iESM
BROUGHT TO YOU BY ARC

international Engineering Safety Management

GOOD PRACTICE HANDBOOK

APPLICATION NOTE 6
MAINTENANCE

Published on behalf of the international railway industry
by Abbott Risk Consulting Ltd.
Issue 1.1 May 2022

arc

CONTENTS

Issue 1.1

DISCLAIMER

Abbott Risk Consulting Limited (ARC) and the other organizations and individuals involved in preparing this handbook have taken trouble to make sure that the handbook is accurate and useful, but it is only a guide. We do not give any form of guarantee that following the guidance in this handbook will be enough to ensure safety. We will not be liable to pay compensation to anyone who uses this handbook.

ACKNOWLEDGEMENTS

This handbook has been written with help from the people listed below.

- S Bickley
- M Castles
- P Cheeseman
- Dr Chen Roger Lei
- J-M Cloarec
- Dr R Davis
- B Elliott
- S Hughes
- Dr KM Leung
- Ng Nelson Wai Hung
- G Parris
- Sen Paul HB
- Mrs Shi Lisa
- A Russo
- G Topham
- Dr Fei Yan
- Dr Zhang Simon

These people worked for the organizations listed below.

- Abbott Risk Consulting Ltd.
- Arbutus Technical Consulting
- Beijing Traffic Control Technology Company
- Bombardier Transportation
- Certifer
- EC Harris
- Electrical and Mechanical Services Department, Hong Kong
- Lloyd's Register
- MTR Corporation Limited, Hong Kong
- Rio Tinto
- Systra
- Technical Programme Delivery Group
- WSP | Parsons Brinkerhoff

This handbook does not necessarily represent the opinion of any of these people or organizations.

Good practice in engineering safety management advances as people build on the work done before by others. This handbook has drawn on the work carried out by the contributors to the Yellow Book [YB4] and to PAS 55 [PAS] among many others and we acknowledge our debt to them.

1 INTRODUCTION

This Application Note (AN) is a component of the international Engineering Safety Management Good Practice Handbook, or 'iESM', for short. The handbook as a whole describes good practice in railway Engineering Safety Management (ESM) on projects. It covers both projects that build new railways and projects that change existing railways.

The iESM handbook is structured in three layers:

- Layer 1: Principles and process
- Layer 2: Methods, tools and techniques
- Layer 3: Specialized guidance

The first layer comprises one volume, Volume 1. Volume 1 describes some of the safety obligations on people involved in changing the railway or developing new railway products. It also describes a generic ESM process designed to help discharge these obligations.

Volume 2 belongs in the second layer. The current Volume 2 provides guidance on implementing the generic ESM process presented in Volume 1 on projects. At the time of writing, this AN contains the content of a second Volume 2 providing guidance on implementing the generic ESM process presented in Volume 1 for maintenance. It is hoped to republish it in that form in due course.

The third layer comprises a number of Application Notes providing guidance in specialized areas, guidance specific to geographical regions and case studies illustrating the practical application of the guidance in this handbook.

The structure of the handbook is illustrated in the figure on the right.

This document is Application Note 6. It supports the main body of the handbook by providing guidance and checklists that may be used when carrying out some of the ESM tasks in a maintenance context.

If you have any comments on this Application Note or suggestions for improving it, we should be glad to hear from you. You will find our contact details on our web site, www.intesm.org. This web site contains the most up-to-date version of this Application Note. We intend to revise the handbook periodically and your comments and suggestions will help us to make the Application Note more useful for all readers.

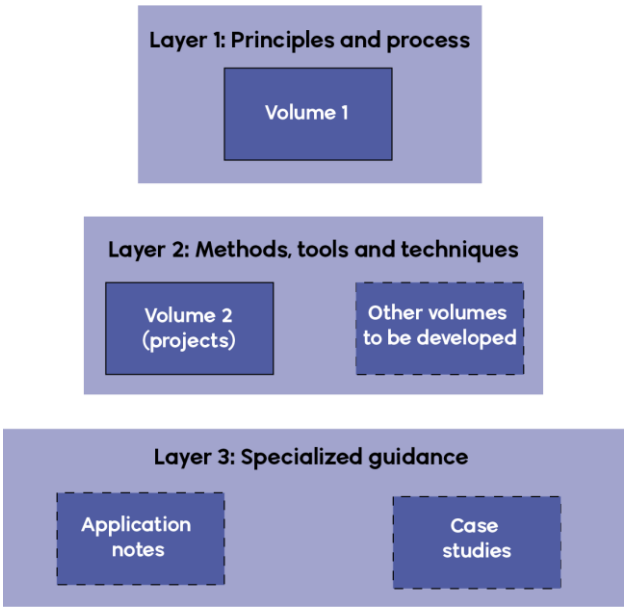

Figure 1 The Structure of iESM Guidance

2 MAINTENANCE AND IESM

2.1 Background

This guidance is aimed at people involved in **railway asset maintenance**, who have to use their judgement to take day-to-day decisions about the safety of the railway. Typically, these are rolling stock maintenance engineers, infrastructure maintenance engineers and senior managers who control organisations that have responsibility for railway maintenance. It provides guidance on some aspects of ensuring that your organisation and processes control the safety risks of the railway system that arise during the operational phase of the railway life cycle.

If all of the decisions that you make are covered by standards, then you don't have to read this guidance but you may find it useful to help understand why those standards are in place.

The AN is structured around engineering safety management principles and processes that are contained in iESM volume 1 [iESM]. We are aware that much guidance already exists for what is often called Asset Management which includes maintenance activities. It is not the intention of this AN to repeat that, but rather to provide a linkage to good practice in wider asset management such as PAS 55 [PAS] and its replacement, ISO 55000 [ISO]. PAS 55 [PAS] aims to achieve the best possible net return from assets while reducing the cost of ownership and this AN should help you achieve that safely in a railway environment.

Other useful rail-specific guidance exists including "Defining a Transit Asset Management Framework to Achieve a State of Good Repair" ref APTA-SGR-TAM-RP002-13 and "Creating a Transit Asset Management Programme" ref APTA-SGR-TAM-RP001-13 both published by the American Public Transport Association. The UIC produce a booklet "Guidelines for the Application of Asset Management in Railway Infrastructure Organisations".

Each main section quotes the relevant iESM Principle(s) and also the related PAS 55 [PAS] clause before giving more detailed guidance. The ISO 55000 equivalent clause where applicable is shown after each PAS reference. All of the iESM Principles relate to maintenance activities, some more than others. There are further clauses in PAS 55 [PAS] that do not appear here as they do not have a direct impact on ESM activities.

This AN gives guidance on setting up your maintenance arrangements and running a maintenance organisation so that you can demonstrate that risk is being managed on the operational railway. We recognize that, in many cases, maintenance organizations already exist and the way they are managed is well established. This AN should therefore also be useful to help you improve the way you do your maintenance. You may wish to review your existing arrangements to see whether your organisation is implementing the iESM Principles along the lines of this AN. It will help you to identify any gaps in safety and help you avoid processes and paperwork that are not necessary for safety.

In addition to Appendix A, we have also published an AN6 supporting checklist on the iESM website (www.intesm.org) to help you assess your actual or planned activities against the guidance here.

Because we do not have the authority to tell you what to do, the guidance in this document uses terms such as 'you should'. However some of the things talked about are likely to be required by law.

If your company decides to implement this guidance:

- your senior managers will need to make sure that all the systems and resources needed to manage safety are identified and put in place;
- a commitment to implementing the iESM Principles and Processes will need to be perceived throughout your organization; and
- front-line managers and staff will need to be empowered (by their line managers) to take safety decisions.

This AN is also relevant to people involved in **railway projects**. If your work interfaces with an operational railway, it is important to understand how it could affect safety, whilst the work is taking place and after it has been commissioned. It is good practice for project and maintenance organisations to work together to make sure that safety is managed continuously; during project implementation, during handover into operational use and throughout the operational life cycle phase. Importantly, the content of this AN is intended to influence asset / system design and decision making during the design phase of the project lifecycle.

When we talk about safety, we include the safety of the railway, the safety of people who maintain the railway, the safety of people who use the railway and the safety of its neighbours.

2.2 Scope

iESM uses the term "maintenance" to describe all of the activities that need to be carried out to keep a system fit for service so that assets (sub-systems, components and their parts) continue to be safe and reliable throughout the operational life cycle phase and in a "state of good repair[1]. This means that we are including activities such as:

- preventative maintenance, inspection and testing;
- fault finding and repair;
- component replacement; and
- like-for-like renewal.

Maintenance is one of the key parts of what is often called "Asset Management". This is defined in ISO 55000 [ISO], which extends consideration beyond physical assets to all types of financial and organization assets, as:

"Co-ordinated activity of an organization to realize value from assets."

A more detailed definition of asset management was used in PAS 55 [PAS] is more detailed, being:

"A systematic and coordinated activities and practices through which an organization optimally and sustainably manages its assets and asset systems, their associated performance, risks and expenditures over their lifecycles for the purpose of achieving its organizational strategic plan."

iESM also covers planning and record keeping for maintenance, including:

- planning and recording the way maintenance will be done for new and changed assets; and
- planning and recording changes to existing maintenance activities.

[1] As described in the US Moving Ahead for Progress legislation

The boundary between what is described as maintenance and what constitutes a project is not always clear. Maintenance sometimes also includes:

- refurbishment;
- system modifications (temporary or permanent); and
- system upgrades.

The guidance in this AN applies to these activities as well, but you may find it better to manage them as small projects. Guidance on ESM for projects is contained in the iESM Guidance, volume 2.

3 MAINTENANCE AND SAFETY

3.1 Introduction

If something could affect safety then part of keeping it fit for service will involve keeping it safe. As nearly all railway equipment has the potential to affect safety then controlling risk is an integral part of nearly all railway maintenance. Maintenance can contribute to risk through both action and inaction.

This AN provides guidance on controlling risk during maintenance. We do not provide guidance on achieving the other aspects of fitness for service but we recognise that they must be achieved together. In particular, we recognise that system reliability (performance) is closely linked to safety, particularly where degraded methods of working need to be introduced to operate trains when an asset fails or when unreliable assets can lead to overcrowding on station platforms.

When we talk about risk, we are considering the likelihood that an accident will happen and the harm that will arise. In many cases, risk cannot be eliminated entirely. We must accept this if we are to continually improve safety and run a useful railway. Other people use the word ‘risk’ in a way that includes commercial and environmental considerations but, in this AN, it always refers to safety risk.

We will show how the type of maintenance work that you do (and what you decide not to do) depends on the risk that you have to control and the performance that you have to achieve.

We will explain why you should understand all of the risks before you plan how you will manage your maintenance work.

We will explain how to manage your maintenance work so that it reflects how things can go wrong.
We will explain why you should justify your maintenance work by linking each maintenance task back to the risk that you need to control.

Many of these things may be covered within an organization’s Safety Management System (SMS).

3.2 New and changed assets

Where projects affect operational railway assets (for example during stage-works), they may introduce new hazards. For example, the safety integrity of operational signalling circuits must be maintained when engineering work is taking place alongside line-side cable routes that contain working control circuits. Responsibilities for maintenance, including any changes to the way maintenance work will be done, will need to be agreed between the project and the maintenance organisations before the project work starts. The maintenance requirements should be fully understood and all of the resources should be put in place to implement them.

Before changes to the railway are placed into service, the project and maintenance organisations will have to agree and make sure that all of the resources that are needed for operational safety are put in place. Resources may include:

- new or upgraded maintenance facilities (such as depots and plant);
- additional maintenance tools and test equipment;
- spare parts;
- new and changed maintenance standards and procedures;
- staff competence changes;
- maintenance manuals and training materials;
- Interim technical support arrangements
- organizational changes; and
- system configuration records.

The maintenance organisation should find out whether the project has considered the risks in the context of the specific application or just the generic risks associated with the new or changed equipment.

Maintenance organisations might also need to change the maintenance for existing equipment as a result of the introduction of the new equipment and any changed railway operations that result from the project.

After the asset has been taken into use and operational experience is gained, you should challenge any assumptions made about safety, particularly where a recommended maintenance regime has been developed using predictive failure and hazard analysis.

3.3 Existing maintenance regimes

If you are already managing an existing railway system, the maintenance work you are doing should be based on existing good practice but you might not be able to fully justify the reasons why the work is being done in the way that it is.

In most cases, the way maintenance is done now is based on years of developing good practice and experience. Some decisions about maintenance work have resulted from enquiries into major incidents and some more recent practices may be fully supported by specific analysis, for example so called “Risk-based Maintenance”.

We will help you to decide whether you are going to continue to work as you are or change something. In either case, you will need to decide whether the maintenance work that you are carrying out makes the best use of available resources and manages all of the risk to the required level. You should record and analyse information about how the railway is actually performing and compare it with the safety performance that you require.

In theory, you should gather information whenever there is a change or an incident that could affect the part of the railway of which you are responsible. In practice, change on the railway is continuous and cannot always be detected easily. For example, changes to:

- traffic patterns, train speeds and loadings;
- organizations and personnel;
- other parts of the railway;
- the local environment;
- society (for example increased vandalism, terrorism threat); and
- the level of risk that is considered to be tolerable.

If you only maintain a part of the railway system, it is important to understand that changes that occur elsewhere can affect the part of the railway for which you are responsible. For example, deterioration of a track-bed can result in a greater rate of deterioration of rolling stock suspension, and vice-versa. This shows that it is good practice for your organisation to work with other organisations in areas where work could result in increased risk.

You should understand how the part of the railway that you are maintaining degrades during the life cycle. To do this, you will need to understand what critical failures modes exist, particularly those where a single item failure could lead to a significant incident. Two examples are:

- failure of a component (such as a station escalator brake) as a result of the expected cyclic loading; and
- abnormal loading of a component because of a failure in some other part of the railway (such as rail failure as a result of excessive wheel flats).

The maintenance work that you do should take these things into account.

You will also have to monitor the actual performance of the railway and compare it with the performance that you predicted when you decided what maintenance work you were going to do. If there is a difference, it could be because:

- the assumptions, dependencies and caveats used as a basis for your maintenance decisions were inappropriate;
- the design of the equipment is not sufficiently robust, or;
- not all of the risks were properly identified or controlled.

Figures 2 and 3 illustrate some of the concepts described above.

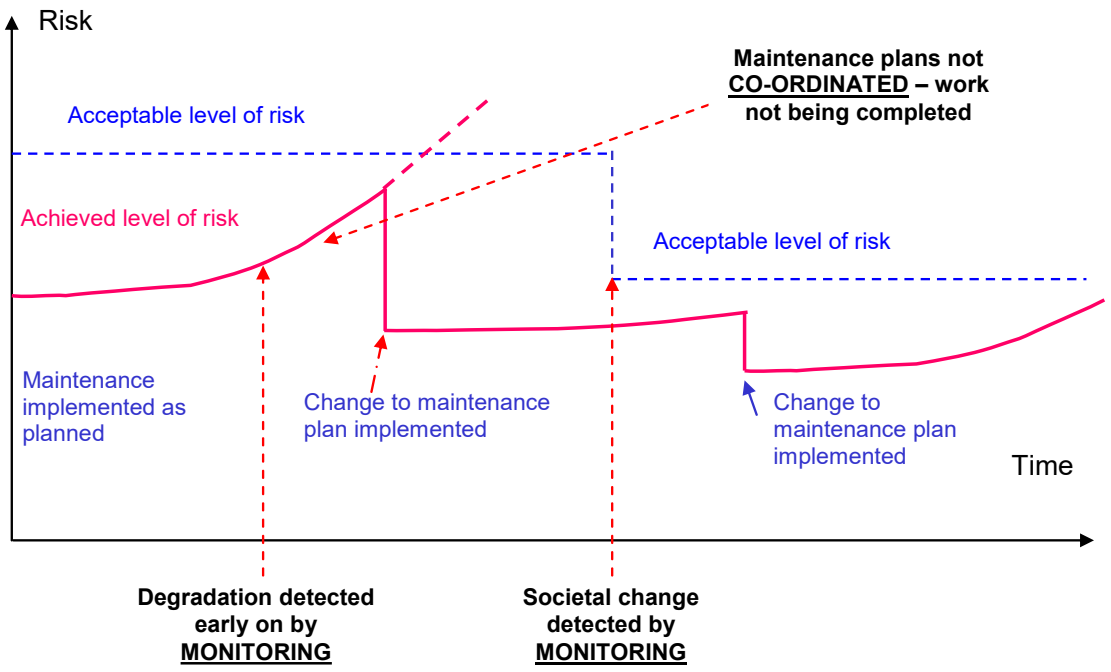

Figure 1 Relationship Between Maintenance and Risk – Operations & Maintenance Phase

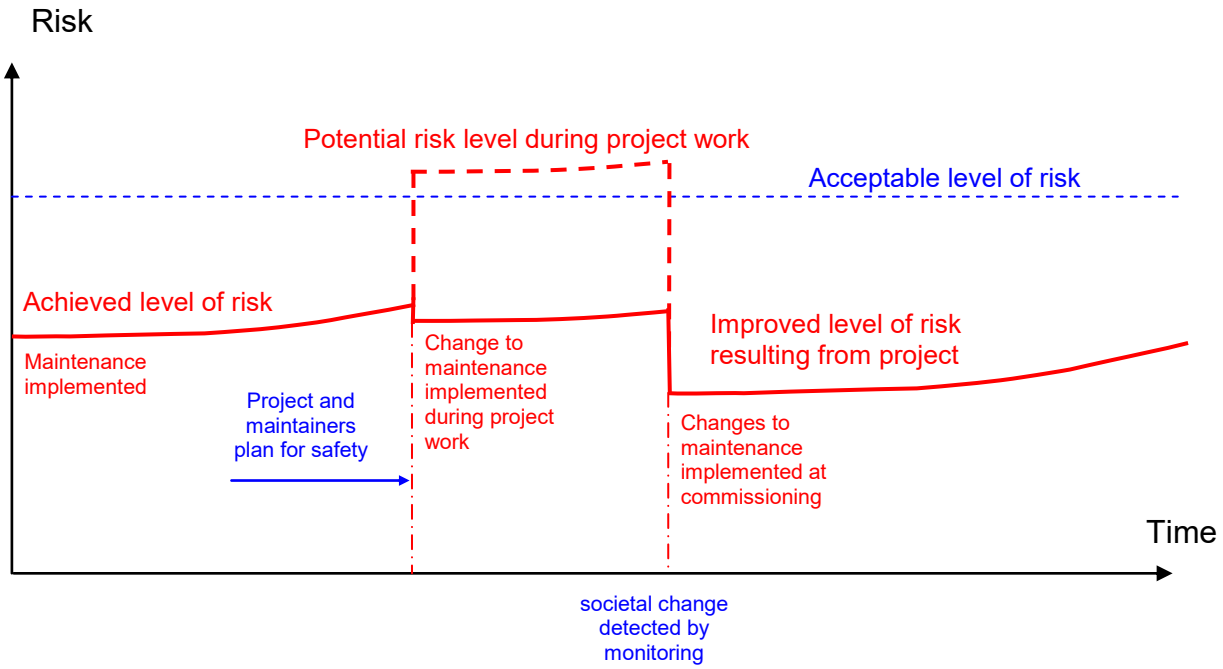

Figure 2 Relationship Between Maintenance and Risk – Project Activity

4 MAINTENANCE DEFINITION

4.1 Defining the scope

Your organization must define the extent and context of any activity that it performs which affects safety-related systems or products [iESM].

The organization shall establish, document and maintain asset management plan(s) to ensure that its asset management system can be adequately understood, communicated and operated, clause 4.4.5 [PAS], clause 2.5.2.3.4 [ISO].

If your organisation is responsible for the part of the railway that you maintain, you should have an up-to-date asset register (see Section 7.3.1). Likewise, if you are maintaining a part of the railway for someone else, you should have an asset register and then agree it with them.

You should understand and record the context in which your maintenance will be done and any assumptions that could affect how you will do it. Examples include:

- available access to parts of the railway;
- traffic types, levels and speeds;
- the railway environment; and
- the way other parts of the railway are managed.

If you are maintaining a part of the railway for someone else's organisation, you should find out how they will approve your safety plans and what work your organisation can approve.

In some areas, all of this is defined in a document called an "Asset Maintenance Regime".

Where your work interfaces with other parts of the railway or organisations, you should consider what work they do (See Section 8.5).

The three stages of the maintenance process can be categorised as **Plan, Implement and Review**. This process should be a continuous part of your maintenance management system.

Safe planning, refer to Figure 4, will enable you to look ahead and predict what needs to be done and then allocate the correct resources to fully justified maintenance activities, thereby improving safety and performance of the railway. You should plan how you will implement all of the iESM Principles and Processes, so you should read Section 4.3, with that in mind.

Safe implementation will make sure that your plans are followed to ensure that work is done properly, safely and efficiently.

Continually reviewing how well you have done your work will help you to improve your plans and learn from mistakes and so further improve safety, performance and efficiency.

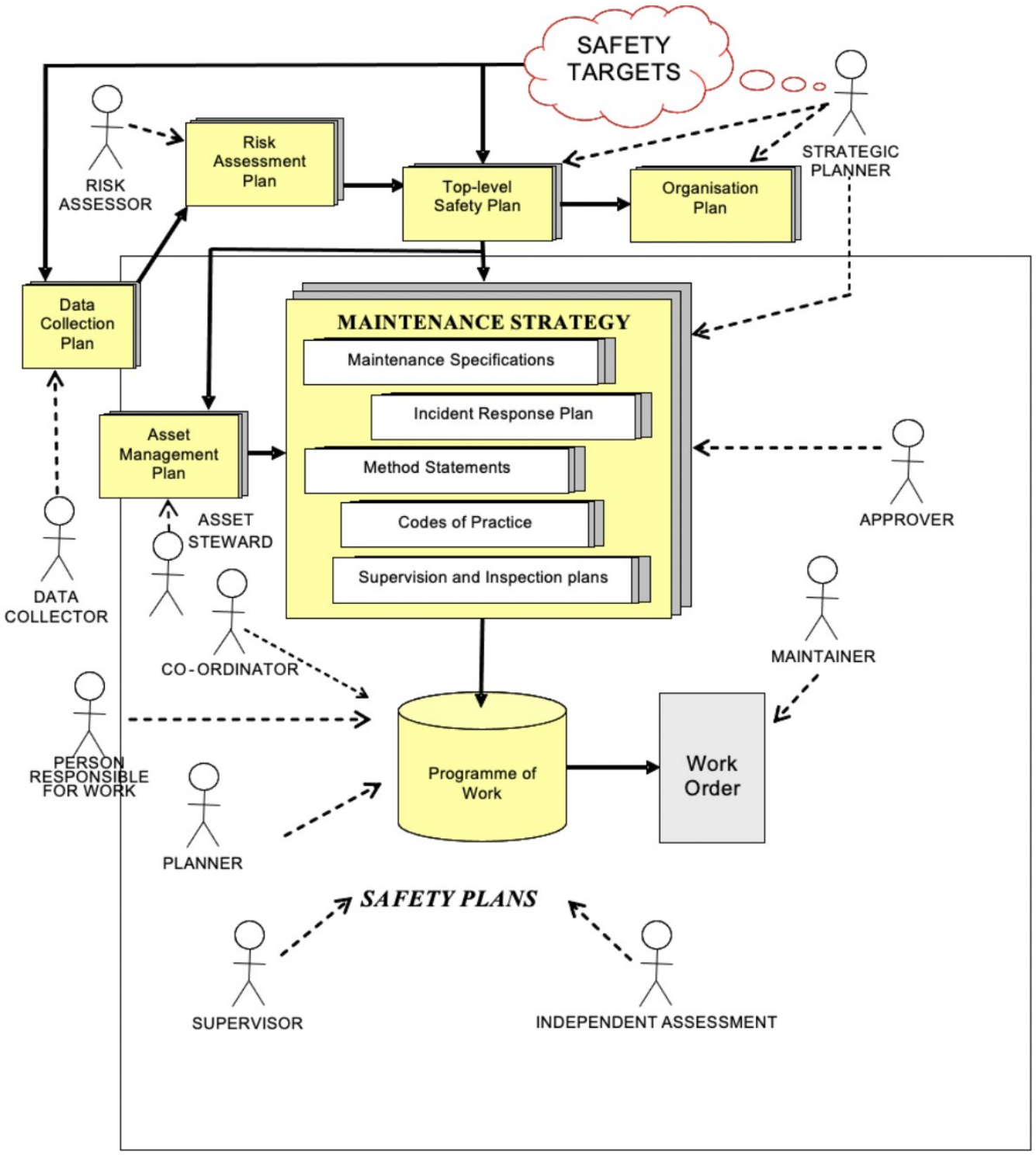

Figure 3 Typical Examples of Safety Planning

4.2 Determining safety obligations, targets and objectives

Your organization must establish the obligations that are relevant to the safety of its systems or products [iESM].

Your organization must define objectives and targets for safety that are consistent with its obligations [iESM].

The organization shall establish, document and maintain processes and/or procedures for identifying and accessing the legal, regularity, statutory and other applicable asset management requirements, clause 4.4.8 [PAS], clauses 2.1, 2.2 [ISO].

The organization shall establish, document and maintain processes and/or procedures for evaluation of its compliance with applicable legal and other regulatory or absolute requirements, clause 4.6.3 [PAS], clause 2.5.2.4 [ISO].

All organisations that do work that could affect safety should have safety as a primary goal. Your organisation should demonstrate a top-level commitment to deliver safety. It is good practice to provide organisational leadership by communicating your safety policy throughout your organisation and motivate your personnel to follow it in full. You will have to identify what legislation applies to your organisation and set your goals to make sure you will comply. Typically this will cover:

- safety of the parts of the railway,
- safety of the personnel assigned to do maintenance work; and
- safety of all those affected by the work.

Your organisation should set targets to manage safety for all three and provide the necessary resources to meet those targets. To meet those targets, you will need to:

- understand how safe you are now;
- decide what your safety targets will be; and
- decide what work you need to do to meet your targets.

To achieve this, you will need to consider:

- how you are going to collect data about safety (See Section 6.5); and
- how you will plan and co-ordinate your work to ensure safety (See Section 8.5).

On the basis that the part of the railway that you are responsible for has been designed to be safe when there are no failures, a good maintenance organisation will have a goal to minimise the number of failures and the effect of failures that occur. It is good practice to set targets to reduce the number of failures that occur. You should also set targets for responding to failures (such as time to repair) and make sure that you meet them.

You should also have goals for reducing staff safety incidents and near misses (or near hits). The long-term aim should be a zero accident level and you should focus your safety policy to achieve this.

When you have decided what your organisational goals are, you should consider whether you have the correct attributes (such as structure, management systems, tools, facilities, equipment, staff motivation and competence) to achieve them. If you do not, you should work out what goals you can achieve and decide whether that is enough to manage safety.

Your organisation should identify its organisational goals and how it will comply with legislation.

Before you can effectively plan for safety and performance, you should understand how well you are doing now and then decide what your new targets will be. You should plan to collect information about safety and performance and select types and sources of information that help you to develop new targets for parts of the railway, personnel, passengers and neighbours. You should plan:

- what information you are going to collect to understand the risks you are responsible for controlling;
- why you are collecting it so that you understand what the objective is for collecting the information
- how you are going to collect and report it;
- where you are going to collect it from;
- when you are going to collect it and how often you will collect it;
- who will be responsible for collecting it, who will review it and who will decide whether something needs to be changed;
- with what mechanism are you going to use to collect and record the information.

When collecting information, you should understand how accurate it is and how representative it is of the situation you are investigating. The output from this level of planning may result in changes to the way you already do your work and stimulate organisational changes.

It is good practice to review your safety and performance targets on a regular basis (such as once a year), to decide whether you need to change them. You should also review the way you plan safety and performance after an incident and whenever a significant change takes place that could affect the work that you are responsible for.

It is important to communicate your top-level safety plans so that people understand what they have to do. It is good practice for organisations to publish a yearly strategic plan that lists all of the safety and performance targets and identifies who is responsible for achieving each target.

4.3 Planning safety activities

Your organization must plan out a program of ESM activities that will deliver the safety objectives and targets [iESM].

Your organization must carry out activities that affect safety by following systematic processes that use recognized good practice. Your organization must write these processes down beforehand and review them regularly [iESM].

The organisation shall establish, document and maintain asset management plan(s) to achieve the asset management strategy and deliver the asset management objectives across the lifecycle, clause 4.3.3 [PAS], clause 2.4.4.3 [ISO].

The way you decide to plan your work will influence the way you set up your organisation (see Section 8.1).

Before you plan your work, you should look ahead, decide what your goals are, understand where you are now and decide what work you need to do to get where you want to be.

Your planning is key to making sure that railway assets are managed in a way that ensures continued safety and performance. If you are planning to make a significant change, you should refer to IESM Guidance, volume 2, however your maintenance planning should allow for the possibility of significant changes, for example an ability to respond to an imminent environmental effect.

Safety planning should occur at all levels of your organisation to manage safety and performance properly. Planning is all about deciding how you are going to do your work in the context of the other parts of the railway that will be affected, including other maintenance organisations and railway operators, so that you can do the work safely.

Your maintenance plans should make sure that standby and protection systems are fit for service as well as operational systems. This will make sure that risk mitigations that are designed into system architectures (such as system multiplication, diversity and protection) remain effective.

Whilst the failure of a component may not cause an accident in itself ('fail-safe' components have safety designed into their failure modes), the overall level of risk on the railway increases when trains are running during degraded operating conditions. For example, the risk associated with hand signalling is greater than normal operations using line-side signals. Therefore a signalling maintenance regime should be planned to minimise the occurrence of signal failures.

Your maintenance plans should identify areas where you depend on others to do your work and where others depend on you.

4.3.1 Planning outputs

Whatever type of planning you are going to do, the objective will be the same, that is to set down all of the things that need to be done to ensure that the work is done safely and efficiently so that it can be agreed and communicated to those who need to know. There are seven basic components of a good plan:

1. **WHAT**: describes what the work involves, including details of the tasks that need to be completed and the records required. The level of detail should reflect the needs of the people using the plan and the consequence of doing the wrong thing.
2. **HOW**: describes the method, often referring to a specification
3. **WHERE**: describes the locations that the work will take place.
4. **WHEN**: describes the overall timescales and the times that parts of the work have to take place, including sequences of actions and periodicities of repetitive tasks.
5. **WHO**: allocates tasks to individuals and names the people responsible for doing and checking the work.
6. **WITH**: describes the resources to be used (tools, materials, plant, supplier resources etc).
7. **WHY**: describes the rationale for the work so that it can be related back to your company goals and the overall railway goals that need to be managed.

All of your plans should be co-ordinated (see Section 8.5).

4.3.2 Organisational level maintenance strategy

At an organisational level, you should plan how you are going to do your work to meet the safety and performance targets that you have set. You should also plan to monitor the progress of your work against your plans and key performance indicators. An example of a policy and strategy for an infrastructure organization can be found at www.networkrail.co.uk

Using the information that you have collected, you should plan how you are going to develop the control measures that your maintenance work will implement.

The output of this planning level will be your organisation maintenance strategy, which should describe how you are going to control the risks that you have identified. Typically, your maintenance strategy could be made up of maintenance specifications and method statements. You should also have a strategy to deal with unforeseen circumstances, including safety incidents.

4.3.3 Maintenance specifications

Your maintenance specifications should describe the maintenance work that needs to be done to each asset type and the periodicity with which it should be applied. You should take account of the assumptions made in safety cases and manufacturers' documents. The level of detail that you prescribe will depend on the competence of the personnel who are going to do the work, the benefits that consistency will bring to controlling risk and the auditable records that you need to keep.

Your specifications should include information about safety tolerances (See Section 6.2).

You may have to supplement your maintenance specifications with other safety information to control risks in particular circumstances (such as references to rules and procedures necessary to manage the safety of railway operations).

Where access constraints mean that limited time is available to maintain particular assets, it is good practice to identify priority tasks such as safety-critical tests, so that they will be completed first. Any uncompleted work will therefore be less urgent and may be easier to re-schedule.

Maintenance specifications are often communicated in the format of equipment manuals, suitable for frequent use at the workplace. Where it is not appropriate to prescribe the way work is done, you should look for, and publish, good practice (for example using codes of practice documents or checklists to ensure consistency of failure investigation).

4.3.4 Method statements (work instructions)

You should supplement your maintenance specifications with method statements that describe how the work will be done, the resources that you are going to use, staff competence and the measures that are necessary to ensure safety at the interfaces (that is with other work activities, the rest of the railway, passengers and neighbours). A good method statement is concise, clearly written and has a level of detail that reflects the competence and experience of the people that will use it.

Method statements shall be described in the order in which the tasks will be carried out. Information should include data such as normal settings, limitations, adjustment and regulation requirements, guidelines for seasonal changeover, procedures to be taken in event of abnormal operation and cross-references to other related procedures.

Emergency actions should be listed separately in a form that is easily accessed by the user. The use of distinctive red paper or tab cards to identify instructions that may be needed at short notice is recommended.

Any illustrations considered helpful to the user shall be inserted in the instructions at the relevant reference point.

When read, a good method statement will briefly describe generic requirements and draw attention to any unusual or uncommon risks that apply in a particular situation (for example confined spaces, electrical hazards and unusual train movements).

You should communicate your method statements to personnel who do maintenance work in a way that meets their needs (see Sections 8.4 and 8.5). Up-to-date method statements should be available for reference at the workplace and it is good practice to use a standard structure and template so that personnel know where to find information.

4.3.5 Planning to collect information

It is important to plan how you are going to collect safety and performance information so that you can decide whether your work is doing enough to control risk, and plan to change the way you specify and program your maintenance work. This information should include achievement of the work you planned to do and effectiveness of the work in controlling the risk. Many maintenance organisations have developed procedures that require maintainers to record critical information about an asset before and after it has been maintained, for example adjustments, replenishments, repairs and replacements, degradation and any exceptional items found.

4.3.6 Detailed maintenance programs

At a detailed level, you should develop a maintenance program that makes sure that your maintenance strategy can be implemented effectively (see Appendix A.5). A good maintenance program will clearly identify when each asset is to be maintained and what needs to be done. It is good practice to include some flexibility to allow time for additional work and failure response, whilst not exceeding maximum maintenance periodicities.

Where your maintenance programs could conflict with each other, you should co-ordinate your work to ensure that they are all fulfilled (See Section 8.5).

It is good practice, where possible, to allocate your competent personnel to a wide range of tasks so that they develop and retain a broad range of competence, avoid complacency and an ability to work with a variety of asset types.

Good maintenance organisations frequently review and update their maintenance programs so that they reflect the status of work. If your planned work cannot be completed on time, you should formally assess the risk of not undertaking that work in terms of the impact on the safety of the railway and take appropriate action such s additional monitoring to mitigate the risk. You should adjust and re-issue your maintenance programs to reallocate your resources to tasks with a high priority.

4.3.7 Planning process

You should make it clear what planning responsibilities people have for all levels and types of plans and give them the planning resources they need. It is good practice to give responsibility for planning to the people who have responsibility for implementing your plans. For example, a track engineer should develop a strategic plan for track maintenance, depot engineers should then develop plans to implement it at specific locations, supervisors plan how the work will be done and so on, down to team leaders who plan the tools and equipment required to do each job.

To be able to plan properly, your planners should be competent, understand the maintenance work that needs to be done and have information about the constraints that could affect the way it is done. You should make sure that planners have information about the railway and other work that could impact on maintenance work delivery. It is good practice to develop a planning procedure to provide consistency in process and output.

You should communicate your plans so that people understand what maintenance work they have to do. It is good practice to manage your maintenance programs using an IT system, which will allow individual jobs to be related to work teams (for instance work orders) and enable maintenance reports to be entered to monitor progress of work against the program. The information contained on the work orders should meet the needs of those who have to do the work and consider the environment in which it will be used.

You should decide how you are going to manage changes to your plans to reflect changes to the railway and changing work priorities. This is particularly important where maintenance work may be delayed due to unforeseen circumstances and missed work needs to be re-prioritised and re-planned and you should assess the risk and the outcome of that risk assessment should be formally recorded, along with any actions arising from the risk assessment.

Whenever you change your plans, you should re-issue them and communicate the changes to all those who need to know.

4.3.8 Plans for supervision and inspection of work done

Having decided your maintenance program, it is good practice to make sure that the work is properly implemented and the results are effective at controlling the risks that you have identified. You should plan to check that safety of the railway, safety of personnel and safety of passengers and neighbours is being properly addressed by the maintenance work.

There are two ways of going about this and you should plan how you are going to address each:

- Supervision of personnel doing work; and
- Inspection of work done.

You should make sure that the way you plan supervision and equipment inspection promotes a 'right first time' philosophy amongst the people doing maintenance work and avoids a culture of 'correction through inspection'.

When you have decided how you are going to check the safety of your maintenance work, you should build the capability into your organisation.

If you find a problem, you should record it and tell those who need to put it right. If safety could be affected elsewhere, you should tell others about it so that risk can be reduced.

Supervision involves observation of work whilst it is being done and is focussed on safety of personnel, passengers and neighbours by checking compliance with and robustness of method statements. It also checks that the work is being done in accordance with the maintenance specification and work orders. You should plan your supervision to make sure that the full range of personnel (including contracted staff) are observed working within their range of tasks over a certain period of time (for instance visit each maintenance team carrying out a range of tasks during each year).

The extent and frequency of supervision should reflect the experience of your personnel and the risk associated with different types of work. It is usually appropriate to closely supervise new or inexperienced personnel at first, where they are faced with new activities and work environments. It is good practice to retain some flexibility in your plan so that supervision can be timed to coincide with significant work activities. Significant activities include working in locations with higher risk (for instance on open running lines or in the vicinity of hazardous equipment) and activities with higher safety consequences (for instance maintenance of facing points or train braking systems).

Inspection of work done involves sample equipment inspections after maintenance to establish whether the maintenance work is adequately managing risk (for instance preventing system deterioration). You should plan your equipment inspections to make sure that asset populations are sampled to take into account a range of locations, ages, conditions and usage. Assets that have a higher safety risk attached to them should be given a higher priority. It is good practice to visit equipment at different times in the maintenance cycle to understand the full effect of your maintenance. For example, by undertaking a pre-maintenance inspection before undertaking preventive maintenance, it is possible to gather information about the robustness of the maintenance specification, the quality of the maintenance done last time and the appropriate periodicity of visits.

4.3.9 Good maintenance practices

Your organisation should seek out and use good maintenance practices. This may include following good practice maintenance specifications published by the railway industry, which set out what maintenance should be done, when and how it should be done and in what circumstances it should be done. It also includes following good practice in the way maintenance is planned, communicated and implemented for personnel safety.

Good practice may involve the use of new technologies, such as vehicle-mounted video inspection techniques and ultrasonic flaw detection. If you do choose to use a new technology, you should consider all of the hazards that the method introduces as well as the existing hazards that it mitigates. Good practice may also involve the way you manage your work, such as restricting on-track maintenance work to periods when the railway is closed to traffic.

If you find a new good practice that improves safety, or you decide that an existing practice is not good enough to manage safety, you should change what you do and tell others about it.

Where you are implementing good practice, you should check that you are using it consistently and everywhere that you can. You should set down how you are going to implement the good practice so that you can communicate it to those who need to know. You should continue to review the way you maintain the railway to make sure that it is still good practice and that changes to parts of the railway have not reduced safety.

Whenever you decide to change the way you maintain a part of the railway, you should make sure that what you are going to do will comply with railway standards and legislation.

You should not change the way you do things if it could reduce safety. Consistent application of an existing good practice is preferable to frequent changes, which may introduce a safety risk.

5 RISK ANALYSIS

5.1 Identifying hazards and estimating risk

Your organization must make a systematic and vigorous attempt to identify all possible hazards related to its systems or products [iESM].

Your organization must assess the effect of its work on the overall risk on the railway [iESM].

The organization shall establish, implement and maintain documented process(es) or procedure(s) for the ongoing identification and assessment of asset-related and asset management-related risks and the identification and implementation of necessary control measures throughout the life cycles of the assets, clause 4.4.7 [PAS], clause 2.5.3.3 [ISO].

These two iESM Principles complement each other and so we discuss them together. iESM Guidance, volume 2 provides guidance on identifying hazards and assessing risk for projects and, although the guidance may require some adaptation for maintenance, you might find it useful to read it.

5.1.1 Hazards that inform development of your maintenance strategy

Your organisation should do its best to predict and identify all of the hazards associated with the parts of the railway that you are responsible for. If you are already following good practice, you should have an up-to-date register of risks and understand the nature of the risks you are managing. Section 6.2 suggests some of the issues that you might need to consider. If you do not have all of the information about the hazards that your maintenance is designed to eliminate, you might not be able to manage all of the risk. You should remember that hazards may exist:

- within the equipment that makes up part of the railway (for instance failure modes);
- as a result of the way equipment is used;
- as a result of the way equipment connects to other parts of the railway;
- at the place the equipment is located (for example within a confined space or adjacent to exposed electrical conductors); and
- as a result of the way that part of the railway is maintained, including the relevant method statement(s).

Hazards may affect all sorts of people including operational personnel, maintenance personnel, passengers and neighbours.

5.1.2 Identifying hazards

Before you identify hazards, you should decide what information you need and gather it from dependable sources. You should gather information about:

- how the part of the railway works and what it is supposed to do;
- how it is going to be used;
- where it is going to be used;
- possible failure modes;
- how other parts of the railway affect it when they operate normally and when they fail;
- how it will affect other parts of the railway when it operates normally and when it fails; and
- how it has to be maintained.

You should also identify all of the additional hazards that arise from doing maintenance, such as hazards associated with using tools and equipment as well as the hazards arising from the maintenance activity. Doing maintenance incorrectly can also be a hazard. Before you decide how to maintain a part of the railway, you should understand:

- the hazards that affect your maintenance personnel; and
- the hazards that affect other parts of the railway, including railway operations.

You should record all of the hazards so that they can be reviewed in the future, for example using a Risk Register or Hazard Log. You should also record the assumptions on which the hazards are based so that you can re-assess risk as part of a future risk review.

If hazards associated with part of the railway have already been identified as part of an organised railway project, you should make sure that you know what they are before accepting safety responsibility for the asset. You might still have to identify other hazards that result from the way you plan to do your maintenance work.

5.1.3 Understanding risk

When you have captured all of the hazards, you should work out the risk that arises from each hazard. The risk level is derived from the likelihood that a hazardous event will occur and the consequence of the event occurring. Some of the techniques that will help you to do this are described fully in iESM Guidance, Volume 2 Methods, Tools and Techniques for Projects (for instance Fault Tree Analysis).

It may be sensible to place hazards in broad categories according to their consequences. If so, then you can categorise all failures using the same categories but extending them to add one or more categories for failures which cannot contribute to an accident.

When you understand the risk, you should look for measures that can help control the risk. Remember that the measures you put in place can introduce additional hazards that need to be taken into account.

6 RISK CONTROL

6.1 Evaluating risk, implementing and validating control measures

Your organization must evaluate the risk associated with each of its systems or products against the criteria for safety that it is obliged to use. If the risk associated with a system or product cannot be reduced to an acceptable level, then it must be abandoned [iESM].

Your organization must design its systems or products to meet its safety requirements and all control measures must be implemented [iESM].

The organization shall establish, implement and maintain documented process(es) or procedure(s) for the ongoing identification and assessment of asset-related and asset management-related risks and the identification and implementation of necessary control measures throughout the life cycles of the assets, clause 4.4.7 [PAS], clause 2.5.3.3 [ISO].

The way you plan, implement and review your work should make sure that the part of the railway that you are responsible for stays within the parameters required to keep it safe (See Section 4.2). If the risk (which is regularly being monitored during the operation of the railway) becomes unacceptable then railway operation must cease until such time as risk can be reduced to an acceptable.

6.1.1 Reducing risk through maintenance tasks

When you have collected all of the risk data, you should decide what maintenance work you need to do to control risk. You should also decide when you are going to do it. Examples of maintenance work that you should consider are:

- checking tolerances using calibrated gauges and measuring instruments (sometimes tolerances may be checked by automatic equipment such as track recording equipment);
- examining equipment for damage and wear;
- non-destructive testing;
- observing that equipment does what it is supposed to;
- following the method statement; and
- running tests.

You should also decide what action should be taken to correct safety problems that you find during maintenance and to restore optimum functionality. Corrective actions should enable the maintainer to clear the fault quickly or temporarily so as to resume the normal operation of the system as soon as possible. Examples include:

- cleaning and adjusting equipment;
- replenishing consumable items;
- refurbishing and replacing worn and damaged parts;
- modifying parts;
- changing the way parts are connected together;
- changing the method statement and
- taking a part, a function or a facility out of use.

The detailed fault diagnosis and appropriate rectification actions shall be comprehensively covered in the maintenance documents. Information shall include a list of alarms, describing the function of each and how the alarm is indicated. All associated detectors and indicators should also be described using diagrams or illustrations to facilitate identification and location.

Issue 1.1

When you decide that you need to do something to control a hazard, you should also identify all of the hazards that arise from doing the work and control them as well. Typically, these hazards may affect the safety of your staff and other parts of the railway. When compiling operating instructions caution notices should be given where the health and / or safety of persons may be at risk. If an action or inaction may lead to a hazard then full details of the nature of the risk must be given. You may be able to remove some hazards by changing the way that you do maintenance to remove the opportunity to make mistakes. For instance if you provide a spanner of the correct size for a task instead of an adjustable spanner, you remove the opportunity to misadjust or damage an asset.

You might need to agree with other organisations how you are going to change a part of the railway or change the way the railway is operated to make sure it is safe enough to maintain. For example, you might have to provide additional facilities or restrict train movements so that your staff can safely access parts of the railway.

When you have put all of these actions into practice, you should regularly review your safety record. The way you monitor risk will help you to decide whether you are still reducing risk to a low enough level (see Section 6.5).

6.1.2 Reducing risk when assets fail

If you are achieving your organisational goals, you should be minimising the number of failures that occur. Where a part of the railway for which you are responsible does fail, it is important that your decisions and the actions you take minimise the effect of the failure on safety (see Appendix A.4).

It is important to understand what constitutes a failure. In the simplest sense, a failure becomes apparent when an asset is unable to deliver one or more of its functions during normal operations. However, you should also look for hidden failures, which are those events that occur that could contribute to a failure when something else happens. If an asset moves outside a defined safety tolerance, it may contribute to a failure. For example, loose permanent way components within a point layout may only become apparent when the point operating equipment fails (see Section 6.5). Ideally, your maintenance program will address this, although it is not always practicable to do this.

When assets fail, you should make sure that you collect enough information about the circumstances of the failure so that you can identify the cause. When you decide what needs to be repaired, you should consider both the equipment that has failed and other parts of the railway that could have contributed to the failure. To help you to prioritise your response to failures, it is good practice to classify failures based on the risk arising (for example high, medium or low risk failure). It is also good practice to apply a hazard rating to failures to reflect the context of the failure (such as, associated line speed, type and level of traffic and location). Many organisations have created registers of asset types, failure modes and locations to ensure consistency of classification and hazard rating and therefore of prioritisation and failure response (see Appendix A10).
When you repair an asset, you should restore the defective components to working order within the safety tolerances that apply. This might include adjusting and resetting components or replacing a broken component with a new one. Before you return an asset to service, you should make sure that it safely performs the function for which it is intended.

If you have to make a temporary repair, you should look for additional risk and decide whether you need to make any changes to your maintenance program or impose restrictions. You should make sure that a permanent repair is completed or arrange for a permanent change to ensure safety. For example, when a broken point switch rail is removed, signalling circuits may have to be temporarily altered. You should make sure that any temporary wiring is clearly identified and maintained until the points are restored to use or a full recovery is made to remove the points.

6.1.3 Reducing risk to staff

Your organisation should plan your work to reduce risk exposure to staff to an acceptable level. Where safety incidents occur, you should collect enough information about the circumstances so that you can identify the cause. You should encourage your staff and your suppliers to report all safety incidents and near misses that occur. Remember that near misses are a valuable contribution to understanding the circumstances that could lead to accidents.

It is good practice to carry out workplace risk assessments and then review them regularly and whenever circumstances or conditions change.

Many organisations have implemented a 'Work-safe' procedure, which encourages personnel to stop work and report if they decide that something is unsafe.

6.2 Setting safety requirements

Your organization must set safety requirements which are sufficient to meet its safety obligations and targets [iESM].

Your safety requirements should be closely linked to your safety plans (see Section 4.3) and should define the operating parameters necessary to ensure that assets meet the safety and reliability targets you have set.

For example, if one of your strategic goals is to reduce the number of broken rails, your maintenance strategy may include periodic visual inspection of track, rail-head profile and side-wear gauging, ultrasonic testing of welds and analysis of train wheel-flats using line-side detection systems. It is important to define what is acceptable in terms of condition, gauge and test values so that you can decide whether the assets for which you are responsible are safe when maintained and will remain safe until the next maintenance takes place.

Your maintenance specifications should clearly describe the safety requirements for each asset that you maintain and include information about the absolute safety tolerances that equipment is designed to operate safely within and also the preferred tolerances to ensure performance. The tolerances that you choose to apply to new assets may be tighter than those you apply to existing and refurbished items, however they must both meet the absolute safety tolerances you have set.

Typical tolerances include:

- torque settings for nuts and bolts;
- electrical voltage, frequency and current levels;
- clearance and proximity gauges;
- spring tensions;
- visibility; audibility and color;
- motion settings; and
- time settings.

It is also good practice to set tolerances for your maintenance periodicities so that you can build some flexibility into your planning and anticipate a degree of late maintenance visits, without incurring additional risk.

You should determine absolute safety limits for each component and then decide how much tolerance you should build in to your maintenance specifications to allow for system degradation between each maintenance visit.

Historically recommended settings and maintenance periodicities should be available from standards or from operation and maintenance manuals provided by manufacturers. If you are going to be responsible for maintaining new equipment, you should find out where these are specified. The tolerances you set and the risks that you have to control will influence how frequently you will maintain the equipment that you are responsible for.

It is good practice to apply risk based maintenance techniques to help you decide what to do and when to do it. This technique considers how assets can fail and the consequence in terms of safety and cost compared with implementing maintenance tasks. This should allow you to tailor your maintenance specifications and maintenance periodicities to cater for different levels of risk (for example; high risk, medium risk and low risk). This will help you to use your maintenance resources more efficiently and reduce risk to your maintenance staff by reducing their exposure to the railway environment.

Some types of asset may also benefit from a condition-based maintenance regime, particularly where asset age, location and use varies. In this case, the maintenance that you do and the frequency that you do it should be related to wear and the age of the asset.

If you decide to set a single maintenance specification and maintenance periodicity for each different asset type, you should make sure that the worst-case degradation is taken into account.

6.3 Compiling evidence of safety

Your organization must demonstrate that risk has been controlled to an acceptable level. Your organization must support this demonstration with objective evidence, including evidence that all safety requirements have been met [iESM].

Good maintenance organisations make sure that safety requirements are met and look for ways of improving safety further. It is good practice to monitor the safety of the work that you do and the safety of the railway (see Section 6.5) to gather evidence that you are safe enough.

Examples of things to look for include:

- completeness of failure investigations;
- improving failure trends;
- a reduction in staff safety incidents and near misses;
- achievement of your safety plans
- demonstrating that you are complying with standards and legal requirements; and
- meeting your safety targets.

It is good practice to make someone responsible for looking for evidence of safety. You should make sure that the evidence that you gather gives a true representation of safety.

6.4 Obtaining approval

Your organization must obtain all necessary approvals before placing a system or product into service [iESM].

Where existing arrangements are revised or new arrangements are introduced that could have an impact on asset management activities, the organization shall assess the associated risks before the arrangements are implemented, clause 4.4.9 [PAS], clause 2.4.5.2 [ISO].

6.4.1 Existing approvals

If you are already maintaining a part of the railway, you should understand what approvals you already have. Where your work is already approved, you may not have to look for approval unless you decide that you need to change something.

If you find that you are doing something that is not approved, you should compare what you are doing with the standards that tell you what you should be doing. If you find a difference, you should either change what you do to comply with the standard or look for approval to continue what you are doing. You might have to request a non-compliance or derogation to do this.

If the part of the railway that you are maintaining was installed under a standards compliance regime (e.g. European interoperability legislation) then one of the conditions will be that it is maintained so as to always be compliant with the specifications under which it was authorised.

6.4.2 Making changes to what you do

Before you start your maintenance work or implement a change, you should make sure that you have all the necessary approvals. You might have to produce a safety case to demonstrate that you have done enough to reduce risk on the railway and that your work can be done safely. You should look for standards that tell you which approvals you need.

If you have to produce any evidence of safety, you should consider all of the iESM Principles in this AN and use the guidance to help you to put it together. If you have met all of the iESM Principles and adopted processes compliant with them, you should be able to demonstrate that you are safe enough.

You should obtain approvals for:

- your maintenance strategy; maintenance specifications and method statements;
- your maintenance programs;
- extensions to useful life; and
- your organization structure.

Your organisation should understand who is responsible for approving the work that you do. The person responsible for approving your work should have sufficient competence and experience to be able to use their professional judgment to decide whether the work will be safe enough.

In some cases, your organisation will be able to approve some types of work. In this case, you should give someone the responsibility and authority necessary to do this. For example, someone should be given responsibility for approving your maintenance programs. The person giving approval should make sure that the maintenance program is capable of fulfilling the maintenance strategy and addresses all of the required assets.

Where you cannot meet the requirements set down in a standard, you should apply for a non-compliance or derogation and provide the evidence to show that you have alternative measures in place to manage risk to a low enough level. You should make sure that the non-compliances and derogations are approved before you go ahead with the affected work.

6.5 Monitoring risk

Your organization must take all reasonable steps to monitor and improve the management of risk. Your organization must identify, collect and analyze data that could be used to improve the management of risk, as long as it is has responsibilities for safety [iESM].

Your organization must take action where new information shows that this is necessary [iESM].

The organization shall establish, implement and maintain process(es) and/or procedure(s) to monitor and measure the performance of the asset management system and the performance and/or the condition of the assets and/or asset systems, clause 4.6.1 [PAS], clause 2.5.2.4 [ISO].

The organization shall establish, document and maintain processes and/or procedures for the handling of failures incidents and non-conformities associated with assets, asset systems and the asset management system, clause 4.6.2 [PAS], clause 2.5.2.4 [ISO].

The organization shall establish, document and maintain processes and/or procedures for investigating corrective actions for eliminating the causes of poor performance and preventive actions to avoid it occurring, clause 4.6.5 [PAS], clause 2.5.2.4 [ISO].

Top management shall review at intervals that it determines are appropriate the organization's asset management system to ensure its continued suitability, including asset management policy, asset management strategy and asset management objectives, clause 4.7 [PAS], clause 2.5.2.4 [ISO].

The part of the railway that you are maintaining will be frequently affected by the changes that you plan to make and by changes to other parts of the railway. Some changes are easy to identify but others are subtle and may result in unintended change that could reduce safety if not identified.

Your organisation should decide what things it needs to monitor and then continue to monitor them as long as you maintain a part of the railway (see Appendix A9). You may need to change the way you monitor these things and change what you monitor as parts of the railway change. You should decide which other parts of the railway you need to monitor for changes as well.

The types of monitoring that you should do and the parts of the railway that you monitor should depend on the risk that your maintenance is designed to control. When you decide what you are going to monitor, you should consider risk to personnel, risk to the public and risk to parts of the railway. When you have decided what you are going to monitor, you should make sure that you do it and communicate the information you gather to those who need it (see Sections 8.4 and 8.5). You should take account of the condition of equipment: if it is nearing the end of its life you may need to monitor it more often. For example you may need to monitor cables more often if the insulation is starting to break down.

You should decide what data you are going to collect, how you are going to collect it and store it and how you are going to analyse it to decide whether your maintenance work continues to control all of the risk.

It is important to decide who is going to collect and analyse the data and make sure that they do it correctly. It is good practice to share data with other organisations and your suppliers where it is needed to monitor risk.

You should decide how you are going to use the results of your analysis and who will decide whether to change your maintenance work or keep things as they are.

Your organisation should also collect data so that you can check that the assumptions that you originally made are still valid.

It is good practice to pro-actively review your safety record against your safety targets on a regular basis, for instance annually or whenever there is a change that you think could affect the risks that you are managing (including changes to equipment, organisations and the way work is done). You should also review your safety record when you receive information about an incident to look for any additional safety measures that might improve safety further.

The data you collect should be used to develop key safety and performance indicators. You should use these as part of the way you review your work and communicate how well you are doing to your personnel, your suppliers and your customers.

7 TECHNICAL SUPPORT

7.1 Managing hazards

Your organization must keep a record of all hazards identified, the analysis of these hazards, the implementation of measures to put in place to control these hazards, and the validation of such measures in order to confirm that the risk associated with each hazard is, and remains, at an acceptable level [iESM].

The Risk Register or Hazard Log evolves and should be updated whenever:

- a relevant hazard or potential accident is identified;
- a relevant incident occurs;
- further information relating to existing hazards, incidents or accidents comes to attention; or
- safety-related documentation is created or re-issued.

You should identify a process for updating the Hazard Log, to include staff with authority to make entries. Each entry should be approved before it is made.

The Risk Register or Hazard Log should be available for inspection by any Safety Auditor, the Safety Assessor and representatives of the relevant Safety Approvers.

You should ensure that adequate provision is made for security and back-up of the Hazard Log and other safety records.

It is not necessary to repeat information documented elsewhere and so the Risk Register or Hazard Log can make reference to other project safety documentation such as analyses and reports.

It is recommended that the Hazard Log be implemented electronically. Special purpose tools are available to enable this, but it is also possible to store the Hazard Log in a database, keeping Hazard Data, Accident Data, Incident Data and the Directory in separate tables.

When you have implemented your maintenance strategy, you should keep looking for new situations that are not addressed by your existing maintenance plans and programs.

For example, a significant system failure may require a temporary method of degraded railway operations using equipment in a different way to that which the maintenance strategy is designed to manage (such as diversion of trains onto a route that is usually only lightly used). In these circumstances, your organisation should work with all the other organisations involved to develop maintenance plans that will ensure the railway will be safe for the duration of the changed circumstances. Local regulations/legislation may place some limits on what degraded working is allowed.

When this happens, you should identify all of the hazards that arise from the change of use and then look at the risk level associated with each hazard. Temporary control measures arising from the example above could include additional equipment inspections, enhanced maintenance, spot renewal of components and re-allocation of fault teams to ensure rapid response targets are met. They might also include placing limits on the way the asset is used (for example a speed restriction or a restricted signal aspect).

7.2 Independent assessment

Your organization must ensure that engineering safety management activities are reviewed by competent people who are not involved with the activities concerned [iESM].

The organization shall ensure that audits of the assessment management system are conducted, clause 4.6.4 [PAS], clause 2.5.2.4 [ISO].

Your organisation should plan a hierarchy of independent assessment activities, such as safety audits, document reviews and inspections, to make sure that all of your maintenance plans and the way they are implemented and reviewed is achieving the required level of safety. These activities should be structured around the requirements contained in standards and planned in the context of your top-level strategy. You should include your suppliers in your safety audit hierarchy.

The type, frequency and extent of the independent assessment activities that you carry out should be proportionate to the risk you are managing (see Appendix A.8). It is good practice to include a level of independence within these activities. When we talk about independence, we mean using people who are independent of thinking and independent of delivery. The people you choose to use may be part of your own organisation or from an external agent.

Not all of your assessment needs to be independent. Supervision and inspection are a form of internal assessment (See Section 4.3), which should be seen in the wider context of the safety assurance regime.

The people you use should be sufficiently competent, familiar with the risk being managed and have the authority to recommend changes where they are required. They should understand the risk that is being controlled and be competent to decide whether your maintenance is sufficiently controlling it.

It is good practice to ensure consistency by using checklists, however you should develop these so that they prompt the checker to ask questions around process and meeting requirements rather than just prescribing what should be checked.

All findings should be formally recorded. If you find a safety or compliance problem, it is good practice to issue a written instruction to the person responsible for putting it right. This should specify the actions that you need to put into place to fulfil immediate, short term and longer-term safety plans.

You should communicate the results to people responsible for work planning and implementation so that they can take decisions about whether things need to be changed elsewhere.

It is good practice to change the scope and frequency of independent assessment activities to reflect what you find. Additional follow-up audits are a good way of verifying that audit corrective actions and recommendations have been implemented.

The findings of independent assessment activities should be used as input to the activities that you carry out to implement the **Monitoring risk** principle (see Section 6.5).

7.3 Managing configuration and records

Your organization must put in place configuration management arrangements that cover everything that is needed to achieve safety or to demonstrate it [iESM].

Full and auditable records of all activities that affect safety must be kept [iESM].

The organization shall identify the asset management information it requires, considering all phases of the asset lifecycle, clause 4.4.6 [PAS], clause 2.5.2.3.4 [ISO].

The organization shall establish and maintain records as necessary to demonstrate conformance to its asset management system and this standard, clause 4.6.6 [PAS], clause 2.5.2.3.4 [ISO].

A **configuration** is a group of related things and the relationships between them and **configuration management** is about keeping track of these things and their relationships.

Configuration management underpins maintenance. If you are setting off to repair some points you need to know what type of rail, what points machine and what points detection equipment is installed there and you need to know what replacement parts you can install.

It is important to realise that some elements of the configuration may be documents or computer files. It is, for instance, important to keep training courses in step with the actual equipment installed.

If someone gives you information about a safety risk that could affect the safety of the part of the railway that you are responsible for, you might need to quickly find out whether you need to do something. Before you can take a safety decision, you will need to understand the risk and the consequences that could arise from your decision. You will also need to find accurate information to be able to take the correct decision. You should store up-to-date configuration information so that it is easily retrievable (see Section 7.3.2).

You should develop a pro-active, systematic configuration management system. The type of information and the amount of detail that you should keep will depend on the safety decisions you have to take and the length of time that you have to respond to situations that arise.

For example: an incident may arise that requires a component batch modification or recall. If you have up-to-date asset configuration and distribution information available, you should be able to respond quickly with minimum effort without having to commission a detailed survey to find where they all are.

7.3.1 Asset configuration

Your organisation should have up-to-date information about how the part of the railway that you maintain is configured. You need to have ‘as-built records’, which contain enough up-to-date information about the railway so that you can take the safety decisions that you need to. This may be structured as an asset register (see Appendix A.10).

You should keep information about the way components and systems connect with each other to ensure safety. You should record the modification status of components, where compatibility with other parts of the railway is required to ensure safety. You should also keep information about adjustments and settings where they can affect other parts of the railway (such as point settings, signal lamp voltages and traction power supplies).

You should understand:

- asset types
- modification states (for example; EPROMs, hydraulic valves, relay units);
- the location and population of assets;
- the status of temporary alterations and adjustments;
- the service duty and condition of strategic assets;
- how each asset is used, particularly where the number of operations is related to an asset servicing or replacement regime;
- the configuration status of spare parts to make sure that when they are used, they are the correct type and modification state; and
- the availability, location shelf life of spare parts (including strategic spares managed by your suppliers).

Where the risk associated with connecting incompatible components is too high, you should do something to prevent this from happening. This might include making sure that incompatible components cannot be connected (for example using a pin code on plug in bases) and you should always make sure that the modification status of components is clearly identifiable.

7.3.2 Information configuration

You should make sure that technical records are up-to-date (for instance layout plans, detailed design drawings, system analyses) and available to personnel who need to use them.

You should make sure that your maintenance documentation is controlled and distributed so that your personnel have the correct, up-to-date version. It is good practice to use an IT tool to help you to manage this.

It is good practice to give someone responsibility for managing the controlled distribution of documents and technical information. You should keep information about what documents are current, their version and the locations to which they are issued. It is also good practice to maintain a master (source document) so that changes to documents can be safely controlled.

Before you take a safety decision about the railway that requires information from technical records, you should make sure that the records you are going to use are up to date and the correct version. If you are not sure, you should compare the record with the assets it describes before making your decision.

7.3.3 Keeping records

Up-to-date and accurate records are essential if you are going to take decisions about your work safely and efficiently and review the way you do your work effectively (see Appendix A.7). You might also need to keep records for legal purposes.

Your organisation should decide what records it needs to keep and then keep them. It is good practice to keep records of:

- the risks you have to control;
- asset operations;
- incidents and failures;
- your maintenance organization;
- your maintenance process:
    - the types of maintenance you are going to do;
    - the maintenance work that you have done
    - the resources you have used;
    - the decisions that you take about maintenance and the justification for the decisions (for instance decisions to defer maintenance or repairs); and

- your communications.

The records you keep should be clear, simple and appropriate to the decisions that may be required in the future. You should know what you are going to do with the records and avoid keeping records that are not needed.

The records you keep and the way you choose to keep records may be laid down in standards and legislation.

Your organisation should review records to decide whether risk is being controlled to a low enough level. This will help you decide whether to change the way you do things to make things safer. You should then record the decisions you take and the basis on which they were taken.

Record	Guidance
Maintenance organisation	You should keep records about the way you have set up your organisation, particularly the scope and allocation of safety responsibilities, your organisational goals, your safety culture and your competence. You should also keep records about your suppliers (see Section 8.4).
The risks you have to control	You should keep up-to-date records of all the hazards that your maintenance work is designed to mitigate.
Records of maintenance process – your decisions	When you decide what maintenance you are going to do, you should keep a record of the decision. Your decisions should be traceable to the risk that your maintenance is designed to control. For example, a record of maintenance shows that a piece of equipment is defective and may pose unacceptable risk. A decision has to be taken whether to allow the equipment to remain in service until it can be repaired or replaced, or to take the system out of service. Your decision will depend on a balance of risk between the effect of taking the equipment out of service and the risk of further degradation. The decision may require reference to other records (such as as-built records, spares records, component specifications) and standards. The decision and the justification (based on available information) should be recorded and retained for future reference. When you take a decision that will change the way you plan and carry out your work (for instance an increased inspection regime in connection with an outstanding defect), you should ensure that the decision is recorded in a way that can be communicated to those who need to implement the decision (see Sections 8.4 and 8.5).
Communications	You should keep records of safety-related communications so that you can review events to support incident investigation, audit and support learning. This includes personnel briefing records, including attendance, content and required actions. Verbal communications that include messages about operational railway safety should be recorded to allow replay at a later date. You should decide and record how long you need to keep records of verbal communications and implement a rotation system to manage the recording media (for example, four- weekly rotation). Written communications relating to safety should be archived in accordance with your company policy and to comply with any appropriate regulations and standards.

Record	Guidance
Asset operations	It is good practice to monitor and record some equipment operations. Sometimes, these facilities will be designed into the system you are responsible for maintaining (such as level crossing event recorders and electronic interlockings) and you will have to manage the records that they produce. In other circumstances, you might decide to connect temporary monitoring equipment to record the behaviour of equipment that is alleged to be faulty. You should make sure that the test instrumentation that you connect to safety-critical systems is approved for use in the manner you are using it and that your staff are competent to install and use it. You should decide what you are going to record, the format in which it will be recorded and how you will record the information to make sure that it can be analysed.
Incidents and failures	You should keep records of safety-related incidents and near misses (see Appendix A.6). You should review them so that you can decide whether to change the way you do things to make things safer.
Maintenance process - what you are going to do	When your organisation decides how it will do maintenance work, you should record it in a format that will allow the decision to be properly implemented (see Appendix A.5 and Section 4.3).
Maintenance process - what you have done	When you maintain a part of the railway, you should record what was done so that you can compare it with what you planned to do (see Appendix A.7).
Maintenance process - resources you have used	You should keep records so that you can find out later on what resources you have used for your work. You might need to do this as part of an incident investigation or as part of an audit. The amount of detail you keep should reflect the need for traceability (see Appendix A.7).

You should improve accessibility to records by making sure that records are available at the locations and in a format so that those who need to use or communicate information about them can do so. The format you choose may be subject to legal requirements (for example, a requirement to keep paper copies of test certificates containing signatures).

If people working on equipment need to refer to records, you should make sure that the records are available at the place that the work is being done. For example, equipment test results should be made available to maintainers and other maintenance organisations to analyse tolerance drifts over time and help with fault rectification work.

You should protect records against loss, for instance by keeping back-up copies.

8 TEAM SUPPORT

This section contains a number of activities that support the others in this AN indirectly by ensuring that the people involved in these activities are competent and well-organized Before you can be sure that your team has all the correct attributes, you need to understand the overall risk that needs to be managed (see Sections 4.1, 5 and 6.5) and your organisational goals.

8.1 Managing safety responsibilities

Your organization must identify and write down safety responsibilities for its staff [iESM].

Your organization must give people who have safety responsibilities sufficient resources and authority to carry out their responsibilities [iESM].

Your organization must give people who have safety responsibilities sufficient resources and authority to carry out their responsibilities [iESM].

The organization shall establish and maintain an organizational structure of roles, responsibilities and authorities consistent with the achievement of its asset management policy, strategy, objectives and plans, clause 4.4.1 [PAS], clauses 2.5.2.2, 2.5.4 [ISO].

These principles apply to people whose action or inaction might contribute to risk. This will include most, if not all, maintenance personnel.

As the principle implies, you can only give responsibility to someone who is prepared to accept it.

8.1.1 Scope of safety responsibility

Your organisation will need to set out and communicate (See Section 7.6), what responsibilities it has for safety, including:

- the parts of the railway it has to maintain;
- the maintenance work it will do;
- the people whose actions it is responsible for; and
- the people whose safety it is responsible for.

You will have to agree responsibilities with any other organisation that the work will involve and be clear how the work that you do interfaces with work done by other organisations. For example, your organisation could be responsible for infrastructure maintenance on a metro system; another organisation is responsible for rolling stock maintenance and a third organisation for incident investigation covering both infrastructure and rolling stock events.

You should understand the relationship between the safety of the parts of the railway that you maintain and the overall safety of the railway. For example, a signalling maintenance organisation should understand how the maintenance work that it does could affect the safe operation of train movements and its own staff. It should also know how the maintenance is directly related to the safety of train operators and the travelling public.

8.1.2 Understanding safety responsibility

You will need to make sure that everyone within your organisation that is given safety responsibility clearly understands the extent of that safety responsibility. This understanding should start at staff induction and be developed throughout their career, for every person.

In some cases, responsibility may be limited to implementing maintenance in accordance with a work plan and reporting defects and deviations to someone else. In other cases, safety responsibility will include deciding what actions you are going to take to improve safety or prevent a reduction in safety.

8.1.3 Allocating safety responsibility

Someone should be given and accept responsibility for managing the safety of each part of the railway. Your organisation should match resources and authorities to the safety responsibilities that each person has. For example, the authority to take a safety-related decision should be matched by the resources the person has available to implement the decision.

You should have contingency plans that make sure that safety continues to be managed when safety-critical staff and support staff are not available.

When you consider the safety of the part of the railway, you should make sure that someone is responsible for collecting and managing up-to-date information about how it is built, how it is maintained, how safe and reliable it is, how it was designed and why it was designed that way (see Section 7.3). This is to help those who are responsible for taking decisions about changing things to do it safely.

8.1.4 Safety responsibilities at boundaries

Your organisation should find out and record how the part of the railway that you are responsible for interfaces with passengers, neighbours, the rest of the railway and the work done by other organisations.

It is good practice to record the railway system boundaries that describe the limits of your maintenance responsibility. These boundaries may be based on particular railway components or by defined geographical boundaries along a line of route.

For example, responsibility for the track system may be divided between a number of maintenance organisations using defined geographical boundaries, whereas the corresponding signalling equipment boundaries may overlap in a more complex component boundary arrangement. Similarly, for rolling stock, the responsibility for maintenance of the traction system on a vehicle may be separate from the responsibility for maintenance of internal fittings on the same vehicle.

It is also good practice to record the limits of your work activities so that you can understand where your responsibilities begin and end.

Where the part of the railway or the work you do has a boundary with another part of the railway or organisation, if there could be any doubt about where safety responsibilities begin and end, the organisations on both sides of the boundary should agree in writing where the boundary is. This agreement is so that additional safety risks do not arise and to make sure that everything that needs to be maintained is covered. This might include sharing information about the type of work that you are both going to do so that you can understand what effect it will have on safety at the boundary.

8.1.5 Recording safety responsibility

Your organisation should write down the safety responsibilities that each person has so that safety decisions are taken at, and escalated to, the correct person in your organisation. You should make sure that personnel are formally advised of their responsibilities and understand what they must do, particularly whenever there is a change in safety responsibility.

One way of doing this is by issuing job descriptions to your staff (See Appendix A.1). You should make sure they are briefed on the contents and confirm that they clearly understand their responsibilities.

8.2 Promoting a safety culture

Your organization must make sure that all staff understand and respect the risk related to their activities and their responsibilities, and work effectively with each other and with others to control it [iESM].

General guidance on safety culture is contained within iESM Guidance, volume 2. Your safety culture should be promoted throughout your organisation and led from the top so that it is felt and observed throughout your organisation.

There are elements of safety culture that particularly apply to maintenance organisations. These include promoting a culture of:

- 'compliance' with standards and procedures;
- 'right first time';
- 'not accepting poor standards of work';
- 'understanding':
    - the overall risks that are being managed;
    - that risk is not constant and that new hazards need to be captured and managed as they arise;
    - what maintenance is supposed to achieve;
- 'learning' from incidents and near misses to improve the safety of work and overall safety of the railway;
- 'sharing information' so that your maintenance staff become the eyes and ears necessary to detect things that are wrong; and
- 'action' where something is found to be wrong.

You should recognise that there can be a tendency for safety culture to deteriorate, particularly where repetitive tasks can result in perceived familiarity and a false sense of security. It is essential to put measures in place that minimise the potential for complacency, such as varying people's tasks and encouraging ownership.

8.3 Building and managing competence

Your organization must make sure that all staff who are responsible for activities that affect safety are competent to carry them out [iESM].

Your organization must monitor the performance of all staff who are responsible for activities that affect safety in order to ensure that they carry out their responsibilities competently [iESM].

The organization shall ensure that any person(s) under its direct control undertaking asset management related activities has an appropriate level of competence in terms or education, training or experience clause 4.4.3 [PAS], clause 2.5.2.3.2 [ISO].

Competence in a maintenance organisation can be categorised in two areas:

- competence and fitness to do the required maintenance work; and
- competence to change the way maintenance is done.

Team competence should be considered as well as individual competence. Your organisation should make sure that all personnel are competent to fulfil their safety responsibility and that all of the people can work effectively together to deliver safety.

Competence and fitness management should start by selecting people who have the basic abilities to do the job. These people should continue to be developed through their careers using training, mentoring and workplace experience. When considering whether a person is competent, you should consider:

- technical skills, knowledge and experience;
- leadership and managerial skills
- attitude and integrity;
- fitness; and
- confidence.

8.3.1 People who do maintenance work

Your maintenance personnel should be competent and fit to do maintenance work, in accordance with the required standard and in the environment that the work is to be done. When deciding who will be responsible for doing maintenance work (such as a team leader), it is good practice to take into account a person's ability to work under pressure, particularly where they will be expected to respond to incidents or failures that affect train service operation.

It is good practice to make sure that the overall capability of your maintenance teams includes the right balance of technical abilities, fitness and leadership qualities (see Appendix A.2) and that team members understand and can use the information and resources they need.

The number and location of your personnel should take into account the need to respond to unforeseen events and the location of the assets that they are responsible for.

8.3.2 People who take decisions about what maintenance to do

In order to effectively manage safety, your organisation will require certain people to use their judgement to take safety decisions. These people should be competent and be located within your organisational structure so that the safety decisions can be effectively implemented (see Appendix A.2).

8.3.3 Assessment

People who work in maintenance should demonstrate that they are competent to do the work safely and in accordance with the requirements. Your organisation should formally assess personnel to verify that they are competent and then give them authority to work (see Appendix A.2). Each person should only be given work to do after they have demonstrated that they are competent to meet the requirements.

For personnel who do maintenance work, the scope and methods of assessment should consider:

- the maintenance processes that need to be followed;
- the systems, components and equipment that they need to work with;
- the underpinning knowledge needed to take decisions;
- the attitude and experience of the person being assessed;
- the required working environment (including situations that they may face); and
- the activities that they are required to do, including use of tools, materials and test equipment.

Pre-employment screening is a good way of filtering potential candidates for a safety position. You will need to fully understand the job profile and health requirements and then screen people for pre-existing conditions as part of the selection process.

It is good practice to assess people by observing them doing the required work, either at the workplace or by setting simulated exercises. Newly qualified staff may require extra supervision and coaching.

When you assess people who have to take safety decisions, you should look for evidence that they have the breadth and depth of competence necessary to take correct decisions. One good way of addressing this is to set scenarios that explore the person's ability to understand and manage the overall safety risk. They should be able to identify the information they need, the communications required with other people, the applicable standards and finally be able to use their judgement to take the correct decision.

You should look for good practice assessment techniques that are used elsewhere in the industry. Sometimes, assessment standards are dictated by railway industry standards. In other cases, assessment standards are published by professional organisations such as the IRSE.

Your organisation should keep up-to-date competence records for all personnel who do safety work, or take safety-related decisions and make them available to people who allocate the work. You should make sure that their competence continues to match the requirements of their job.

Your organisation should regularly review competence records and work allocation to make sure that an authority to work does not lapse through certification expiry or lack of application. It should continue to monitor the integrity of work that is done and look for any lapses in competence. Where competence lapses are identified, you should restore the competence and implement remedial work where lapses may have introduced a safety risk. If you find a competence gap, you should look for alternative ways of managing the work safely. Solutions include mentoring staff or reallocating work to other competent staff until additional training and assessment has been completed.

You should keep records and regularly review competencies, work requirements and standards and decide whether any additional training is required. Where you identify training needs, you should make sure that the training is provided to all those who need it.

8.3.4 Resources and authority

People who are authorised to do work should also be given responsibilities for putting things right.

People should not be asked to take responsibility for controlling a risk if they do not have the authority to take the necessary action to control it.

People should be given sufficient resources to carry out their responsibilities. This includes having the information that they need to take sound decisions.

8.4 Working with suppliers

Whenever your organization contracts out the performance of activities that affect safety, it must confirm that the supplier is capable of doing the work, including any necessary aspects of engineering safety management [iESM].

Whenever your organization contracts out the performance of activities that affect safety, it must confirm that the supplier does what they are required to do [iESM].

Where an organization chooses to outsource any aspect of asset management that affect conformity with clause 4, the organization shall ensure control over such aspects. The organization shall determine and document how these parts shall be controlled and integrated into the organization's asset management system, clause 4.4.2 [PAS], clause 2.5.4.3 [ISO].

8.4.1 Selecting suppliers

Most maintenance organisations rely on suppliers for some element of delivering maintenance work. Suppliers generally provide one or more of the following resources:

- products, such as materials, tools, equipment and spare parts;
- individual staff, typically contract laborers; and
- services, for example outsourced repairs and specialist investigation.

Where safety could be affected, it is good practice to assess your potential suppliers and the resources you obtain before you use them. This is so that you can understand the limits of their capabilities. Where possible, it is good practice to use preferred accredited suppliers, who are regularly assessed against accepted railway industry supplier standards.

You should work with your suppliers to improve safety and cover any safety gaps. You may do this using your own resources, by bringing in additional outsourced resources or, if necessary, by stopping the work.

You should work out whether you need to do anything else to improve safety, such as establishing appropriate controls to monitor safety, such as sample checks, product inspection, supervision and audit.

8.4.2 Managing safety requirements with suppliers

You should make sure that each supplier is fully aware of the risks they are exposed to, and fully accepts its safety responsibilities. You cannot pass your safety responsibilities onto a supplier but you can share responsibilities with them. If you do decide to use a supplier, you should make it clear which safety responsibilities you are sharing and agree with them how you are going to work together to manage safety.

Ways of doing this include:

- insisting that suppliers provide method statements that explain how the risk will be controlled; and
- requiring suppliers to provide certificates of conformity.

You should make sure that your suppliers have processes in place that fulfil the safety, quality and performance standards that you require and deliver the things that you need from them. This includes ensuring that supplied staff are fit and competent to deliver the work that you require from them. For example, you should make sure that the materials and test equipment you use for railway safety applications have been accepted for use and have been properly handled, maintained and calibrated to meet your safety requirements. Similarly, you should make sure that supplied personnel fulfil your competence and fitness requirements and comply with working time limits.

You should make sure that your suppliers know which records they have to keep and when they must be made available to you (see Section 7.3).

Your organisation should agree methods of communication and procedures with suppliers to make sure that your requirements are both properly specified and understood.

You should monitor the safety and quality of work done by suppliers and implement the necessary measures where uncontrolled risk is found. One way of doing this is by carrying out regular audits (see Section 7.2). If you find a problem, you should consider removing a supplier from a preferred supplier list or changing the scope of responsibility granted to that supplier, until they can demonstrate that they have put things right. In some cases certain obligations may be handed over to suppliers and therefore these need to be defined and agreed between both parties. This is common where you might outsource maintenance or fault response to a specialist supplier and no-one from the client organisation acts as on-site supervisor.

You may also have to notify others where a supplier causes a safety incident. Sometimes, this will be required by a standard.

8.4.3 Supply of products

If you can establish that a product is safe by inspection of the product itself it may not be necessary to assess the supplier. However unless you have confidence in their processes you should continually inspect their product to check that the quality is maintained over time.

The thoroughness with which you inspect products or assess their suppliers will depend upon the potential for the product to contribute to a hazard.

8.4.4 Supply of services

Some railway maintenance organisations rely on suppliers to provide some of the support services needed to carry out railway maintenance work. For example, your organisation may hire a complete team of staff to provide signalling support in connection with track renewal work. You may ask a supplier to do the work but check the integrity of the work yourself, before the railway is returned to operational use.

In another circumstance, you may use a supplier to repair and return railway components that are worn out or broken. In this case, it is good practice to agree a repair specification, including the testing specification that will satisfy the safety requirements for re-using the component.

Where responsibility for work is to be shared with a supplier, you should agree your plans with them (see Section 4.3). You should make sure that your suppliers understand the division of responsibilities, in particular (where appropriate):

- what specification of work they have to follow;
- what work and level of checking they have to do ;
- who is responsible for checking that the work has been done correctly;
- who is responsible for site safety;

- what records are required and how they will be recorded;
- the competencies and authorities required for each part of the work;
- who is responsible for making safety decisions about the work; and
- the methods they should use to communicate information about the work.

You should do this for work of a one-off nature as well as repetitive and regular tasks.

8.4.5 Supply of individual staff

If supplier personnel are to be used within your own work teams, it is good practice to include the subcontract personnel within your own arrangements, including competence management and shift management.

8.5 Communicating and coordinating

If your organization has information that someone else needs to control risk, your organization must pass it on to them and take reasonable steps to make sure that they understand it [iESM].

If someone tells you or your organization something that suggests that risk is too high, prompt and effective action must be taken [iESM].

Whenever your organization is working with others on activities that affect the railway they must co-ordinate their engineering safety management activities [iESM].

The organisation shall ensure that pertinent asset management information is effectively communicated to and from employees and other stakeholders, including contracted service providers, clause 4.4.4 [PAS], clauses 2.4.2, 2.5.2.3.2 [ISO].

Good communication is essential if you are to manage safety properly. Your organisation should have methods to communicate up-to-date information about safety of the railway to all those who need to know, at the time and place that they need it. You should have good communication systems so that information can be passed throughout your organisation. This will help the correct people to take the correct safety decisions and understand their safety responsibility (see Section 8.1).

You should make sure that everyone in your organisation knows who to tell if they find information that there is an unacceptable safety risk (see Section 8.2).

When you communicate information, you should make sure that the information has been correctly received and is understood by the recipient.

8.5.1 Why communication is important

The sources of information needed to take safety decisions may exist anywhere within your organisation, such as a report from a maintenance technician at the front-line. Alternatively information may come in to your organisation at any point from somewhere else, such as a railway operator, or from the general public (see Appendix A.3).

Where information about safety risk could have wider implications, your organisation should have communication systems in place that allow you to pass the information to someone who has the authority to decide what action to take. This may require communication with other organisations that look after parts of the railway. For example, an axle defect that you find in a railway vehicle may have implications on other vehicles, including those that are looked after by other maintenance organisations.

Decisions taken by management need to be communicated to those at the front line who have to implement the decision. You should communicate information throughout your organisation to make sure that your standards and procedures are properly implemented, particularly when work requirements change.

Decisions taken at the front line need to be communicated to management, for example, a decision to allow degraded equipment to temporarily remain in service until a replacement can be planned.

When you communicate safety information, you should consider the needs of the recipient and you should choose a method and a time that reflects the urgency and value of the information relative to any other information that needs to be communicated.

8.5.2 Communication systems

It is essential to establish communication systems that are capable of use in normal, degraded and emergency situations. In all cases, your organisation should have a system to record the safety information that you need to communicate (see Section 7.3). This will help you to communicate the information safely and accurately to those who need to use it.

For example, someone at the front line should have a way to quickly communicate information about a safety failure or incident to the person who will decide what action to take. Further communications may then be required to quickly gather the necessary information. The decision should then be clearly communicated to the person who has to take the corrective action and finally, completion of the work should be communicated and recorded.
The types of communication system you use should be appropriate to meet the needs of the user and the type of information to be communicated.

It is good practice for maintenance organisations to co-ordinate the flow of safety-related and time-critical information using a dedicated reporting facility (examples range from a maintenance control centre to a single telephone hotline). You should make sure that people have the contact details and that the resources you provide are sufficient to manage and prioritise all of the information types that you need to deal with.

Methods of communication include:

- written communication;
- verbal communication; and
- Information Technology and data systems.

When you choose a method of communication, you should consider the need to maintain a record of the communication. You should identify and select good practice where it exists within the railway industry. Some of these good practices are mandated by railway standards (such as use of the phonetic alphabet). Sometimes, it is good practice to implement anonymous and / or independent reporting facilities, particularly in order to capture information about personnel safety incidents, however you should make sure that these are only used where appropriate.

8.5.3 Written communication

Good written communications use clear language and graphics to communicate information in a consistent way. Written communication is particularly effective where consistency is required, including:

- communicating maintenance requirements using method statements, written specifications or checklists;
- communicating system configuration information using design drawings; and
- communicating system status information using written reports.

If you are using written documents to communicate your requirements, you should make sure that all of your personnel have access to the correct, up-to-date version (see Section 6.3). You should make sure that the document hierarchy is clearly understood and that front line specifications and organisational policy documents are consistent with each other.

8.5.4 Verbal communication

Good verbal communication also relies on use of clear language. Use agreed technical vocabulary and natural language; avoid informal jargon or colloquialisms. It is good practice to use a structured message notation for communicating safety information. This includes the phonetic alphabet and a structured message format that uses positive statements.

It is good practice for message recipients to repeat verbal messages back to the sender to confirm their understanding. This is particularly important where face-to-face communication is not possible.

It is also good practice to record and store safety-related verbal messages using backed up information technology systems so that they can be replayed, typically to support incident investigations and support learning to prevent incidents becoming future accidents.

8.5.5 Information Technology and data systems

If your company has internet capability, mobile telecommunication and email facilities, these can be used to quickly make a large amount of information available to a large number of people. You should make sure that processes are in place to maintain communication integrity (including coverage and back-up systems). You should avoid sending out too much information, because the information you want people to use could be overwhelmed by other, less important or less accurate material.

Information Technology (IT) systems provide an alternative way of communicating a written message and so clarity of language is essential.

Because this method of communication is largely one way at a time, you should have procedures that require recipients to acknowledge receipt.

Your organisation should have a fall back method to maintain communication in the event of an IT failure.

8.5.6 Co-ordination within your own organisation

Most railway maintenance organisations have to implement a number of safety plans (see Section 4.3) at the same time. It is good practice to co-ordinate your work programs so that all of your plans can all be implemented safely and completely within defined timescales.

It is very important to give someone responsibility for co-ordinating all of your plans (including interfaces with other organisations - see below). The co-ordination role should encompass all activities that affect your work, including co-ordinating:

- access to the railway and assets;
- use of available resources (such as plant, personnel and materials);
- different types of maintenance work;
- project work and maintenance work, including hand-over and hand-back;
- maintenance work with railway operations; and
- maintenance work associated with degraded and emergency situations.

Where conflicts arise between different plans, you should look for solutions that ensure that additional risk is managed.

For example, routine, cyclic signal testing requirements often require the absence of trains from a part of the railway, whereas permanent way and electrification maintenance often uses rail mounted plant. In order to implement all of your plans within the access time available, it is good practice to plan the work well in advance and adjust work programs to allocate available resources to critical items.

Where it is not possible to implement all of your plans, you should look for alternative ways of managing the risk that the work is designed to control and change your plans to implement them.

Where you are maintaining a range of assets spread over a wide area, it is good practice to co-ordinate your plans so that you reduce wasteful travelling time and multiple visits to a location. This might mean that you adjust your maintenance periodicities within acceptable safety limits to co-ordinate maintenance dates.

8.5.7 Co-ordination with other organisations

Co-ordination is particularly important where your work includes maintenance at boundaries. Your organisation should co-operate with other organisations to agree and set down the arrangements for co-ordinating all of the work safely.

For example, another organisation that maintains a telecommunications structure may need to disconnect a part of it for testing. The continued operation and integrity of the safety-related data carried by the data channels is the responsibility of your organisation. You should both co-ordinate the work by agreeing what needs to be done and planning together how it will be done safely. Both organisations will have to agree timescales, responsibilities for parts of the work and what information needs to be exchanged.

Similarly, train maintenance is usually managed within the controlled environment of a depot, however where unplanned maintenance or repairs are required at the trackside, you should make sure that you co-ordinate with the other parts of the railway, particularly railway operators.

Your organisation should co-operate to develop procedures and a co-ordinated work plan so that safety is not affected by the work.

9 GLOSSARY

This glossary defines the specialized terms and abbreviations used in this AN.

9.1 Abbreviations

ESM	Engineering Safety Management
SMS	Safety Management System

9.2 Specialized terms

Engineering Safety Management (ESM)	The activities involved in making a system or product safe and showing that it is safe. Note: despite the name, ESM is not performed by engineers alone and is applicable to changes that involve more than just engineering.
human factors	The field of study and practice concerned with the human element of any system, the manner in which human performance is affected, and the way that humans affect the performance of systems.
Hazard	A condition that could lead to an accident. A potential source of harm. A hazard should be referred to a system or product definition.
maintenance	All of the activities that need to be carried out to keep a system fit for service so that assets (sub-systems, components and their parts) continue to be safe and reliable throughout the operational life cycle phase.
System	A set of elements which interact according to a design, where an element of a system can be another system, called a subsystem and may include hardware, software and human interaction.
system lifecycle	A sequence of phases through which a system can be considered to pass. A product may also pass through some of these phases.
systematic failure	A failure due to errors, which causes the product, system or process to fail deterministically under a particular combination of inputs or under particular environmental or application conditions.
triggering event	An event, outside the system or product of interest, which is required in order for a Hazard to result in an Accident.

A APPENDIX: DATA CHECKLIST

A.1 Suggested contents of job descriptions

The job description / safety responsibility statement should contain information such as:

a. the scope of work activity, including information about boundaries and asset registers; ☐

b. where the post fits into the organisation hierarchy; ☐

c. responsibilities for collecting and passing on information about safety; ☐

d. personal safety responsibility and safety responsibility for others; ☐

e. safety responsibility allocated to others associated with the work; ☐

f. safety decision making authority; ☐

g. deputising arrangements; ☐

h. competence and certification requirements for safety ☐

i. safety equipment; and ☐

j. controlled safety documentation issued to the post-holder and the source of other controlled documents. ☐

A.2 Suggested competence and fitness requirements

Personnel who are responsible for doing maintenance work:

a. knowledge and experience of the railway parts that they maintain and the way they interface with other parts of the railway; ☐

b. knowledge of safety procedures (including any 'work safe procedures); ☐

c. knowledge of maintenance procedures; ☐

d. an ability to safely do maintenance work in accordance with the requirements, including use of tools and materials; ☐

e. an understanding of how the maintenance work that they do could affect the safe operation of the railway; ☐

f. an ability to identify failures or degradation that could reduce safety; ☐

g. knowing how to respond to incidents; ☐

h. an ability to communicate information about work, including information about work status and safety risk; ☐

i. knowledge of the limits of their safety responsibility and the safety responsibility of others; and ☐

j. an ability to work as part of a team. ☐

Fitness should include:

k. appropriate physical strength (including stamina and manual-handling abilities); ☐

l.	mobility;	☐
m.	not excessively fatigued	
n.	eyesight; and	☐
o.	hearing	☐

People who take decisions about safety

p.	knowledge of the parts of the railway they are responsible for;	☐
q.	knowledge of the information that is required to take decisions and where to find it;	☐
r.	knowledge of standards and legislation that influence decisions;	☐
s.	an understanding of how the safety risk being managed could affect other parts of the railway;	☐
t.	an ability to assess risk;	☐
u.	an ability to take correct decisions based on the information available;	☐
v.	confidence and integrity to defend their decisions	☐
w.	an ability to communicate decisions to others who need to know; and	☐
x.	an ability to make sure that required work is implemented properly.	☐

A.3 Examples of communications required for maintenance

Examples of information that starts at the front line of a maintenance organisation

a.	details of completed work;	☐
b.	details of additional reports and maintenance work requirements;	☐
c.	test results;	☐
d.	requests for authorisation to proceed with work;	☐
e.	details of problems affecting completion of work; and	☐
f.	reports of safety hazards.	☐

Examples of information that should be communicated through a maintenance organisation and with your suppliers:

g.	information about changes to maintenance procedures and standards;	☐
h.	information about work being done on other parts of the railway that may affect your work;	☐
i.	details of required work;	☐
j.	details of required special inspections;	☐
k.	technical information that is relevant, including results of special investigation reports, audits, inspections and reviews;	☐
l.	information about safety hazards and safety alerts;	☐
m.	changes to organisation and reporting lines;	☐
n.	changes to safety rules, and	☐

o. changes to the part of the railway you are responsible for.

Examples of information that is passed between maintenance organisations include:

p. details of failures and hazards that affect more than one part of the railway; and

q. details of work in progress where more than one maintenance organisation is involved at a maintenance boundary.

Examples of information that passes between a project and a maintenance organisation

r. information that the project needs from the maintenance organisation so that the project can be safely implemented; and

s. information that the maintenance organisation needs from the project so that the maintenance requirements contained in the engineering safety case can be implemented.

A.4 Suggested contents for an asset failure response plan

An asset failure response plan should include information about:

a. what the asset failure response plan covers (such as Signal Passed At Danger / Movement Authority exceeded and 'wrong-side failure' investigation), what information needs to be collected, secured and recorded;

b. how you will manage safety and security when a failure occurs; how you will obtain and manage the resources you will need; how information will be collected, secured, recorded and communicated to those who need to take decisions;

c. when you will implement the plan;

d. who will be responsible for co-ordinating failure response; who will be responsible for making decisions and providing resources to do the work;

e. with - the resources that you have identified that are necessary to manage the incident; and

f. where the resources can be obtained from.

g. why - your organisational target, such as response time.

A.5 Detailed maintenance programs

Your maintenance program should address:

a. **what** work you are going to do;

b. **how** the work will be done and recorded;

c. **where** you will do the work;

d. **when** the work will be done, including timescales and safety priority;

e. **who** will do the work, who will check the work and who is responsible for making sure the work is completed on time;

f. **with** – list the tools, equipment and materials required for the work; and

g. **why** the work is being done, such as relating to a company target or standard.

A.6 Suggested records required for incidents and failures

Examples of the records you should keep include:

a. details of the reported event (who reported it, what the symptoms were and when the failure was found);

b. details of the investigation;

c. the results of the investigation;

d. the root cause of the event;

e. the level of risk caused by the event;

f. who was responsible for the investigation;

g. who decided what action to take, and

h. how the risk was eliminated or mitigated.

A.7 Suggested maintenance records

For recording what maintenance you are going to do, examples of good practice include:

a. formal work orders

b. activity specific method statements

c. maintenance test plans

d. failure investigation test plans and checklists

e. maintenance specifications, including tests

f. equipment manuals and technical handbooks

g. inspection and surveillance checklists

For maintenance that you have done, examples of what you should record include:

h. the date you maintained it;

i. who undertook the maintenance;

j. what maintenance you have done;

k. the results of measurements and tests;

l. the status of any additional work that was required; and

m. details of outstanding defects.

Examples of good practice for recording work done include:

n. maintenance record cards and logbooks that are kept with the asset;

o. completed work orders that record the status of work and additional requirements;

p. checklists to record actions taken and information collected (such as failure investigation checklists) ☐

q. marked up drawings with dates and signatures (such as testing copy drawings); ☐

r. verbal reports to a central control point (for instance a fault control); and ☐

s. electronic reporting using portable IT equipment, which can then be downloaded to a database. ☐

Examples of good practice for recording use of resources include:

t. the people involved in planning, doing and checking the work and their competence; ☐

u. the test and measuring equipment used, including reference to calibration data; and ☐

v. emergency contacts and methods ☐

w. access arrangements ☐

x. hours of work ☐

y. the materials used to support traceability and configuration management ☐

A.8 Suggested content for a maintenance audit

When you audit maintenance, you should check that:

a. you are using a complete, accurate and up-to-date asset register; ☐

b. an up-to-date Risk Register is available; ☐

c. sufficient competent staff are available and consistently allocated to safety-critical work; ☐

d. correct resources (materials, calibrated tools and equipment) are obtained from approved suppliers, available and used correctly during maintenance work; ☐

e. tools and equipment are correctly used; ☐

f. detailed maintenance programs are planned and delivered in accordance with your organisation maintenance strategy; ☐

g. planned changes are fully justified; ☐

h. where maintenance programs are not fulfilled, changes to the maintenance programs are fully supported by justified safety decisions; ☐

i. the people doing the maintenance work are complying with the relevant maintenance specifications, method statements and safety procedures; ☐

j. the maintenance specifications and safety procedures, when properly applied, control risk to the required level. This includes checking that the part of the railway is safe and the way your personnel do the maintenance work is safe; ☐

k. all of the correct maintenance records are being managed to allow information about maintenance to be traced and reused; ☐

l. your maintenance is achieving the required outcome; ☐

m. supervision and inspection plans comply with your organisation maintenance strategy; ☐

n. surveillance is effective and any actions are being managed; and ☐

o. interfaces to other parts of the railway are understood and managed safely, including handover and hand-back between maintenance and projects. ☐

A.9 Suggested data to be collected to support monitoring

Examples of data that you should collect include:

a. data about how well you are meeting your maintenance plan; ☐

b. data about the quality of your maintenance work; ☐

c. data about asset condition; ☐

d. data about repair and rectification work arising from maintenance visits; ☐

e. data about failures in parts of the railway that you are responsible for; ☐

f. data about failures in other parts of the railway that could be connected to your work; ☐

g. data about safety incidents, accidents and near misses involving personnel; ☐

h. data about how well your staff personnel are complying with your procedures and instructions; and ☐

i. data about safety that you are given, including feedback from your own staff and information that other organisations give to you. ☐

j. the type, speed and density of rail traffic; ☐

k. the way the railway is managed; and ☐

l. the effect of the environment on your maintenance work and the part of the railway you maintain. ☐

A.10 Suggested data to be stored in an asset register

Examples of data that you should store include:

a. asset types; ☐

b. asset locations; ☐

c. size of asset populations; ☐

d. the status of temporary alterations and adjustments; ☐

e. the service duty and condition of strategic assets; ☐

f. how each asset is used, particularly where the number of operations is related to an asset servicing or replacement regime; ☐

g. the configuration status of spare parts to make sure that when they are used, they are the correct type and modification state; and ☐

h. the availability, location shelf life of spare parts (including strategic spares managed by your suppliers). ☐

10 REFERENCED DOCUMENTS

This section provides full references to the documents referred to in the body of this volume.

[ISO] ISO 55000:2014 Asset Management Overview, Principles and Terminology

[iESM] international Engineering Safety Management Guidance, Volume 1

[PAS] Publicly Available Specification 55:2008 Publicly Available Specification for the optimal management of physical assets

[YB4] Engineering Safety Management, issue 4, “Yellow Book 4”, ISBN 978-0-9551435-2-6
Yellow Book 4 now has the status of a withdrawn document.

Note: This revision (Issue 1.1) of the Application Note has not modified any of the technical content present in the previous revision. Some of the standards referenced may have been revised. A full technical review is planned to be undertaken of this Application Note prior to its next revision.

iESM

BROUGHT TO YOU BY ARC

international Engineering Safety Management

Published on behalf of the international railway industry
by Abbott Risk Consulting Ltd.
Issue 1.1 May 2022

arc