On the way to virtual certification: An NSA's point of vue

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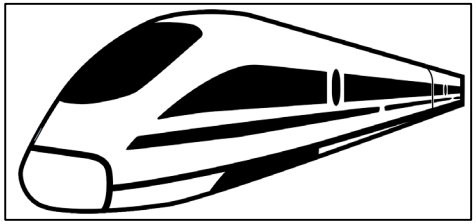
CLASSIC PROCESS TO APOM



Safety demonstration

Risk analysis

Tests in the field

Current collection

Signalization

Dynamic behavior

Braking

…

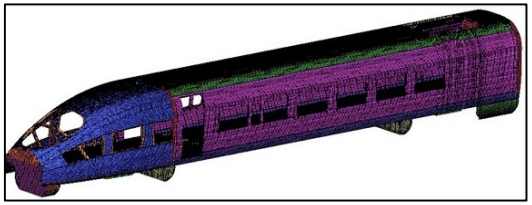
Virtual certification

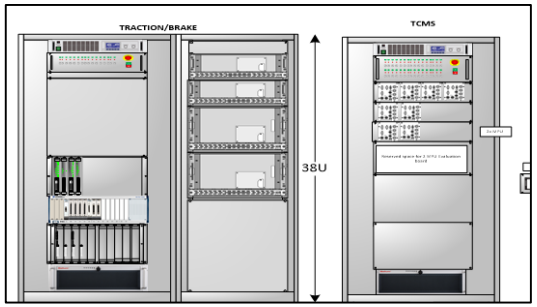
Finite elements

Multibody simulation

HIL

Labtrain





TEST VS SIMULATION: PRO & CONS

FIELD	VIRTUAL
+ Real conditions	+ Exhaustivity / Degraded modes
+ « Justice of the peace » / Trust	+ Minimized risk
+ Deal with complexity	+ Cost ↓
+ Accredited staff	
- Available slots / cost	- Confidence
- Limited measurements	- Representativeness
- Potentially dangerous	- Data & model integrity
- No mastering of environmental conditions	- Complex phenomena / Interfaces

USE OF SIMULATION

	Automotive	Aviation	Railway
Design	HIGH	HIGH	HIGH
Pre-validation / industrialization	HIGH	HIGH	MEDIUM/HIGH
Validation / certification	LOW/MEDIUM	MEDIUM	LOW
Expertise	HIGH	HIGH	MEDIUM

Mainly used before certification

Reduce uncertainty in the success of tests and their number

In many cases, a test is performed at the end

Test results feed numerical models

ON THE WAY TO VIRTUAL CERTIFICATION

Strong **will** of stakeholders

Tests are regulated (authorized). Simulations are not.

Certification bodies and regulators are **careful** regarding simulation

Confidence in the proofs is the key to **accept** such a demonstration means

Current innovations **multiply** the test configurations (autonomous driving)

An applicant could ask an authorization **mainly based** on virtual tools & proofs

What guidelines for the assessors?

Based on this finding, EPSF decided to build an official « NSA » position.

2 years think tank with the railway sector

ACTIONS

Deliverable n°1: Mapping matrix (example of Loc&Pas TSI)

STI					TSI			Standard called in the TSI					Other Standard NOT called in the TSI, but used for design				
TSI paragraph	Subject	TSI requirement	Design or Evaluation requirement	Defined as safety requirement in the TSI	Test required in the TSI	Partial evaluation of the requirement authorised by simulation/calculation in the TSI	Total evaluation of the requirement authorised by simulation/calculation in the TSI	Standard called in the TSI	Paragraph of the standard concerning simulation/Calculation	Test required in the Standard	Partial evaluation of the requirement authorised by simulation/calculation in the Standard	Total evaluation of the requirement authorised by simulation/calculation in the Standard	Standard called	Paragrah of the standard concerning simulation/Calculation	Test required in the Standard	Partial evaluation of the requirement authorised by simulation/calculation in the Standard	Total evaluation of the requirement authorised by simulation/calculation in the Standard
CARACTÉRISATION DU SOUS-SYSTÈME «MATÉRIEL ROULANT»																	
4.2.2.4.	Strength of vehicle structure	4)Proof of the strength of the vehicle body may be demonstrated by calculations and/or by testing, according to the conditions set up in the specification referenced in Appendix J-1, index 7, clause 9.2.	Design	Yes	No	Yes	Yes	EN 12663-1:2010	5.1 General	Yes	Not specified	Yes	EN 13749:2011	§ 6.2.1 Content	Yes	Yes	No
4.2.2.6.	Lifting and jacking	9) The structure shall be designed with consideration of the loads specified in the specification referenced in Appendix J-1, index 11, clauses 6.3.2 and 6.3.3; proof of the strength of the vehicle body may be demonstrated by calculations or by testing, according to the conditions set up in the specification referenced in Appendix J-1, index 11, clause 9.2.	Design	No	No	Yes	Yes	EN 12663-1:2010	5.1 General	Yes	Not specified	Yes					

Same work in process for infrastructrure, noise, tunnel TSI

Target 1: to cross regulation requirements with possibilities to use simulation

Target 2: to identify the possible levers for changing standards

Target 3: to co-construct these evolutions between assessment bodies and applicants

ACTIONS

Deliverable n°2: Position Paper

Published on the 1st of february 2019

Position of the French NSA regarding the use of simulation in the safety demonstrations

Deals with:

- **Qualification of the simulation tool**
- **Skills required to use the simulation tool – The process**
- **Validity of equipment and environment models**

Summary of the validation plan for the simulation tool

User declaration confirming compliance with the validation plan for the tool;

Processes in place to guarantee the organisation's capacity to perform simulations (expertise of users, independence between designers and validation experts)

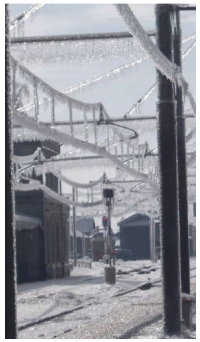
APPLICATION CASE : RER NG

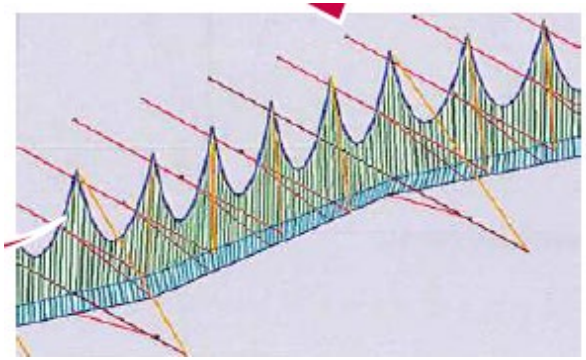
Paris new suburban train

Authorizations scheduled on 2023 and 2025

Current collection under low temperature:

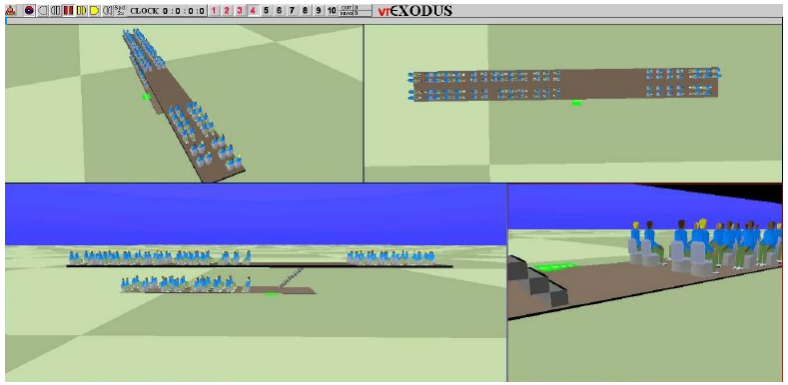
- using « OSCAR + » tool
- **30%** less required days for field tests





Train evacuation:

- using « building EXODUS » tool
- **No in field test**



NEXT STEPS

The position paper gave rise to a CEN/CENELEC WG

Recommandations to convenors for the use of simulation in european standards

Two concrete cases currently emerging for future APOM

Still a lot a work to lead to full virtual certification !

THANK YOU FOR YOUR ATTENTION