MetroLink Railway Order

Fire Strategy – Supporting Documentation for Oral Hearing

28/02/2024

Contents

1. Purpose

TII presented an overview of the fire strategy, emergency and evacuation strategy including the basis of a) intervention shaft location at Albert College Park and b) Intervention lifts at station for the MetroLink project on 19th of February 2024, Day 1 of the Railway Order Oral Hearing.

During Week 1 of the hearing, issues were raised by the residents of Seatown Villas, Hampstead Avenue and GADRA that has necessitated further clarification in respect to spacings between Intervention Shafts. TII has, with the consent of the Inspector, prepared this technical memo to further clarify matters about intervention shafts to be submitted to the Board.

The overview presented by TII in Day 1 was focused towards addressing the Intervention shaft at Albert College Park (ACP) which falls on the TBM bored tunnel section of the route (from Northwood to Charlemont AZ4 termed herein as “enclosed sections”). The route from Estuary to Northwood Portal comprises of open sections, retained cuts, U-Cuts, and cut & cover section (termed herein as “open sections”) and, while the fire and evacuation strategy for both these sections are largely similar, the requirement in the “open “sections are not identical to the covered AZ4 sections of the railway. This will be described in further detail in this memo.

In addition to the above, during the Q&A session between the Inspector and TII, TII have been requested to clarify the roles of the Commission of Railway Regulations (for Ireland) and Dublin fire Brigade (DFB). The Inspector also requested written justification on the requirements of the NFPA standards.

This technical memo aims to address all the above question and is divided into the following sections:

- Role of Commission of Railway Regulations (CRR)
- Role of Dublin Fire Brigade (DFB)
- Intervention Shafts
- NFPA 130 Requirements for (“Enclosed”) Sections – AZ4 & Dublin Tunnels
- Escape & Intervention Strategy for Surface (“Open”) Sections- AZ1-AZ3 Sections

2. Role of the CRR

2.1 Liaison with CRR

The Commission for Railway Regulation (CRR) is established under the Railway Safety Act 2005 and TII is required to submit a safety assessment (or “safety case”) to the CRR for consideration prior to construction and placing into service of a new railway system. This is a 6-stage process called the Application for Acceptance (AFA) process.

The CRR prescribes several guidelines to assist those who wish to develop and submit a safety case for consideration. The purpose of the safety case, as per the Railway Safety Act, is as follows:

- to demonstrate that the railway undertaking can properly assess and effectively control risks to the safety of persons,

- to provide a working document by which the railway undertaking, and the Commission can ensure that the safety systems described in the safety case are being properly implemented and continue to be maintained.

TII have achieved Stage 1 of the AFA process and are currently developing Stage 2. The relevant CRR guidelines outline the specific procedure to be followed to submit the safety case and obtain the safety certificate. The process starts during the concept stage of the project. The staged approach is shown in Table 1 below.

Table 1 AFA Staged Approval Process with the CRR

AFA Stage	Typical activities at project level	Core Document to be submitted with AFA (content always appropriate to the level of AFA Stage)
1 Concept	After performing general concept studies or feasibility studies and prior to requesting tenders.	- SP
2 Preliminary Design	After evaluation of tenders and preliminary decision on functional and technical design and prior to awarding a contract for execution of building/ manufacturing work.	- SP - HR - SCM
3 Detailed Design	After awarding a contract for execution of work, after detailed overall design has been elaborated and prior to production/ building.	- SP - HR - SCM
4 Testing	After production (construction, including, in particular, civil-engineering activities, manufacturing, constituent assembly and overall adjustment) and prior to any Testing in the live Railway System.	- SP - HR - SCM - ASPSC for Testing Stage - IA Report (if applicable) - IPR Report(s) (if applicable) - ISA Report(s) (if applicable)
5 Interim Operation	After principal completion of project specific safety assessment activities (incl. final testing), prior to full close out of open issues and prior to interim operation.	- SP - HR - SCM - ASPSC for Interim Operation - IA Report (if applicable) - IPR Report(s) (if applicable) - ISA Report(s) (if applicable)
6 Operation	After full completion of project specific safety assessment activities and prior to operation.	- SP - HR - SCM - ASPSC for Interim Operation - IA Report (if applicable) - IPR Report(s) (if applicable) - ISA Report(s) (if applicable)

2.2 Commission of Railway Regulations (CRR) Guidelines

The AFA process is conducted in accordance with guidelines issued by the CRR.

Table 2 CRR Guidelines relevant to MetroLink

CRR-G-032B	Guidelines for the Application for Acceptance (AFA) for New Light Rail Works or New Light Rail Rolling Stock Guidance for CRR Inspectors and Railway Organisations
CRR-G-033D	Guidelines for the Application for Acceptance (AFA) for New Light Rail Works or New Light Rail Rolling Stock – To be read in Conjunction with CRR-G-032 Guidance for CRR Inspectors and Railway Organisations

CRR-G-033D- Annex 1	Check List for Safety Guidelines for the Application for Acceptance (AFA) for New Light Rail Works or New Light Rail Rolling Stock

2.3 Standards applicable under the CRR Guidelines

There are no applicable Irish regulations and/or design standards directly related to fire and life safety in tunnels and underground stations.

Section 20 of CRR-G-033D Annex 1 – Requirements for Safety in Railway Tunnels states the following.

> *"** The safety in railway tunnels TSI (EU) 1303/2014 is not mandated for Light Rail/Metrolink systems. However, the CRR see it as good industry practice and apply a similar approach to both Heavy Rail and Light Rail/Metrolink systems."*
>
> *"Applicants may choose an alternative approach for requirements for safety in railway tunnels, but applicants must demonstrate that this alternative approach will result in providing evidence that the topics listed in this section 20 are adequately captured and safety requirements fulfilled."*

TSI SRT

The TSI-SRT is a standard meant for the interoperable rail system within Europe and it sets out the requirements for fire safety in railway tunnels over 100m up to 20km in length. These standards are often targeted at heavy passenger rail and freight trains. Metro Systems are designed for urban environments covering short stretches of tunnels and often not required to be interoperable. Nevertheless, it is considered as good practice to apply the principles of the TSI-SRT relating to tunnel evacuation facilities to all tunnels where possible, as identified by the CRR.

NPFA 130

National Fire Protection Association (NFPA) 130 – Standard for Fixed Guideway Transit and Passenger Rail Systems is the most widely recognised standard internationally and is specifically developed for railway stations and tunnels. It has been globally accepted as a railway safety standard.

NFPA 130 has been prepared by a prestigious Technical Committee of fire safety experts from USA, Canada, Singapore, Germany, and Australia. It is widely used and globally accepted as an underground station design standard, NFPA 130 standard was first developed in 1983 and has since been adopted and consulted for the use of various Metro Systems worldwide including modern European Metro lines in Copenhagen, Canada, USA, Singapore, Malaysia, UK, Brazil, Saudi Arabia, UAE, Qatar and is extensively referred to for most Metro System Fire safety and Ventilation design around the world. It is the most up-to-date guidance document available for the design of underground rail systems.

Other railway standards

Other railway standards have also been developed, e.g., London Underground (LU) standards, French Standards (Arrêté du 22 novembre 2005 relatif à la sécurité dans les tunnel des systèmes de transport public guidés urbains de personnes), German Regulations for Heavy and for Light Rail Systems (BOStrab).

However, these other standards generally have lower familiarity outside the country of origin and may not be as appropriate as NFPA 130, which is an internationally recognised standard prepared by subject matter experts from throughout the world. It is a continuously peer reviewed document, which is updated regularly by a technical committee of experts from across the railway industry in a three-year cycle.

2.4 Adoption of Fire Safety Standards for MetroLink

Taking into consideration the guidelines set out above, a hierarchical approach was adopted at the outset of the project, in respect to fire safety comprising the following three steps.

2.4.1 Step 1 - SI No 115/2006 Building Regulation notably Part B relating to Fire Safety.

Technical Guidance Document B (TGDB) is the national fire safety guidance document in Ireland. It is mainly applicable to stations. Paragraph 0.1.4 of TGDB states that alternative fire engineering approaches are acceptable on the basis that compliance with the functional requirements of Part B of the Building Regulations.

2.4.2 Step 2 - European Standards

EN45545 is a standard covering the fire safety requirements of new rolling stock. EN 45545 has also been locally adopted in Ireland and represents a standard which is most appropriate for the fire performance criteria of new rolling stock.

It is also necessary to examine the requirements of the Commission Regulation (EU) No 1303/2014 of 18 November 2014 concerning the technical specification for interoperability relating to safety in railway Tunnels of the rail system European Union (SRT-TSI), as stated in the CRR guidelines CRR-G-033D.

2.4.3 Step 3 – Other international standards and regulations

In addition to SRT-TSI, to ensure a robust fire safety strategy for the project, and in line with practice in other jurisdictions, the decision was taken through consultation with key stakeholders to adopt NFPA 130 2020 "*Standard for fixed guideway transit and passenger rail systems*" to develop the fire strategy for the Tunnels and Stations.

2.5 Other Guidance Documents

The following other standards and best practice guidance have also been consulted and referenced by the project.

- BS 9999: Code of Practice for fire safety in the design of design, management, and use of buildings.
- BS 9992: Fire Safety in the design, management, and use of rail infrastructure. Code of Practice
- S1080 A3 London Underground Standard Guidelines (LU). Transport for London
- Ireland National Disability Authority's Centre, Building for Everyone and Access Handbook Guidance 2005
- International Tunnelling Association (ITA) guideline 'Engineering Methodology for Performance-Based Fire Safety Design of Underground Rail Systems'

3. Dublin Fire Brigade (DFB)

In addition to the AFA process, it is necessary that TII apply for and obtain a fire safety certificate (FSC) in respect of buildings from Dublin City Council (DCC) and Fingal County Council (FCC). On behalf of DCC and FCC, DFB carry out assessment of all fire safety certificate applications.

A FSC is granted by the local Building Control Authority based on the direction of the local fire service (in this case Dublin Fire Brigade) and confirms that, the design of the building, as presented within the FSC application, complies with the requirements of Part B (Fire Safety) of the Building Regulations. A FSC must be granted prior to the opening, operating or occupation of a building.

A FSC is granted after the railway order process and prior to commencement of construction.

On MetroLink, in addition to DFB's role as Building Control Authority, DFB are a key stakeholder in the development of the MetroLink project, and TII recognise the importance of anticipating the requirements of DFB when developing the Project's fire safety strategy and its ultimate design. Engagement with DFB commenced in 2018 for the purpose of sharing information on the evolving MetroLink design and the specific fire safety requirements of DFB, including the First Safety Strategy, which has been and continues to be updated on an iterative basis. This engagement will continue throughout the ongoing design development process and into the operational stage of the Project.

4. Intervention Shafts & NFPA 130 Requirements

Intervention shafts are needed:

- to provide for an effective ventilation response during an incident, by drawing smoke away from the direction of escape.
- to reduce the travel distance and thus time needed for occupants to escape from an incident and emergency services to reach an incident on foot carrying breathing apparatus and other equipment.

This determines the location and the design and location (including the spacing) of the shafts.

The section on Intervention is separated into two parts. These are a) Enclosed Sections and b) Open Sections. The requirements in respect to each are different.

For clarity, the expression “intervention” (and “emergency access”) refers to means of access for emergency services to the track and tunnel.

This is to be distinguished between emergency egress or escape which denotes means of evacuation, although frequently an intervention shaft will also be used as a means of escape.

5. Enclosed Sections

Section 5 deals with the enclosed sections. This is the 2.3 km Dublin Tunnel Section located with AZ2 and the 9.4 km City Tunnel Section from Northwood portal up to the Charlemont Section of the Tunnel (AZ4).

5.1 Compliance to Standards & Guidelines; Evacuation and Intervention

Guidance in the NFPA 130 for spacing between evacuation shafts applies equally to intervention for enclosed sections.

For evacuation from the enclosed sections, NFPA 130 (2020) Clause 6.3.1.4 recommends a spacing of 762m between two shafts but Clause A.6.3.1.4 allows this spacing to be increased through an engineering analysis assessing 9 listed criteria (See Appendix A).

An evacuation spacing of 1km has been proposed for MetroLink in light of its engineering analysis under Clause A.6.3.1.4, which comprises of a detailed numerical analysis using Three-Dimensional (3-D) Computational Fluid Dynamics (CFD) Modelling and 3-D Evacuation Modelling which considers a probability of a design fire in the tunnel and how people can escape from it in tenable conditions. It also supports that tenable conditions are maintained for fire service intervention in the tunnel.

An evacuation spacing of 1km is also supported by SRT-TSI as incorporated in the CRR-G-032 Annex 1.

As noted above, Clause 6.4.1 of NFPA 130 states that means of escape and exits from the tunnel can also be used for intervention by the Fire Service. All Metrolink escape shafts have been designed to be suitable for intervention through provisions of lifts, stairs, and pressurised lobbies.

The MetroLink escape and Intervention spacing fulfils the requirements of both NFPA 130 and CRR guidelines (incorporating EU SRT-TSI). The relevant extracts of the NFPA 130 and SRT-TSI are set out in Appendix A and Appendix B respectively.

5.2 Evacuation/Intervention Shafts in Enclosed Sections of MetroLink

The following Table 5 shows the spacings currently designed for MetroLink. Due to the distance between Collins Avenue and Griffith Park exceeding 1km, a shaft between Collins Avenue and Griffith Park is required to provide emergency egress not exceeding 1km from either of the stations. Similarly, due to the distance between Dublin Airport and South Portal exceeding 1km, an intervention tunnel is provided.

Table 3 Intervention Distances along the Enclosed Sections

Evacuation Sections (N-S)	Distance between Escape/Intervention Exits
Portal – Dublin Airport	936m
Dublin Airport – Evacuation Gallery	1000m
Evac Gallery – Portal	315m
Northwood – Ballymun	860m
Ballymun – Collins Avenue	877m
Collins Ave – Albert College Park	573m

Albert College Park – Griffith Park	928m
Griffith Park – Glasnevin	975m
Glasnevin – Mater	699m
Mater – O'Connell Street	933m
O'Connell Street – Tara	660m
Tara- St. Stephens Green	1000m
St. Stephens Green – Charlemont	806m

6. Open Sections – Estuary to Northwood Portal (AZ1 to AZ3)

This section deals with the open sections of the route. This is the section spanning from Estuary Station to Northwood portal (AZ1 to AZ3) but excluding the Dublin Tunnels and comprises of open cut, retained cut, U-cuts, and cut & cover section of the railway. Further details on these types of tunnels are provided in the Railway Order EIAR submissions -reports and drawings.

6.1 Compliance with Standards

For evacuation from the Open Sections, NFPA Clause 6.3.1.10 recommends that for open-cut sections, an engineering analysis an engineering analysis shall be conducted to evaluate the impact of the trainway configuration on safe egress from a train fire to a Point of Safety. Following engineering analysis, it is concluded that open sections (including viaduct) and retained-cut sections by their very nature are open to atmosphere and enable direct upward ventilation of smoke with the ability for passengers to escape either direction for the fire. Therefore, the structure does not prevent passengers from reaching a Point of Safety along the railway. For evacuation from the open section, the fire strategy is to evacuate to the nearest upstream or downstream stations. The stations in the open are between 580m to 1535m apart.

Clause 6.4.1.8 of NFPA states "*that where an open-cut trainway prevents or impedes access for firefighting, provisions shall be made to permit fire fighter access to that section of train at intervals not exceeding 762m*". To comply with this, fire intervention stairs are provided at regular interval (not exceeding 762m) along the open section to enable intervention from the emergency services.

Intervention stairs are proposed in the open sections of the railway between Estuary Station and Fosterstown Station at intervals not exceeding 762m. The intervention stairs are provided for fire service access into the railway.

There are some short sections of the railway in this "open section" that are built as cut and cover and are enclosed. In these locations, mechanical ventilation (jet fans) is provided within the tunnels to ensure smoke back layering is prevented as passengers escape to fresh air. The strategy for escape will be the same as the enclosed section, whereby occupants will evacuate to one direction from the fire, supported by the ventilation system. All cut and cover tunnels greater than 61m in length are provided with mechanical ventilation. The longest cut and cover section is 430m in length.

The MetroLink Intervention spacing fulfils the requirements of both NFPA 130. The relevant extracts of the NFPA 130 are set out in Appendix B.

6.2 Intervention Stairs in Open Sections of MetroLink

Intervention stairs are provided in the open sections in the following locations.

Table 4 Intervention Distances in the Open Section of the MetroLink

Location	Station	Emergency Access	
	Chainage	Chainage	m
Estuary Station	1+300		
			650
Balheary Park		1+915	
			415
Seatown Villas		2+330	

			470
Seatown Station	2+800 - 2+900		
			280
near Ashley Avenue		3+180	
			590
Swords Station	3+770 - 3+870		
			590
Pinnock Hill R/A		4+450	
			290
Fosterstown Station	4+740 - 4+830		
Nevistown Lane Bridge	+5410		
			670
North Portal	+6080		

7. Summary

The CRR guidelines CRR-G-032 and CRR-G-033 have been used as guidance documents for the project.

The MetroLink project is compliant with NFPA 130 and TSI-SRT with respect to evacuation and intervention from Railway. In the open sections an intervention distance of 762m is mandated by the fire strategy while in the enclosed sections an intervention distance of 1000m is proposed.

Appendix A. NFPA 130 Extracts - Enclosed Sections

"Clause 3.3.42 – Point of Safety *An enclosed exit that leads to a public way or safe location outside the structure, an at grade point beyond an enclosing structure, or other areas that affords adequate protection for evacuating passengers".*

"Chapter 6 – Emergency Egress"

"Clause 6.3.1.1 *The system shall incorporate a walk surface or other approved means for passengers to evacuate a train at any point along the trainway so that they can proceed to the nearest station or other point of safety."*

"Clause 6.3.1.4* *of NFPA 130 states that within enclosed trainways, the maximum distance between exits shall not exceed 762 m."*

*"****Clause A.6.3.1.4*** *- "The maximum distance between exits* ***<u>can be increased</u>*** *where supported by an engineering analysis that considers the following nine factors." Other factors as considered relevant can be included in this section."*

I. *Probability of a design fire event.*

II. *Probability of a train evacuation being conducted other than at a point of safety.*

III. *Probability that another compartment in the train is a point of safety for the design fire event.*

IV. *Fire growth rate during the evacuation phase of the design fire event*

V. *Maximum expected fire load during the evacuation phase of the design fire event*

VI. *Expected fire resistance characteristics of the rolling stock.*

VII. *Maximum time necessary for evacuating a train after immobisation of the train.*

VIII. *Maximum time necessary for all passengers to reach the nearest station or point of safety.*

IX. *Ability of tunnel vent system to provide a tenable environment along the path to the nearest station or other point of safety.*

Please note that in NFPA 2023, a further criterion was added as follows:

X. *Firefighters' response capabilities (e.g., SCBA limitations) and incident response procedure as determined through consultation.*

Chapter 6.4 Fire protection and Life Safety Systems

6.4.1 Emergency Access

Clause 6.4.1 *Except as described herein, means of egress, and exits from the guideway shall serve as emergency access routes (for Fire Service Intervention hence termed as "Intervention Shafts").*

Appendix B. EU TSI SRT Extracts

Section 20 of CRR-G-033D Annex 1 – Requirements for Safety in Railway Tunnels states the following.

> *"** The safety in railway tunnels TSI (EU) 1303/2014 is not mandated for Light Rail/Metrolink systems. However, the CRR see it as good industry practice and apply a similar approach to both Heavy Rail and Light Rail/Metrolink systems."*
>
> *"Applicants may choose an alternative approach for requirements for safety in railway tunnels, but applicants must demonstrate that this alternative approach will result in providing evidence that the topics listed in this section 20 are adequately captured and safety requirements fulfilled."*

Clause 4.2.1.5.2 of EU TSI SRT

"One of the following solutions shall be selected for access points from a train to the safe area:

I. ***Lateral and/or vertical emergency exits to the surface. These exits shall be provided at least every 1 000 m.***

II. *Cross-passages between adjacent independent tunnel tubes, which enable the adjacent tunnel tube to be employed as a safe area. Cross-passages shall be provided at least every 500 m.*

III. *Alternative technical solutions providing a safe area with a minimum equivalent safety level are permitted. The equivalent level of safety for passengers and staff shall be demonstrated using the Common Safety Method on risk assessment."*

Appendix C. NFPA 130 Extracts – Open Sections

***"Clause 3.3.42 – Point of Safety** An enclosed exit that leads to a public way or safe location outside the structure, an at grade point beyond an enclosing structure, or other areas that affords adequate protection for evacuating passengers".*

"Authority Having Jurisdiction (AHJ) – An organisation, office, or individual responsible for enforcing the requirements of a code or standard, or for approving equipment, materials, an installation, or a procedure.

Chapter 6 – Emergency Egress

***"Clause 6.3.1.1** The system shall incorporate a walk surface or other approved means for passengers to evacuate a train at any point along the trainway so that they can proceed to the nearest station or other point of safety."*

***"Clause 6.3.1.10** For open-cut trainways, an engineering analysis shall be conducted to evaluate the impact of the trainway configuration on safe egress from a train fire to a Point of Safety."*

***"Clause 6.3.1.11** Where the engineering analysis indicated that the configuration would impact tenability beyond the immediate vicinity of the fire, egress routes shall be provided such that the maximum distance from any point with the open-cut section to a point of egress from the trainway shall not exceed 381m."*

Chapter 6.4 Fire protection and Life Safety Systems

6.4.1 Emergency Access

***Clause 6.4.1** Except as described herein, means of egress, and exits from the guideway shall serve as emergency access routes (for Fire Service Intervention hence termed as "Intervention Shafts").*

***Clause 6.4.1.4** If security fences are used along the trainway, access gates shall be provided in security fences, as deemed necessary by Authority Having Jurisdiction.*

***Clause 6.4.1.8** Where the configuration of an open-cut trainway prevents or impedes access for firefighting, provisions shall be made to permit fire fighter access to that section of train at intervals not exceeding 762m.*