

# **RAILWAY SERIOUS INCIDENT INVESTIGATION REPORT**

## **Overrun on main track**

**(railway serious incident related with “the situation that the train or the vehicle overrun on the main track between stations” stipulated in Article 4, paragraph (1), item (iv) of the Ordinance on Report on Railway Accidents),  
Miyazu Line, WILLER TRAINS Inc.**

**August 26, 2021**

The objective of the investigation conducted by the Japan Transport Safety Board in accordance with the Act for Establishment of the Japan Transport Safety Board is to prevent future accidents and incidents. It is not the purpose of the investigation to apportion blame or liability.

TAKEDA Nobuo  
Chairperson  
Japan Transport Safety Board

Note:

This report is a translation of the Japanese original investigation report. The text in Japanese shall prevail in the interpretation of the report.

《Reference》

The terms used to describe the results of the analysis in "3. ANALYSIS" of this report are as follows.

- i) In case of being able to determine, the term "certain" or "certainly" is used.
- ii) In case of being unable to determine but being almost certain, the term "highly probable" or "most likely" is used.
- iii) In case of higher possibility, the term "probable" or "more likely" is used.
- iv) In a case that there is a possibility, the term "likely" or "possible" is used.

# Railway Serious Incident Investigation Report

Railway operator	WILLER TRAINS Inc.
Serious incident type	Overrun on main track, railway serious incident related with "the situation that the train or the vehicle overrun on the main track between stations" stipulated in Article 4, paragraph (1), item (iv) of the Ordinance on Report on Railway Accidents
Date and time	About 21:04, October 4, 2020
Location	Around 18,500 m from Nishimaizuru station, between Tangoyura station and Kunda station, Miyazu Line, Miyazu City, Kyoto Prefecture

August 2, 2021

Adopted by the Japan Transport Safety Board

Chairperson	TAKEDA Nobuo
Member	OKUMURA Fuminao
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## SYNOPSIS

### <SUMMARY>

At about 21:04, October 4, 2020, while the driver operated the outbound Local 249D train, started from Nishimaizuru station bound for Toyooka station of Miyazu Line of WILLERS TRAINS Inc., between Tangoyura station and Kunda station at the velocity of about 68 km/h in the coasting operation, the driver heard the dull sound like "bump", after that, he felt that the brake did not act well as usual, therefore, stopped the train using the emergency brake.

The driver checked the instruments of the pressure gauge, etc., and found that the pressure in the main air reservoir was 0 kPa. The driver tried to implement the measures to prevent rolling wheels, but the train started to move, therefore, he applied the security brake and the conductor's valve but the brake had not been acted. After the train passed Kunda station, stopped again temporarily and ran in the reverse direction, and stopped at the place about 206 m from Kunda station in the direction to Toyooka station.

There were three passengers and two train crews were boarded on the train, but no one was injured.

## <PROBABLE CAUSES>

The JTSB concludes that the probable cause of this serious incident was highly probable that the train, that stopped once by the emergency brake in the down grade section, overran in this serious incident, because all brake shoes pushed to each wheel were released and both the service brake and the security brake became not to function, resulted from that the compressed air, stored in the main air reservoir, the supply air reservoir and the security brake air reservoir, had been lost completely due to the leakage of the compressed air between the main air reservoir and the brake cylinder completely, since the train had collided with the animal invaded to the front part of the rear axle in the front bogie from right side and the pipe connected to the brake cylinder had folded and broken.

Regarding that the pipe connected to the brake cylinder had folded and broken, it is probable that the pipe had been bent around the root part in the direction opposite to the direction of travel, because the pipe had been overhung in lower side of the brake cylinder in the near place to side surface of the vehicle body and the collision with the animal which invaded to front part of the rear axle of the front bogie from right side of the track could not been prevented.

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# 1. PROCESS AND PROGRESS OF THE RAILWAY SERIOUS INCIDENT INVESTIGATION

## 1.1. Summary of the Railway Serious Incident

At about 21:04, Sunday, October 4, 2020, while the driver operated the outbound Local 249D train, started from Nishimaizuru station bound for Toyooka station of Miyazu Line of WILLERS TRAINS Inc., between Tangoyura station and Kunda station at the velocity of about 68 km/h in the coasting operation, the driver heard the dull sound like "bump", after that, he felt that the brake did not act well as usual, therefore, stopped the train using the emergency brake.

The driver checked the instruments such as the pressure gauge, etc., and found that the pressure in the main air reservoir was 0 kPa. The driver tried to implement the measures to prevent rolling wheels, but the train started to move, therefore, he applied the security brake<sup>\*1</sup> and the conductor's valve<sup>\*2</sup> but the brake had not been acted. After the train passed Kunda station, stopped again temporarily and ran in the reverse direction, and stopped at the place about 206 m from Kunda station in the direction to Toyooka station.

There were three passengers and two train crews were boarded on the train, but no one was injured.

*\*1 "Security brake" is the independent brake that can be used when the service brake had failed, and can be activated the brake on the vehicle in operation.*

*\*2 "Conductor's valve" is the valve of the automatic air brake device which is mainly operated by the conductor to activate the emergency brake.*

## 1.2. Outline of the Railway Serious Incident Investigation

### 1.2.1. Organization of the Investigation

This serious incident is the "situation that the train or the vehicle overrun on the main track between stations, *i.e.*, the overrun on main track" stipulated in Article 4, paragraph (1), item (iv) of the Ordinance on Report on Railway Accidents(the Ordinance of Ministry of Transport No.8 of 1987), and was judged as necessary to be investigated the causes objectively and thoroughly from the viewpoint of technology, therefore, the Japan Transport Safety Board determined this serious incident as the subject of the investigation which was the "incidents that are particularly rare and exceptional" stipulated in Article 3, item (vi) of the Ordinance for Enforcement of the Act for Establishment of the Japan Transport Safety Board (the Ordinance of Ministry of Land, Infrastructure, Transport and Tourism No.124 of 2001).

The Japan Transport Safety Board designated an investigator-in-charge and a railway accident investigator to investigate this serious incident, on October 5, 2020.

The Kinki District Transport Bureau dispatched its staffs to the incident site, etc., to support the investigation of this serious incident.

### 1.2.2. Implemented Period of the Investigation

October 5 and 6, 2020	On-site investigation and hearing statements
June 4, 2021	On-site investigation

### 1.2.3. Comments from Parties Relevant

Comments were invited from parties relevant to the cause of the serious incident.

## 2. FACTUAL INFORMATION

### 2.1. Process of the Train Operation

*[Refer to Attached Figures 1 and 2]*

The outbound 249D train, started from Nishimaizuru station bound for Toyooka station of Miyazu line of the WILLER TRAINS Inc., was operated by the probationary driver, and the leading driver was coaching standing next to the driver's seat, *hereinafter referred to as "the Train", "the Company", "the Probationary driver", "the Leading driver", respectively*. Based on the statements of the Probationary driver and the Leading driver, the summary of the process to cause this serious incident was as follows.

#### (1) The Probationary driver

I started the duty of the Train from Nishimaizuru station, and started from Nishimaizuru station on schedule. After departed from Tangoyura station, located at 14,400 m from Nishimaizuru station, *hereinafter "from Nishimaizuru station" was omitted*, at about 90 seconds behind the scheduled time 20:58, while operated in the coasting operation between Tangoyura station and Kunda station, at the velocity of 68 km/h, I heard the sound as the train was collided with something once at around 18,500 m. When I applied the brake to decelerate to 65 km/h, that is the limit speed in the curved track just ahead, the effect of the brake was worse compared to as usual, and the sound like leaking air was heard from the under floor. Therefore I applied the emergency brake and stopped the Train at around 19,100 m. After the Train stopped, I took over the operation of the Train to the Leading driver. When the Leading driver was preparing the procedure to prevent wheel rolling, the Train started to move, and after passed through Kunda station the train stopped at around 20,700 m in the upgrade track. When I moved to the driver's desk in the side opposite to the direction of travel by the instruction of the Leading driver, the Train ran in reverse direction very slowly and stopped at around 20,546 m.

#### (2) The Leading driver

I boarded on the Train from Nishimaizuru station together with the Probationary driver, and was instructing the Probationary driver. After the Train departed from Tangoyura station 90 seconds behind schedule, while operated in the coasting operation at the velocity of 68 km/h between Tangoyura station and Kunda station, I heard the dull sound like "bump". When the Probationary driver applied the brake to decelerate to 65 km/h, the limit speed in the curved track just ahead, the brake did not act well as usual, and the pressure of the brake cylinder was low compared with the usual status, therefore, I instructed the Probationary driver to apply the emergency brake. The pressure of the emergency brake had been low compared with as usual, but the Train stopped very slowly.

When I took over the train operation from the Probationary driver and looked the instruments to check the pressure of the main air reservoir, I found that the needle indicated 0 kPa, therefore,



I thought to set the chock to prevent wheel rolling. However, while I am considering how to get the chock, which was stored in the under floor opposite to the driving desk in the direction of travel, whether I get off the vehicle from the driving desk and walk to cross the railway track or go opening the passenger door, the Train started to move again. I applied the security brake and the conductor's valve, but they did not work at all. The velocity of the Train increased to 30 km/h because the track was the down grade track, I reported the situation to the train dispatcher using the train radio and the business cellular phone. Here, I checked that the warning devices in all level crossings were operated.

The Train passed Kunda station and stopped at around 20,700 m in the upgrade track. At that time, as I supposed that the Train would move in the reverse direction, I moved to inverse side driving desk in the direction to Nishimaizuru station together with the Probationary driver. As the Train ran in reverse direction very slowly and stopped at around 20,546 m, I applied the hand brake<sup>\*3</sup>, after that I set the choke, and reported the situation to the train dispatcher again.

*\*3 "Hand brake" is the method or device to activate the brake by the human power. The hand brake of the vehicle described in this report, is the method or the device to press the brake pad against the propeller shaft by the human power.*

## 2.2. Information on the Railway Facilities

*[Refer to Attached Figure 1]*

The Miyazu Line of the Company is 83.6 km in extent from Nishimaizuru station to Toyooka station, with the gauge of 1,067 mm single track section, without electrification.

The Kitakinki Tango Railway Corporation, *hereinafter referred to as "the Tango Railway Co."*, owned and managed the railway facilities of the Miyazu Line and the Miyafuku Line as the Class 3 railway operator<sup>\*4</sup>, and the Company operated the trains as the Class 2 railway operator<sup>\*5</sup>.

*\*4 "Class 3 railway operator" is the operator who constructed the railway track and let the Class 2 railway operator, who transported the passengers or the freights, to use them.*

*\*5 "Class 2 railway operator" is the operator to implement the transportation of the passengers of the freights using railway track that was constructed by the other operator.*

## 2.3. Information on the Vehicles

### 2.3.1. Information on the Train

Outline of the Train was shown in Figure 1. The major specifications of the vehicles are as shown in the followings.

Vehicle category	Internal combustion railcar, <i>i.e.</i> , diesel car
Symbol and number	KTR802
Vehicles in the trainset	1 vehicle
Capacity of the trainset	114 persons
Category of the bogie	Air suspension type bolsterless bogie
Bogie type	FU38D, FU38T
Brake system	Automatic electromagnetic air brake
Manufactured date	December, 1989

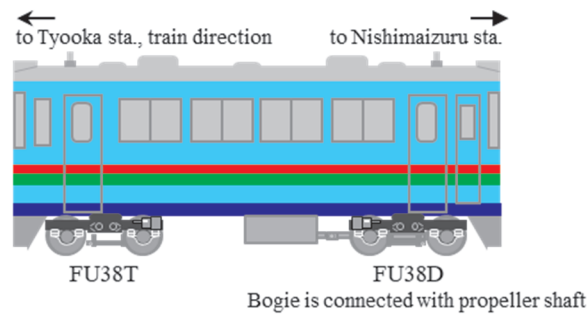


Figure 1. Outline of the Train

### 2.3.2. Information on the Maintenance, etc., of the Vehicle

The maintenance of the vehicles in the Company has been stipulated to implement the periodic inspections corresponding to the used status of the vehicles in the "diesel railcar maintenance standard" which is one of the implementing standards, *hereinafter referred to as "the Reported Implementing Standard"*, notified by the Company to the Director General of the Kinki District Transport Bureau based on the "Ministerial Ordinance Providing for the Technological Standard for Railways", (Ordinance of the Ministry of Land, Infrastructure, Transport and Tourism No.151 of 2001).

As for the latest periodic inspections, etc., of the Train implemented before the occurrence of this serious incident, the train inspection<sup>\*6</sup>, the monthly inspection<sup>\*7</sup>, the general inspection<sup>\*8</sup> were implemented on October 4, 2020, August 7, 2020, March 15, 2019, respectively, and there was no abnormal situation in the records of these inspections.

<sup>\*6</sup> "Train inspection" is the supplementation and replacement of the consumables and the inspection on the status and the action of the power generating device, etc., from outside, in every period not exceeded 10 days, from the start of operation.

<sup>\*7</sup> "Monthly inspection" is one of the periodic inspections implemented in the Company, to inspect the status and the function of the internal combustion railcar in every period not exceeded 3 months.

<sup>\*8</sup> "General inspection" is one of the periodic inspections implemented in the Company, to inspect the whole internal combustion railcars in every period not exceeded 8 years.

## 2.4. Information on the Situation that Brake did not work in the Train

### 2.4.1. Information on the Brake System of the Train

The brake system of the Train was composed of the service brake device, the security brake device and the hand brake.

The service brake functions when the compressed air in the main air reservoir produced by the air compressor, is stored in the supply air reservoir through the pipe, and the compressed air, which was sent to each brake cylinder through the service brake device and the multi-step check valve, pushed the brake shoes against each wheel. Here, the status that the service brake was operated in the maximum is called as the emergency brake.

Similarly, the security brake functions when the compressed air in the main air reservoir produced by the air compressor, is stored in the security brake air reservoir through the pipe, and the compressed air, which was sent to each brake cylinder through the security brake device and

the multi-step check valve, pushed the brake shoes against each wheel.

The service brake system and the security brake system of the Train were as shown in Figure 2.

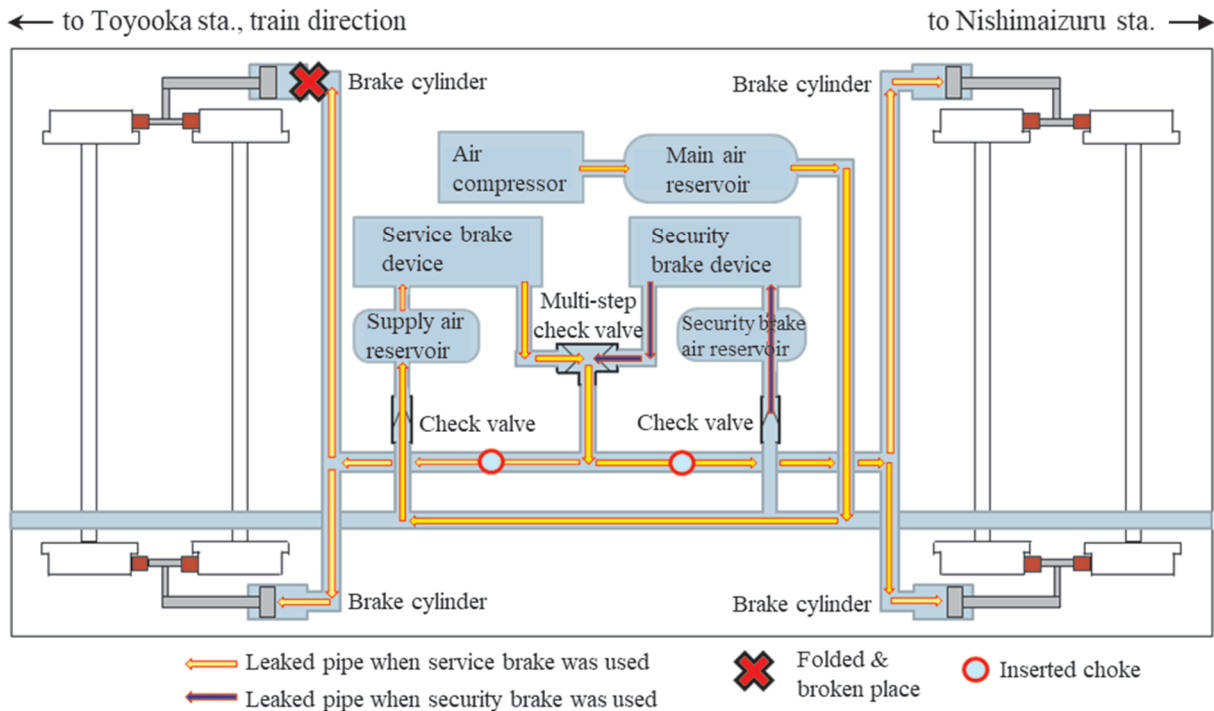


Figure 2. Service brake system and security brake system of the Train

When the service brake was operated in the Train, in the situation as the pipe connected to the brake cylinder had been folded and broken, the compressed air between the main air reservoir and the brake cylinder via the supply air reservoir, the service brake device and the multi-step check valve, was leaked completely, and the compressed air stored in the main air reservoir and the supply air reservoir was lost. Furthermore, because the pipes from the multi-step check valve to the brake cylinder was commonly used in the service brake and the security brake, the compressed air from the security brake air reservoir to the multi-step check valve via the security brake device was leaked completely when the security brake was operated, and the compressed air stored in the security brake air reservoir was also lost. Although the air compressor, which was driven by the power of the engine, continued to produce the compressed air, the service brake and the security brake became not to function because all brake shoes pushing each wheel were released because the volume of the leaked air was larger than the produced compressed air. Additionally, the improving maintenance of the brake device described in 2.9 (2) (vi) (b) had been implemented and the choke has been inserted in around the BC cock<sup>\*9</sup> of the pipe connected to the bogie, in the Train.

As the mechanism of the hand brake is to prevent rolling of the propeller shaft by pulling the wire without using the compressed air, therefore, the hand brake was installed only in the driving desk in the opposite side of the direction of travel of the Train, *i.e.*, the side of the bogie connected to the propeller shaft. The hand brake is used to keep halting status so that the stopping vehicle does not move, and it was not assumed to be used to stop the running train.

\*9 "BC cock" is an abbreviation of the "brake cylinder cock", which is the cock to open and close the air passage of the brake cylinder pipe connected to the bogie.

#### 2.4.2. Information on the Status of Brake Pipes, etc., of the Train

The concerned vehicle was investigated and it was found that the pipe, *hereinafter referred to as "the Pipe"*, connected to right brake cylinder of the 1st bogie was folded and broken at the root part which had been bent in the direction opposite to the direction of travel. , *following the bogie, etc., was counted from the outbound direction of the track route of the Company and the words "left" and "right" are based on the running direction of the outbound train.* Furthermore, animal hair was adhered to the joint part of the Pipe and the bottom of the brake cylinder, and the scratched trace was found in the bottom of the brake cylinder.

The brake cylinder of the Train was laid in outside of the side beam of the bogie and the Pipe was in the position close to the side surface of the vehicle body. Furthermore, the Pipe had been overhung in lower part of the brake cylinder.

*[Refer to Attached Figure 3]*

#### 2.5. Information on the Collision of the Train and Animals in the Company

According to the Company, number of the collisions of the vehicle and animals in the 30.4 km long single track in Miyazu Line and Miyafuku Line, operated by the Company was as shown in Table 1. In addition, number of the collisions of the vehicle and animals in the track between Tangoyura station and Kunda station where this serious incident had occurred was as shown in Table 2. The incident that the vehicle collided with animals had been occurred even in the track section where this serious incident had occurred.

Table 1. Number of collision of vehicle and animals in Miyazu Line and Miyafuku Line

		2019FY	2020FY
Total		507	548
Classification	Deer	449	476
	Wild boar	40	39
	Bear	7	10
	Others	11	23

Table 2. Number of collision of vehicle and animals between Tangoyura station and Kunda station

		2019FY	2020FY
Total		38	38
Classification	Deer	32	35
	Wild boar	1	1
	Bear	2	1
	Others	3	1

Additionally, as the measures to prevent the collision with animals, the protective fences as the measure to prevent invasion of animals were installed in the track side in 5 places between Oeyamaguchinaiku station and Futamata station of Miyafuku Line on 2016, *refer to Figure 3*, but the protective fence was not installed in Miyazu Line at all. The Company and the Tango Railway Co., discuss each other on the installation of the protective fence, and the Tango Railway Co.,

arrange the budget and install the fences. Furthermore, the measures other than the protective fence had not also been implemented in Miyazu Line.

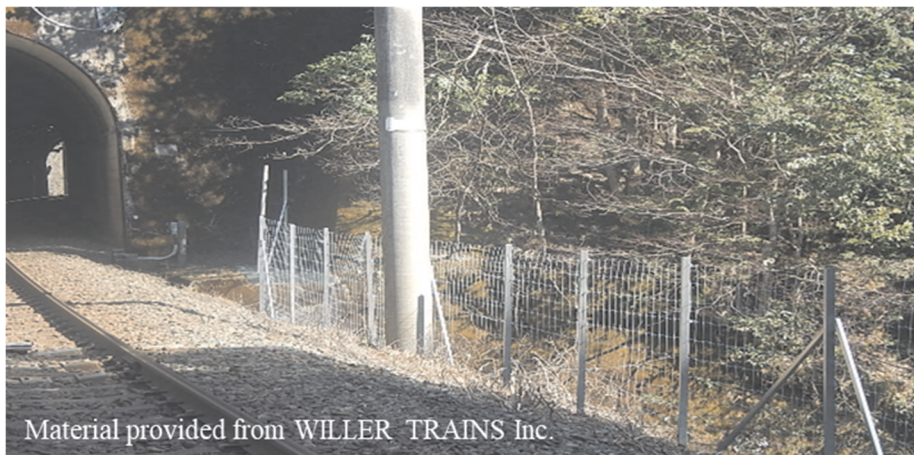


Figure 3. Measures to prevent invasion of animals installed in Miyafuku Line

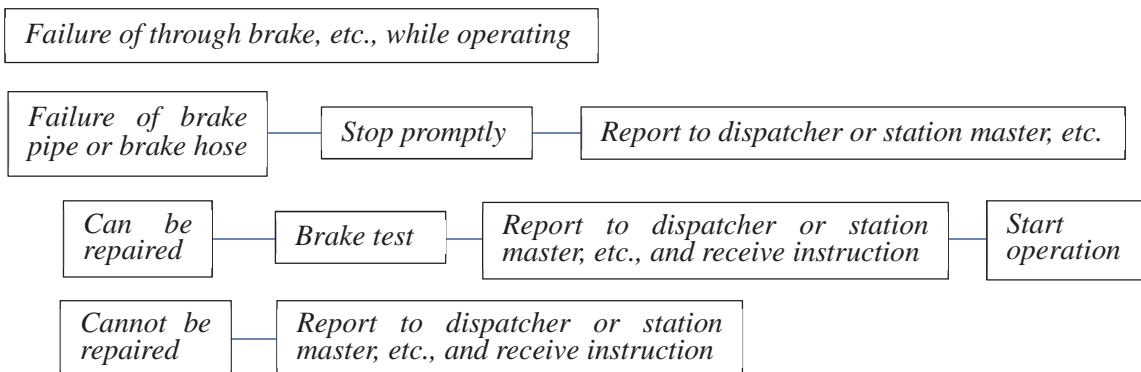
### 2.6. Information on the Train Crews, etc.

The Probationary driver was the 29 years old. The Leading driver was the 45 years old, having the driver's license of the Class A electric rolling stock issued on March 18, 2013, and the driver's license of the Class A internal combustion rolling stock issued on December 14, 2016, and experienced for about 3 years and 10 months.

### 2.7. Information on the Handling Train Operation

In the "basic procedure when faced abnormal status, crew edition" decided by the Company, there is the following description on the handling when the through brake<sup>\*10</sup>, etc., had failed while operating.

"Basic procedure when faced abnormal status, crew edition", extracted.



In the "regulation of implementing standard of handling operation" which is one of the Notified Implementing Standards of the Company, there are the following descriptions on the handling of parking vehicle.

"Regulation of implementing standard of handling operation", extracted.

## *Chapter 7. Parking of vehicles*

### *Article 87. [Place to park vehicles]*

*When park the vehicle, halt the vehicle in the protection area of the fouling point indicator.*

### *Article 88. [Arrangement to prevent vehicle rolling]*

*When park the vehicle, the arrangement should be taken to prevent vehicle rolling by tightening the brake. In this case, the chock should be used according to the necessity.*

*2. In case of the previous paragraph, the vehicles should be coupled each other when park the vehicles on the main track, or there is the risk that the parking vehicle on the side track overrun on the main track or the parking vehicle on the side track roll and hinder the main track.*

*3. When park the vehicle, the maintenance car, the trolley, etc., on the track equipped with the scotch block, it should have been closed.*

### *Article 89. [Parking of power car]*

*When park the power car equipped with the power device, in order to prevent self-moving, the required measures to prevent self-moving should be implemented, such as to tighten brake by the through brake, to set the reverse handle of the master controller in the neutral position, to take out the transmission handle, the operation key, the brake valve handle, etc.*

*2. In case of the previous paragraph, the hand brake and the chock should be used according to the necessity.*

Similarly, in the "standards of official duty of driver" decided by the Company, there are the following descriptions on the handling to park the vehicles.

"Standards of official duty of driver", extracted.

### *Number 41. [Arrangement of parking]*

*When park the diesel railcar and electric railcar, the following handlings should be implemented.*

#### *(1) Common items*

*(a) When the hand brake or the chock was used, the card written as "hand brake and chock" should be posted on the master controller in the driving desk that used the card.*

*(b) The chock should be used to combine with the 7th place wheel. However, the chock should be used to combine with the wheel in the driver's seat side in the direction to Nishimaizuru station, i.e., the 2nd place, when used in Toyooka station, in the premises of Fukuchiyama Operation Office and Fukuchiyama station.*

*# When it could not be used in the driver's seat side unavoidably, it should be used in the assistant seat side. Furthermore, if it could not be used as being combined, it should be used as in wedge shape.*

*(c) All switches, etc., should be operated in the designated positions, after that stop the engine.*

#### *(2) Diesel railcar*

*(a) Handle the emergency brake, and set the reverse handle and the transmission handle in*

*the neutral position.*

*(b) Tighten the hand brake, and take out the transmission handle and the brake valve handle.*

*(c) When the change-over switch was in the forward position, set it to the neutral or the reverse position.*

*(d) Unlock the fare collection box, according to the necessity.*

*(e) Confirm that there is nothing to cause a fire in the cabins.*

*(f) Set the chocks.*

*(g) Post the chock card.*

*(h) Lock the doors of the driver's cab.*

*\*10 "Through brake" is the brake which can activate the brake in the whole vehicles coupled each other by the operation of the driver, by laying the brake pipes or the electric cables to control brake through all vehicles.*

## 2.8. Information on Weather Condition

It was fine at the time of the occurrence of this serious incident around the site of this serious incident.

## 2.9. The Other Information

The investigation on the past incidents occurred in the other operators that the vehicle overran on the main track due to the failures of the brake and implemented the safety actions, as the results, two incidents had been occurred, summary of them were as shown in the followings.

(1) The train derailment in Fuji Kyuko Co., Ltd.

(a) Date of the occurrence: At about 08:25, Thursday, March 4, 1971, weather was fine.

(b) Railway operator: Fuji Kyuko Co., Ltd.

(c) Site: Between Kurechi station, renamed as Kotobuki station at present, and Mitsutoge station, Otsuki Line.

(d) Number of injuries: 86 persons, *i.e.*, 17 persons were dead and 69 persons were injured seriously and slightly.

(e) Outline: The 14 train, composed of 2 vehicles and started from Kawaguchiko station bound for Otsuki station departed from Fujiyoshida station, renamed to Mt. Fuji station at present. While the train approached Midorigaoka No.2 level crossing at the velocity of 30 km/h, collided with the compact truck entered the level crossing road after broke through the crossing gate. Because the train, after collided, started to overrun on the downgrade track, the driver applied the conductor's valve and the hand brake immediately, but the train did not stop and overran for about 4 km, and derailed in the 240 m radius curved track, and wrecked.

(f) Probable Causes: Because the air reservoir was broken when the collided compact truck had been caught in the under floor of the vehicle, the supplied air to the brake cylinder was shut down, and the vehicle became in the status unable to be controlled.

(h) Measures: "On the implementation of improvement and preparation of the brake device for railway vehicles", Railway transport No.255, October 30, 1972.

- I. Install the security brake.
  - II. Install the devices and the pipes related with the brake device in the inside bogie width, and reinforce by the protecting wall, etc.
- (2) Train overrun in Etsumi-Hoku Line of West Japan Railway Company
- (a) Date of the occurrence: At about 07:26, Sunday, February 11, 2001, weather was snow.
  - (b) Railway operator: West Japan Railway Company.
  - (c) Site: Between Echizen-Tomida station and Echizen-Oono station, Etsumi-Hoku Line.
  - (d) Outline: While the 724D train, composed of 1 vehicle and started from Kuzuryuko station bound for Fukui station, was passing the Post Office level crossing between Echizen-Tomida station and Echizen-Oono station at the velocity of 60 km/h, the sedan collided from lateral direction. When the train received the impact, the driver operated the emergency brake but the brake was not acted, therefore, the driver operated the security brake. However the security brake was not acted and the train overran for about 2 km.
  - (e) Probable Causes: When the sedan collided with the vehicle from lateral direction, the brake pipe, etc., were broken and damaged, and the vehicle became in the uncontrollable status.
  - (f) Measures:
    - (i) Implement one of the following measures for the newly manufactured passenger carrying vehicles operated in the single vehicle trainset.
 

"On the improvement and preparation of the brake device of railway vehicles", Railway Technology No.29, issued on March 13, 2001

      - I. The service brake device and the security brake device should be equipped with two sets of independent brake systems between the air reservoir and the brake cylinder, and consider the layout not to damage two brake systems simultaneously when collided.
      - II. Double the air reservoir and the check valve of the security brake device, and enable to secure one of the brakes of the front or the rear bogies by placing the check valves in each left and right side of the vehicle, etc.
    - (ii) Implement the following measures for the existing passenger-carrying vehicles operated by the single vehicle trainset.
 

"On the improvement and preparation of the brake device of railway vehicles", Railway Technology No.184, and Railway Facility No.242, issued on March 29, 2002

      - I. Installation of the protective boards
 

Equipment to be protected is the multi-step check valve, and the security brake system.
      - II. For the vehicle, which is equipped with the brake cylinders mounted on the end bogie in the vehicle that the brake cylinder pipes originated from the brake device branch to the both bogies, insert the choke or something equivalent to the choke of the inner diameter of less than 8 mm, in the half way, near the BC cock, of the piping route connected to the bogie.



## 3. ANALYSIS

### 3.1. Analysis on the Situation that Brake did not Work in the Train

#### 3.1.1. Analysis on the Broken Places in the Train

It is probable that the Train collided with the obstacle, based on the statement of the Probationary driver that "I heard the sound as the train hit something once" described in 2.1 (1), and the statement of the Leading driver "the dull sound like 'bump'" described in 2.1 (2).

As described in 2.4.2, the brake cylinder of the Train has been laid in outer side of the side beam, and the Pipe has been laid in the position close to the side surface of the vehicle body. Furthermore, the Pipe has been overhung to lower side of the brake cylinder, therefore, it is probable that the Pipe could not prevent the collision with obstacle invaded in the forward of the rear axle in the front bogie from right side of the Train, and the strong force had acted from the front to the lower part of the pipe when collided, and the Pipe was bent in the direction opposite to the direction of travel, and folded and damaged in the root part. *[Refer to Attached Figure 3]*

Therefore, it is probable that the measures are necessary, such as to relocate not to overhang to lower part of the brake cylinder, or to install the protective board to protect the brake pipe that has never been implemented until now, etc.

Additionally, it is probable that the Pipe was folded and damaged due to collided with the animal invaded in forward of the rear axle of the front bogie from right side of the Train because the hair of animal had been adhered to the joint part of the Pipe and the bottom of the brake cylinder. However, it could not be cleared the precise situation because there was no dead body of animal, etc.

#### 3.1.2. Analysis on the Brake System of the Train

As described in 2.4.1, when the pipe connected to the brake cylinder was folded and damaged in the Train, the operation of the service brake causes the complete leakage of the compressed air in the range from the main air reservoir to the brake cylinder via the supply air reservoir, the service brake device, and the multi-step check valve, and the compressed air stored in the main air reservoir and the supply air reservoir were lost. Furthermore, because the pipe from the multi-step check valve to the brake cylinder was commonly used in the service brake and the security brake, when the security brake was operated, the compressed air from the security brake air reservoir to the multi-step check valve via the security brake device was leaked completely, and the compressed air stored in the security brake air reservoir was also lost. It is highly probable that the service brake and the security brake became not to function, because all brake shoes pushing each wheel were released as the volume of the leaked air was larger than the produced compressed air, although the air compressor continued to produce the compressed air. Therefore, it is probable that the study should be implemented on the replacement of the vehicles equipped with the brake system which adopted the fault tolerant design<sup>\*11</sup>, *i.e.*, the design that can secure the security brake function even when the pipe of the service brake had folded and damaged, such as to consider the

layout to make independent two brake systems and not to damage two brake systems simultaneously, concerning the vehicle in which the pipe from the multi-step check valve to the brake cylinder was used in both the service brake and the security brake. If it is difficult to replace the vehicles described in the above, it is considered as necessary to implement measures such as to relocate the pipes not to overhang to lower part of the brake cylinder or to install the protective board to protect the brake pipes which has never been implemented until now, etc., in order to prevent the recurrence of this serious incident. In addition, if it is difficult to relocate pipes or to install protective board promptly, it is considered as necessary to operate the train with the trainset composed of two vehicles or above, so that the brake can be operated by the other vehicle, till the above measures are implemented.

It is highly probable that the Train once stopped by the emergency brake, but overran after the service brake and the security brake became not to function and all brake shoes were released, because the stopped position was in the down grade section. It is likely that the Train could stop once by the emergency brake, because the choke has been inserted around the BC cock of the pipe connected to the bogie, and worked to gain times which lead to leak compressed air.

*\*11 "Fault tolerant design" is a method of the system design such as that the entire system continues operation unless to stop functions in the whole even when some troubles occurred in a part of the system.*

### 3.2. Analysis on the Collision of the Train and Animals in the Company

As described in 2.5, according to the Company, as the measures to prevent the collision with animals, the protective fences as the measure to prevent invasion of animals were installed in the track side in 5 places between Oeyamaguchinaiku station and Futamata station of Miyafuku Line on 2016, but the protective fence was not installed in Miyazu Line at all. However, the incidents collided with animals had been occurred in the section where this serious incident occurred as described in Table 2. Therefore, it is considered as necessary for the Company to request to implement the measures preventing the invasion of animals to the Tango Railway Co., who is the owner of the facilities. It is considered as necessary for the Tango Railway Co., responding to the above request, to implement the measures to capture animals, etc., in cooperation with the track side local government, in addition to the installation of the protective fences. Furthermore, it is considered as necessary for the Company, referring to the measures implemented in the other railway operators, to implement continuously the studies on the other effective measures to prevent the collision of train and animals.

### 3.3. Analysis on the Handling of the Hand Brake

As described in 2.7, the Probationary driver and the Leading driver stopped the train immediately by the emergency brake and reported to the dispatcher, based on "the situation that there is malfunction in the through brake, etc., while operating" stipulated in the "Basic procedures when faced abnormality, crew edition". It is likely that the Train could prevented the overrun, if the hand brake had applied when the Train stopped once by the emergency brake or stopped in the upgrade track at around 20,700 m. Therefore, it is probable that it is desirable to prescribe the handling

method of the hand brake in the "Basic procedures when faced abnormality, crew edition", and let the train crews known well, to use the hand brake promptly when there is a malfunction in the through brake, etc.

#### 4. PROBABLE CAUSES

The JTSB concludes that the probable cause of this serious incident was highly probable that the train overrun, that stopped once by the emergency brake in the down grade section, because all brake shoes pushing each wheel were released and both the service brake and the security brake became not to function, resulted from that the compressed air, stored in the main air reservoir, the supply air reservoir and the security brake air reservoir, had been lost due to the complete leakage of the compressed air between the main air reservoir and the brake cylinder, since the train had collided with the animal invaded to the front part of the rear axle in the front bogie from right side and the pipe connected to the brake cylinder had folded and broken.

It is probable that the pipe connected to the brake cylinder had folded and broken which had been bent around the root part in the direction opposite to the direction of travel, because the pipe had been overhung in lower side of the brake cylinder in the near place to side surface of the vehicle body and could not prevent the collision with the animal invaded to front part of the rear axle of the front bogie from right side of the track.

#### 5. SAFETY ACTIONS

##### 5.1. Safety Actions Considered as Necessary

It is necessary to implement the following measures in order to prevent the recurrence of this serious incident.

- (1) Relocation of pipe, installation of protective boards, or operation by two or more vehicles trainset.

As for the vehicles in which the pipe from the multi-stage check valve to the brake cylinder was used in the both brakes, *i.e.*, the service brake and the security brake, in order to prevent the recurrence of this serious incident, it is probable that the measures are required such as to relocate the pipe not to overhung to lower part of the brake cylinder and to install the protective board to protect the brake pipe, when the brake cylinder has been laid outside of the side beam, and the pipe connected to the brake cylinder has been overhung to lower part of the brake cylinder. When it is difficult to relocate pipes or to install protective board promptly, it is considered as necessary to operate the train with the trainset composed of two vehicles or above so that the brake can be operated by the other vehicle, till implementation of above measures.

Additionally, it is desirable to study the replacement of the vehicles with the vehicles

equipped with the brake system based on the fault tolerant design such as to secure the function of the security brake even when the pipe of the service brake had folded and damaged, as the substantial measure.

(2) On the implementation of grappling to prevent collision of train and animals

It is considered as necessary for the Company to request the Tango Railway Co., who is the owner of the railway facilities, to promote the measures to prevent invasion of animals. It is considered as necessary for the Tango Railway Co., responding to the above request, to implement the measures to capture animals, etc., in cooperation with the track side local government, in addition to the installation of the protective fences. Furthermore, it is considered as necessary for the Company, referring to the measures implemented in the other railway operators, to implement continuously the studies on the other effective measures to prevent the collision of train and animals.

(3) On the handling of the hand brake

It is desirable to clarify the handling method of the hand brake by the driver and to prescribe in the "Basic procedures when faced abnormality, crew edition" and let the train crews known well so that the driver use the hand brake promptly when there is a malfunction in the through brake, etc.

## 5.2. Measures Implemented by the Company after this Serious Incident

(1) Urgent measures

The Company decided to implement the following items.

- (i) The Company let all train crews in the Company be known about this serious incident, and pay the closest attention to the air leakage from the brake pipe of the cylinder part when implemented the under floor inspection during operation, etc., including the inspection implemented in the train depot. Finished to be commonly known this item on October 11, 2020.
- (ii) The Company implemented the measures in order that the pipe was not folded and broken easily when collided with animals, fixing the pipe connected to the brake cylinder to the bogie frame in all 16 vehicles of the same kind of structure, and completed on October 23, 2020. Additionally, the Company and the Tango Railway Co., discussed each other on the measures, and the Tango Railway Co., arranged the budget and implemented the measures. *[Refer to Attached Figure 4]*
- (iii) The Company and the Tango Railway Co., requested the track side local government on the activities to capture animals, and the track side local government asked their jurisdictional hunting companions and started to capture animals in the places where there were many records of collision along the track side.

(2) Permanent measures

The Company decided to implement the following items.

- (i) Revised the "Basic procedures when faced abnormality" to make clear the handling when the brake did not work, and prescribed to use the hand brake, on November 1, 2020.

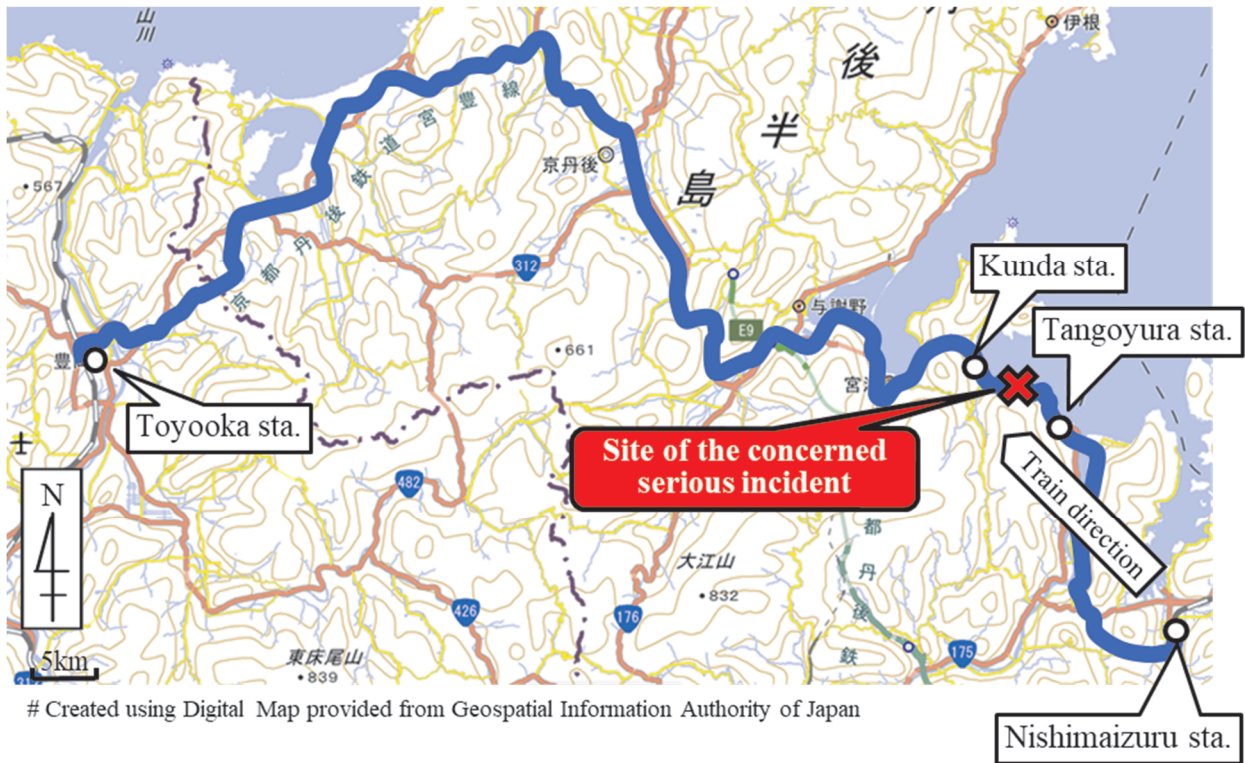
- (ii) The Company and the Tango Railway Co., discussed each other and promote the preparation toward the implementation of changing layout of the pipe connected to the brake cylinder in the all 16 vehicles of the similar structures. *[Refer to Attached Figure 4]*

### 5.3. Measures Implemented by the Ministry of Land, Infrastructure, Transport and Tourism after this Serious Incident

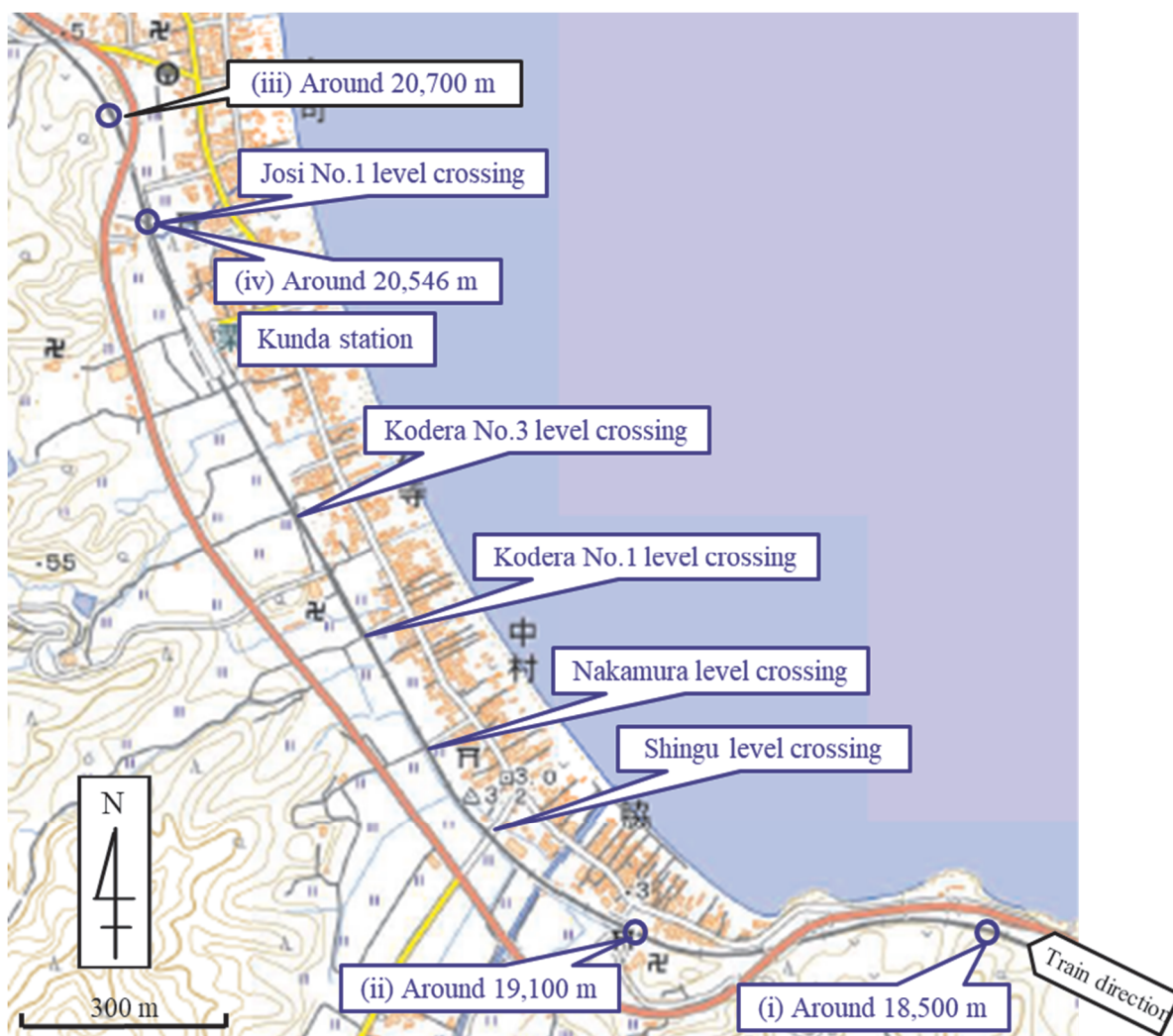
The Ministry of Land, Infrastructure, Transport and Tourism took the following actions based on the occurrence of this serious incident.

- (1) On October 5, 2020, implemented the "information provision" to the railway and tramway operators, and instructed the "investigation of causes and implementation of the safety actions" to the Company.
- (2) On October 6, 2020, instructed the railway and tramway operators to report on the existence of the vehicles with the similar structure, *i.e.*, both the brake pipe and the brake cylinder are laid in the most outside of the bogie frame in the vehicle operated alone.
- (3) On May 6, 2021, let the railway and tramway operators be known well on the contents of the measures described in 5.2 (1) (ii) and (2) (ii), and instructed the railway and tramway operators who owned the vehicles with the similar structure, to study on the similar measures.

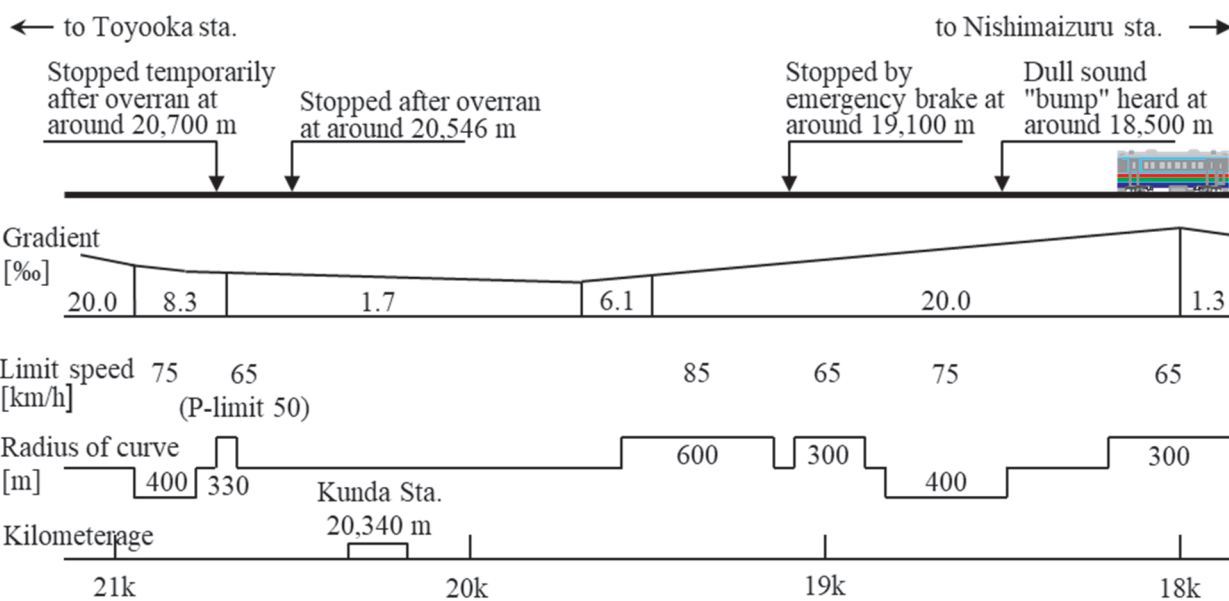
Attached Figure 1. Route Map of Miyazu Line



Attached Figure 2. Plane Figure and Cross Section of the Track in Around the Place Where the Train Overran

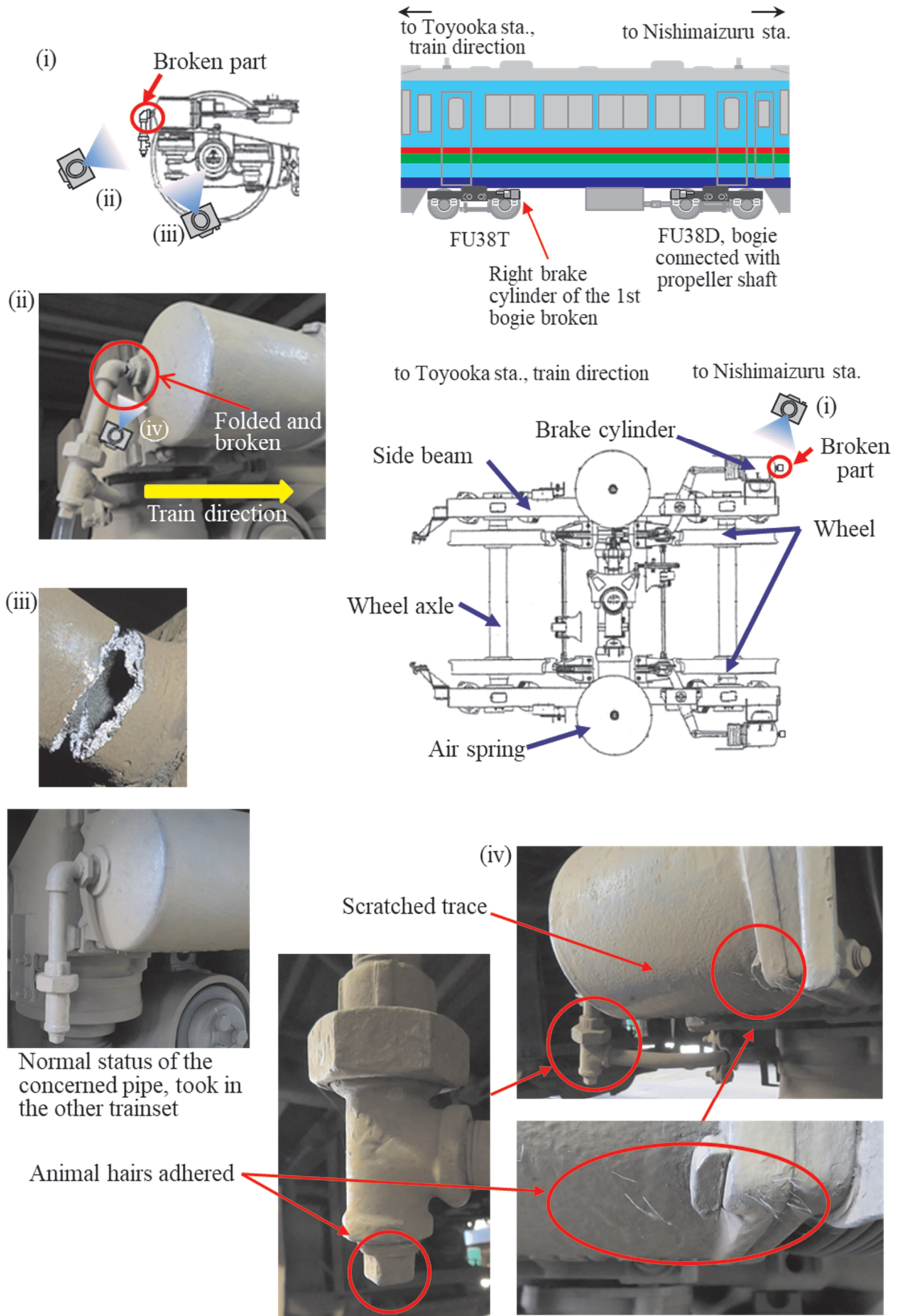


# Created using Digital Map provided from Geospatial Information Authority of Japan



# Created based on the materials provided from WILLERE TRAINS Inc.

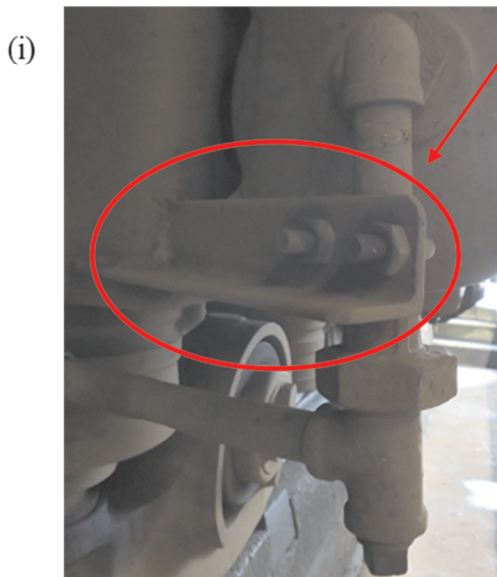
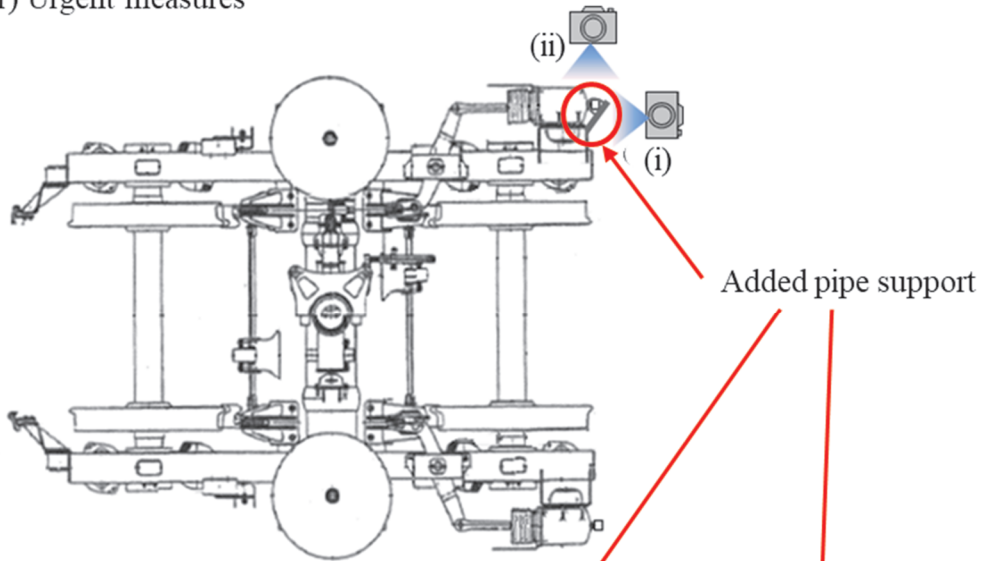
Attached Figure 3. Damaged Status of the Train





Attached Figure 4. Implemented Status of Urgent Measures and Permanent Measures taken by the Company

(1) Urgent measures



(2) Permanent measures

Piping route is planned to change to upper side of the brake cylinder.

