Changing RAMS for Railways: Proposals from Japan

Masayuki Matsumoto

General Manager, Electrical & Signal Network System Dept., East Japan Railway Company

Compliance to international standards is demanded today when introducing railway systems. In light of that, moves are currently underway to make European standards related to railways into international standards, and one of those is the RAMS standard. This is a management standard that applies across the lifecycle of a railway system for reliability, availability, maintainability and safety, and it greatly affects Japanese railways. We thus need to pay close attention to trends in revision of the standard underway in Europe and make sure that they do not adversely affect Japan. This article covers an overview of the RAMS standard and introduces efforts for revision to the standard with Japan at the lead.

1 Introduction

Compliance to international standards such as International Electrotechnical Commission (IEC) standards is demanded with the Agreement on Technical Barriers to Trade (TBT) and Agreement on Government Procurement coming into force of at the World Trade Organization (WTO), which commenced in January 1995. Moves are currently underway to make European standards such as those of the European Committee for Electrotechnical Standardization (CENELEC) into international standards. And a typical example is the RAMS standard (IEC 62278).

The RAMS standard is expected to greatly affect Japanese railways into the future. It applies specifically to railways, and it covers the entire lifecycle from system concept through to disposal. Japanese railways are renowned worldwide for their high levels of safety and stability. But if traditional methods of Japanese railway operation will differ from those of the RAMS standard, we will be forced to make corrections. This article will thus cover an overview of the RAMS standard as well as current trends and Japan's efforts.

2 Overview of RAMS

The RAMS standard (IEC 62278) came into effect in October 2002. This standard had been called the RAMS standard even at its original draft, EN 50126.

RAMS stands for the four assessment indicators of reliability, availability, maintainability and safety. It requires systems to which it is applied to maintain good balance, considering those indicators and economical efficiency.

For Japan to maintain its low failure rate and on-time operation, broad-ranging organizations with technology and knowhow for safe and stable transport as well as systems for maintaining and passing on such qualities are indispensable. Those are in addition to laws and regulations. Japan's railway systems thus have already achieved a high level in terms of the words behind R, A, M, and S. However, IEC 62278 does not necessarily match the way work is done in Japan, so railway operators and manufacturers both must be cautious. This section explains the positioning of RAMS and its concepts.

2.1 Positioning of International Standard IEC 62278

This standard is based on IEC 61508, which stipulates safety management methods for electric, electronic, and programmable electronic control systems for industry in general. IEC 62278 is the standard for management related to R, A, M, S and economical efficiency when developing and operating railway systems related to safety. It reflects the concepts of safety lifecycle and safety integrity level introduced in IEC 61508.

Other international standards related to safety of railways, which came into effect at about the same time as IEC 62278, are IEC 62279 (software for railway control and protection systems) and IEC 62280 (safety-related communication). Later, IEC 62425 (system safety), which stipulates documentation for certifying safety, came into effect.

2.2 Items to which RAMS Applies

There is no specific limit to the items to which IEC 62278 applies. Whether wayside or onboard, if the system making up an element of the railway is connected to safety in the slightest way, the standard will apply if planned or developed after this standard comes into effect. In other words, it applies to all equipment for new or extended sections of lines, equipment for existing lines where major renovations are made, newly developed products, and products undergoing major design changes. However, this specification has no stipulations regarding the positioning or scope of systems to which it applies. What is considered a "system" is decided on a case-by-case basis. In other words, it may apply to a broad-ranging, large-scale system in its entirety or to a single device.

Activities for complying with the standard may be done

by a railway operator or railway system manufacturer, either independently or jointly. This is related to work for the RAMS lifecycle to be covered later in this article.

2.3 The RAMS Concept

Details on the concept of RAMS shown in Fig. 1 are stipulated in the standard. Here, quality of service is seen as being most important, and that quality of service is made up of RAMS for railways and other attributes. Furthermore, RAMS for railways is made up of safety and availability, which are based on reliability and maintainability plus operation and maintenance. In this way, the components of RAMS are expressed in a straightforward manner.

2.4 The RAMS Lifecycle

The lifecycle from system concept to disposal in the RAMS standard is stipulated as being classified in 14 phases as shown in Fig. 2. The text of the standard stipulates by phase work such as the purpose, input items (documents and information required to conduct the activities of the phase, including output of the previous phase), requirements (activities that should be conducted in each phase), output items (documents and information recording the process and results of activities of the phase), and verification (process of activities of the phase and assessment of results).

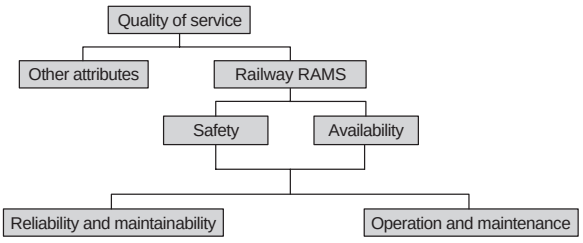


Fig. 1 The Concept of RAMS

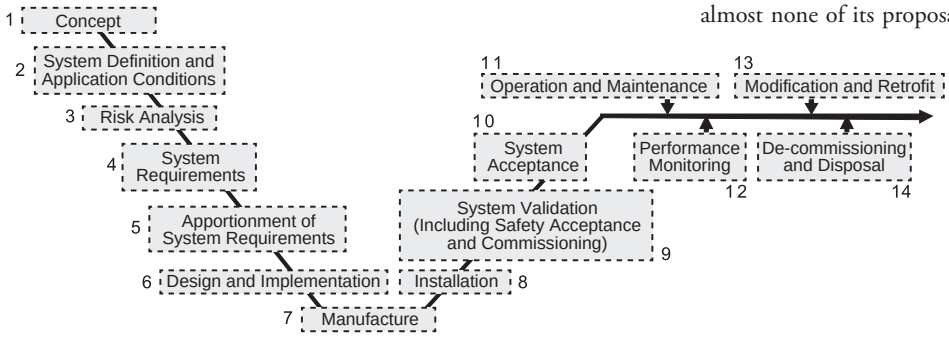


Fig. 2 The RAMS Lifecycle

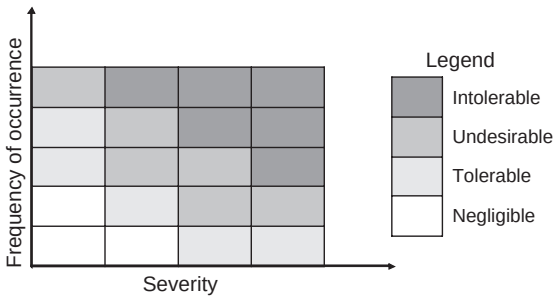


Fig. 3 Concept of Risk Analysis in RAMS

Risk analysis and assessment are stipulated as being carried out in documenting for each phase of the lifecycle. Fig. 3 shows the concept of risk analysis in RAMS.

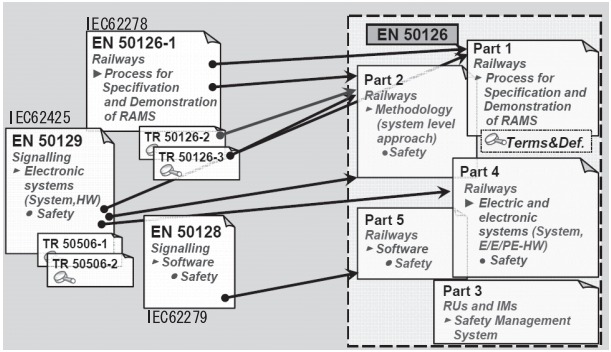
This method of identifying risk from "frequency of occurrence" and "severity" and managing risk on a matrix is the basic concept of work of each phase.

3 Trends in Europe

In Europe, work on revising RAMS (EN 50126) stared at CENELEC in around 2008. For IEC 62278, which came into operation in 2002, we see an attempt to unify the signal software safety standard (EN 50128) and safety case standard (EN 50129) into a single standard. With that, the standard will apply to railway systems as a whole, including rolling stock, and we see this attempt as going beyond just maintenance of the standard as time has passed since its establishment (Fig. 4). If an EN standard is put together, we can assume efforts will start on making that into an IEC standard by applying the Dresden Agreement, meaning it is important to pay close attention to trends in this area.

Particularly with the RAMS standard becoming an international standard in 2002, Japan suffered the setback of almost none of its proposals being adopted in the international standard. The reason behind that was mostly the Japanese railway industry's insufficient efforts and lack of experience in international standards, resulting in us having little say in and influence on matters.

We must sufficiently prepare so as not to repeat that past mistake. In light of this situation, a variety of information gathering activities are



Movements in reorganizing RAMS in European standards (from about 2008)

Need for reorganizing: To reflect application and experience with standards as time has passed since their establishment.

Need for systematization: To provide a unified approach applied in all railway applications.

Fig. 4 Overview of RAMS Reorganization in Europe

ongoing in Japan under the assumption that European standards will be proposed in the maintenance cycle of RAMS (periodic review cycle of the standard).

4 Japan's Response

A variety of information gathering, exchange, and dissemination activities have been underway in Japan since learning in about 2008 of moves in Europe for revising RAMS. We have also established an organization in Japan for studying the standard so as to be able to propose revisions to the IEC ahead of those of Europe. The following will cover some of such responses by Japan.

4.1 Information Exchange with European Organizations

We have been conducting advance information exchanges with European railway operators, manufacturers, and the like. Through those, we have been gathering information from Europe and building a system of cooperation ahead of studies on revision of the standard.

(1) Exchange of opinions with Deutsche Bahn

The topic of exchange of opinions and cooperation regarding RAMS was floored at a general meeting for periodical technical exchanges between JR East and Deutsche Bahn on October 7, 2010. As a result, we were able to secure agreement on cooperation and information exchange for the next year's general meeting.

(2) JISC-CENELEC information exchange

Information on RAMS was exchanged at a JISC-CENELEC information exchange meeting held on November 24, 2010. The topic of Japanese observer participation in CENELEC meetings was floored, but CENELEC rejected that at a later date.

(3) Meeting with SNCF

A meeting between JR East and France's SNCF was held on November 29, 2010 at which information was exchanged on the status of RAMS being applied in Europe and on management of reliability and availability. SNCF representatives stated their opinion that they would like to apply RAMS and other standards to relieve disparity within Europe.

(4) Exchange of opinions with Siemens

An exchange of opinions regarding RAMS was held with persons in charge of European standard revision work at German manufacturer Siemens on December 1, 2010. We were able to gain information on the status and details of revision work underway and on manufacturer efforts.

4.2 Academic Conference Presentations

Activities are underway in Japan to present at academic conferences information on details being studied and increase the number of supporters.

(1) J-Rail 2010 (December 16, 2010, Japan)

"Application of RAMS Related to Railway Signal System Maintenance"

Methods of applying the RAMS risk analysis/assessment concept to maintenance and providing feedback to systems were proposed.

(2) J-Rail 2011 (December 15, 2011, Japan)

"Method of using availability to evaluate the quality of railway operation"

Methods assessing the quality of operation that apply the RAMS availability concept were proposed.

(3) FORMS/FORMAT 2010 (December 12, 2010, Germany)

"The policy of applying RAMS to evaluate railway signalling systems for reliable transportation" and one other presentation

Studies on establishing maintenance methods that implement the RAMS concept were presented, and support was received.

(4) FORMS/FORMAT 2012 (December 11, 2012, Germany)

"A novel evaluation method of availability using the train operation quality"

A proposal was made on specific methods of notation in the context of availability from a customer perspective, and support was received from Europe.

4.3 Studies in Japan and Proposals to IEC/TC 9 Plenary Meeting

Revision of RAMS started to be considered in Europe in 2008, so Japan too began studies so as to be able to make proposals to prevent adverse affects on Japan by the time European standards are brought before the IEC.

Study groups on RAMS started to be held periodically from 2010 by personnel involved in signaling with the involvement of the Railway Technical Research Institute (RTRI) also. Later, in about 2012, we found out that a revised standard was being put together at CENELEC, so we needed to set up an official committee in Japan to study how to respond to that. We therefore set up a group to study the RAMS standard in July of 2012 with the RTRI Railway International Standards Center as the secretariat and members assembled from railway operators and manufacturers in Japan. The study group held three meetings from July to October 2012. It came to the conclusion that the current RAMS standard was lacking in content related to availability from a railway operator perspective and that supplementing such content should be studied (details noted later). Such content was proposed at the IEC/TC 9 plenary meeting (IEC plenary meeting on railway standards) held in Oslo in October 2012. A resolution was passed on Japan's proposal at the plenary meeting, and a special committee was set up to study the details of Japan's proposal (AhG 9: Ad hoc Group 9). The study group in Japan was renamed the RAMS Standard Preparation Group, and it commenced activities to respond to AhG 9. Meetings were held 13 times from January 2012 to November 2013.

5 Proposal to IEC/TC 9

Railway RAMS is, as shown in Fig. 1, supported by safety and availability. While the current standard covers safety in detail, it does not sufficiently cover availability. We feel that all activities for better maintenance of safety and availability throughout the lifecycle should be covered for railway RAMS.

We thus believe that railway RAMS for maintaining quality of service, the perspective of operators for availability in particular,

needs to at least be qualitatively covered. This perspective specifically is the effect RAMS for systems (devices) has on quality of service for passengers.

5.1 Circumstances Behind Establishment of AhG 9

We felt that the aforementioned points need to be discussed in coming deliberations for revision of the standard. We thus proposed at the IEC/TC 9 plenary meeting, as Japan's opinion, that an ad hoc group (AhG) be set up and preparation work be done ahead of revision. Japan's proposal was passed with the following written resolution (abstract).

"TC 9 resolves to set-up AhG 9 with the remit to study the possibilities to develop an amendment to IEC 62278 in order to incorporate considerations of RAM. TC 9 resolves to appoint Mr. M. Matsumoto (Japan) as AhG 9 rapporteur and to circulate a call for experts. TC 9 instructs AhG 9 to report at its next plenary meeting."

As a result of recruiting experts (committee members) for various countries based on the resolution, 18 members from Europe and Asia were assembled. Including observers and a rapporteur (who actually holds the position of "chief administrator") AhG 9 is made up of 21 members.

5.2 Policy of AhG 9 Activities

The objective of AhG 9 is to "to study the possibility to develop an amendment to RAMS and report at the next plenary meeting." Japan thus made the policy of activities be to present the basic concept of a proposal and to establish and conduct international deliberation on a revision proposal as a case study on the possibility of amending the standard.

5.3 Status of AhG 9 Activities and Future Plans

The first meeting of AhG 9 on April 3, 2013 saw the participation of 16 members from six countries. We proposed that availability needs to be made more substantial as the current standard overemphasizes safety. We also proposed a method of evaluating availability from a railway operator perspective (Fig. 5) based on the risk analysis concept of RAMS. The representatives gave many opinions on the Japanese proposal. There was little opposition to the basic concept of the proposal, and most discussion was on how to go forward with deliberation.

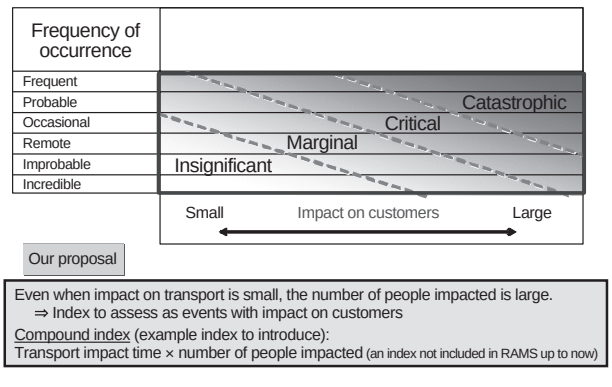


Fig. 5 Evaluation Method of Availability from an Operator Perspective

Follow-up meetings were held in July 2013 in Tokyo and September 2013 in Germany. Items deliberated on at the second and third meetings were the proposal for amending the RAMS standard as the case study presented by Japan and proposals from other countries. The results of discussions were reported at the TC 9 plenary meeting held November 6-8, 2013.

Japan's report derived the following resolution (abstract).

"Noting the report from AhG 9 rapporteur, TC 9 resolves to instruct him:

- to check the consistency with IEC/TC 56 documents on dependability
- to review the terms and definitions to avoid overlap with already existing terms and definitions"

Based on the resolution, we are currently performing a survey on existing documents and checking consistency with them. We will report the results the TC 9 Chairman's Advisory Group (CAG) meeting in April 2014, with hope of leading to actual revision of the standard.

6 Conclusion

This article has covered an overview of and the current situation of the RAMS standard (IEC 62278), which will have an impact on Japanese railways into the future, and it introduced Japan's efforts in relation to that. There was more support from European and Asian countries than we expected for the proposal from Japan, and active discussions are underway that will probably lead to future revision of RAMS. Japan is determined as the proposing country to make continuous efforts in RAMS deliberation and to maintain a central position in work for actual revision after AhG 9. We will also make an effort to identify situations with other international standards in addition to the RAMS standard.

Reference:

1) Masayuki Matsumoto, Atsushi Watanabe, Kazue Yasuoka, Tetsunori Hattori, "Application of RAMS Related to Railway Signal System Maintenance" (S7-3-1), *Proceedings of the 17th Jointed Railway Technology Symposium (J-Rail 2010)* (December 2010)

2) Satoru Masutani, Kenji Fujita, Kazue Yasuoka, Masayuki Matsumoto, "Method of using availability to evaluate the quality of railway operation" (S7-6-6), *Proceedings of the 18th Jointed Railway Technology Symposium (J-Rail 2011)* (December 2011)

3) Kazue Yasuoka, Atsushi Watabe, Tetsunori Hattori, Masayuki Matsumoto, "The policy of applying RAMS to evaluate railway signalling systems for reliable transportation", *FORMS/FORMAT 2010* (2011): 55 - 63

4) Yamato Fukuta, Satoru Masutani, Kenji Fujita, Kazue Yasuoka, Masayuki Matsumoto, "A novel evaluation method of availability using the train operation quality", *FORMS/FORMAT 2012* (2013)

5) Korefumi Tashiro, "RAMS (Reliability, Availability, Maintainability, Safety) [in Japanese]", *Railway & Electrical Engineering*, Vol. 14, No. 1 (2003): 39 - 42

6) Shigeto Hiraguri, "RAMS Kikaku ni kansuru Doukou to Kadai [in Japanese]", *Railway & Electrical Engineering*, Vol. 16, No. 3 (2005): 21 - 25