Since its foundation in April 1987, JR East has treated “safety” as the most important management issue. We have established and implemented three 5-year safety plans so far to help create a safer railway system. As a result, the number of railway operating accidents has decreased dramatically, and safety has been steadily improving.

In FY 2004, we have established a new 5-year safety plan called “Safety Plan 2008 - Back to Basics and Renewing Safety Strategies” for the entire JR East group to work on in order to further improve safety.

1 Introduction

The business environment for JR East has changed a great deal since its foundation due to the bursting of the bubble economy, and the advance of globalization and informatization in various fields. Also, competition between companies has become increasingly fierce because of rapid aging of the population resulting from the decline in the birthrate as well as accelerating technological innovation. Under such circumstances, our most important mission is to respond to passengers' expectations and trust from the shareholders, and to ensure safer and more stable transportation.

Since the foundation of the company, we have treated “safety” as the most important management issue, and we have all been working on improvement of safety, and as a result, the number of railway operating accidents has decreased to approximately 1/4 of what it was previously.

Fig 2: Changes in the number of railway operating accidents

Nevertheless, there have been events that required caution and transport problems that have caused trouble for the passengers; therefore, strengthening of safety measures from both the hardware and software perspectives is important in order to achieve improved safety.

2 JR East’s approach to the safety issue

Since FY 2001, we have implemented the medium term business plan “New Frontier 21.” Based on the keywords “autonomy and liaison,” New Frontier 21 states that individual JR East group companies are to operate while fully recognizing their missions and responsibilities in order to: maximize the effectiveness of the JR East brand images of “sound,” “reliable,” and “safe;” remain as strictly customer-oriented organizations; provide high quality products; establish a reliable business group; and to promote growth of the entire group.

Especially in the railway business, we have been attempting to effectively use our accumulated technologies and also to establish the “world’s best railway system” in terms of “safety,” “convenience,” “technological advancement,” “comfort,” and “efficiency,” by putting together our advanced technologies and by improving our railway systems.

As for “safety,” we have established and implemented 5-year safety plans, three times so far since 1989 (Safety Priority Investment Plan, Safety Basic Plan, and Safety Plan 21), to improve various preventive measures for safety and to shift these measures from “passive safety measures” to “proactive safety measures.”

This time, we have created a new 5-year safety plan, “Safety Plan 2008,” which will be in effect from FY 2004 to FY 2008, with the aim of creating a railway system with higher transport quality. Based on this “Safety Plan 2008,” we will make efforts to accurately and promptly respond to diversification of passengers’ value perspectives, technological advancement, changes in employee organizational structures, and changes in maintenance systems, and also the JR East group companies will all work together to let individual group companies willingly and independently improve “safety.”

3 “Safety Plan 2008”

3.1 Objective of “Safety Plan 2008”

For us to go back to the basics of safety and create a railway system with higher transport quality, “Safety Plan 2008 - Back to Basics and Renewing..."
Safety Strategies has the following three objectives:

- Prevention of railway operating accidents
  - Lessons learned from previous accidents, analysis of events requiring caution, and establishment and implementation of measures against these events
- Evaluation and re-establishment of the safety management system
  - Establishment of the safety promotion system from a fundamental standpoint
- Accurate response to increasing and diversifying passenger perspectives on safety
  - Creation of a people-friendly railway system

Then, with special emphasis on the four major subjects in Figure 3, we will make efforts to achieve each individual goal in order to achieve the ultimate goal of "zero fatalities or injuries resulting from accidents involving passengers, and zero fatal accidents involving JR East employees (including employees of group companies)."

3.2 Four main pillars of "Safety Plan 2008"

3.2.1 Safety equipment priority upgrade plan
In order to further ensure safety of railways, it is essential to detect all safety weaknesses inherent to the current railway system, effectively and intensively improve safety equipment, and establish measures to prevent serious accidents. In this safety plan, approximately 400 billion yen will be invested in safety improvements over a 5-year span to intensively and systematically upgrade safety equipment.

3.2.2 Improvement of safety
When train operation is affected by a problem of some kind, the basic procedure to secure safety is to immediately stop the train and avoid dangerous situations. Meanwhile, when an on-board problem or wayside equipment problem occurs and the mode of transport is no longer stable, unusual or unfamiliar procedures are required to handle the situation, and this may lead to unexpected mistakes. For this reason, in order to improve safety, it is necessary to secure safety first and then to resume train operation as quickly as possible. To avoid such mistakes, the reliability of wayside equipment and on-board equipment must be improved, and they must be correctly handled in accordance with safety rules. This will then allow us to accurately respond to passengers' expectations toward improvement of the sense of safety.

3.2.3 Reforming the safety management system
In the future, railway systems must be able to accurately respond to the introduction of various types of systems, changes in the age distribution of employees, and diversification of passengers' value perspectives. Therefore, "Safety Plan 2008" proposes the following topics for JR East and its group companies to cooperate on:

- Create a safety promotion system in the railway business by JR East group companies as an integrated unit (JES-Net25)
  The JR East group companies share various tasks. For them to work on safety promotion as one integrated unit, we are currently upgrading our inter-group cooperation systems by creating information networks and regularly convening a group safety promotion committee.
  (JES-Net: JR East Safety Network)
- Create a new vision for future signals
  Renovation of signals, improvement of engineering work quality, and renovation of maintenance methods are all important issues directly linked to safety in train operation. By launching this project, we will focus on creating specific visions for future signals at an early project stage and implement these visions.
- Establish measures to maintain or improve knowledge of train operations at stations or in car depots
  Accompanied by implementation of systems such as PRC, opportunities to experience train operation when the train is running have been decreasing. Therefore, we are encouraging maintenance and improvement of knowledge of train operation at stations or in car depots.
- Safety and adequate human resource development, education, and training
  Based on the understanding that it is important to develop accurate knowledge of safety, to accumulate safety technologies, and to
develop a broad view of safety, we will improve development and training of human resources, and at the same time, promote establishment of measures to share and effectively use the know-how of highly-experienced employees.

Establish a crisis management system for earthquakes
In response to how imminent large earthquakes are, and in response to the current status of review and establishment of prevention schemes of the national and local governments and business organizations, we will create earthquake-proof railways, improve responsiveness at the time of earthquakes, and improve the detailed earthquake management system for a Tokai (eastern seaboard) earthquake. Through these activities, we will enhance our crisis management system in a practical manner.

Establish a risk assessment system
Identification of not only the obvious weaknesses of a railway system but also potential weaknesses, followed by improvement of preventive measures, is important if the safety level is to be improved. For this reason, we have been conducting quantitative analyses and evaluation based on risk predictions in order to develop a method that will allow the establishment of futuristic safety measures.

3.2.4 Creating a "safety culture"
Safety of a railway system is secured through collaboration among "humans (employees)," "equipment," and "rules." It is important that each employee correctly understands the structure of railway safety and strictly adheres to the basic operations when any kind of work must be done, while proper functioning of the above mentioned liaisons is always monitored and improved. Based on these concepts, we are promoting the following approaches to safety.

Correct understanding of accidents and identification of potential accidents
Correct understanding of accidents and identification of "events that require caution," or potential accidents, are the basis of safety, and are important elements for correct "identification of the cause" and for establishment of measures to prevent a recurrence of accidents. We have been using the "4M4E" accident analysis method used in the medical field in order to accurately identify the cause. In this method, factors triggering accidents or errors are analyzed from the "4Ms" point of view and measures against these "4Ms" are studied from the "4Es" point of view.

We have also been revising the existing safety measures and rules in order to adapt their contents to the current activities.

Boosting CS activity
Since September 1988, we have been promoting "CS (Challenge-Safety) activity" for all front-line employees to participate in and endeavor to secure safety. All JR East employees are currently further promoting this CS activity to detect or identify the "hidden potential accidents."

4 Detailed description of improvement of safety equipment
As stated as the goal of "Safety Plan 2008," we have been trying to eliminate accidents that are induced by incorrect operations or equipment problems which would lead to "fatalities or injuries resulting from accidents involving passengers" or "fatal accidents involving JR East employees (including employees of group companies)." For this reason, we will analyze the current status of train operations and the mechanisms of maintenance work, and based on the results of these analyses, we will create a railway system in which the structure of each department is viewed from a cross-sectional standpoint. The following sections introduce the current status of safety equipment and our future vision.

4.1 Train collision preventive measures
After the two-train collision that occurred at Mikawashima station on the Joban line in 1962, an ATS (automatic train stop device) was
installed on all JNR lines. An ATS is a device that automatically activates an emergency brake to stop a train when the operator does not correctly respond to a stop signal.

Subsequently, an ATS-P (ATS with higher safety, and P stands for "pattern") was introduced on the Keiyo line in December 1988, and it was then installed on major train tracks in the Tokyo metropolitan area. An ATS-P sends information on the distance between the wayside coil installed between rails and the stop signal to the cab coil on the train car. In response to the communicated information, the car-borne computer calculates a deceleration pattern suitable for the car, and then checks the current distance to the signal as well as the current train speed. The train automatically activates the brake when the actual speed exceeds the computer-generated deceleration pattern. The ATS-P is scheduled to be installed on the Tohoku line (between Utsunomiya and Kuroiso) and on the Ito line (between Kinomiya and Ito) in FY 2004, and its application will be further expanded.

For the tracks where installation of ATS-P is not planned, installation of ATS-SN started in November 1989 and the installation was completed on all target lines by 1993. An ATS-SN is a device that automatically activates the emergency brake immediately before the signal when the signal is indicating a stop sign. However, the ATS-SN does not have the speed check function. Therefore, a problem remains to be resolved since the train may pass the signal at a high speed. To respond to this problem, we have developed an ATS-Ps, having the same speed check function as the ATS-P, based on ATS-SN, and we are now sequentially installing it in the Sendai and Niigata areas. We plan to install it in other areas as well.

The ATS-P and ATS-Ps described above, together with ATC (automatic train control device), now cover over 90% of the entire JR-East area in terms of load on section (passenger-kilometers).

We are also promoting the introduction of digital ATC, which is the more advanced model of the conventional ATC. This device transmits information on the position of the preceding train in the form of a digital signal from wayside to the train car, and executes the most appropriate brake control while taking various track conditions such as curves and slopes into consideration. The digital ATC uses continuous single-stage braking which eliminates the waste of time and achieves smooth brake control instead of the conventional multi-stage braking (which executes multi-stage deceleration in accordance with the position of the preceding train). This, in turn, allows dramatic improvement of ride quality. Also, providing the operator with support information, such as the position of the preceding train, allows smooth train operation.

The digital ATC was first used between Morioka and Hachinohe on the Tohoku Shinkansen track which started operating on December 1 of 2002. Application of this device will be expanded to other sections on the Tohoku Shinkansen line and also on the Joetsu Shinkansen line. As for the existing lines, the use of digital ATC started between Minamisuna and Tsurumi on the Keihintohoku line in December 2003. Application of this device will be expanded to other sections on the Keihintohoku and Negishi lines, and also on the Yamanote line.

4.2 Accident prevention measures for station platforms

In order to secure the safety of station platforms, we have installed train emergency stop warning devices so that trains can be immediately stopped when there is a possibility that a passenger may be hit by a train due to, for example, the passenger falling off the platform or falling on the platform. To make this device accessible not only to station staff but also to the passengers, we have installed signs indicating where the switches are at very visible locations and also clearly differentiated columns with switches from columns without them. This emergency stop warning device is currently installed at approximately 350 stations mainly in the Tokyo metropolitan area.

Furthermore, in July 2004, we installed an image processing fall detection system which uses stereo image processing technology to automatically detect abnormalities and stop trains when a passenger...
falls off the platform. This device is capable of monitoring a wide area of track in 3D and capable of detecting fallen passengers with a high degree of accuracy virtually anywhere in the area below the platform.

While implementing these concrete preventive measures, we also hold a "platform campaign" every year as an abstract raising awareness preventive measure. We will continue to hold this campaign twice a year to obtain passengers' understanding and cooperation.

4.3 Accident prevention measures for crossings

4.3.1 Improving and expanding use of crossing obstacle detection devices
When cars, especially large vehicles, get stuck in a crossing due to heavy traffic and as a result collide with a train, many of the passengers or crew on board the train may be injured or even killed. To avoid such accidents, we are promoting installation of a crossing obstacle detection device which automatically detects vehicles stuck in a crossing and informs the train operator of danger. As of the beginning of FY 2004, this device was installed at approximately 2,450 crossings.

4.3.2 Measures for improving deterrence capability at crossings
Due to implementation of various crossing accident preventive measures, the number of crossing accidents has dramatically decreased since JR East was established. However, approximately 40% of such accidents occur because cars attempt to cross the crossing when crossing barriers are already lowered or are being lowered. In response to this, we are now promoting measures to improve recognition of crossing areas by hanging bells and flasher signals above the crossing or by installing large-diameter crossing bars with a diameter approximately twice as large as the conventional barrier.

Also, similar to the accident prevention on station platforms, we will continue to hold “zero crossing accident” campaigns as a raising awareness measure to obtain understanding and cooperation of passengers and drivers.

4.4 Safety in maintenance work

Safety in maintenance work still relies on staff members' attention, and also as maintenance work is usually carried out on tracks or near tracks, maintenance staff members may be involved in collisions with trains, or tools or materials may be hit by trains resulting in damage. Furthermore, vehicles used in maintenance work have recently become increasingly larger, and it is thus necessary to prevent collisions between trains and maintenance vehicles. For this reason, we are improving the work environment in order to achieve “separation of train operation and maintenance work.”

4.4.1 Promotion of systematization of track closure procedures
When it is necessary to close tracks to carry out some kind of work, communications and meetings among maintenance crews, traffic controllers, and station crews are required before and after the work in order to secure safety of the maintenance crews and trains. We are currently promoting systematization of track closure procedures in an attempt to eliminate complicated tasks in which human errors are likely to occur, and to reduce the burden imposed on maintenance crews and traffic controllers.

Today, a train operation management system for high traffic density tracks called ATOS (Autonomous Decentralized Transport Operation Control System) is installed on major tracks in Tokyo. In this system, a subsystem is provided to allow work crews to use portable terminals to directly specify work areas so that entry by trains into that maintenance work area will be automatically prevented. In this way, safety in maintenance work is secured.
possible to obtain information on train operation status, and also, the
track closure procedures are carried out by maintenance workers who
use general-purpose mobile terminals to directly inform (i.e. not
involving station crews) the traffic controllers of starting and
completion of work.
Furthermore, as safety measures to be implemented when
maintenance vehicles are used, we are now developing a system that
prevents collisions between trains and maintenance vehicles.
4.4.2 Prevention of collision accidents while conducting
maintenance work
When patrolling or checking tracks or electric car lines, accident
prevention entirely depends on how careful the train lookouts are. In
order to move away from such a condition, we have used systems
such as crossing signals and train approach warning devices to
prevent train accidents. For further improvement of these backup
systems, we have installed TC model radio train approach warning
systems that use existing wayside telephone lines to inform work
crews of train approach information on tracks of approximately 5,200
km in total.

4.5 Reforming train operation systems
4.5.1 Improving and expanding use of ATOS
ATOS stands for the "Autonomous Decentralized Transport Operation
Control System." This system effectively uses computer technologies
as well as data processing technologies to achieve train operation
management for the next generation railway business. It is equipped
with not only the conventional PRC function but also a function to
automatically control the station guidance device based on the train
operation diagram, such that information can be promptly provided to
passengers when train schedules change. Also, when maintenance
work is being carried out, maintenance workers can use mobile
terminals to close tracks without involving stations or traffic
controllers in that operation, and also they can use the terminals to
arrange routes for maintenance vehicles, resulting in improved safety
in maintenance work.
This system went into operation on the Chuo line (between Tokyo
and Kofu) in December 1996, and its installation has been promoted
for the major tracks of the Tokyo metropolitan area. The system went
into operation on the Joban line (between Ueno and Hatori) last year,
and its application extended to a track length of approximately 690
km (12 lines) by the end of FY 2003. This system will be sequentially
installed on tracks of other lines such as the Tohoku line or Takasaki
line.
4.5.2 Promoting the implementation of CTC and PRC
Train operation management systems for tracks outside Tokyo are
CTC (centralized traffic control), controlled by the central command
center, and PRC (programmed route control), controlled automatically
by a computer.
We have actively promoted the implementation of CTC and PRC. As
a result, CTC is used on approximately 5,700 km of track, of which
PRC is used on approximately 5,000 km of track.
4.5.3 Shinkansen operation management system
Since 1995, COSMOS (new comprehensive shinkansen system) has
been introduced to replace the conventional operation management
system which was used since the time Shinkansen was put into
operation.
COSMOS uses a network to integrate subsystems for transport
planning, operation management, car management, car depot, and
equipment-related commands in order to enhance information sharing
and coordination among various tasks. COSMOS can be
characterized by: (1) modernization of station related tasks and
maintenance work; (2) support for new types of transport-related
demands; and (3) improvement of functionality of command tasks.
4.5.4 Improvement of train radios
We have been installing three types of train radios in accordance with
the characteristics of each line.
Type A train radio (duplex type) is used for high traffic density lines
in large cities and Shinkansen tracks that are highly important since
for these lines, it is necessary to quickly transmit a large volume of
information. Type B train radio (half-duplex type) is used for tracks
with high traffic both in volume and frequency that are not subject to
Type A train radio. Type C train radio (simplex type) is used for
We have installed train radios on approximately 5,800 km of track, of which, Types A and B account for approximately 2,400 km of track mainly in the Tokyo metropolitan area. We are now working on improvement of functionality and expansion of application.

As for digital train radio, its use started in November 2002 for the Tohoku and Joetsu Shinkansen lines, and it was also installed between Morioka and Hachinohe in December 2002 when the operation of Hachinohe station for the Tohoku Shinkansen started.

5 Conclusion

As described above, we have regarded “safety” as the most important management issue and have been improving safety equipment. However, no matter how sophisticated the developed systems are or no matter how thoroughly the rules are reviewed, the most important element in order to realize sufficient system functionality or expected good results is the human factor. To achieve these goals, we are trying to establish a “safety culture” in which each employee, including those who belong to group companies, realizes that they are the basis of safety, and endeavors to improve safety through their own will and responsibility.

For JR East, this fiscal year is an important year since the newly established “Safety Plan 2008” will be implemented. Putting “equipment,” “rules,” and “people” together as one unit, we plan to further improve safety in order to achieve “zero fatalities and injuries resulting from accidents involving passengers and zero fatal accidents involving JR East employees (including employees of group companies).”