Understanding FRA's Alternative Crashworthiness Compliance Approach

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Rail Conference

Discussion Topics

- Introduction
- Key Facts
- Case Study: TEX Rail DMU Procurement
- Best Practices/Lessons Learned

Alternative Crashworthiness Introduction

- Current FRA regulations in 49 CFR Part 238 outline a prescriptive path to demonstrating the crashworthiness of rail vehicles

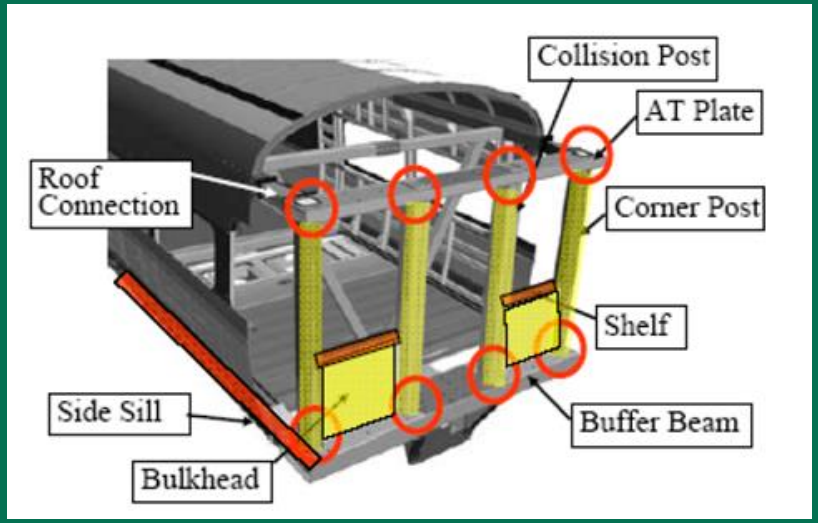
- New approaches to rail vehicle crashworthiness deviate significantly in some areas from current FRA regulations

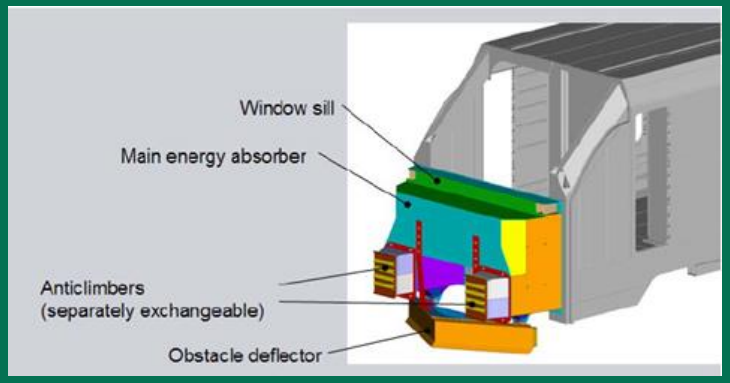
Alternative Crashworthiness Introduction – Cont.

- Waivers from meeting specific requirements of current FRA crashworthiness regulations have always been an available option
- Until recently, the path to supporting such a waiver has not been clearly defined
- Report DOT/FRA/ORD-11/22 describes how to demonstrate alternative crashworthiness compliance

Alternative Crashworthiness Key Facts

- Current approach in 49 CFR Part 238 focuses on force resistance of key structural members

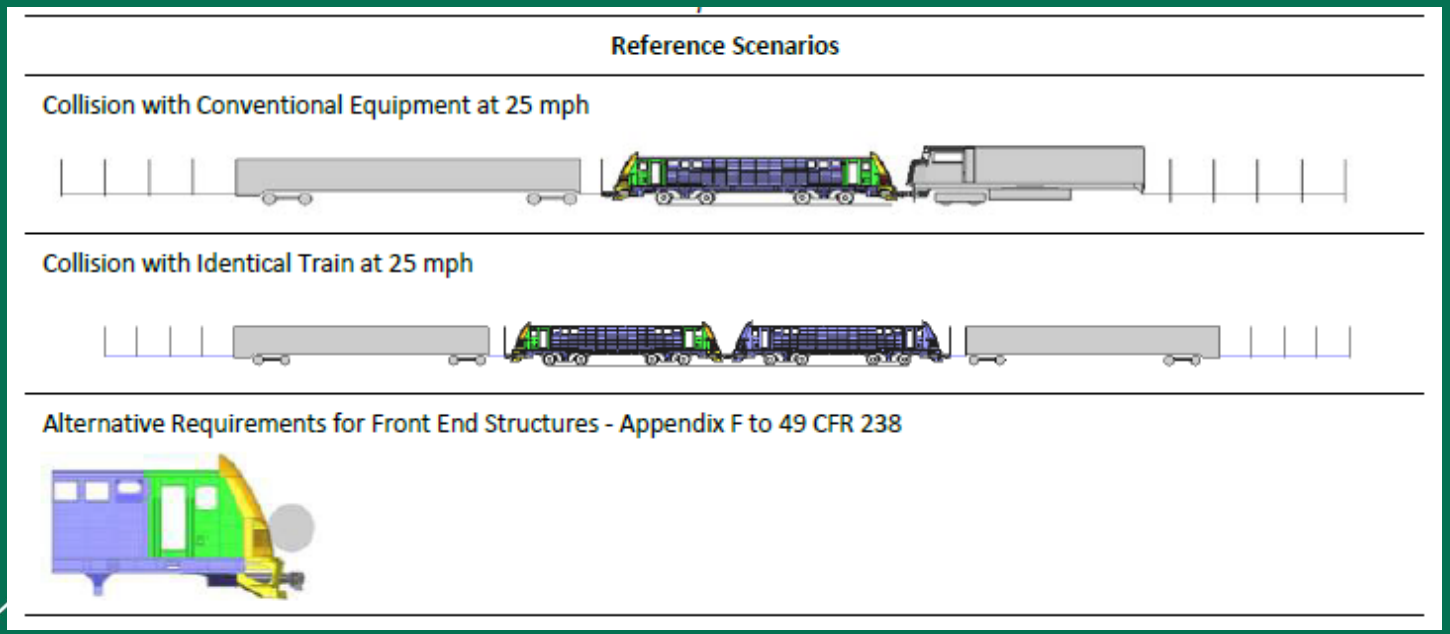




- Alternative compliance approach focuses on crash energy management (CEM) and occupied volume integrity

Alternative Crashworthiness Key Facts

- CEM approach has been used in Europe for a number of years
- Mirrors many requirements of EN 15227 with additional crash cases required



Alternative Crashworthiness Key Facts

Comparison of 49 CFR Part 238 Requirements to Alternative Compliance requirements from DOT/FRA/ORD-11/22 (1 of 3)

49 CFR 238 Requirement	Alternative Compliance Requirement
§238.203 Static end strength	3.1 Collision with Conventional Equipment: Cab/MU Led Moving 20 mph @AW0: as planned for service Loco Led Moving 25 mph @AW0: as planned for service Stationary: Conventional Loco (260 kips) + 5 Coach (95 kips) 3.2 Occupied Volume Integrity (Options A, B or C)
§238.205 Anti-climbing mechanism	3.3 Colliding Equipment Override (Scenario 3.1)

Alternative Crashworthiness Key Facts

Comparison of 49 CFR Part 238 Requirements to Alternative Compliance requirements from DOT/FRA/ORD-11/22 (2 of 3)

49 CFR 238 Requirement	Alternative Compliance Requirement
§238.205 Anticlimbing mechanism §238.207 Link between coupling mechanism and carbody	3.4 Connected Equipment Override (Scenario 3.1)
§238.209 Forward end structure of cab cars	3.5 Fluid Entry Inhibition
§238.211 (b) Collision posts §238.213 (b) Corner posts	3.6 End Structure Integrity of Cab End (Appendix F to Part 238)
§238.211 (a) Collision posts §238.213 (a) Corner posts	3.7 End Structure Integrity of Non-cab End Collision Post (not required), Corner Post (3 load cases)

Alternative Crashworthiness Key Facts

Comparison of 49 CFR Part 238 Requirements to Alternative Compliance requirements from DOT/FRA/ORD-11/22 (3 of 3)

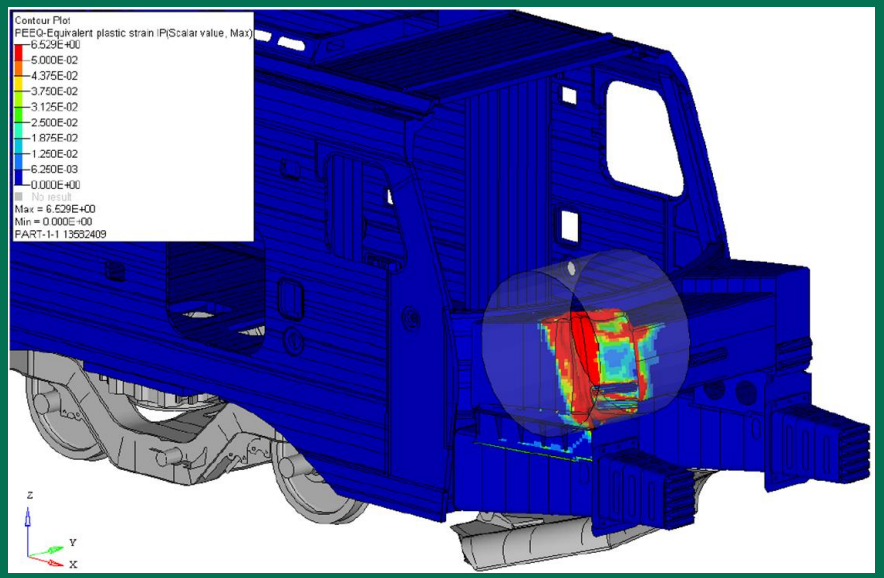
49 CFR 238 Requirement	Alternative Compliance Requirement
§238.215 Rollover strength	3.8 Roof Integrity (No option)
§238.217 Side structure	3.9 Side Structure Integrity (No option)
§238.219 Truck-to-carbody attachment	3.10 Truck Attachment (Option A or B)
§238.233. Interior fittings and surfaces	3.11 Interior Fixture Attachment (No option)
APTA SS-C&S-016-99, Rev. 2 – Standard for Row-to-Row Seating in Commuter Rail Cars APTA SS-C&S-011-99 – Standard for Cab Crew Seating Design and Performance	3.12 Occupant Protection Features (No option)

Alternative Crashworthiness Key Facts

- Currently available through waiver process
- Denton County Transportation Authority(DCTA) DMU project is an example of a successful application
- Process underway to make Alternative Crashworthiness part of CFR (new Appendix G)

Alternative Crashworthiness Pros

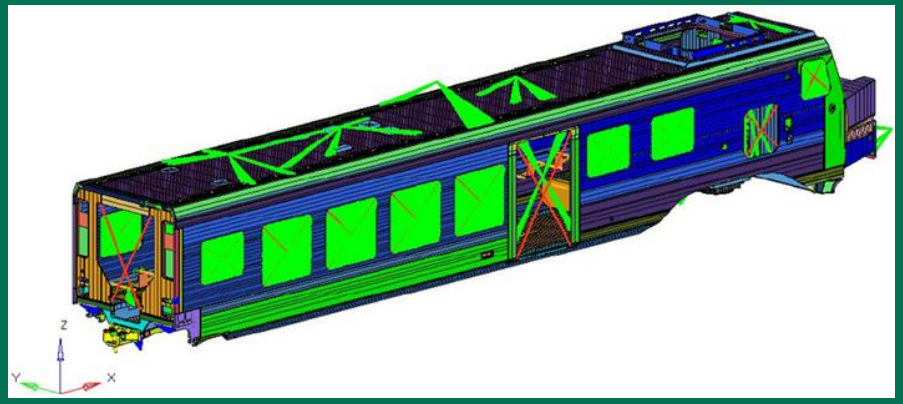
- Better management of crash forces and effects
- Generally lighter structure

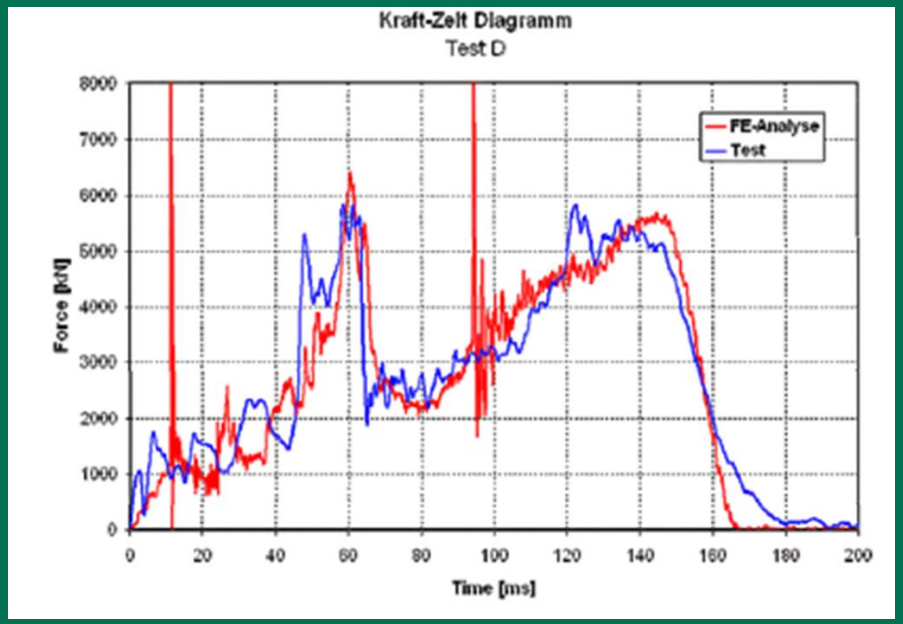


- Greater variety of existing designs can be adapted

Alternative Crashworthiness Cons

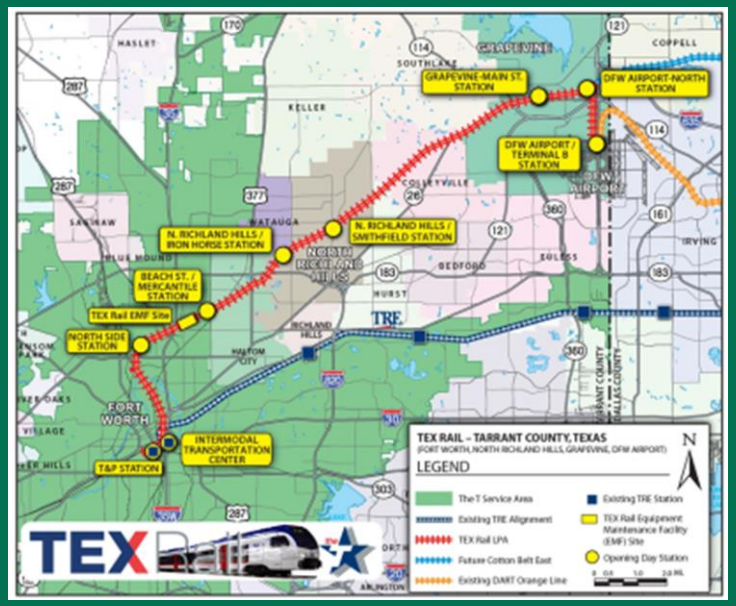
- Increased design complexity
- Higher level analysis to document compliance (explicit finite element analysis with large number of elements)





Case Study: TEX Rail DMU
Project in Brief

- 27 mile commuter rail project
- Will interoperate with freight traffic



- Will utilize 8 FLIRT3 DMU train sets built by Stadler

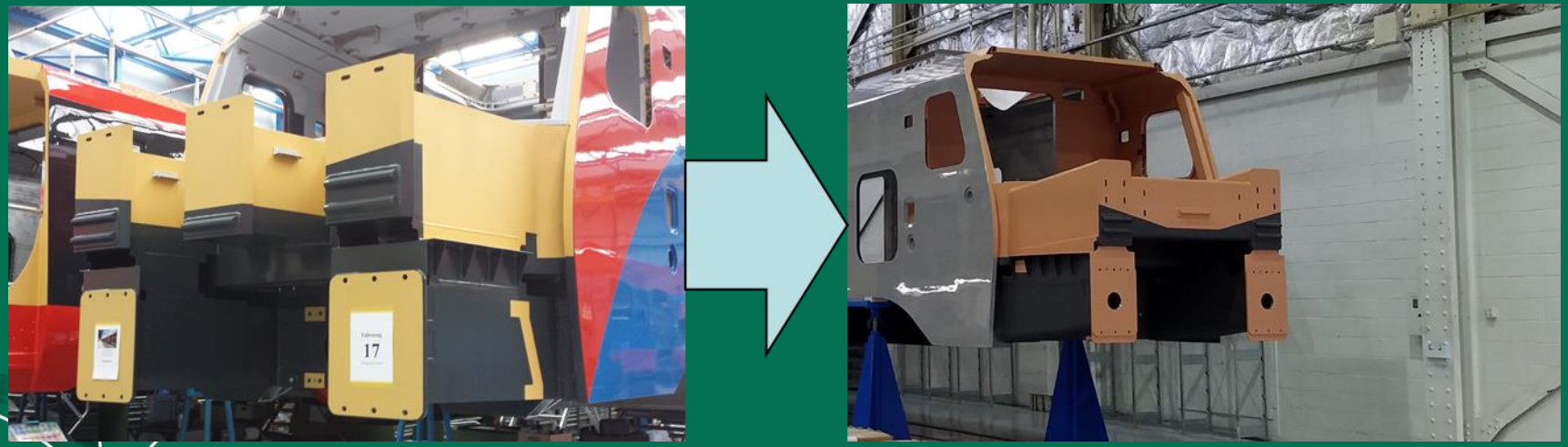
Case Study: TEX Rail DMU
Project in Brief

FLIRT3 DMU Specifications:

- Length: 266’
- Passenger Capacity: 225 seated, 225 Standees
- Weight: 352,000 lb empty, 443,000 lb @ AW3
- Top Speed: 79 MPH

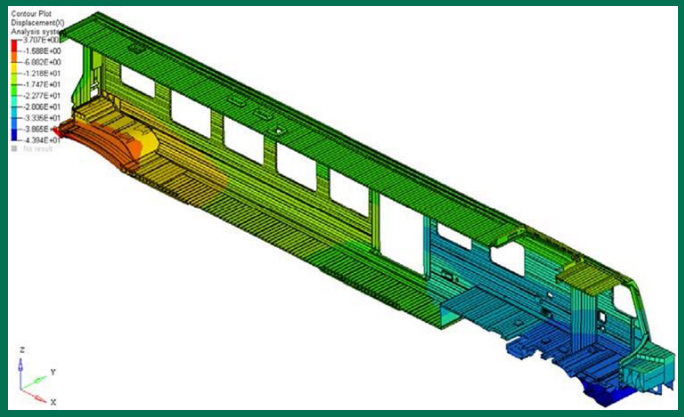
Case Study: TEX Rail DMU Project in Brief

- Over 1000 FLIRT train sets successfully delivered in Europe, built to EN 15227
- Basic FLIRT design required some modifications to meet FRA Alternative Compliance requirements



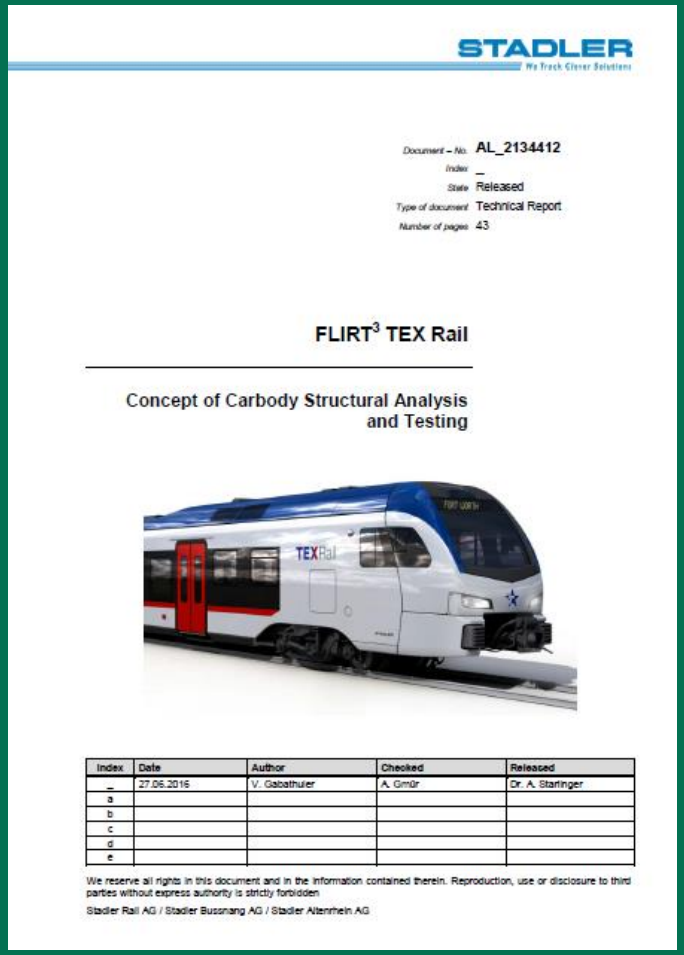
Case Study: TEX Rail DMU Alternative Compliance

- Design changes focused on some structural strengthening and new energy absorbing elements
- Design began at end of 2015



Case Study: TEX Rail DMU Alternative Compliance

- Initial report outlining design/analysis approach was submitted to FRA in June 2016
- Detailed preliminary analysis submitted in January 2017



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Document – No. AL_2134412
Index –
State Released
Type of document Technical Report
Number of pages 43

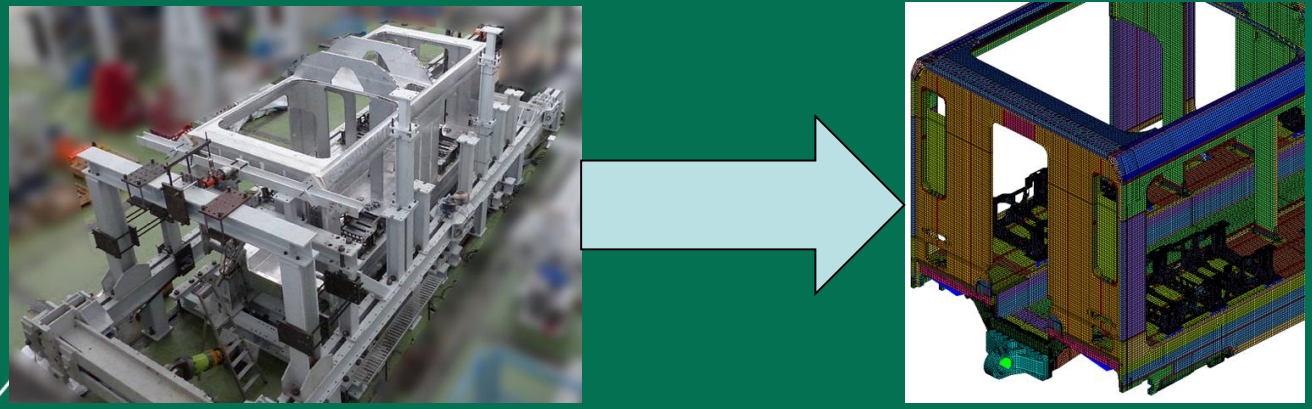
FLIRT³ TEX Rail

Concept of Carbody Structural Analysis and Testing

Index	Date	Author	Checked	Released
–	27.06.2016	V. Gabathuler	A. Gmür	Dr. A. Starlinger
a				
b				
c				
d				
e				

Case Study: TEX Rail DMU Alternative Compliance

- Validation expected to be completed in July 2017
- FRA waiver approval expected in fourth quarter of 2017



Alternative Crashworthiness Process Lessons Learned

- Maintain open communication with FRA stakeholders from Day 1 of project
- Continue regular information exchange with FRA as design evolves
- Submit alternative crashworthiness support documentation at each stage of the analytical process (preliminary, final, validation) to allow proper time for FRA review and comment

Alternative Crashworthiness Process Summary

- Due to recent FRA work, this process is now clearly defined
- One successful application already in service with as many as four others in service by 2020
- Current Alternative Crashworthiness (waiver) process on track to become part of the regulation (no longer a waiver)

Alternative Crashworthiness Process Links/Resources

- NPRM -Standards for Alternative Compliance and High-Speed Trainsets
  http://www.fra.dot.gov/eLib/details/L18433
- Technical Criteria and Procedures for Evaluating the Crashworthiness and Occupant Protection Performance of Alternatively Designed Passenger Rail Equipment for Use in Tier I Service (DOT/FRA/ORD-11/22)
  https://www.fra.dot.gov/eLib/details/L01292

Thank you for your attention

Questions?