Abstract

Level crossing accidents cause heavy damage to people, rolling stock and surrounding infrastructure as well as huge impacts on society. Therefore we are trying various measures to minimize these kinds of accidents, thinking of level crossing accidents as one of the most important issues for railway companies. By seeking how to manage these measures, we, JR East, have been able to decrease the number of accidents by 80% to about 40 a year compared with about 250 in 1987 when we started our company. It means the safety level at JR East level crossings is much higher than before.

However, as the number of level crossing accidents has stayed at the same level in the past few years, we have collected data on the recent level crossing accidents, investigated the details and discussed how to get functional countermeasures to make level crossings safer and our investment more effective.

In this report, we would like to introduce the outline of risk analysis and countermeasures for this current situation.

1. Outline of JR East

Our predecessor, Japanese National Railways, was divided and privatized into six passenger railway companies and one freight railway company in 1987. JR East is one of these companies, covering the northeastern half of the main island in Japan. We have about 60,000 employees, and about 7,500 kilometers of railway lines. The number of trains operated per day is about 12,700. The number of passengers per day is about 16 million. Our main operations are the commuter lines in the Tokyo metropolitan area, and the Shinkansen (high speed train) network connecting major cities.
2. 2013 Safety Vision

Since our establishment in 1987, we have implemented four five-year safety plans, and have taken various approaches. As a result, the number of railway operating accidents has steadily decreased. However, an accident occurred on the Uetsu Line in December 2005, in which five passengers were killed and 33 persons were injured. Serious accidents haven’t vanished.

We have taken this situation very seriously. In addition to ensuring a steady progress with the measures we have already put into practice, we have added a new viewpoint to respond to changes in the environment that surrounds our company. We are thus executing a new five-year safety plan, “2013 Safety Vision”, which started in fiscal year 2009. (See Figure 1)

3. New risk evaluation

In “2013 Safety Vision”, we put emphasis on “prevention of accidents by evaluating risks in advance” as new perspectives. Our present method to prevent serious accidents is mainly to prevent repeating the accidents or events that had happened. We will continue countermeasures to prevent repeating the accidents or events that had happened, but there are also events that seem unimportant only because they have not yet caused major damage.

For example, there have been some level crossing accidents in which a derailed train was an obstacle to movement on the other track, but this has never led to major accidents. However, in this case there is a hidden risk of a serious accident if another train is approaching. (See Figure 2)
This time, we introduced risk evaluation that takes into consideration the frequency of the events we have experienced in the past, including those with only small damage, and the maximum scale of damage of the events we can imagine. We will give high priority to preventing such accidents by using this evaluation.

Evaluating the damage rank first. Examples: (See Figure 3)

A: Hanshin-Awaji Earthquake, Tokyo metropolitan area large earthquake (assumption)
B: Osutakayama airplane disaster, Tsurumi collision, Mikawashima collision, Fukuchiyama line derailment
C: Shigaraki-kougen Railway collision, Uetsu Line derailment
D: People being hit by a train at a station platform

Figure 3: Examples of evaluating the damage rank

We will classify events in this way and will analyze the correlation between the frequencies of these accidents or events and the damage from them.

The following figure is an example of the risk evaluation. (See Figure 4)

Light and shade of the color of the background in the figure shows the priority level. This figure shows that we will take firm countermeasures against accidents leading to major damage, even though their frequencies of occurrence are small. Also, we will take firm countermeasures against accidents or events which occur many times, even though each of them causes only small damage.

According to this evaluation, we will advance the following measures, along with others.

- Countermeasures against level crossing accidents
- Countermeasures against Tokyo metropolitan area large earthquake
- Countermeasures against excessive speed
- Safety measures for station platform

4. Countermeasures for the prevention of level crossing accidents

This time we have conducted further analysis specifically on the countermeasures against level crossing accidents. We will describe the results of the analysis, the accident prevention measures we have formulated based on the analysis, and how we plan to proceed with each item in the measures.
4-1. Trend in the number of level crossing accidents in our company
Because of installing level crossing obstruction detectors and other countermeasures, the number of level crossing accidents has decreased by about 80 percent since our establishment. (See Figure 5)
However, there is a hidden risk of a serious accident.

4-2. Risk evaluation for level crossing accidents
This time, as a result of risk analysis of main events of level crossing accidents performed by this method, we have found the risks of the following to be relatively high. (See Figure 6)
· Level crossing derailment accident
· (in Class 1 crossing) A collision with a stranded car
· (in Class 3 or Class 4 crossing) A collision with a car

Based on this evaluation, therefore, we are taking countermeasures against level crossing accidents as follows.
· Installing guards to prevent deviation
· Installing level crossing obstruction detectors
· Upgrading level crossings for greater safety

Figure 5: Trend in the number of level crossing accidents
Figure 6: Risk evaluation for level crossing accidents
In our country, level crossings are classified as follows. (See Figure 7)

- Level crossing, Class 1
  Crossing gates are lowered to close road traffic for all passing trains.
- Level crossing, Class 2
  Crossing gates are lowered to close road traffic for trains passing through during a certain period of time.
  (At present, this class does not exist in Japan.)
- Level crossing, Class 3
  An alarm is installed to signal the approach of trains.
- Level crossing, Class 4
  A crossing other than class 1, class 2 or class 3.

4-3. Our measures in the future

4-3-1. Guards to prevent deviation
As a means of reducing the chance of a derailment resulting from a level crossing accident and secondary damage from interference with trains on adjacent tracks, “guards to prevent deviation” will be installed, when we have verified their effectiveness, on quadruple-track sections (where ordinary automobiles can cross) and double-track sections (where trains pass at high speed and large vehicles can cross). (See Figure 8)

4-3-2. Level crossing obstruction detectors
Obstruction detecting devices which detect automobiles stranded in the crossings and give a stop signal to trains will continue to be installed in high-risk crossings, as we have already been doing.
In analyzing the accidents involving automobiles in class 1 crossings without obstruction detectors, we have found certain trends in terms of number of trains, passing speed of trains and width of crossings (which is related to vehicle traffic volume). (See Figure 9)
For this reason, we will take countermeasures with high priority for level crossings where (See Figure 10)

1. Many trains pass through.
2. Trains run at high speed. (Damage from accidents is serious)
3. The width is narrow or many cars pass through.
4. Accidents occurred in the past.

And we will consider secondary damage (such as a fall into a river due to derailment) on a case by case basis. (See Figure 11)
4-3-3. Upgrading level crossings for greater safety

In analyzing accidents involving automobiles in class 3 and class 4 crossings, we have found that accidents occurred a number of times at the same crossing and that many of them involved cars that entered the crossing just before the train arrived or cars that collided into the train broadside. (See Figure 12)

![Figure 12: Level crossing accidents with road vehicles](image)

On the basis of the results of this analysis we have decided to proceed with the reclassification (upgrading) of class 3 or class 4 crossing into class 1 crossing in the order that gives priority to crossings with a history of accidents (especially, those involving fatalities) and crossings where visibility is poor.

Also, as a drastic measure, we will move to eliminate level crossings by grade separation, or to install restriction barriers to make it physically impossible for cars to pass through and to encourage pedestrians and bicycle riders to stop before proceeding.

4-3-4. Further enhancement of safety

In addition to these measures, we will work jointly with the police, schools, road administrators and trucking associations to prevent crossing accidents and, as a new measure to prevent people and cars from crossing just before the train arrives, we will study improvement of visual recognition of crossings. (See Figure 13)
5. Conclusions

There is no end for safety. The wisdom and efforts of humanity are required to build up safety. Therefore, we will take countermeasures against level crossing accidents based on our risk evaluation in the future. In addition, we will make an effort to aim at zero accidents involving passengers injured or killed and zero accidents involving employees killed. Furthermore, we will challenge continually and completely for “ultimate safety”, so that we can provide our customers with a feeling of relief.