BEATT Bureau d'Enquêtes sur les Accidents de Transport Terrestre

Tram derailment in Lyon after collision with car – August 2015

BEA-TT's technical investigation and recommendations

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RÉPUBLIQUE FRANÇAISE
MINISTÈRE DE LA TRANSITION ÉCOLOGIQUE ET SOLIDAIRE
MINISTÈRE CHARGÉ DES TRANSPORTS

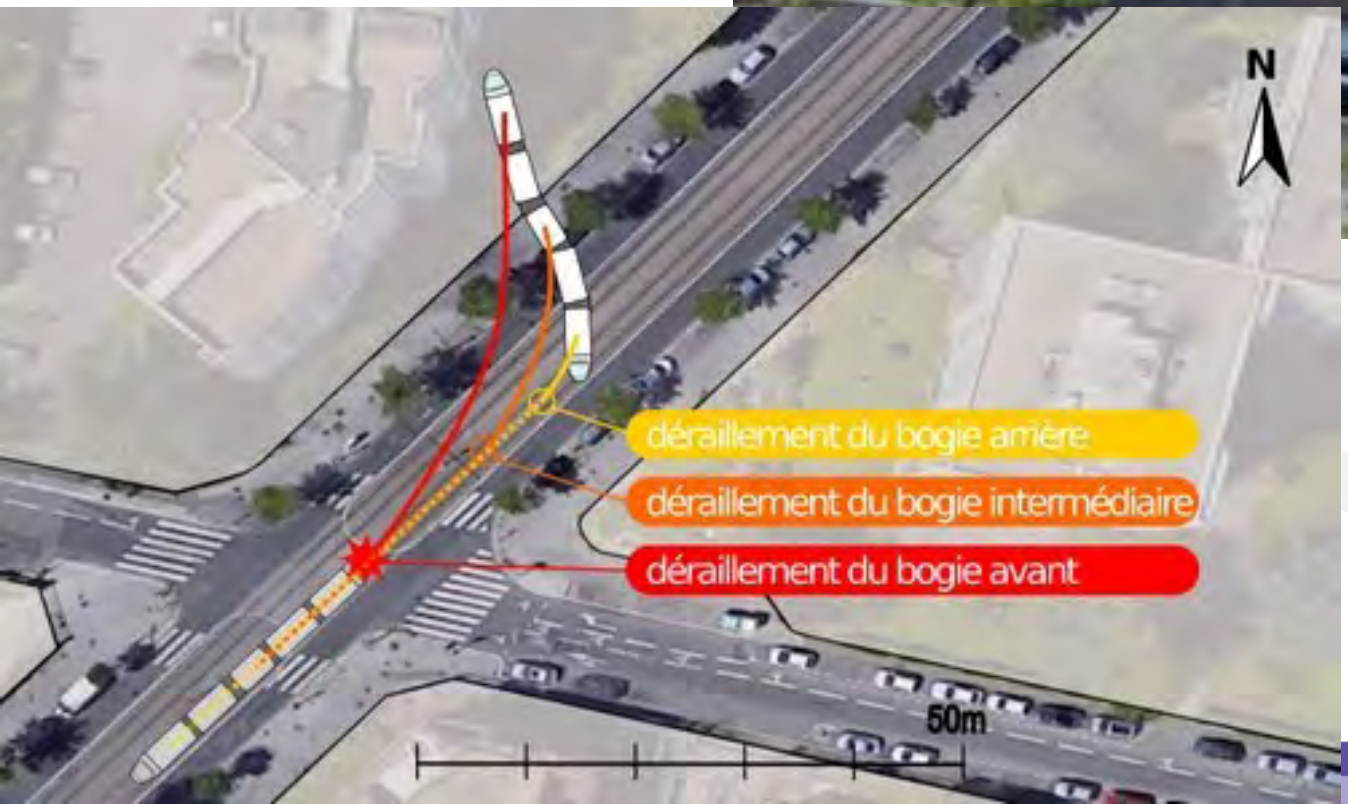
What is the BEA-TT ?

- Bureau d'Enquêtes sur les Accidents de Transport Terrestre
- 12 persons, located in Paris
- Technical investigations on road, fluvial, train including level crossing, trams, subways, ropeways accidents
- No determination of responsibilities
  ⇒ recommendations on the system
- Access to all information
- On-going investigations :

1. The accident – 23/08/2015
2. The investigation on tram derailment
3. Tram crossing junctions
4. BEA-TT's Recommendations

1 The Accident – 23rd of August 2015

1 Visualisation

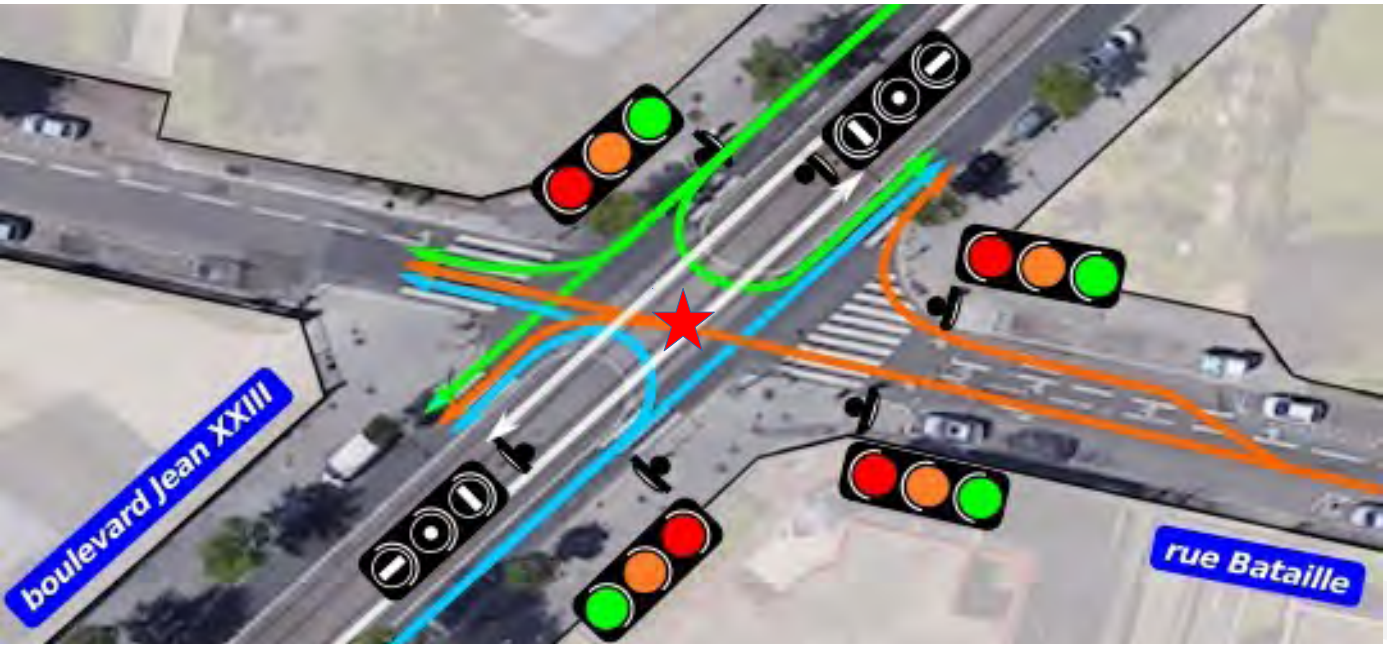


1 What happened ?

- 23rd of August, 15h51, Lyon, line T2, in a junction
- Tram hit by a car coming from its right side
- The tram derailed 3 bogies, crossed the opposite tram tracks, the road, hit 2 parked cars, crossed the fence and stopped a few meters before the building
- Travelled 55 meters in total after the collision
- 5 slightly injured persons
- Could have been more dramatic

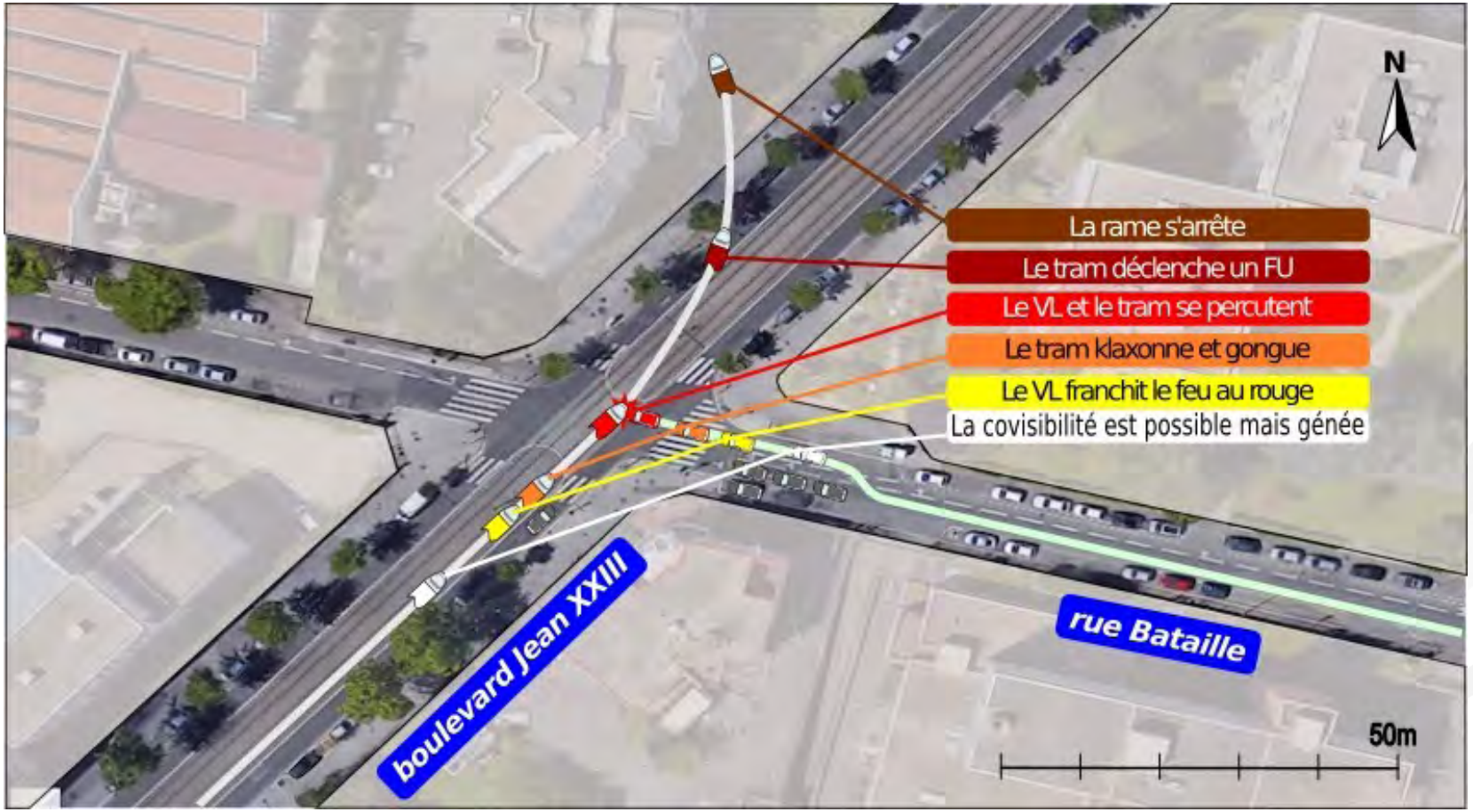
1 Where it happened ?

- Junction of 2 roads at 120°, tram line is centred
- Rue Bataille is one way, two lines of cars, one phase
- All traffic lights are red when the tram crosses



1 How it happened ?

- Car has not respected the red traffic light
- Car has not applied the breaks, tram applied EB after collision
- Collision = car at 29 km/h and tram at 47 km/h



1 Which causes ?

- Direct cause = car driver has not respected his traffic signalisation, on red light for 30 seconds
- Inattention and lack of mutual visibility
- 2 other factors have made this derailment so consequent :
    - High sensibility to derailment in this type of rolling stock when colliding with cars
    - High speed of the tramway and the absence of breaking by the tram driver before the collision

2 The investigation on tram derailment

② Feedback

- Comparison Citadis X02 to others - on 10 years' figures

Période 2004-2014	Véhicules routiers de poids **inférieur à 3,5 t**	Véhicules routiers de poids **supérieur à 3,5 t**
Nombre de collisions	9159	433
Nombre de déraillements induits	54	27
Déraillement pour 1000 collisions	**6**	**62**
Déraillement pour 1000 collisions avec un tramway Citadis X02 (302 ou 402)	11 (45 déraillements pour 4053 collisions)	112 (18 déraillements pour 161 collisions)
Déraillement pour 1000 collisions avec un tramway d'un autre modèle	2 (9 déraillements pour 5106 collisions)	33 (9 déraillements pour 272 collisions)

- 2 other examples of derailment after collision
  - Valenciennes 8th October 2008
    (BEA-TT's investigation and recommendations)
  - Lyon 10th November 2017

② Feedback from Valenciennes's accident

- BEA-TT had made recommendations on tram derailment ⇒ STRMTG guide on conception of trams' front head (oct 2016)
- This guide proposes a method which determines through modelling, the theoretical speed of a car that makes a tram (30 km/h) derail, in a 90° collision at the extremity of the front cabin
- ⇒ to check if the car's speed making the tram derail, is above or equal to the existing rolling stock (defined as "the reference" by the manufacturer)
- Alstom has applied this methodology to his range Citadis X05 (on-going conception and production). Alstom has compared it to the existing X02 = its reference ⇒ have a similar "deraillability"
- **So, sensibility to derailment is better evaluated now. But there is no significant improvement compared to X02...**

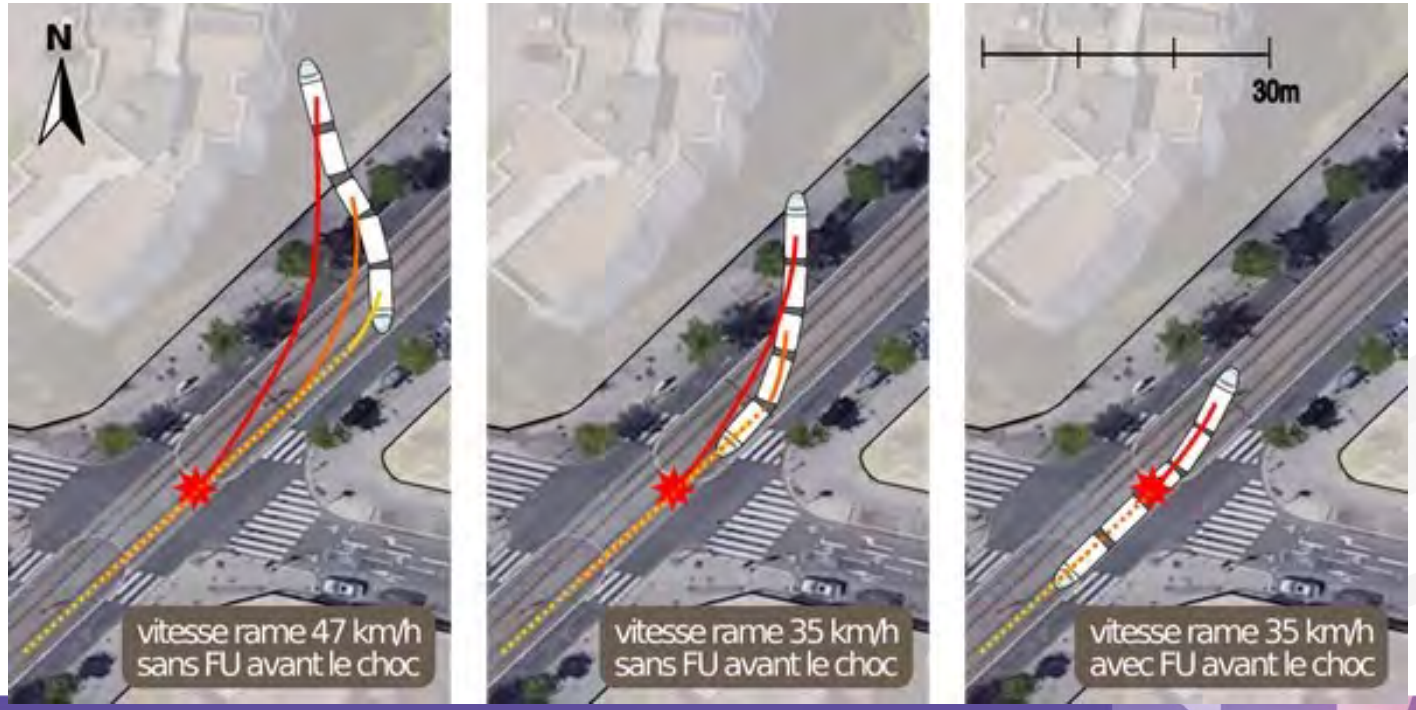
② Lyon accident November 2017

- 10th of November 2017, 8 h 23
- line T4, junction Bonnel & Villette
- Car has not respected the red traffic light
- Tram has derailed, hit a tree and then a pole supporting the catenary
- 15 slightly injured persons
- Tram was at 40 km/h, applied the normal breaks and then stopped, EB not applied, only the horn (as in 2015)
- Tram hit the pole at 20 km/h.
  If there was the EB when the horn was applied, it could have avoided the collision with the tree & pole

3 Tram crossing junctions

3 Which consequences with lower tram speed ?

- Max Lyon = 50 km/h everywhere, no specification for junctions
- Various possibilities have been considered in the investigation :
  - Tram speed = 35 km/h with Emergency Breaking after the collision
  - Tram speed = 35 km/h with EB before the collision



3 What are the operator's rules to cross junctions?

- Lyon and Grenoble = only two networks with no limitation rules when crossing, only driving at sight
- Lille and Orléans impose a limitation, up to 50 km/h in certain locations
- The 24 other networks limit the speed in junctions to 30, 35 or 40 km/h

- Lyon rules = no indication where poor visibility in junction, no indication on the joystick's position, nor when to apply EB = too large range of appreciation amongst drivers and no defensive attitude implemented
- Question raised about drivers' experience (a student part-time driver)

4 BEA-TT's Recommendations

4 3 recommendations

- R1 addressed to the STRMTG

  For the tram types not yet developed, in the application of the guide « *Conception des bouts avants des tramways* », do not validate a reference of rolling stock with no favourable feedback as the Citadis X02. If the manufacturer can't reasonably propose an other reference, demand a significant improvement of the derailment rate compared to the reference or compensatory measures notably reducing the importance of a derailment

- R2 addressed to Alstom

  Propose in the next ranges post Citadis X05, solutions for a significant improvement of the deraillability compared to the Citadis X02. If not possible, propose compensatory measures reducing the importance of a derailment, these measures could be presented as a retrofit to the actual types

- Invitation to the STRMTG

  To animate a debate with all actors (cities, manufacturers) to improve notably the future rolling stocks' sensibility to derailment

4 3 recommendations

- R3 addressed to Kéolis-Lyon, SYTRAL, SÉMITAG and SMTC

  Impose to the trams an adapted speed limitation when crossing the intersections, adapted to the danger and visibility, and in general between 30 and 40 km/h.

  Precise, in driving rules and in the drivers' trainings, the modalities to approach and cross the junctions in order to prevent collisions.

- Answers to the recommendations must be officially sent to the BEA-TT before 90 days and are published on our website, next to the report

Thank you for your attention.

BEATT

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