Railway Accident and Incident Investigation Unit

Safety Notice Derailment of a work train (ballast regulator) of the infrastructure manager Infrabel Tubize - 14 April 2020



December 2020

REPORT VERSION TABLE

Version number	Subject of revision	<u>Date</u>
1.0	First version	04/12/2020



Any use of this report with a different aim than of accident prevention - for example in order to attribute liability - individual or collective blame in particular - would be a complete distortion of the aims of this report, the methods used to assemble it, the selection of facts collected, the nature of questions posed and the ideas organising it, to which the notion of liability is unknown. The conclusions which could be deduced from this would therefore be abusive in the literal sense of the term. In case of contradiction between certain words and terms, it is necessary to refer to the French version.

TABLE OF CONTENTS

1.	GENERAL INFORMATION	5
2.	IMMEDIATE FACTS	7
2.1.	The event	7
	2.1.1. Brief description of the event	7
	2.1.2. Location	8
2.2	2.1.3. The decision to open an investigation	8
2.2.	The circumstances of the event	9
	2.2.1. Concerned company. Initiastructure manager initiaber	10
	2.2.2. India	10
2.3.	Deaths, injuries and material damage	15
	2.3.1. Passengers, personnel and third parties	15
	2.3.2. Damage to rolling stock	15
	2.3.3. Damage to the infrastructure	15
	2.3.4. Delays caused	15
2.4.	External circumstances	16
	2.4.1. Weather conditions	16
	2.4.2. Geographical references	16
3.	REPORT OF INVESTIGATIONS AND ENQUIRIES	19
3.1.	Summary of witness statements	19
3.2.	Safety management system	19
	3.2.1. Role and responsibility	19
	3.2.2. Procedure	20
3.3.	Rules and regulation	21
	3.3.1. Applicable community and national public rules and regulations	21
	3.3.2. Other rules, such as operating rules, local instructions, staff requirements,	21
3 /	The functioning of rolling stock and technical installations	22
5.4.	3.4.1 Inspection of the rolling stock	22
	3 4 2 Inspection of the infrastructure	22
	3.4.3. Work and decommissioning of line 96	27
3.5.	Measures taken to protect and safeguard the site of the occurrence	28
3.6.	Man-Machine-Operation interface	29
	3.6.1. Training	29
	3.6.2. Performing the manual switch operation	29
	3.6.3. The window of the switch motor housing cowl	30
4.	ANALYSIS AND CONCLUSIONS	33
4.1.	Final summary of the chain of events	33
4.2.	Analysis	34
	4.2.1. Regarding the ballast regulator	34
	4.2.2. Regarding switch 02c	34
	4.2.3.Regarding the performance of the manual operation	34
4.2	4.2.4. Regarding the window glass of the switch motor housing cowl	35
4.3.	Conclusion	36
	4.3.1. Direct Causes	26
	4.3.3 Systemic factors	30
	4.3.4. Other findings	37
-		
5.	MEASURES TAKEN	39
6.	RECOMMENDATIONS	41



1. General Information

Nature of the event:

Derailment of a work train (ballast regulator) of the infrastructure manager, Infrabel.

Type of event and safety investigation:

Significant accident with safety investigation.

Date and time of the event:

Tuesday 14 April 2020 around 4:40 am.

Place of the event:

Line 96, at Tubize station on switch 02C.

<u>Train:</u>

Work train: ballast regulator no. 998894252134.

Victim:

There are no victims.

Material damages and consequences:

Damages to infrastructure elements and the rolling stock. Stoppage of rail traffic on both tracks of the line for more than two hours.

Direct cause:

The direct cause of the derailment of the ballast regulator at switch 02C was the movement of the switch point of switch 02C while being traversed by the ballast regulator, as a result of the switch not being locked after a manual operation on a track taken out of service for work.

First indirect factor:

The switch points moved under the train because the switch locking system was not engaged following an incomplete manual operation.

Second indirect factor:

The track officer who handled the switch followed the requirements of the procedure. The officer chose to check the execution of his manoeuvre via the characteristic end-of-operation click, a characteristic click that may not be correctly heard in a noisy environment. He did not check the position of the diabolos¹ under the window of the engine housing cowl.

System factors:

The procedure does not involve checking both indicators (the characteristic click and the position of the diabolos), but only a choice of one of the two.

Only checking the characteristic click increases the risk of human error: it appears that only checking the characteristic click is not sufficient to ensure that the position of the switch has been checked after it has been operated, particularly in a noisy environment such as track work.

Recommendations:

In view of the measures taken and proposed by the infrastructure manager Infrabel, the Investigation Unit did not issue any recommendations following the derailment of a ballast regulator on switch 02C on 14 April 2020.

5

1 Diabolos: functioning and positioning indicators in the switch's motor.



2. IMMEDIATE FACTS

2.1. THE EVENT

2.1.1. BRIEF DESCRIPTION OF THE EVENT

During the night of 13 to 14 April 2020, Infrabel, the infrastructure manager, carried out work on line 96, near Tubize station.

Tracks A and B of line 96 were taken out of service between Lembeek and Braine-le-Comte.

During this work, a ballast regulator belonging to the infrastructure manager travelled along the tracks to put back in place the ballast.

Around 4.30 am, the Infrabel ballast regulator finished working on track A and stopped at the Tubize platforms. The next sequence of the planned route required the ballast regulator to run on track B to return to Braine-le-Comte.

The track change was made via switch 02C, which was manually operated by a track officer. Once the switch had been operated, the ballast regulator left the platforms at Tubize and used switch 02C to go from track A to track B.

While traversing this switch, the first axle of the ballast regulator derailed at low speed. On feeling the shocks, the driver braked immediately. The ballast regulator came to a standstill on the switch, encroaching on the loading gauge of both tracks.

The alert was sounded and the work was interrupted.

The track and track units were damaged.

With the ballast regulator stationary within the loading gauge of both tracks, train movements were halted on both tracks of the line.

2.1.2. LOCATION



Illustration: Signalling plan (SSP) with indication of the intended train route

2.1.3. THE DECISION TO OPEN AN INVESTIGATION

The Investigation Unit (IU) on-call investigator was notified by Traffic Control and went to the accident site.

The occurrence was a significant accident: a main line derailment resulting in a rail traffic interruption of more than two hours.

In accordance with Article 111 (paragraph 2) of the Law of 30 August 2013², the Investigation Unit decided to open an investigation and informed the parties concerned accordingly.



Art. 111, § 1. The Investigation Unit:

2

1° carries out an investigation after each serious accident on the railway system;

^{2°} in addition to serious accidents, may carry out investigations into accidents and incidents which, under slightly different circumstances, could have led to serious accidents, including technical failures in the structural subsystems and interoperability constituents of the high-speed or conventional rail system. Where appropriate, it takes into account the criteria determined by the King; [...];

2.2. THE CIRCUMSTANCES OF THE EVENT

2.2.1. CONCERNED COMPANY: INFRASTRUCTURE MANAGER INFRABEL

Following the Royal Decree of 14 June 2004, Infrabel is the infrastructure manager. The infrastructure manager must ensure the correct application of the technical standards and rules relating to the safety and use of the railway infrastructure.

Infrabel's activities are organised into six general services:

- I-FBA : Finance & Business Administration;
- I-HRO: HR & Organisation;
- · I-SCPA: Strategy, Corporate & Public Affairs;
- I-ICT: Information & Communication Technlogy;
- I-CBE : Customer & Business Excellence;
- I-AM: Asset Management.



Illustration: organisational chart of Infrabel (source: Infrabel)

2.2.2. TRAIN

The derailed train was a work train owned by the infrastructure manager Infrabel.

It was a Plasser & Theurer model SSP 203 ballast distributing and profiling regulator. A ballast regulator is a self-propelled machine that distributes the ballast discharged during track construction or maintenance work in accordance with regulatory profiles.



Illustration: ballast regulator no. 998894252134



2.2.3. DESCRIPTION OF THE INFRASTRUCTURE

2.2.3.1. LINE 96

Line 96 runs from Brussels-Midi station to Feignies station (French-Belgian border).

Tubize station is located at kilometre marker 18,458 of the line, south of Brussels in Walloon Brabant. This part of line 96 is managed by signal block 27 in Mons, equipped with the EBP system.

2.2.3.2. SWITCH 02C

Switch 02C is located at the exit of Tubize station in the direction of Braine-le-Comte.



Illustration: diagram of a switch

The switch stand is the switch motor, to which the two switch points are connected by means of rods (in blue on the diagram).

They are equipped with a locking device to hold the switch points in position. There are different types: the 02C switch is a switch with vertical staple locking.



Illustration image: Vertical staple locking (source: Infrabel)

There is a significant risk of derailment if a switch is not properly locked. The vertical staple locking device is not sufficient to secure the switch points when a switch is traversed by a train at speeds in excess of 90 km/h³. These switches are thus equipped with an additional locking device.

The additional locking device for the 02C switch is an actuator system. It consists of a rack and pinion that will rotate to allow the actuator rod to extend and engage in the notch provided for this purpose in the control rods. Once the actuator is engaged, the control rods and switch points will not be able to move.



Illustration image: Locking device for the motor rack and pinion (actuator) (source: Infrabel)

The running speed of work trains and machinery operating on a track closed to normal traffic (out of service track) is limited to a maximum of 30 km/h.

2.2.3.3. THE DIABOLOS

The diabolos are located in the switch motor housing. They constitute the position indicator within the switch motor.

They are easily recognisable, as they are small white squares with two red triangles (see illustration below).



Illustration: Interior of the motor housing of the 02C switch. It is possible to see the diabolos in the red circle and the emergency crank in the bottom left of the picture.

In the locked position of a switch, they are positioned in line with the window on the switch stand cowl and are therefore visible when the window is raised.



Illustration image: Motor housing of a switch (source: Infrabel)

2.2.3.4. THE EMERGENCY CRANK

The emergency crank is the tool for manually operating a switch. It makes it possible to manually turn the motor that will move the switch points.



Illustration image: an emergency crank (source: Infrabel)

2.2.3.5. THE WORK

A line can be taken out of service during works. This is mentioned in the works bulletin, which must include clear and precise instructions in accordance with RGE/ARE⁴ 741-1.

Information on the planned work on Line 96 on the night of 13-14 April 2020 is contained in BNX 45M-07377-005.

The list of switches that could be manually operated during the planned work on Line 96 during the night of 13 to 14 April 2020 is contained in ILT/TPO⁵ L96 2020 P3 S16.



2.3. DEATHS, INJURIES AND MATERIAL DAMAGE

2.3.1. PASSENGERS, PERSONNEL AND THIRD PARTIES

There are no victims.

2.3.2. DAMAGE TO ROLLING STOCK

The damage to the ballast regulator is very limited.

2.3.3. DAMAGE TO THE INFRASTRUCTURE

Switch 02C was damaged as shown in the illustration below.



Illustration: Damage observed on switch 02C on 14 April 2020 (source: Infrabel)

2.3.4. DELAYS CAUSED

Rail traffic was stopped on both tracks for more than two hours, causing various trains to be delayed.

2.4. EXTERNAL CIRCUMSTANCES

2.4.1. WEATHER CONDITIONS

There were no particular weather conditions on 14 April 2020.

2.4.2. GEOGRAPHICAL REFERENCES

Tubize station is a Belgian railway station on line 96, which goes from Brussels-Midi to Quévy. It is located in the municipality of Tubize in the province of Walloon Brabant in the Walloon Region.



Illustration: Location of Tubize station and line 96 on the Belgian map.







3. REPORT OF INVESTIGATIONS AND ENQUIRIES

3.1. SUMMARY OF WITNESS STATEMENTS

During the investigation, the Investigation Unit obtained the testimony of the ballast distributor regulator driver and the statement of the track officer who manually operated the switch.

These two testimonies will not be reproduced here but were used in substance for analysing the causes of the derailment.

3.2. SAFETY MANAGEMENT SYSTEM

3.2.1. ROLE AND RESPONSIBILITY

The organisation of the manual operation of a switch on a track that is out of service requires the ability to perform A.R.E.T. safety duties (Agent Responsable de l'Exécution des Travaux - Agent Responsible for the Execution of the Works).

The personnel certification for performing A.R.E.T. safety duties (critical safety task) is issued after the successful completion of the corresponding certification training course.

The work manager appointed to oversee and supervise the work was certified to carry out A.R.E.T. safety duties.

The work manager may delegate the manual operation of a switch to a track officer from his crew. However, although the task may be delegated, responsibility for the proper performance of this manoeuvre cannot be delegated and rests with the work manager with A.R.E.T. safety duties.

At the time of the accident, there was no formally defined procedure for the delegation of this mission. This delegation was nevertheless noted on the worksheet prepared for this service.

3.2.2. PROCEDURE

The directives and work instructions for performing a manual operation on a switch are contained in RGE/ARE 728-2 and RGE/ARE 741-1.

Before manually operating the switch, the officer performing the operation must verify that the switch is clear and can be safely operated. He then installs mobile red signals to protect the switch (so that it cannot be traversed during the switch operation) before completing the manoeuvre, which can then be safely completed.

The indication of a complete and correctly performed manoeuvre is either the characteristic end-of-operation click (the typical "click" sound) or the raising of the window cover located on the motor housing cowl to check the correct position of the diabolos (position indicator).

Finding no. 1:

20

The procedure provides for, but does not require, the checking of the correct position of the diabolos to ensure that the switch operation is complete.

3.3. RULES AND REGULATION

3.3.1. APPLICABLE COMMUNITY AND NATIONAL PUBLIC RULES AND REGULATIONS

3.3.1.1. EUROPEAN LEGISLATION

• Commission delegated regulation (EU) 2018/762 of 8 March 2018 establishing common safety methods on safety management system requirements.

3.3.1.2. BELGIAN LEGISLATION

- Law of 30 August 2013 on the railway code
- Royal Decree of 9 July 2013 determining the requirements applicable to security personnel (updated on 23 August 2018)

3.3.2. OTHER RULES, SUCH AS OPERATING RULES, LOCAL INSTRUCTIONS, STAFF RE-QUIREMENTS, MAINTENANCE PRESCRIPTIONS AND APPLICABLE STANDARDS

3.3.2.1. INFRABEL

RGE/ARE 741.1

"Temporary decommissioning of a track on lines equipped with lineside signals"

RGE/ARE 728.2

"Switch Disruptions - 1st Supplement"

Circular 29 I-AM 2017

"Switch operation on a decommissioned track and ban on bringing a work train onto a main line section prior to it being taken out of service"

21

PTR/RTV 314 "Switch command and control devices - Booklet 6: Maintenance"

3.4. THE FUNCTIONING OF ROLLING STOCK AND TECHNICAL INSTALLATIONS

3.4.1. INSPECTION OF THE ROLLING STOCK

3.4.1.1. FINDINGS ON THE DAY OF THE ACCIDENT

During the planned work and before the derailment at approximately 4.40 am, the ballast regulator crossed the manually operated switches, including switch 02C, several times. No problems were reported during these journeys prior to the derailment.

3.4.1.2. MAINTENANCE

In accordance with the requirements, the last maintenance of the ballast regulator was on 19 August 2019. The worksheets for this maintenance do not contain any particular comments.

During the investigation, Infrabel informed the Investigation Unit that the axles of the ballast regulator had been replaced with new axles in December 2019.



Illustration: Profile and measurements of the new axles installed in December 2019 on ballast regulator no. 998894252134.

3.4.1.3. MEASUREMENTS AFTER THE ACCIDENT

Once the ballast regulator was back on the track, Infrabel technicians carried out a check of the ballast regulator and the axles. As no anomaly requiring immobilisation was found, the ballast regulator travelled to the Clabecq set of tracks. The wheels and axles were then thoroughly checked.

The sheet with the wheel and axle measurements taken after the accident of 14 April 2020 shows figures within the margin of tolerance.

Finding no. 2:

The ballast regulator was in working order.

3.4.2. INSPECTION OF THE INFRASTRUCTURE

3.4.2.1. MAINTENANCE OF SWITCH 02C

The switch maintenance history provided by Infrabel indicates that the switch was fully renewed in 2015. The information in this history indicates that this switch is visited and checked as prescribed.

Début souh	PosteResp.	Typ	P	Texte	Avis	Code	Texte du code	Descript.	TD	Désignation	. Local	Ordre	I Chrg est H	Date min.	Date initiale	Date max.	Date Sécurt
13.07.2016	5311	T3	3	Haute	10915037	CS01	CS Contrôle Simplifié		x	AWT 02C 07443		817811	0,0	23.05.2016	22.06.2016	28.08.2016	18.09.2016
14.07.2016	5311	Τ1	5	Basse	11486173	MS_	Meulage - ébavurage			AWT 02C 07443		818070	0,0	14.07.2016	31.12.9999	31.12.9999	31.12.9999
19.07.2016	5311	Τ1	4	Nor_	11491472	MS	Reprofilage + balast c_	rebalast_		AWT 02C 07443		818297	0,0	18.07.2016	15.11.2016	15.03.2017	31.12.9999
28.02.2017	5311	T3	3	Haute	11491745	CS02	CA Contrôle Approfondi			AWT 02C 07443		831503	5,9	14.03.2017	13.04.2017	19.06.2017	10.07.2017
14.03.2017	5311	T1	4	Nor_	12033538	MS_	Nivelement - dressage_	cable +_	x	AWT 02C 07443		834565	20,0	05.03.2017	03.07.2017	31.10.2017	31.12.9999
	5311	T1	4	Nor_	12033539	MS_	Nivelement et bourra_	Correcti	x	AWT 02C 07443		834565	1,0	05.03.2017	03.07.2017	31.10.2017	31.12.9999
16.03.2017	5311	T1	4	Nor	12033540	MS.	Divers	raccroc_	x	AWT 02C 07443		834802	4,7	05.03.2017	03.07.2017	31.10.2017	31.12.9999
14.09.2017	5311	T1	4	Nor	12536122	MS_	Meulage - ébavurage		х	AWT 02C 07443		849271	5,8	12.09.2017	10.01.2018	10.05.2018	31.12.9999
13.12.2017	5311	T3	3	Haute	12034754	CS01	CS Contrôle Simplifié	12 MON		AWT 02C 07443		857754	2,4	09.01.2018	23.02.2018	25.05.2018	23.06.2018
28.04.2018	5311	T1	4	Nor	13095859	MS_	Nivelement - dressage	Avis de		AWT 02C 07443		868225	13,3	06.03.2018	04.07.2018	01.11.2018	31.12.9999
04.06.2018	5311	T3	3	Haute	13158777	CS02	CA Contrôle Approfondi	6 MON		AWT 02C 07443		873378	5,5	27.04.2018	11.06.2018	26.07.2018	09.08.2018
14.06.2018	5311	T3	3	Haute	12816494	CS02	CA Contrôle Approfondi	6 MON		AWT 02C 07443			5,5	30.04.2018	14.06.2018	29.07.2018	12.08.2018
16.06.2018	5311	T1	4	Nor	13416790	MS	Reprofilage + balast c_	Avis de		AWT 02C 07443		876072	11,6	30.05.2018	27.09.2018	25.01.2019	31.12.9999
	5311	T1	4	Nor	12813523	MS.	Meulage - ébavurage	headch_		AWT 02C 07443		865883	5,8	13.12.2017	12.04.2018	10.08.2018	31.12.9999
	5311	T1	4	Nor	12813522	MS.	Soudage	début h		AWT 02C 07443		865883	2,0	13.12.2017	12.04.2018	10.08.2018	31.12.9999
21.11.2018	5311	T3	3	Haute	13439330	CS01	CS Contrôle Simplifié	6 MON		AWT 02C 07443		895298	2,4	27.10.2018	11.12.2018	26.01.2019	10.02.2019
12.06.2019	5311	T3	3	Haute	14271681	CS02	CA Contrôle Approfondi	6 MON		AWT 02C 07443			5,5	28.04.2019	12.06.2019	28.07.2019	12.08.2019
29.06.2019	5311	T1	5	Basse	15747509	MS_	Nivelement - dressage	Fond co		AWT 02C 07443		919768	24,8	27.06.2019	31.12.9999	31.12.9999	31.12.9999
03.07.2019	5311	T1	5	Basse	15771598	MS_	Divers	fare tol		AWT 02C 07443		920241	8,9	01.07.2019	31.12.9999	31.12.9999	31.12.9999
04.07.2019	5311	T1	5	Basse	14268646	MS	Reprofilage + balast c_	quelque		AWT 02C 07443		920367	11,6	22.11.2018	31.12.9999	31.12.9999	31.12.9999
10.09.2019	5311	T1	5	Basse	14222127	MS	Meulage - ébavurage	headch		AWT 02C 07443		924592	5,8	16.11.2018	31.12.9999	31.12.9999	31.12.9999
	5311	T1	4	Nor	14222128	MS.	Régénération	Avis de		AWT 02C 07443		924592	23,2	16.11.2018	16.03.2019	14.07.2019	31.12.9999
	5311	T1	4	Nor	16076133	MS	Entretien mécanisé	Transiti		AWT 02C 07443		927002	12,5	06.08.2019	02.02.2020	31.07.2020	31.12.9999
	5311	T1	4	Nor	15979518	MS	Nivelement - dressage	danse p		AWT 02C 07443		927002	24,8	24.07.2019	21.11.2019	20.03.2020	31.12.9999
26.01.2020	5311	T1	4	Nor	16229417	MS	Nivelement - dressage	danse s		AWT 02C 07443		939774	24,8	26.08.2019	24.12.2019	22.04.2020	31.12.9999
	5311	T1	4	Nor	17069308	MS	Nivelement - dressage	danse c		AWT 02C 07443		939774	24.8	06.12.2019	04.04.2020	02.08.2020	31.12.9999

Illustration: RIAM⁶ history of switch 02C (source: Infrabel)

The last measurement of switch 02C by the measuring train dates from 6 April 2020: this check indicates that the measurements were within tolerances.

Finding no. 3:

The switch was in working order.

3.4.2.2. FINDINGS ON THE DAY OF THE ACCIDENT

After lifting the switch motor housing cowl, the Investigation Unit investigator found that the diabolos were not in the expected position relative to the position to which the switch had been manoeuvred.

Infrabel's investigator found that the window on the cowl that allows the inside of the engine housing to be seen was dirty.

Finding no. 4:

The dirty window made it difficult to check the position of the diabolos without lifting the motor housing cowl.

It was apparent from the investigation that the movement during the last manoeuvre before the ballast regulator derailed was not fully completed, as evidenced by the position of the diabolos after opening the engine housing cowl (see illustration below)⁷.



Illustration: In the red circle, the diabolos of the 02C switch in the position found by investigators after the accident.

3.4.2.3. THE TESTS CARRIED OUT ON SITE

Once the ballast regulator was returned to the rails and cleared the switch, the investigators from the Investigation Unit and Infrabel observed that the switch was not locked.

After requesting an emergency crank, the investigators manually operated the 02C switch and could see that the previous manual operation of this switch was not fully completed: the switch point was not fully to the right and the switch lock was not engaged.

Investigators were then able to complete this manoeuvre and obtain control to the right of the switch. The position of the diabolos confirmed the locking of the switch: they were in the axis of the window (see illustration below).



Illustration: In the red circle, the diabolos of the 02C switch in the position indicating control to the right of the switch.

24

Infrabel and IU investigators then decided to carry out manual operation tests on switch 02C. They used the emergency crank and a screwdriver to perform the tests.

For each test sequence, the investigators checked the movement of the switch points during the manoeuvre and the position of the diabolos.

All the manual manoeuvres performed by the investigators were carried out and completed in accordance with procedure (cf. Infrabel regulations - The indication of a complete and correctly performed manoeuvre is either the characteristic end-of-operation click (the typical "click" sound) or the raising of the window cover located on the motor housing cowl to check the correct position of the diabolos).

3.4.2.4. THE LARA⁸ FILES

Studies of the LARA files for the 02C switch operations preceding the accident

On the night of 14 April 2020, the following sequence was recorded in the LARA files:

- at 1.29 am 33' 848", the LARA files recorded a manoeuvre to the right of switch 02C: this indicated that the switch was locked in the right position.
- at 1.32 am 09' 425", the LARA files recorded the loss of control to the right of the switch: this indicated that the switch point was in motion and that a manoeuvre was in progress to change the switch position.
- at 1.32 am 21' 177", the LARA files recorded a manoeuvre to the left of the switch: this indicated that the manoeuvre was completed correctly and completely. The switch was now locked in the left position.

The switch therefore moved from the right to the left position in just under 12 seconds.

13392	14/04/2020 1:29:33.848	FMS1	Tigin	07 (P2)		P2_02C RIGHT
13393	14/04/2020 1:29:33.848	FMS1	Tigin	10 (P2)	P1_02C RIGHT	
13408	14/04/2020 1:32:09.425	FMS1	Tigin	07 (P2)		P2_02C NOCTRL
13409	14/04/2020 1:32:09.761	FMS1	Tigin	10 (P2)	P1_02C NOCTRL	
13410	14/04/2020 1:32:21.177	FMS1	Tigin	07 (P2)		P2_02C LEFT
13411	14/04/2020 1:32:21.177	FMS1	Tigin	10 (P2)	P1_02C LEFT	

Illustration: extract from the LARA files of 14 April 2020 (source: Infrabel)

Study of the LARA files for the last 02C switch operation preceding the accident

At 4.38 am on the day of the accident, the LARA files recorded the loss of control to the left of the switch: the switch point was in motion and a switch operation was in progress.

13888	14/04/2020 4:38:27.569	FMS1	TlgIn	07 (P2)		P2_02C NOCTRL	
13889	14/04/2020 4:38:27.570	FMS1	TlgIn	10 (P2)	P1_02C NOCTRL		

Illustration: extract from the LARA files of 14 April 2020 (source: Infrabel)

Study of the LARA files for the first 02C switch operation after the accident

The LARA files did not record any other data before 11.57 am, when the manoeuvre to the right was recorded: this corresponds to the time when investigators noted that the manual operation of this switch had not been completely performed and completed this operation using the emergency crank until the switch was manoeuvred completely to the right.

18	14/04/2020 11:57:30.517	FMS1	Tigin	07 (P2)		P2_02C RIGHT
19	14/04/2020 11:57:30.517	FMS1	TlgIn	10 (P2)	P1_02C RIGHT	

Illustration: extract from the LARA files of 14 April 2020 (source: Infrabel)

Study of the LARA files of the 02C switch manoeuvre tests carried out by the investigators on site

The illustrations below show the sequences recorded in the LARA files when IU and Infrabel investigators conducted manual manoeuvre tests (with the crank and screwdriver) of the 02C switch.

14/04/2020 11:57:30.517	FMS1	Tigin	07 (P2)			P2_02C RIGH	Г
14/04/2020 11:57:30.517	FMS1	TlgIn	10 (P2)	P1_02C RIGH	Т		
14/04/2020 11:57:40.591	FMS1	TlgIn	07 (P2)			P2_02C NOCT	RL
14/04/2020 11:57:40.591	FMS1	TigIn	10 (P2)	P1_02C NOCT	RL		
14/04/2020 11:57:58.670	FMS1	Tigin	07 (P2)			P2_02C LEFT	
14/04/2020 11:57:58.670	FMS1	Tigin	10 (P2)	P1_02C LEFT			
14/04/2020 12:00:52.789	FMS1	Tigin	07 (P2)			P2_02C NOCT	RL
14/04/2020 12:00:52.789	FMS1	Tigin	10 (P2)	P1_02C NOCT	RL		
14/04/2020 12:01:05.894	FMS1	Tigin	07 (P2)			P2_02C RIGH	Г
14/04/2020 12:01:06.234	FMS1	Tigin	10 (P2)	P1_02C RIGH	Т		

Illustration: extract from the LARA files of 14 April 2020 (source: Infrabel)

14/04/2020 12:03:36.760	FMS1	Tigin	07 (P2)		P2_02C NOCT	ΓRL
14/04/2020 12:03:36.760	FMS1	Tigin	10 (P2)	P1_02C NOCTRL		
14/04/2020 12:03:59.938	FMS1	Tigin	07 (P2)		P2_02C LEFT	
14/04/2020 12:03:59.938	FMS1	Tigin	10 (P2)	P1_02C LEFT		
14/04/2020 12:04:03.300	FMS1	Tigin	07 (P2)		P2_02C NOCT	IRL
14/04/2020 12:04:03.300	FMS1	Tigin	10 (P2)	P1_02C NOCTRL		
14/04/2020 12:04:16.400	FMS1	Tigin	07 (P2)		P2_02C RIGH	Т
14/04/2020 12:04:16.738	FMS1	Tigin	10 (P2)	P1_02C RIGHT		

Illustration: extract from the LARA files of 14 April 2020 (source: Infrabel)

14/04/2020 12:08:46.213	FMS1	Tigin	07 (P2)		P2_02C NOCTRL
14/04/2020 12:08:46.213	FMS1	Tigin	10 (P2)	P1_02C NOCTRL	
14/04/2020 12:09:00.323	FMS1	Tigin	07 (P2)		P2_02C LEFT
14/04/2020 12:09:00.323	FMS1	Tigin	10 (P2)	P1_02C LEFT	
14/04/2020 12:09:03.685	FMS1	Tigin	07 (P2)		P2_02C NOCTRL
14/04/2020 12:09:03.685	FMS1	Tigin	10 (P2)	P1_02C NOCTRL	
14/04/2020 12:09:29.563	FMS1	Tigin	10 (P2)	P1_02C RIGHT	
14/04/2020 12:09:30.230	FMS1	Tigin	07 (P2)		P2_02C RIGHT

Illustration: extract from the LARA files of 14 April 2020 (source: Infrabel)

14/04/2020 12:21:19.201	FMS1	TlgIn	07 (P2)		P2_02C RIGHT
14/04/2020 12:21:19.201	FMS1	Tigin	10 (P2)	P1_02C RIGHT	
14/04/2020 12:21:27.260	FMS1	TlgIn	07 (P2)		P2_02C NOCTRL
14/04/2020 12:21:27.605	FMS1	Tigin	10 (P2)	P1_02C NOCTRL	
14/04/2020 12:21:40.698	FMS1	Tigin	07 (P2)		P2_02C LEFT
14/04/2020 12:21:40.698	FMS1	Tigin	10 (P2)	P1_02C LEFT	

Illustration: extract from the LARA files of 14 April 2020 (source: Infrabel)

Each test sequence indicates that switch control was obtained after the manoeuvre.

The studies of the LARA files confirm the observation made on site by the investigators: the last manoeuvre performed by Infrabel's track agent was incomplete.

Finding no. 5:

All the elements (position of the diabolos, tests performed by the investigators and study of the LARA files) concur and confirm that switch 02C was not completely locked.

3.4.3. WORK AND DECOMMISSIONING OF LINE 96

When a section of line is taken out of service, protective measures are placed on the signal block that manages the line section involved, in accordance with RGE/ARE 741-1.

At the signal block, a locking device (IS with motives) is put in place for the switches and does not permit any operation of the affected switches without it being lifted. The switches in the decommissioned section of the track can then be manually operated. This procedure is set out in RGE/ARE 728-2.

3.5. MEASURES TAKEN TO PROTECT AND SAFEGUARD THE SITE OF THE OCCURRENCE

At 4.40 am, the BNX 45M-07377-005 work manager informed the Mons signal block (Block 27) that the ballast regulator had derailed.

The track and track devices were damaged.

As the ballast distributor regulator was stationary in the loading gauge of both tracks, rail traffic could not be diverted onto a single track. Trains were stationary on both tracks of the line. The line remained out of service.

The transport plan had to be adapted and alternative transport was organised to ensure continuity of service for passengers.

At 6.20 am, a re-railing train was used to evacuate the ballast regulator.

The necessary repairs were made to the damage to the crocodile box of signal FX-C.27.

At 10.35 am, the re-railing train arrived on site and began to put the ballast regulator back on the track. This operation ended at 11.49 am.

After an initial inspection, the ballast regulator was evacuated to the Clabecq set of tracks.

Track A needed repairs following the derailment. The track remained out of service between switches 01C and 06C so that repairs could take place.

At 1.05 pm, tracks A and B of line 96 were returned to service. Trains could resume operation without restrictions, but only on track B.

Work continued during the night of 14 to 15 April 2020 in accordance with BNX 45M-07377-005. Normal operation (unrestricted movement on tracks A and B of Line 96) was restored at 4.33 am on 15 April 2020.



3.6. MAN-MACHINE-OPERATION INTERFACE

3.6.1. TRAINING

It appeared from the investigation and the information provided by Infrabel that the work manager of BNX 45M-07377-005 had the A.R.E.T. safety duties (appointed A.R.E.T. in 2019).

The manager had delegated the task of manually operating the 02C switch to a track officer from his regular crew who had been a track officer since 2006.

3.6.2. PERFORMING THE MANUAL SWITCH OPERATION

According to the information received from Infrabel, the same track officer successfully operated the 02C switch previously on 14 April 2020 (manoeuvre at around 1.30 am), allowing the ballast regulator to pass through the switch without problems during the night of the work.

During the 02C switch operations at 4.38 am on 14 April 2020, the track officer relied on the characteristic end-of-operation click to confirm that the operation had been completed correctly.

This manual operation was performed in a noisy environment during track work.

Finding no. 6:

The characteristic click may not be heard correctly in a noisy environment.

The track officer used a screwdriver to perform the manual manoeuvres on switch 02C. The tool specified by the procedure is the emergency crank, but track officers in the field customarily use a screwdriver to turn the engine.

Finding no. 7:

During the on-site tests, Infrabel and IU investigators carried out manoeuvres with the emergency crank and with a screwdriver. Studies of the LARA files show no difference in obtaining control of the switch.

3.6.3. THE WINDOW OF THE SWITCH MOTOR HOUSING COWL

On site, it was found that the window pane in the cowl of the motor housing of the 02C switch motor was dirty. It is through this window that the position of the diabolos can be checked without having to open the switch motor cowl.

Once a year, Infrabel provides for a check of the switches in accordance with a checklist (checklist 12E); the first item on the list is "check the condition of the cover of the switch stand". This is when the switch motor housing cowl is inspected.

CONTROLE DE L'APPAREIL DE MANOEUVRE + VERR ELECTROMECANIQUE	OUILL.	AGE
 Contrôlez l'état du couvercle de l'appareil de manœuvre. Vérifiez l'absence de traces d'infiltration d'eau. 	D	
 Contrôlez la lisibilité du numéro de l'appareil de voie sur le couvercle de l'appareil de manœuvre. 	-	
 Contrôlez la fixation et le réglage des verrous de commutation et la présence d'un faible jeu (0,2 mm). 	s	
 Si le réglage de l'accouplement de friction l'exige ou si les efforts de talonnement dévient des valeurs prescrites, remplacez le bloc de commande complet. 	D	
 5. * Si verrouillage électromécanique : vérifier le jeu latéral entre le verrou et la crémaillère (minimum 2 mm). 	D	
 6. Mesurer le courant du verrouillage électromécanique au moyen d'une pince ampèremétrique. La valeur doit être entre 110 – 170 mA pour les vérins de type « Servomech ». 	D	1

Illustration: checklist 12E (source: Infrabel)

Finding no. 8:

The inspection procedure is not explicit regarding checking the condition of the window glass. There is therefore no indication as to whether or not the inspection crews check the condition of the window glass.







4. ANALYSIS AND CONCLUSIONS

4.1. FINAL SUMMARY OF THE CHAIN OF EVENTS

During the work carried out in the night of 13 to 14 April 2020, a ballast regulator (no. 998894252134) belonging to the infrastructure manager travelled along the tracks to put back in place the ballast.

As line 96 was out of service (between Lembeek and Braine-le-Comte), several switches were due to be operated manually so that the ballast regulator could travel along both tracks of the line (switches 01BC, 02C, 03C).

Switch 02C was manually operated several times during the work night, each time by the same track officer to whom the work manager, who had A.R.E.T. safety duties, had delegated this task. This manoeuvre was successfully performed at 1.29 and 1.32 am.

Shortly before 4.30 am, the track officer manoeuvred the switch so that the ballast regulator, which was stationary on track A at the Tubize station platforms, could change tracks through switch 02C and return to Braine-le-Comte, which required it to travel on track B.

The movement authorisation signal was therefore given to the driver of the ballast regulator.

While traversing this switch, the first axle (no. 17.2.037) of the ballast regulator derailed at low speed. On feeling the shocks, the driver braked immediately. The ballast regulator came to a standstill on the switch, encroaching on the loading gauge of both tracks.

33

The alert was sounded and the work was interrupted. Line 96 between Halle and Tubize could not be put back into service.

4.2. ANALYSIS

According to the investigation and the information gathered by the Investigation Unit, the most probable hypothesis is that the derailment of the ballast regulator at Tubize on 14 April 2020 was the consequence of the movement of the switch points of switch 02C when the ballast regulator was travelling over it.

This observation is based on the following information:

4.2.1. REGARDING THE BALLAST REGULATOR

The ballast regulator was in serviceable condition and the post-derailment measurements indicated that the wheels and axles were within the allowable tolerances. The investigation led us to consider that the ballast regulator was in order.

The ballast regulator set off from the platforms at Tubize station, some seventy metres from the switch; the speed at which it travelled over the switches was very slow and was not a contributing factor to the derailment.

4.2.2. REGARDING SWITCH 02C

Switch 02C had no anomalies and was correctly maintained and visited by the infrastructure manager's crews.

Measurements taken a few days before the derailment (6 April 2020) also indicated that the track gauge and profile were within the allowable tolerances.

The investigation found that the switch had been manually operated previously on the night of the work by the same track officer: the review of the LARA files indicated that control of the switch had been obtained.

Analysis of the LARA files indicated that control of the switch was not obtained during the manual manoeuvre preceding the derailment of the ballast regulator.

4.2.3. REGARDING THE PERFORMANCE OF THE MANUAL OPERATION

To ensure that the manoeuvre was complete and correctly performed, the track officer relied on the characteristic end-of-operation click and not on the other possible option provided for in the regulations: by raising the window cover on the motor housing cowl to check that the diabolos were in the correct position.

The characteristic click may not be heard correctly in a noisy environment during work on the track, which increases the risk of human error.



4

4.2.4. REGARDING THE WINDOW GLASS OF THE SWITCH MOTOR HOUSING COWL

The window glass was dirty. However, it is through this window that the position of the diabolos can be checked without having to open the switch motor cowl.

Infrabel provides a checklist for its teams when inspecting and maintaining switches. Once a year, the crews use checklist 12E on each track device. The first task on this list is "check the condition of the switch device cover". The inspection of the switch motor housing cowl is therefore expected but not explicitly stated. Indeed, no clear instruction is given as to checking the cleanliness of the glass or the possibility of raising the window cover to see the position of the diabolos inside the housing. There is therefore no indication as to whether or not the inspection crews check the condition of the window glass.



4.3. CONCLUSION

4.3.1. DIRECT CAUSES

The direct cause of the derailment of the ballast regulator at switch 02C was the movement of the switch point of switch 02C while being traversed by the ballast regulator, as a result of the switch not being locked after a manual operation on a track taken out of service for work.

4.3.2. INDIRECT FACTORS

Indirect factor no. 1

The switch points moved under the train because the switch locking system was not engaged following an incomplete manual operation.

Indirect factor no. 2

The track officer who handled the switch followed the requirements of the procedure. The officer chose to check the execution of his manoeuvre via the characteristic end-of-operation click, a characteristic click sound that may not be correctly heard in a noisy environment. He did not check the position of the diabolos under the window of the engine housing cowl.

4.3.3. SYSTEMIC FACTORS

The procedure does not involve checking both indicators (the characteristic click and the position of the diabolos), but only a choice of one of the two.

Only checking the characteristic click increases the risk of human error: it appears that only checking the characteristic click is not sufficient to ensure that control over the switch has been obtained after it has been operated, particularly in a noisy environment such as track work.



4.3.4. OTHER FINDINGS

Finding no. 1

The cowl window was dirty and the diabolos were not visible. In the checklist provided for the inspection of track devices, there is no explicit indication to the inspection crews that they must ensure that the window glass under the cover in the cowl is clean enough to see through (particularly for a check on the position of the diabolos) and that they must clean it if necessary.

Finding no. 2

The track officer who performed the manoeuvre did not have A.R.E.T. safety duties. The switch manoeuvre was delegated to this officer by the work manager who had these safety duties and was therefore responsible for the organisation of this manoeuvre.

At the time of the accident, there was no formally defined procedure for the delegation of this manoeuvre. This delegation was nevertheless noted on the worksheet prepared for this service.

Finding no. 3

A screwdriver, which is less burdensome than the emergency crank, is regularly used by track officers and is available on site. But the use of this tool does not comply with the procedure established by the manager.



5. MEASURES TAKEN

Following this accident, the infrastructure manager Infrabel proposed taking a number of actions:

- formalisation in the internal regulations (RGE/ARE 300) of an "insider agent authorised agent" role that assists personnel performing a critical safety task.
- adaptation of the training material, which serves as work instructions, for the A.R.E.T. training to include didactic elements (element films) aimed in particular at performing manual switch operations and locking of moving parts.
- creation of a work instruction detailing the application of RGE/ARE 741.1 and RGE/ARE 728.2 for the operation of switches within a track or an area that is out of service, with the integration of the requirements and procedures for delegating this task (excluding A.R.E.T. certified officers).
- adaptation of the instructions (checklist E12) for the execution of the periodic checks and maintenance of the switch stand (inclusion of the cleaning of the switch motor window).



6. Recommendations

In view of the measures taken and proposed by the infrastructure manager Infrabel, the Investigation Unit did not issue any recommendations following the derailment of a ballast regulator on switch 02C on 14 April 2020. hail Accident and Incident Investigation Unit