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The International Railway Solution

The International Railway Solutions (IRS) are structured in a General Part and in some eventual Application Parts.

The General Part is valid worldwide, while the Application Parts are valid for a specific railway application, based on a geographical or on a service implementation.

The eventual Application Parts may thus be added according to the current needs of the Railway Community.

Structure of the International Railway Solution:

IRS 60662: Railway Application - High-Speed - Maintenance of High-Speed Lines

General Part

CONTENTS

Foreword	7
Summary	8
Normative references	9
List of abbreviations	10

General Part

1 - New technical boundary conditions in the railway sector	13
1.1 - Mixed traffic lines	13
1.2 - Increased design speed	13
1.3 - Tilting trains	13
1.4 - High-speed freight	13
1.5 - Normalisation and standardisation	14
1.6 - Coordinate base reference data	14
1.7 - RAMS requirements	14
1.8 - Contract types	14
1.9 - Life cycle cost (LCC)	14
1.10 - Corporate social responsibility (CSR)	14
1.11 - Disposal	15
2 - Maintenance requirements	16
2.1 - Introduction	16
2.2 - Maintenance method	17
2.3 - Level of maintenance	17
3 - Maintenance requirements in the design phase	19
3.1 - Introduction	19
3.2 - Access to the infrastructure	19
3.3 - Assembly area for switches and crossings	22
3.4 - Longitudinal service paths for maintenance staff	22
3.5 - Lighting	22
3.6 - Maintenance bases	23
3.7 - RAMS data	25
3.8 - Structure and organisation of operating services	28
3.9 - Structure and organisation of maintenance services	28
3.10 - Test devices, wear parts, spare parts	28
3.11 - Emergency equipment, traction units	29

4 -	Maintenance requirements during the construction phase	30
4.1 -	Introduction.....	30
4.2 -	Collaboration between builders and maintenance staff.....	30
5 -	Maintenance requirements during the "test and service shadow" phase	31
5.1 -	Introduction	31
5.2 -	Table of inspections to be conducted during test and service shadow phase ...	32
6 -	Inspections and tests during operation of the line	33
6.1 -	Introduction.....	33
6.2 -	Components to be examined during monitoring (non-exhaustive checklist of elements to be examined)	33
7 -	Sweep trains - track possessions	38
7.1 -	Introduction.....	38
7.2 -	"Sweep" train	38
7.3 -	Track Possessions (Working Windows)	39
8 -	Best practice in maintenance works	42
8.1 -	Introduction.....	42
8.2 -	Integrated maintenance	42
8.3 -	Minimum maintenance requirements between completion of construction and tests and commencement of operations	42
8.4 -	Track	43
8.5 -	Structures	45
8.6 -	Energy	45
Appendix A -	Examples of tables with inspection frequencies on high-speed lines	47
Appendix B -	Overview of OCS maintenance intervals	50

Foreword

This International Railway Solution (IRS) relates to the maintenance of high-speed railway lines.

The document contains general requirements for maintenance of high-speed lines and detailed information on the principles that apply to organisation of track supervision and maintenance work.

New technologies, and widespread adoption of some such technologies, have been a feature of railway infrastructure over the last number of decades. The railways and railway environment have changed fundamentally in recent times due to the internationalisation of high-speed traffic.

This International Railway Solution on maintenance of high-speed lines takes into account these developments.

Significant technological changes include:

- technological changes to account for increasing health and safety requirements,
- general use of non-ballasted track on some lines and under certain circumstances,
- use of new fastening systems,
- introduction of new signalling and communication systems,
- new materials,
- new monitoring systems,
- absolute coordinate-based referencing of infrastructure assets to support track maintenance work network-wide,
- new techniques for maintenance equipment,
- development of new sensors to prevent infrastructure downtime or to reduce breakdown time.

This IRS deals with these elements and management thereof. According to *IRS 60670*, a high-speed railway (HSR) or high-speed line (HSL) refers to a railway system (line) with an operational speed of at least 250 km/h. In some areas, HSLs can also include railway lines with an operational speed of at least 200 km/h or even less if constrained by nearness/inclusion to urban areas or use of layout of classical lines. HSLs can use ballasted or non-ballasted track.

Summary

The railways and railway environment have changed fundamentally in recent times due to the internationalisation of high-speed traffic.

This IRS is applicable independently of railways' various organisational models and takes into account:

- new techniques introduced for different subsystems, including the latest technological developments relating to infrastructure and other subsystems,
- the publication of international rules and standards,
- new types of contracts to build, operate and maintain railways, requiring longer-term commitment,
- interfaces between operators (rolling stock) and infrastructure managers (maintenance),
- the extensive worldwide experience and expertise acquired over the last number of decades.

This IRS provides recommended practices for inspection and maintenance work. However, in light of future technological development and the variety of different maintenance strategies employed in different countries, the maintenance intervals/frequency contained in this IRS (e.g. in Chapter 9, Chapter 12, Appendix A and Appendix B) are for reference only, and users of this IRS may adapt them according to their own particular circumstances.

Normative references

1. International Railway Solution (IRS)

International Union of Railways

IRS 60670: Implementation of a high-speed railway, definition and features, in course of preparation

IRS 70001: Railway application - High speed - Dynamic integration tests and trial operation before revenue operation, 1st edition, April 2016

IRS 70014: Railway Application - Fixed installations - Maintenance Guidelines for OCL, 1st edition, September 2016

IRS 70015: Railway Application - Fixed Installations - Diagnosis of OCL Conditions, 1st edition, November 2016

IRS 70018: Railway Application - Fixed Installations - Guidelines on OCL earthing systems for safety in tunnels, 1st edition, September 2016

2. Technical reports

International Union of Railways

UIC Report: Maintenance of High Speed Lines, 2010

3. International Standards

(IEC) International Electrotechnical Commission

IEC 62278:2002: Railway applications - Specification and demonstration of reliability, availability, maintainability and safety (RAMS), 2002

List of abbreviations

ADIF	Administrador de Infraestructuras Ferroviarias (Spanish infrastructure manager)
ALARP	"As Low As Reasonably Practicable" principle
AT	Auto-transformer
CBM	Condition-based maintenance
CSR	Corporate social responsibility
CWR	Continuous welded rails
DB	Deutsche Bahn (German Railways)
GAME	Globalement au moins équivalent ("globally as least equivalent") principle
GAMAB	Globalement au moins aussi bon ("globally at least as good") principle
GSM-R	Global system for mobile communications - railway
HSL	High-speed line
JR EAST	East Japan Railway Company
KORAIL	Korean Railways
LCC	Life cycle cost
LRU	Line replaceable unit
MDT	Mean down time
MTBF	Mean time between failure
MTBSF	Mean time between service failure
MTTR	Mean time to repair
MTTRS	Mean time to restore service
OCS	Overhead contact system
PPP	Public private partnership
RAMS	Reliability, availability, maintainability, safety
RFI	Rete Ferroviaria Italiana (Italian infrastructure manager)

SNCF	Société National des Chemins de Fer Français (French Railways)
THSRC	Taiwan High Speed Rail Corporation

Railway Application - High-Speed - Maintenance of High-Speed Lines

General Part

1 - New technical boundary conditions in the railway sector

The following new boundary conditions affect the maintenance of high-speed lines and shall be taken into consideration.

1.1 - Mixed traffic lines

Most high-speed lines have, until now, been dedicated exclusively to passenger traffic and predominantly to one type of train.

With an increase in the number of high-speed lines and congestion on the roads, more and more infrastructure managers have extended use of infrastructure to different kinds of mixed traffic:

- passenger traffic with different types of trains running at the same or different speeds and with the possibility of using push-pull trains on the route,
- high-speed passenger trains and high-speed freight traffic,
- passenger and freight traffic with large differences in speed.

Mixed traffic can have a significant effect on infrastructure maintenance, depending on the operating model used.

1.2 - Increased design speed

Railway operators are seeking to reduce travel times.

There is increased demand for greater maximum speeds on (new) lines.

Some new lines are designed for speeds of up to 350 km/h.

These increased speeds affect line surveys and maintenance.

1.3 - Tilting trains

Some networks have put tilting trains into operation to increase travel speed in small curves, thus reducing travel time and increasing capacity.

Maintenance requirements relating to tilting trains shall be taken into account.

1.4 - High-speed freight

Some HSLs are also used for freight traffic. Maintenance of these lines may differ from passenger-dedicated line maintenance.

The similarities between high-speed lines and heavy-haul traffic may vary from one operator to another.

1.5 - Normalisation and standardisation

Standardisation works on high-speed lines are increasingly being performed around the world.

There is a tendency for the designers of new high-speed lines to "import" a complete system from another country; this limits flexibility in adapting to specific local conditions.

This IRS applies to "proven" designs and implementations such as GAME, GAMAB and ALARP, which are increasingly in demand.

1.6 - Coordinate base reference data

Within the scope of boundary conditions for the definition of a high-speed system, coordinate base reference data is an essential feature.

This data comprises, at a minimum, the national coordinates of the reference network and numerical/digital delimitations of the lines, tracks and, depending on tracks and lines, the operational surface of elements in the network.

1.7 - RAMS requirements

A high-speed network's performance depends largely on line availability.

Availability is all the more important when the infrastructure owner's and/or line operator's revenue depends directly on availability.

There is increasing demand for RAMS studies to prove that the infrastructure being designed will meet all of the requirements relating to reliability, availability, maintainability and safety over its entire life cycle.

Compliance with requirements must be provided for during the line's design and construction phase; follow-up must be performed over the entire life cycle.

1.8 - Contract types

New types of contract are being used to finance the construction, operation and maintenance of large infrastructure works, such as PPP.

1.9 - Life cycle cost (LCC)

Choices between different technologies and selection of manufacturing/construction companies are increasingly based on total cost over the life cycle rather than on initial investment costs.

Availability and guaranteed delivery of spare parts are important concerns.

1.10 - Corporate social responsibility (CSR)

During design, construction and operation of the high-speed line, the commitment to corporate social responsibility of the companies involved is an important factor which must be taken into consideration.

1.11 - Disposal

Material disposal or recycling in the event of renewal or upgrading work is an important consideration.

Recent technological, procedural and operational developments will have an impact on the design of new high-speed lines as well as upgrades and maintenance over the entire life cycle.

2 - Maintenance requirements

2.1 - Introduction

Adequate maintenance procedures must be adopted for each component of the system in order to guarantee very high levels of performance for the high-speed railway system over its entire life.

These procedures must also be extended to cover non-specific railway subsystems such as surrounding roads, access points, fences, etc.

The people responsible for the design, construction, upgrading and maintenance of a high-speed line shall satisfy various requirements concerning reliability, availability, maintainability, safety and security by seeking to:

- design the infrastructure so that concurrent faults are minimised and taking into account the results of RAMS studies,
- minimise systematic faults by implementing a robust quality system,
- maximise safety by implementing a risk management system,
- maximise system performance by reducing train delays and disruptions,
- maximise the system's availability by reducing the number of hours of possession,
- put measures in place to enable rapid recovery from disruption.

Preference will be given to incremental/evolutionary improvements rather than revolutionary improvements.

These objectives can be achieved by effectively managing maintenance and implementing clearly identified procedures to:

- guarantee the safety of the system and the reliability and availability of its infrastructure,
- ensure adequate maintenance with a rapid response time at an optimal cost,
- establish an extensive database to ensure accurate analyses to assist in the planning and selection of a specific type of maintenance, be it on a short-, medium- or long-term basis,
- deal with asset management issues/requirements.

2.2 - Maintenance method

The generalised, systematic periodic maintenance that was common practice a few decades ago is no longer considered best practice. It is costly, requires track possession and results in deterioration of components. However, it may be still used to maintain certain critical components.

With the development of new maintenance options and expertise, this kind of maintenance has progressively been replaced with "condition-based maintenance" (CMB).

The popularity of curative maintenance has been further diminished because it has a negative impact on infrastructure availability and as well the rest of the line's RAMS performance parameters.

The maintenance manager must make a choice between:

- investing in a well-developed diagnostic system and maximising data quality,
and
- limiting supervision with the risk of reducing line availability.

This choice is often limited by the supplier's delivery and warranty conditions.

Today, curative maintenance costs more than condition-based maintenance.

Curative maintenance operations require organisation of the maintenance service as appropriate (availability of specialists and intervention teams outside normal working hours and scenarios, means of communication, availability of machinery, etc.).

Selecting maintenance providers who are more flexible and offer greater flexibility in this regard will result in lower costs for curative interventions.

It is very important to have a database for curative maintenance interventions.

Performing analysis using this database can be a real help in transforming various curative, unplanned interventions into condition-based or preventive maintenance operations (e.g. the catalogue of rail defects published by UIC can be helpful in organising rail inspections and planning for preventive maintenance or renewal work).

2.3 - Level of maintenance

Maintenance of high-speed lines is normally classified at different levels.

For each subsystem or component of a subsystem, the maintenance manager shall analyse and define the limits and responsibilities at each level of maintenance.

A clear and detailed classification shall be performed when subcontracting certain maintenance works to third parties.