between two passenger trains resulting from a passenger train Cat A SPAD, Cat D SPAD/runaway train, misrouted train, or WSF
HET-02P	Collision between a passenger train and non-passenger train resulting from a passenger train Cat A SPAD, Cat D SPAD/runaway train, misrouted train, or WSF
HET-02NP	Collision between a non-passenger train and passenger train resulting from a non-passenger train Cat A SPAD, Cat D SPAD/runaway train, misrouted train, or WSF
HET-03	Collision between two non-passenger trains resulting from a non-passenger train Cat A SPAD, Cat D SPAD/runaway train, misrouted train, or WSF
HET-04	Collision of train with object (not resulting in derailment)
HET-06	Collision between two passenger trains in station (permissive working)
HET-09	Collision with buffer stops
HET-10	Passenger train collision with road vehicle on level crossing
HET-11	Non-passenger train collision with road vehicle on level crossing
HET-12	Derailment of passenger trains
HET-13	Derailment of non-passenger train
HET-17	Fire on passenger train
HET-20	Fire on non-passenger train
HET-21	Train crushed by structural collapse or large object (not at station)
HET-22	Structural collapse at station
HET-23	Explosion on passenger train
HET-24	Explosion on freight train
HET-25	Train divisions (not leading to collision)
HET-26	Collision between a failed train and an assisting train
<b>Movement Accidents</b>	
HEM-01	Passenger injury during evacuation following stopped train
HEM-03	Passenger struck while leaning out of train (train in running)
HEM-05	Train door closes on passenger
HEM-06	Passenger fall between train and platform
HEM-07	Passenger fall out of train onto track at station
HEM-08	Passenger fall from platform and struck by train
HEM-09	Passenger injury while boarding/alighting train (platform side)
HEM-10	Passenger struck by train while on platform
HEM-11	Passenger struck by train while crossing track at station on crossing
HEM-12	Adult/child trespasser struck while crossing track at station
HEM-13	Train crowding leading to passenger injury
HEM-14	Workforce (not track worker) struck/crushed by train
HEM-15	Workforce fall from train in running
HEM-16	Workforce injury while boarding/alighting train
HEM-17	Workforce struck while leaning out of train (train in running)
HEM-19	Track worker struck/crushed by train
HEM-20	Workforce struck by flying object (includes objects thrown by OTM movements outside a possession)

<b>H. E. Code</b>	<b>Hazardous Event Description</b>
HEM-21	Workforce fall between train and platform
HEM-22	Workforce fall out of train onto track at station
HEM-23	Train door closes on workforce
HEM-25	Adult trespasser struck/crushed while on the mainline railway
HEM-26	Child trespasser struck/crushed while on mainline railway
HEM-27	MOP pedestrian struck/crushed by train on level crossing or footpath crossing
HEM-29	MOP outside mainline railway struck/crushed as a result of mainline railway operations
HEM-30	MOP fall while riding illegally on train
HEM-31	MOP suicide or attempted suicide (open verdict)
HEM-32	MOP struck by object from the mainline railway
HEM-38	Passenger injury due to braking or lurching
HEM-39	Train crew injury due to braking or lurching
HEM-40	MOP struck by train due to standing too close to platform edge
HEM-41	MOP fall between train and platform
HEM-42	Passenger struck by flying object thrown up by passing train
HEM-43	Train door closes on MOP
HEM-44	Passenger jump from train in running
<b>Non-movement Accidents</b>	
HEN-01	Workforce exposure to fire
HEN-02	Lineside fire in station
HEN-03	Fire in station
HEN-04	Workforce exposure to lineside explosion
HEN-05	Explosion at station
HEN-07	Passenger exposure to hazardous substances
HEN-08	Passenger exposed to electrical arcing at station
HEN-09	Passenger electric shock at station (OHL)
HEN-10	Passenger electric shock at station (conductor rail)
HEN-11	Passenger electric shock at station (non-traction supplies)
HEN-13	Passenger fall from platform onto track (no train present)
HEN-14	Passenger slip, trip or fall
HEN-15	Passenger fall from overbridge at station
HEN-16	Passenger fall during evacuation at station
HEN-17	Passenger crushing caused by overcrowding at station
HEN-21	Workforce struck/crushed by structural collapse or large object
HEN-22	Workforce trapped in machinery
HEN-23	Workforce struck by/contact with/trapped in object at station
HEN-24	Workforce slip, trip or fall <2m
HEN-25	Workforce slip, trip or fall >2m
HEN-26	Workforce struck/crushed by non-train vehicle
HEN-27	Workforce burns due to welding etc
HEN-28	Workforce exposure to arcing
HEN-29	Workforce exposure to hazardous substances (including stings, bites and needle injuries)
HEN-30	Workforce electric shock (conductor rail)
HEN-31	Workforce electric shock (OHL)
HEN-32	Workforce electric shock (non-traction supply)
HEN-33	Workforce asphyxiation / drowning
HEN-35	Workforce involved in road traffic accident whilst on duty
HEN-36	Adult trespasser fall while on the mainline railway
HEN-37	Adult trespasser electric shock (OHL)
HEN-38	Adult trespasser electric shock (conductor rail)

<b>H. E. Code</b>	<b>Hazardous Event Description</b>
HEN-39	Adult trespasser electric shock (non-traction supply)
HEN-40	Child trespasser fall while on the mainline railway
HEN-41	Child trespasser electric shock (OHL)
HEN-42	Child trespasser electric shock (conductor rail)
HEN-43	Child trespasser electric shock (non-traction supply)
HEN-44	MOP struck / trapped by level crossing equipment
HEN-45	MOP (non-trespasser) fall from outside onto the mainline railway
HEN-46	MOP slip, trip or fall on level crossing or footpath crossing
HEN-48	MOP exposure to fire on the mainline railway
HEN-49	MOP exposure to explosion on the mainline railway
HEN-50	MOP exposure to electrical arcing
HEN-51	MOP electric shock (OHL)
HEN-52	MOP electric shock (conductor rail)
HEN-53	MOP electric shock (non-traction supplies)
HEN-54	MOP exposure to hazardous substances leakage on the mainline railway
HEN-55	Passenger struck by/contact with/trapped in object at station
HEN-56	Workforce struck by/contact with/ trapped in object not at station
HEN-57	Passenger burn (not on train)
HEN-58	MOP injury on bridges/steps/subways (other than in stations) whilst on the mainline railway
HEN-59	MOP struck by/contact with/trapped in object at station
HEN-60	Workforce exposure to noise (not on train)
HEN-61	Passenger exposure to noise (not on train)
HEN-62	Passenger on-train incident (excluding sudden train movement & assaults)
HEN-63	Workforce on-train incident (excluding sudden train movement & assaults)
HEN-64	Passenger assault
HEN-65	Workforce assault
HEN-66	MOP assault
HEN-67	MOP fall from platform onto track (no train present)
HEN-68	MOP non-trespasser fall in stations
HEN-71	Adult trespass fall/jump from outside onto the mainline railway
HEN-72	Child trespasser fall/jump from outside onto the mainline railway
HEN-73	Passenger manual handling
HEN-74	Workforce manual handling
HEN-75	MOP involved in RTA on level crossing

## Appendix C Frequency, Consequence and Risk Categorisation

**Table C1 Hazardous Event Frequency Definition**

Frequency Category	Classification Term	Time frame	Midpoint Frequency Estimate	Description
5	Frequent	Less than a year	1 in 6 months	The event is likely to occur frequently (probably on a daily basis)
4	Probable	1 year to 10 years	1 in 5 years	The event will occur several times and is likely to occur often
3	Occasional	10 years to 100 years	1 in 50 years	The event is likely to occur several times
2	Remote	100 years to 1000 years	1 in 500 years	The event can be expected to occur during the lifecycle
1	Improbable	1000 years or greater	1000 years	The event is unlikely to occur but may by exception occur

**Table C2 Consequence Definition**

Consequence Category	Classification Term	Description
1	Negligible	Non-reportable injury
2	Minor	Minor injury
3	Major	Major injury/multiple minor injuries
4	Critical	Single fatality/multiple major injuries
5	Catastrophic	Multiple fatalities

**Table C3 Risk Classification**

Frequency	Consequence				
	1	2	3	4	5
5	T	I	I	I	I
4	T	T	I	I	I
3	N	T	T	I	I
2	N	N	T	T	I
1	N	N	N	T	T

I = Intolerable (High risk that is unacceptable), T = Tolerable risk, (when reduced ALARP is acceptable), N = Negligible low risk (that is generally acceptable)