

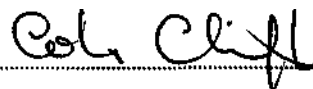
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Business Process Document

Track Warning Systems

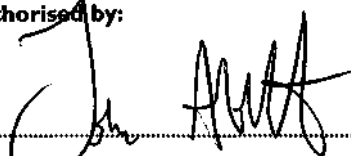
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Issue record

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Implementation

With effect from 6 August 2005 for the whole document except Appendix F.

Appendix F shall be implemented with effect from 1 January 2006. In the meantime, the manufacturers' existing arrangements for training and competence assessment shall apply.

Compliance

This Network Rail Business Process Document is mandatory and must be complied with by Network Rail, Contractors, Suppliers and TWS Manufacturers from 6 August 2005.

When this Business Process Document is implemented, it is permissible for all projects, which have formally completed GRIP Level 4, to continue to comply with the Issue of any relevant Network Rail Standards current when GRIP Level 4 was reached and not to comply with requirements contained herein unless the designated Professional Head of Occupational Health & Safety has stipulated otherwise in the accompanying Briefing Note.

Where the Professional Head of Occupational Health & Safety has specified that all projects will comply with the requirements, specific authority not to comply can be sought in the usual manner using the appropriate non-compliance authority processes described in Network Rail Standard, RT/LS/P/045 (Managing the process for Non-compliance Authority).

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1. Purpose

The purpose of this Business Process Document is to mandate the requirements for the safe use of Track Warning Systems (TWS) on Network Rail controlled infrastructure.

2. Background

The primary purpose of TWS is to provide timely warning of the approach of trains to personnel working on or near the line.

An overview of TWS is provided in Appendix A.

Responsibility for the safe operation of TWS is shared between several different organisations. Details of the division of responsibilities are provided in Appendix B.

3. Scope

This Business Process Document applies to Automatic Track Warning Systems (ATWS) and Lookout Operated Warning Systems (LOWS) when used to provide warning on fixed and mobile sites of work, including situations in which the warning equipment is:

- Deployed at the lineside
- Attached to rail vehicles
- Worn by track workers

All requirements and statements in this document apply to both ATWS and LOWS unless indicated otherwise.

This Business Process Document does not apply to:

- Fixed ATWS with train detection provided through interface with the signalling system interlocking.
- Other systems, such as TOWS and Pee Wee, which share some of the characteristics of TWS.

TWS shall be installed and operated in accordance with the relevant requirements of legislation, Railway Group Standards, Network Rail Company Standards, accepted product safety cases and product acceptance certificates. In the event of any conflict, these requirements shall take precedence over the requirements of this Business Process Document.

4. Reference Documentation

Railway Group Standards

GE/RT8000	The Rule Book
GI/RT7002	Acceptance of Systems, Equipment and Materials for Use in Railtrack Controlled Infrastructure
GI/RT7007	Low Voltage Electrical Installations
GM/RT1403	Use of Plant and Work Equipment
GO/RT3091	D.C. Electrified Lines Instructions

Network Rail Company Standards

RT/E/C/11731	Signalling Failure Investigation
RT/E/P/30066	Signalling and Telecommunication Technical Clearance for Radio Antenna Systems
RT/E/S/10047	Management of Safety Related Reports for Signalling Failures
RT/E/S/11231	Signalling Maintenance Testing
RT/E/S/29987	Working on or about 25 kV A.C. Electrified Lines
RT/LS/P/013	System Review Panel and Technical Review Groups
RT/LS/P/029	Product Approval
NR/SP/OHS/019	Safety of People Working On or Near the Line

External Publications

Engineering Safety Management Issue 3 (Yellow Book 3), published by Railtrack, 2000

EN 954-1 - Safety of Machinery Safety Related Parts of Control Systems, published by European Committee for Electrotechnical Standardisation (CENELEC), 1997

EN 50121 - Railway Applications - Electromagnetic Compatibility, published by European Committee for Electrotechnical Standardisation (CENELEC), 2000

EN 50126 - Railway Applications - The specification and demonstration of Reliability, Availability, Maintainability and Safety (RAMS), published by European Committee for Electrotechnical Standardisation (CENELEC), 1999

EN 50128 - Railway Applications - Communication, signalling and processing systems - Software for railway control and protection systems, published by European Committee for Electrotechnical Standardisation (CENELEC), 2001

EN 50129 - Railway Applications - Safety Related Electronic Systems for Signalling, published by European Committee for Electrotechnical Standardisation (CENELEC), 2003

IEC 61508 - Functional Safety of Electrical/Electronic/Programmable Electronic Safety-Related Systems, published by International Electrotechnical Commission (IEC)

Individual Warning Systems for Personnel Working on the Track (ERRI A 158/RP3 Parts I and II), published by ERRI, 1996

5. Definitions

Abbreviations

ALARP	As Low As Reasonably Practicable
ATWS	Automatic Track Warning System(s)
COSS	Controller of Site Safety
e.r.p.	Effective radiated power
ERRI	European Rail Research Institute
LOWS	Lookout Operated Warning System(s)
Ofcom	Office of Communications
Pee Wee	Portable Warning System
RIMINI	Risk MINImisation (process for the implementation of NR/SP/OHS/019)
SIL	Safety Integrity Level
TOWS	Train Operated Warning System
TWS	Track Warning System(s)

Terminology

Term	Definition
Assessment	The process of collecting and judging evidence of competence
Assessor	A person who is competent to assess the competence of others in the performance of their work.
ATWS Installer	A person appropriately trained, competent and certificated to install ATWS. The key purpose of the Installer role is to ensure that ATWS equipment is installed in accordance with general and equipment specific requirements and with the layout design and component list produced by the Planner. This role may be assisted by other personnel working under the ATWS Installer's authority (e.g. with manual handling and positioning of equipment).
ATWS Operator	A person appropriately trained, competent and certificated to operate ATWS. The key purpose of the Operator role is to operate the ATWS in accordance with general and equipment specific requirements, as instructed by the COSS.
ATWS Planner	A person appropriately trained, competent and certificated to plan installation of ATWS. The key purpose of the ATWS Planner role is to plan the installation of ATWS equipment to deliver the warning requirements specified by the person planning the work.
Automatic Track Warning System	Form of TWS with train detection provided by detection devices(s). ATWS is typically used to provide a suitable warning for work (either one off or repetitive) exceeding one day's duration.
Availability	The ability of a product to be in a state to perform a required function under given conditions at a given instant of time or over a given time interval assuming that the required external resources are provided.
Collective warning	Warning provided by TWS to a group of people working on or near the line.

Term	Definition
Collective Warning Device	A device designed to give a collective warning
Competence	The ability to perform work consistently to the standards expected within employment
Competence Standard	Specifies what a person must be able to do and how well in order to achieve the intended outcome at work; how this would be assessed; the range of circumstances in which the ability would have to be demonstrated; the types of evidence needed to ensure that performance is consistent and can be sustained.
Continuous warning	Warning given after the initial warning to announce the approach of trains and continuing until it has been cancelled (i.e. until all trains have passed clear of the warning area).
Controller of Site Safety	A person appointed and certificated as competent to ensure a safe system of work is in place to enable a group of people to work in a Red or Green Zone.
Cross Acceptance	The status achieved by a product that has been accepted by one authority to the relevant European Standards and is acceptable to other authorities without the necessity for further assessment.
Detection Device(s)	Device(s) such as treadles fixed to the running rails or to other track components at the strike in and strike out points.
Effective radiated power	Maximum power level of a radio device, a function of both radio frequency power provided by a radio transmitter and the directional power gain provided by an aerial.
Fault Alarm	Signal given in the event of a fault in TWS. The alarm signal may be given by acoustic, optical or vibrating means or by a combination of these.
Functional Requirements	Functional requirements define the requirements from TWS of users and other people working on or near the line.

Term	Definition
Hand Switch	Manual device used by a LOWS Lookout to initiate or cancel a warning. The term encompasses the whole of the handset used including the vigilance control, the activating control and the indications that show operation of the activating control has been registered and the device's battery condition.
Link-Up	Supplier qualification and verification scheme, designed to assure the quality of products and services bought by the rail industry.
Lookout Operated Warning System	Form of TWS with train detection provided by a LOWS Lookout. LOWS is typically used to provide a suitable warning for small groups and short duration work.
LOWS COSS	COSS with enhanced competence to set up and operate LOWS
LOWS Lookout	A person appropriately trained, competent and certificated to operate a LOWS hand switch. The role of the LOWS Lookout is to initiate warning of approaching trains, as instructed by the LOWS COSS.
Maintainability	The probability that a given active maintenance action, for an item under given conditions of use can be carried out within a stated time interval when the maintenance is performed under stated conditions and using stated procedures and resources.
Maintainer	A person appropriately trained, competent and certificated to maintain TWS in accordance with equipment specific maintenance instructions.
Maintenance	Actions undertaken by competent persons to ensure TWS equipment remains in a fit for purpose condition and performs reliably as designed. In this document, the term encompasses repair, servicing and calibration of TWS.
Manufacturer	Organisation identified as the manufacturer in the product safety case for the TWS concerned.

Term	Definition
Operating Instructions	Documentary instructions providing competent TWS users with a source of reference to use when carrying out their roles. Operating instructions are required to incorporate details of any operating conditions or restrictions imposed by Network Rail on use of the TWS.
Personal Warning	Warning provided by TWS individually to personnel working on or near the line
Personal Warning Device	A device (warning signal generator) worn or carried by an individual and designed to give a personal warning
Product	A collection of elements, interconnected to form a system/sub-system/equipment, in a manner that meets the specified requirements.
Product Acceptance	The procedure for accepting products for use on Network Rail Controlled Infrastructure.
Product Safety Case	A documented demonstration that a product is safe and fit for purpose for use on Network Rail infrastructure.
Rail vehicle	A powered vehicle operating on railway lines (including trains, on track machines, road rail vehicles and rail mounted maintenance machines)
Reliability	The probability that an item can perform a required function under given conditions for a given time interval or for a stated demand.
Safety	Freedom from unacceptable risk of harm
Safety critical fault	Fault that impairs the system's ability to issue timely warning of approaching rail vehicles
Safety integrity	The likelihood of a system satisfactorily performing the required safety functions under all the stated conditions within a stated period of time.
Safety Integrity Level	A number which indicates the required degree of confidence that a system will meet its specified safety functions with respect to systematic failures. Defined in Engineering Safety Management (Yellow Book).

Term	Definition
Semi Permanent ATWS	ATWS in which all components (excluding personal warning devices, if used) are installed for six months or more on a semi permanent ruggedised basis and ready for use on demand.
Site of Work	Location on or near the line where personnel are working
Specially Briefed COSS	COSS who has received a general introduction to ATWS as part of their COSS training and a documented, installation specific briefing.
Strike in	The action of the train being first registered by the system
Strike in point	The physical location at which strike in occurs
Strike out	The action of the train leaving the warning area and cancelling its registration in the system.
Strike out point	The physical location at which strike out occurs
Switching off	The act of de-energising TWS following its use to warn workers of approaching trains
Switching on	The act of energising TWS so that it will warn workers of approaching trains.
System Operator	Collective term incorporating ATWS Operator/specially briefed COSS and LOWS COSS, as appropriate.
Technical Requirements	Technical requirements enable the Functional Requirements to be realised but are not necessarily apparent to, or capable of being influenced by, the user. Technical Requirements include the expression in quantitative form of a Functional Requirement set out in qualitative terms as well as manufacturing and materials requirements.
Track Warning System	A system that warns people who are on or near the line of an approaching train. The system may be either temporarily or permanently installed. The train detection function may be undertaken automatically (ATWS) or manually (LOWS).

Term	Definition
Train	In this document means any powered rail vehicle, including on track plant
Trainee	A person undertaking training, assessment or mentoring, as appropriate, prior to issue of a certificate confirming their competence
Training and Competence Assessment Scheme	Training plans, competence standards, assessment materials and supporting documents prepared by the manufacturer or an organisation approved by the manufacturer.
Training and Competence Assessment Supplier	Organisation approved by the manufacturer to provide training and competence assessment services in relation to specified TWS.
TWS owner	Company that owns TWS either for its own use or for hire to others.
TWS users	Collective term incorporating LOWS Lookout, LOWS COSS, ATWS Operator/specially briefed COSS, ATWS Installer, ATWS Planner and TWS Maintainer. See Appendix E for a general description of the duties of these TWS users.
Verification	The process by which the quality of the assessment process and the systems and procedures that underpin it are independently assured.
Warning	Signal produced by a warning signal generator in TWS. The warning signal may be given by acoustic, optical or vibrating means or by a combination of these.
Warning Area	Area within which warning is provided.
Warning Time	The minimum time needed to stop work, down tools and reach a position of safety at least 10 seconds before a train arrives at the site of work.
Wrong Side Failure	Incident in which a train approaches without warning.

Interpretation

These terms are to be interpreted as follows throughout this document:

Term	Meaning
<i>May</i>	The requirement is optional. Depending on the context of the requirement, alternative solutions may be offered or a business and/or technical justification may be required.
<i>Must</i>	The requirement is mandated by another document.
<i>Shall</i>	The requirement is mandated by this document.
<i>Should</i>	The requirement is desirable but not mandatory.

.....

6. Specification

6.1 TWS Functional and Technical Requirements

All TWS within the scope of this Business Process Document shall meet the requirements specified in Appendix C in so far as they are relevant to a specific system.

Nothing in Appendix C shall remove from a manufacturer the general duty to ensure, so far as is reasonably practicable, that equipment supplied is safe and without risks to health.

6.2 TWS Operating Conditions and Restrictions

TWS shall be operated in accordance with the conditions and restrictions defined in Appendix D and in system specific product acceptance certificates issued by Network Rail.

6.3 Duties of TWS Users

All TWS users shall understand and discharge competently the duties specific to their role. The general duties of TWS users are described in Appendix E.

6.4 Training and Competence of TWS Users

TWS users shall be trained and competent to discharge their duties. The minimum requirements with which training and competence assessment arrangements for TWS users shall comply are defined in Appendix F.

Nothing in Appendix F shall remove from an employer the general duty to ensure, so far as is reasonably practicable, that employees are competent to carry out their duties.

6.5 Maintenance of TWS

TWS shall be maintained in accordance with the requirements specified in the manufacturer's maintenance instructions.

Appendix A – Overview of TWS

A1. TWS in the Track Worker Safety Hierarchy

Network Rail Business Process Document [NR/SP/OHS/019](#) establishes a hierarchy of measures to be considered for the safety of people working on or near the line. The standard requires the highest level safe system of work in this hierarchy to be selected consistent with the nature, location and duration of the work.

ATWS is identified in [NR/SP/OHS/019](#) as the preferred method of warning for Red Zone working. LOWS is the preferred method of warning where trains are detected by Lookout(s).

A2. Pre-Planning of Work

[NR/SP/OHS/019](#) emphasises the need to pre-plan work and the design of safe systems of work necessary to prevent people being struck by trains. Where, as part of this pre-planning, it is decided to provide warning by means of either ATWS or LOWS, use of this warning shall itself be planned.

The general duties and training and competence requirements of ATWS Planners are shown in Appendices D and E respectively of this document.

A3. Principles of TWS Operation

At its most basic, TWS works by:

- Detecting a train approaching the warning area
- Instigating a warning to personnel working in the warning area
- Cancelling the warning when the train has passed the warning area.

TWS consists essentially of the key elements outlined in A3.1 to A3.5 below:

A3.1 Train Detection Function

This provides the train status information necessary for the system to initiate a warning.

Train detection may be achieved by one of two methods:

- Detection device(s) (e.g. treadles) attached to the rails at the strike in point; or
- Use of a LOWS Lookout initiating the warning by means of a hand switch.

[NOTE: A further method of train detection, using train position information derived from the signalling system, is outside the scope of this document.]

A3.2 Calculation Function

This carries out through a central unit any necessary processing of the train status information to enable warnings to be initiated or cancelled when set conditions are met.

These conditions are established by the System Operator selecting pre-determined options on the central unit (e.g. lines for which warnings are to be provided).

Warning cancellation may be achieved by one of two methods:

- Automatically by detection device(s) attached to the rails at the strike out point; or
- Manually by a LOWS Lookout or LOWS COSS located at the site of work (e.g. from a central unit or hand switch).

A3.3 Warning Function

This issues the warning to the personnel within the warning area.

Warnings may be given by collective warning devices (e.g. lineside horns and lamps), personal warning devices (e.g. radio-fed personal earpieces or vibration generators) or a combination of both collective and personal warning devices.

A3.4 Transmission Function

This transfers data between the equipment discharging the Train Detection, Calculation and Warning functions.

Data transmission may be achieved using either cables or radio.

A3.5 Power Supplies

These energise the TWS equipment and enable it to respond as required.

Power may be supplied to TWS equipment (except personal warning devices) either by fixed electricity supply from a mains source or generator or by batteries. Personal warning devices shall necessarily be powered by battery alone.

A4. General Sequence of ATWS Operation

The following general sequence of operation is envisaged for each ATWS installation. It should be noted, however, that some site or system specific variations may apply.

Further details of the general duties of TWS users are provided in Appendix E.

A4.1 Planning

Use of ATWS will have been selected as part of the RIMINI planning process in accordance with [NR/SP/OHS/019](#).

The ATWS Planner will:

- Establish the warning requirements for the work
- Confirm that ATWS is able to be used at the proposed site of work and is suitable for the job
- Identify the warning time required for the work concerned
- Confirm that the warning time provided by the system will be adequate
- Design the layout of the system to enable the warning requirements for the work to be delivered
- Communicate the necessary information to the ATWS Installer
- Carry out sampling checks to confirm that systems have been installed as designed.

The plan will be checked independently by another ATWS Planner before being issued to the ATWS Installer.

A4.2 Installation

The ATWS Installer will install the system in accordance with the plan produced by the ATWS Planner and test it to ensure it is functioning as intended.

The installation will be checked independently by another ATWS Installer before being handed over for use.

The Installer will hand over the installation to the System Operator (ATWS Operator or specially briefed COSS, as appropriate)

A4.3 Switching On

The System Operator will switch the system on and select the means of warning on the central unit as applicable to the work, environment and system concerned:

- Collective warning by lamps and horns or by lamps only (night mode); **and/or**
- Personal warning by sound or vibration generator.

On being energised, the system will:

- Conduct an initialisation self-test
- Confirm it is operational
- Confirm the warning selections made.

A4.4 Use

The COSS will brief the work group on the warnings given by the system and the appropriate action to be taken.

The ATWS will automatically provide warning of approaching trains for the duration of the period it is in operation. It will provide this warning for all trains approaching the site of work over a strike in point and will continue this warning until it is cancelled. Workers will move to a position of safety when the warning is issued. The ATWS will cancel the warning automatically and the COSS will instruct the workers when it is safe to go back on or near the line.

The ATWS will issue a fault alarm in the event of a safety critical fault. Workers will move to a position of safety when the alarm is issued.

The ATWS will issue a fault indication or alert to the System Operator in the event of a non-safety critical fault.

A4.5 Switching Off

The System Operator will switch the system off when the COSS has confirmed that no one is relying on it for warnings at the time.

A4.6 Removal

The ATWS Installer will remove the system from site when it is no longer required, having checked first that the system is switched off and no one is relying on it for warnings at the time.

A5. Sequence of LOWS Operation

The following general sequence of operation is envisaged for each LOWS installation:

A5.1 Planning

Use of LOWS will have been selected as part of the RIMINI planning process in accordance with [NR/SP/OHS/019](#).

The person planning the work will:

- Establish the warning requirements for the work
- Confirm that LOWS is able to be used at the proposed site of work and is suitable for the job
- Indicate the minimum warning time required for the work concerned
- Communicate the necessary information to the LOWS COSS

A5.2 Set Up

The LOWS COSS will set the system up, position the LOWS Lookout to achieve the necessary sighting distance to meet the warning requirements for the work and test the system to ensure it is functioning correctly.

A5.3 Switching On

The LOWS COSS will switch the system on and select the means of warning on the central unit as applicable to the work, environment and system concerned:

- Collective warning by lamps and horns or by lamps only (night mode); **and/or**
- Personal warning by sound or vibration generator.

On being energised, the system will:

- Conduct an initialisation self-test
- Confirm it is operational
- Confirm the warning selections made.

A5.4 Use

The LOWS COSS will brief the work group on the warnings given by the system and the appropriate action to be taken.

The LOWS Lookout will provide warning of approaching trains for the duration of the period the system is in operation. Workers will move to a position of safety when the warning is issued. The LOWS COSS will cancel the warning manually, or instruct the LOWS Lookout to cancel the warning, and will instruct the workers when it is safe to go back on or near the line.

The LOWS equipment will issue a fault alarm in the event of a safety critical fault. Workers will move to a position of safety when the alarm is issued.

The LOWS equipment will issue a fault indication or alert to the LOWS COSS in the event of a non-safety critical fault.

A5.5 Switching Off

The LOWS COSS will switch the system off or instruct the LOWS Lookout to switch it off having confirmed that all workers are in a position of safety.

A5.6 Removal

The LOWS COSS will remove the system from site when it is no longer required, having checked first that the system is switched off and no one is relying on it for warnings at the time.

A6. Use of TWS on Rail Vehicles

In conventional TWS applications, warning equipment is positioned at the lineside. In this variant application, warning equipment is mounted on a rail vehicle (eg. On Track Machine).

The sequence of operation is the same as for conventional ATWS or LOWS except where indicated below.

A6.1 Planning

Use of TWS will have been selected as part of the possession work planning process.

Planning for this application will take into account:

- Warning requirement
- Size of the machine
- Distance to the transmitter
- Working pace
- Duration of use
- Ambient lighting and noise conditions

ATWS

The ATWS Planner will carry out the duties listed in A4.1. The plan will be checked independently by another ATWS Planner before being issued to the ATWS Installer.

LOWS

The possession work planner will:

- Establish the warning requirements for the work
- Confirm that LOWS is able to be used at the proposed site of work and is suitable for the job
- Indicate the minimum warning time required for the work concerned
- Communicate the necessary information to the LOWS COSS

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A6.2 Installation/Set Up

Except where fitted permanently on the vehicle, equipment may be fitted on a vehicle at a depot or on site.

ATWS

The ATWS Installer will install equipment on the lineside in accordance with the plan produced by the ATWS Planner and test it to ensure it is functioning as intended. The ATWS Installer will also fit equipment on a vehicle where this is done on site.

The installation will be checked independently by another ATWS Installer before being handed over for use.

The Installer will hand over the installation to the System Operator (ATWS Operator or specially briefed COSS, as appropriate)

LOWS

The LOWS COSS will carry out the duties listed in A5.2. The LOWS COSS will fit equipment on a vehicle where this is done on site.

A6.3 Switching On

ATWS

- The System Operator will carry out the duties listed in A4.3.

LOWS

- The LOWS COSS will carry out the duties listed in A5.3.

A6.4 Use

ATWS

- The COSS and System Operator will carry out the duties listed in A4.4.

LOWS

- The LOWS COSS and LOWS Lookout will carry out the duties listed in A5.4.

A6.5 Switching Off

ATWS

- The System Operator will carry out the duties listed in A4.5.

LOWS

- The LOWS COSS will carry out the duties listed in A5.5.

A6.6 Removal

Except where fitted permanently on the vehicle, equipment may be removed from a vehicle at a depot or on site.

ATWS

- The ATWS Installer will carry out the duties listed in A4.6 in respect of equipment removed on site.

LOWS

- The LOWS COSS will carry out the duties listed in A5.6 in respect of equipment removed on site.

A7. Maintenance

Maintenance of TWS will be undertaken in accordance with the manufacturer's requirements. No maintenance will be undertaken when the system is being used for warnings unless such maintenance is of a minor nature and will not impair the ability of the equipment to provide timely warnings.

Appendix B - TWS Organisational Responsibilities

Responsibility for the safe operation of TWS is shared between several different organisations. A single company may discharge the responsibilities of more than one organisation (e.g. A TWS Manufacturer could also act as a TWS Owner, Employer of TWS Users and Training and Competence Assessment Supplier). The following table indicates the division of the main responsibilities:

ORGANISATION	RESPONSIBILITIES
Employers of TWS users	• Ensure TWS users hold current competence certification relevant to the roles they are required to undertake • Ensure records are maintained of each user's employment of their specific TWS competence. • Ensure users make sufficient use of the equipment in a working environment to maintain their specific TWS competence. • Ensure controlled copies of up to date TWS operating instructions are made available to TWS users • Have systems in place to ensure safe planning, installation and operation of TWS • Report and, if required, investigate accidents and incidents involving TWS and co-operate with investigations into them • Ensure users of radio based TWS equipment comply with the conditions of the TWS radio licence.
Manufacturers	• Submit a product safety case to Network Rail for acceptance. • Consistently produce equipment compliant with the requirements and specifications in the accepted product safety case for the TWS concerned • Provide up to date TWS operating instructions, including any specified operating restrictions • Provide a Training and Competence Assessment Scheme in respect of all accepted TWS • Issue controlled copies of up to date TWS Operating Instructions and, when required, Urgent Operating Notices (Safety Bulletins) to TWS owners and Network Rail • Provide a maintenance service for equipment that has received Network Rail product acceptance • Ensure traceability of main items of equipment through the use of serial numbers • Approve Training and Competence Suppliers in respect of their TWS • Licence TWS Trainers and Competence Assessors in respect of their TWS.

ORGANISATION	RESPONSIBILITIES
Network Rail	• Review and, where satisfactory, accept the product safety cases for TWS, including any associated Training and Competence Assessment Schemes and Operating Instructions, submitted by Manufacturers. • Provide guidance on industry standards aspects that need to be covered in Training and Competence Assessment Schemes • Ensure TWS Owners supplying TWS for use on Network Rail infrastructure are accredited through the Link-Up Scheme. • Manage the TWS radio licence issued by Ofcom and provide copies of the licence to manufacturers and owners of radio based TWS equipment. • Ensure wrong side failures of TWS are fully investigated and corrective actions are undertaken to prevent recurrence.
Training and Competence Assessment Suppliers	• Be approved by the manufacturer to provide training and assessment services covering TWS roles for one or more systems • Have fully operational TWS and test track available to enable trainees to get practical experience through training courses • Ensure there are no more than 8 trainees on any given TWS training course. • Ensure that an Internal Verifier meeting the competence requirements specified in Appendix F sub section F11 verifies a minimum 10% sample of all assessment records (course registers, theory assessment answer papers, assessor records of practical assessment) per annum.
TWS Owner	• Ensure TWS equipment is stored, maintained and transported in accordance with the Manufacturer's instructions • Ensure controlled copies of up to date TWS operating instructions are made available to the employers of TWS users • Ensure details of the conditions of the TWS radio licence are made available to the employers of radio based TWS users • Only issue equipment which is in a fit for use condition • Arrange maintenance of equipment as required • Co-operate with investigations into accidents and incidents involving TWS

Appendix C – Functional and Technical Requirements

CI. Acceptance for use on Network Rail Infrastructure

Functional Requirements

- Systems shall successfully complete the Network Rail product acceptance process before being used on Network Rail infrastructure.

Technical Requirements

Product Acceptance Process

In order to gain product acceptance, the Manufacturer shall submit the following documents to Network Rail for review:

- A Product Safety Case
- Operating Instructions
- A Training and Competence Assessment Scheme

Details of the acceptance process are set out in Network Rail Company Standard RT/LS/P/029 (Product Acceptance).

Following the initial acceptance of a system and issue of a product acceptance certificate, outline details of any proposed changes to TWS configuration or application shall be submitted to Network Rail HQ Acceptance Services prior to their implementation. Network Rail shall determine whether the changes require to be supported by a product safety case or other information before they are accepted.

Any deficiency affecting product quality, functionality or safety integrity shall be notified in writing to Network Rail HQ Acceptance Services within 48 hours, including details of corrective actions undertaken or proposed. This is in addition to any immediate action taken in response to a wrong side failure (see D9).

Structure and Content of a Product Safety Case

Details of the techniques to be employed and the suggested structure for a product safety case are covered in Engineering Safety Management (Yellow Book).

The product safety case shall state clearly:

- Whether the TWS is new to Network Rail or a change of configuration or application is being proposed for an already accepted product; and
- What is being sought from Network Rail (e.g. full acceptance or authority to trial under controlled conditions)

Network Rail will normally require a new TWS to be trialled on its infrastructure before being accepted.

The product safety case shall contain a coherent argument to demonstrate that the TWS is fit for purpose in the UK environment and that all associated risks have been controlled so far as reasonably practicable. The product safety case shall include:

- A comprehensive description of the system, including the principles of operation, the major components, brief development history and details of any railways where it is already in use. It shall also contain details of how the system is to be used on Network Rail infrastructure.
- Details of the Reliability, Availability, Maintainability and Safety of the TWS
- The operating conditions and restrictions that will apply in the Network Rail environment.
- A demonstration that the TWS has been analysed for all credible failure modes and the associated risks have been reduced to ALARP
- A demonstration that TWS is compatible with Network Rail infrastructure (see below for details) and that all credible risks arising from interference to or from Network Rail's infrastructure have been identified and reduced to ALARP.
- A demonstration that the TWS meets the Technical Requirements specified in this Appendix. Where a TWS does not meet these requirements, the safety case shall contain a demonstration that the risks associated with non-compliance are ALARP.
- Evidence from any trials in the UK environment. This shall include details of the performance against the objectives set for the trials and feedback on the acceptability of the equipment to TWS users and track workers.
- Details of a human factors assessment conducted to confirm the ability of users to operate the equipment safely in accordance with its design intent and of track workers to wear any personal warning equipment with reasonable comfort while carrying out their duties and to respond promptly to warnings and fault alarms.
- A suitable and sufficient assessment of any new or changed risks arising from the proposed application on Network Rail infrastructure (including installation, operation, maintenance and removal), including details of the controls necessary to reduce these risks to ALARP.

- Demonstration that the TWS as a whole, when set up and operated in accordance with the operating instructions, will meet or exceed the safety target for TWS specified below.
- Demonstration that any personal warning devices are compatible with any personal protective equipment which might reasonably be required (e.g. safety helmets, ear defenders).
- Demonstration that any TWS using radio transmission meets the specific requirements detailed in sub section C6.
- Details of the required maintenance arrangements for the TWS, including service frequencies, assurance processes and repair arrangements. Details of any licensing arrangements of UK agents by the manufacturer or supplier to maintain TWS should also be included.
- A description of how the manufacturer will provide assurance that all models of the TWS will be built consistently to the same standard and have the same functionality and reliability.

Use of TWS Mounted on Rail Vehicles

This application will require an amendment to the product acceptance of any TWS equipment that has been accepted by Network Rail on the basis that it will not be fitted on vehicles.

Where it is proposed to fit TWS on rail vehicles, the user shall provide a demonstration to Network Rail HQ Product Acceptance Services that:

- Noise/light associated with operation of the vehicle will not render the TWS warnings ineffective.
- Electro Magnetic Interference from the TWS equipment will not adversely affect the vehicle or its on board equipment.
- Electro Magnetic Interference from the vehicle or its on board equipment will not compromise the integrity of the TWS equipment.
- The existing vehicle acceptance of any rail vehicle on which the TWS is fitted will not be compromised. It should be noted that if it is intended to incorporate TWS as a permanent fixture on a rail vehicle a suitable entry will be required in the Vehicle Acceptance Body certificate for the vehicle concerned.

Cross Acceptance

Where a TWS is new to the UK and has not been accepted for use elsewhere, the product safety case shall incorporate a safety argument 'from first principles'.

Where a TWS has been accepted for use elsewhere, a cross acceptance safety argument may be applied. In this case, the scope of the product safety case may be limited to addressing only those risks that are specifically associated with the system's deployment on Network Rail infrastructure. Manufacturers wishing to use a cross acceptance argument should request early guidance from Network Rail HQ Acceptance Services regarding the scope of the product safety case required.

Evidence of compliance to requirements of other railway administrations may be offered:

- For the whole system, or
- For parts of the system.

It should be noted that the use of TWS on other railway administrations is likely to vary from application on Network Rail's infrastructure (e.g. rules of use, type of traction current, train detection systems). It follows that evidence of such use alone is unlikely to provide an acceptable product safety case demonstrating suitability for use on Network Rail's infrastructure.

Any cross-acceptance evidence (e.g. certificates of acceptance from recognised independent testing bodies such as TÜV) and/or details of acceptance from other railway administrations shall be provided in English or with an English translation. The safety case shall state unequivocally exactly what has received prior approval by such bodies or administrations.

Independent Assessment of Safety Cases

The product safety case shall contain or be submitted with an independent assessment that has been carried out in accordance with the principles laid out in Engineering Safety Management (Yellow Book).

The purpose of the assessment shall be to demonstrate that the safety case is complete and fit for purpose. It should be noted that there may have to be several iterations between the assessor(s) and the sponsor of the safety case in order to close out issues before the safety case is submitted to Network Rail.

Reliability

The minimum reliability target for a complete installed system shall be a Mean Time Between Failures (MTBF) of 5000 hours of operation. Within this context any fault that prevents the system being used shall be considered a failure except where the fault has arisen from misuse or inadequate maintenance of equipment. Equipment shall be designed to meet its reliability target over its expected service life of at least 10 years.

Safety Target

TWS equipment shall be certified by a recognised independent testing body (such as TÜV) as meeting the safety target of at least SIL 3 in accordance with IEC 61508.

Operating Instructions

Each user shall have access to a current, up-to-date version of system operating instructions relevant to the equipment being used.

These instructions shall be written in English and sufficiently comprehensive to provide competent TWS users with a source of reference for use when carrying out their roles. The style and content of the instructions shall be suitable for the persons using them with appropriate use of colour and diagrams.

As a minimum, operating instructions shall include details of:

- Planning requirements for the equipment
- How the equipment works under normal conditions
- How the equipment works in fault conditions.
- How to install/set up and operate the equipment
- Any operating conditions or restrictions imposed by Network Rail on use of the TWS, including the general operating conditions and restrictions detailed in Appendix D of this document and the system specific conditions and restrictions specified in product acceptance certificates. These may be provided as an appendix to a general international set of instructions provided there is no contradiction between the two documents.
- What to do in the event of an accident, incident or failure involving the equipment

Operating instructions issued to ATWS Planners shall include details of any delays inherent in the system including equipment delays in detection of trains, processing the detection data and activation of warning devices and human response delays associated with the use of LOWS Lookout. Where radio is used as a transmission medium any delays inherent in the process of verifying data messages shall also be included. This information is required to ensure that adequate warning time is planned.

Training and Competence Assessment Scheme

The Training and Competence Assessment Scheme shall comply with the requirements specified in Appendix F.

Electric Traction Systems

The system shall be compatible with electrification systems as applied to Network Rail Infrastructure. It will be installed on lines electrified with the Network Rail standard systems of 25kV AC and 1500V DC overhead, 750V DC third rail and 750V DC third/four rail systems. TWS will also be installed next to lines electrified with the Eurotunnel 25kV AC overhead system, the London Underground third and four rail system and metro 750V and 1500V DC overhead systems. TWS shall be able to work correctly within all these environments.

Interference with Signalling and other Systems

The system shall not interfere, by means of electromagnetic interference or any other effect, with the operation of other fixed or moving equipment.

The system shall be designed so as not to cause any reduction in the safety and efficiency of trackside electrical and electronic systems. The following list of systems is not exhaustive but is included to show the range to be considered:

- Hot Axle Box Detectors
- Axle Counters
- Automatic Train Protection
- Point Heating
- TCAIDs (see below for further information)
- Insulated rail joints
- Level Crossing predictors
- AWS
- TPWS (see below for further information)
- Automatic Power Control
- Tilt Advisory and Supervision System
- Level crossing treadles
- Track circuits, including jointless types
- Wheel Impact Load Detectors
- Relay or computer based interlocking systems including SSI
- Train radio systems, including CSR, IVRS and GSM-R

TWS Manufacturers should note that devices known as track circuit assister interference detectors (TCAIDs) exist at certain locations on Network Rail infrastructure. These receive electromagnetic radiation in the range 150kHz – 180kHz at up to 10w power output from a transmitter located on certain trains in order to ensure a track circuit is actuated. TCAIDs could affect certain devices within a TWS and should therefore be considered in the TWS product safety case.

In respect of the train protection warning system (TPWS), a TWS shall not emit any frequencies between 60 KHz and 70 KHz. Any emissions either by design or as a result of uncontrolled harmonics from a TWS in this range shall result in a magnetic field component of less than 10 nanoTesla in the four foot. This value must not be exceeded, as a result of cross talk interference feeding the TWS.

Manufacturers should contact Network Rail for any technical data and details of potential interference modes required to enable them to prepare a product safety case.

Conversely, interference from other trackside systems, and from power supplies and traction systems, with the TWS shall not prevent the reliability target of the TWS being achieved.

If constraints on the use and location of TWS components are required to be imposed, each constraint shall be documented in the product safety case and these operating restrictions shall be included in the system operating instructions and training of personnel responsible for the planning, installation and operation of TWS.

C2. System Level Requirements

Functional Requirements

- When installed correctly the system shall issue a timely warning to workers on or near the line on the approach of a train and cancel the warning when the train has passed the site of work.
- System faults shall be detected automatically by the system and made known to the System Operator and, in the case of safety critical faults, to all people relying on the system for warning of trains.

Technical Requirements

ATWS Requirements

Means shall be provided to:

- Detect the approach of trains automatically (see sub section C3 for more details)
- Carry out any necessary processing of that detection data (see sub section C4 for more details)
- Initiate warnings to workers working on or near the line automatically (see sub section C5 for more details)
- Cancel warnings when the train has passed the site of work (see sub section C4 for more details)

LOWS Requirements

There shall be the means for the warning to be initiated manually by a LOWS Lookout positioned either at the site of work or remotely where a conventional Distant Lookout would stand. The system shall cater either for a single LOWS Lookout or for more than one LOWS Lookout to be able to initiate warnings (see sub section C3 for more details).

There shall also be means for the LOWS COSS to cancel warnings at the central unit when the train has passed the site of work (see sub section C4 for more details).

System Faults

TWS shall be designed as a fail safe system that monitors the integrity of its operation at the time of switching on and continuously through the period of its use. System faults shall be detected automatically by the TWS.

Non safety critical faults requiring attention but which do not impair the system's ability to issue timely warning of approaching rail vehicles shall cause the system to issue a fault indication or alert to the ATWS Operator, LOWS COSS or LOWS Lookout, as appropriate.

Any safety critical faults shall cause the system to issue a fault alarm to the ATWS Operator, LOWS COSS or LOWS Lookout, as appropriate, and all people being warned. When a fault alarm has been raised, the alarm shall continue until either the fault is rectified or the system is switched off.

Power supply arrangements (see sub section C7) shall ensure that a fault alarm continues for sufficient time to enable all people to move to a position of safety.

The fault alarm shall either be independent of the normal means of giving warning or there shall be adequate redundancy in the normal warning devices, either by quantity of provision or by design of personal units, if the same device gives both warnings and fault alarms.

Operation of the system in "night mode" (e.g. when any collective, acoustic warnings have been de-selected to prevent annoyance to lineside neighbours) shall not reduce the system's ability to give an acoustic fault alarm, where this is the normal method of issuing fault alarms.