UGL REGIONAL LINX

TRACKSIDE MONITORING EQUIPMENT

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CRN SM 001

LINKING COMMUNITIES. CONNECTING CUSTOMERS.

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Document Control

Function	Position	Name	Date
Approver	A&E Manager	Lucio Favotto	27/01/2022

Revision	Issue Date	Revision Description
1.2	24/01/2022	UGLRL Operational Standards Template applied
2.0	27/01/2022	First approved and issued UGLRL version

Summary of changes made from previous version

Section	Summary of change
All	This document is based on the previous rail infrastructure maintainer (RIM). Full revision history is available on request from UGLRL.

1 Introduction

Trackside monitoring systems can be categorised into three areas:

Category 1. Those that directly monitor the safety of the infrastructure, and for which train drivers must be given an "all clear" in order to proceed.

These devices include embankment slip or rock fall detectors.

Category 2. Those that provide additional monitoring of trains but for which a failure of the equipment need not delay traffic.

These devices include hot box detectors, dragging equipment detectors, structure gauge and high load detectors, wheel impact detectors, and train weighing systems.

Category 3. Those systems that provide data to engineering and/or operations to assist in environmental monitoring and decision making.

These systems include rainfall monitoring and remote temperature sensing.

In both categories 1 & 2 various means may be provided in order to convey the information to train drivers. These generally are:

a) By direct interconnection to the vital signalling or Safeworking system

b) By indication to a Network Control Centre to permit the Network Controller to take the appropriate action via the signalling or train radio

c) By digitised voice on the driver's train radio.

d) By automated message and alarm via the ICE train radio

Each of the various options requires slightly different treatment in the layout of the equipment.

This document describes the various configurations, the responsibility of the installation personnel, and the procedures to be followed to ensure a consistent and acceptable installation.

2 Slip Detectors

These detectors may take a variety of forms, with the embankment slip detector being the most common installation (on the Illawarra line within the NSW Trains area of the Sydney Trains network) and with rock fall and ground heave installations also in place.

These detectors directly impact on the running of trains and hence need to be designed to be reliable and with a high degree of system integrity.

2.1 Detection Devices

Detectors must always comply with the following requirements:

2.1.1 Micro Switches

To be sealed, waterproof and high-quality mechanisms.

2.1.2 Two Micro Switches

Must always be used to maintain system integrity should one fail to operate, and to double switch the detection circuit.

2.1.3 Detectors (Latching Out Capabilities)

Must mechanically latch out when operated to avoid any possibility of automatically resetting with a collapsing formation, and to simplify circuit arrangements.

2.1.4 Mechanical Plunger or Operating Mechanism

Is to be calibrated for ready adjustment. The calibration is to indicate the distance the mechanism is engaged from the tripping position.

2.1.5 Detectors (Construction Material)

Must be constructed of corrosion resistant material (brass, stainless steel etc) and be maintained in position by a spring tension or other suitable arrangement.

2.1.6 Detectors (Housing)

Should be housed in a sturdy steel case, hot dipped galvanised and with a suitable, lockable lid for maintenance access, and vandal protection.

2.1.7 Drawings

Refer to Drawings M4: 89-051A and M4: 89-065A for details.

2.1.8 Other Detection Devices

May be suitable for different applications (e.g. Rock fall installations) and providing they meet the functional requirements above they may be submitted for type approval.

2.1.9 Equipment

Must be designed to withstand track stresses and be secured from outside interference (such as manual tripping by vandals) as far as possible.

2.2 Detector Indicator

A green LED is to be provided in the adjacent equipment location. This LED is to indicate when the slip detector is normal and is used by operations and maintenance personnel and also drivers at Digitised Voice Installations to check the detector status. The green LED must always be wired from the detector circuit so that it will always indicate the detector position under most other failure conditions.

2.3 Construction

The slip detector is mounted in a weatherproof box bolted to a concrete block on one side of the railway line on the unstable embankment. An anchor point is installed in a weatherproof box on the opposite side of the track. Connecting the two boxes is a stainless steel cable running through a PVC pipe. The concrete blocks are cast 0.5m deep in the ground and to a height equivalent to the bottom of the adjacent track sleepers.

The slip detector consists of a specially shaped cylindrical piston in a stainless steel tube. Two micro switches are inserted into the bore of the tube to switch signalling circuits as the piston moves along the tube. A section of piston protrudes from the rear of the detector and has lines inscribed on it 10 millimetres apart to provide a visual indication of the setting of the detector. The front of the piston has a hole with grub screws for securing the connecting stainless steel cable. A spring presses against the front of the piston to maintain tension on the connecting stainless cable and for failsafe operation of the detector should the cable be disconnected or broken.

The anchor point consists of a threaded eye bolt on a bracket in a weatherproof box bolted to the concrete block. The stainless steel cable is secured to the eye bolt by means of a U-bolt. Adjustment of the detector is then made by altering the length of cable between the anchor and detector.

Two concrete bases are required, one for each side of the track over the unstable embankment. Typically one block is installed on the unstable section and the other on stable ground beyond the slip. The slip detector box can be bolted on either side of the track and is usually placed with best access to the existing signalling cable run. A 100mm PVC sewer pipe is run from the detector box across the track to the other block which has the anchor box. A 25mm PVC agricultural pipe is run through the sewer pipe terminating at a fixed point at the detector box and to an expansion fitting at the anchor box.

A 3.5mm stainless steel cable is run through the 25mm PVC pipe. It is held by two grub screws in a hole at the front of the detector piston and U- bolted to the eye bolt at the anchor.

2.4 Adjustment

The detector is adjusted by altering the length of cable from the anchor end to the detector to show the required number of calibration lines at the rear of the detector. There are eleven lines inscribed ten millimetres apart on a section of the piston which protrudes from the back of the detector.

The contact actuating section of the detector piston is 100mm long. A failsafe requirement is that the switches would trip for both extension and contraction of the cable. Typically the detector is adjusted for extension detection so for a 40mm adjustment the switches would trip when the distance between the two blocks increased by 40mm. At this setting should the distance between the blocks be reduced (or cable slip etc.) by 60mm the return spring pushes the piston past the back tripping point.

The detector piston will be locked in position when it is pulled past the tripping point. This is to ensure a definite trip when operated and must be manually reset by removing and reinserting the micro switches.

2.5 Maintenance

During maintenance, the correct operation of each micro switch must be established. This is to be done by removing the switches and manually operating each switch in turn and watching the end function follow.

The plunger must be checked for freedom of movement, and the whole system inspected for any damage.

Any movement in the calibration should be investigated by the CRN Track and Civil Engineer.

The slip detector and associated equipment are made from corrosive resistant metals and plating but must still be kept as dry as possible. The penetration of ground water into the detector would leave deposits and could cause jamming of the mechanism. As the equipment is mounted close to the ground adequate drainage must be maintained in the immediate area to prevent ground water entering the detector or anchor box.

The PVC pipes and cable passing under the track must be kept free from damage or distortion. The cable between the blocks must be able to move freely without binding on the PVC pipe. The 100mm pipe should be left visible at each end to avoid damage by track tamping machines.

It is not expected the slip detector mechanism will experience much wear except for loss of tension in the return spring and micro switch plungers. At the monthly maintenance visit the detector should be tripped by pulling the cable at the anchor point. This will reveal if any problems are developing with the cable or spring as the movement should be smooth and spring tension sufficient to keep the cable taut and push the detector piston fully back when released.

At regular intervals it is recommended that the detector be disassembled for cleaning and to check for any wear. The cable retaining screws in the piston should also be checked for tightness and "locktited" if loose.

2.6 Equipment Out of Use

When the equipment is out of service the system is to be formally booked out of order using an Infrastructure Booking Authority (IBA) form NRF 003.

The Track Engineer will be responsible for ensuring that any protection deemed necessary is arranged for the period the equipment is booked out of use.

The emergency switch (if provided) is used for disconnecting the system.

When being booked back into use the equipment is to be thoroughly tested before certification.

2.7 Detectors Interlocked with Signalling

2.7.1 System Circuit Design

All circuit design and installation work for slip detectors which are to be interlocked with the signalling system is to be done in accordance with the various Signals Standards Specifications and Procedures.

All designs must be approved by CRN.

2.7.2 System Configuration

The slip area is to be identified by its kilometrage and the words 'Slip Board' on a notice board with black lettering on a yellow background. The kilometrage is to be rounded to the nearest 100m.

The Slip Boards are to be located close to, but at a safe distance from, the slip area, as nominated by the Civil Engineer. (This distance is nominally 50m but may vary for the particular circumstance.)

Signals interlocked with the slip detector are to be fitted with a notice board (black letters on silver background) inscribed "Slip Area - Drivers must not pass this signal at stop until authorised by the Signaller."

The arrangements are shown in Diagram 1.

The local control panel and main control centre shall be provided with indicator lights to indicate the status of the slip detector.

A green light is displayed when the slip detector is normal. A red light indicates an embankment slip or equipment failure. Should the system be disconnected through use of the emergency switch, in the 'Override' position no lights will be displayed.

An audible alarm is to sound when the indicators change status. The alarm is to be suppressed by depressing an alarm cancel pushbutton. This may be the same audible alarm as already provided for other purposes on the control panel.

A telephone is to be provided near the slip site.

2.7.3 Multiple Slip Sites in Close Proximity

Where multiple slip sites exist in close proximity, the alarms and notice boards may be arranged to treat all the slip detectors as a single installation.

Each slip detector is to be individually identified by its grouped kilometrage, and then the letters A, B, C etc for each different detector e.g. 104.6A, 104.6B etc. The 'A' detector is to be nearest to Sydney.

Each detector is fitted with its own green LED drivers indicators in the emergency switch box on site, Diagram 5, but at the Local Control Panel and Main Control Panel, one light will indicate all detectors at that site.

2.7.4 Emergency Switches

A key locked 2 position emergency switch is to be provided on the equipment location to permit the slip detector to be removed from circuit, when formally booked out of use or during maintenance and testing.

Where multiple slip detectors are employed, one emergency switch is provided for the total slip site. Should one of the detectors require booking out of use while the others remain in use arrangements must be made for the electrician to bridge the contacts in the appropriate detector. An Infrastructure Booking Authority (IBA) form NRF 003 is still required prior to the bridging out of the device.

2.7.5 Standard Circuit Design

The standard circuit design arrangement for an interlocked slip detector is shown in Diagrams 6 & 7.

2.7.6 Operations Instructions

Instructions for signallers, train controllers and drivers are advertised in the Weekly Notice prior to the work coming into use.

Typical instructions are shown in Appendix 1.

Procedures for testing and adjusting of slip detector which are connected to signalling circuits are covered by the Procedures for Safeworking Systems on Track Circuited Lines.

2.8 Digitised Voice Installations

Where there are no signalling systems or signals are too far apart to be able to be practically interfaced with the slip detectors, or in remote areas, digitised voice equipment can be used to convey information to the train.

The system integrity is maintained by drivers not being able to proceed unless an all clear message is received. In the event of no message being received, the driver is to stop his train and check the green indicator light on the equipment housing. If this is showing, then normal running can resume. The fault must be reported to the next convenient signaller or train controller.

2.8.1 System Configuration

The basic arrangements are shown in Diagram 8.

The typical design parameters are shown in Diagram 9.

2.8.2 Circuit Design

It is not necessary to have circuit design approved by the Signal Design Manager for these applications, unless part of the installation (e.g. track circuits) forms any part of an existing signalling installation.

2.8.3 Documentation

Each system installed is to be fully documented and certified as installed to the design documentation by the Signal Engineer.

All documentation is to be on A3 paper to similar standards as described in Standard Specification CRN SC 006 for circuit books.

All design to be in accordance with the standard arrangements shown in Diagram 10.

2.8.4 Digitised Voice Equipment & Radios

2.8.4.1 Digitised Voice Equipment

The digitised voice equipment is considered non-vital and accordingly to ensure system integrity a minimum of two inputs must be utilised to provide a clear indication for the slip detectors. It is preferred that the Digitised Voice Recorder requires an absence of input to initiate the defect message. This is to ensure that, as far as is practical, the system is designed in accordance with fail safe principles.

Where the equipment requires an active input to initiate the defect message, the field equipment shall be configured to operate a relay in the normal (safe) condition. When an unsafe or fault condition exists, the relay is to drop away and provide the active input to the digitised voice recorder. When this arrangement is provided the following details must be incorporated:

- The controlling relay shall be mounted physically as close as is practically possible to the digitised voice recorder.
- At least two drop contract of the relay are to be used to provide the inputs to the digitised voice recorder.
- These two inputs are to be wired through independent circuits (including fusing, wiring and terminations) to ensure that the system is fully redundant.
- During functional testing the system should be thoroughly assessed as to the output that can be expected with the various combinations of inputs that could occur under fault (either open or short circuit) conditions. Any result that tends to decrease the safety integrity of the system shall be protected against by additional insulation, separation of duplication of wiring, or other methods as may be deemed appropriate. Separate digitised voice announcers for the clear and fail messages may be necessary.

The digitised voice equipment shall have the digitised voice message stored on an EPROM or similar. Systems where the message may be lost during power outages (of any duration) or an internal system fault should not be accepted. The equipment is to be provided with adequate lightning and surge protection. Solar powering may be considered for the equipment whereby the system is powered up on the train approach. Where mains supply is available, back up supplies or batteries are not required, unless desired due to the unreliability of the mains supply. If this occurs it may be necessary to provide a supply indicator over the digitised voice system.

The following radio requirements are to be met:

2.8.4.2 Audio Levels

The audio levels between the voice generator and the radio's audio input shall be matched and set at 0dBm.

2.8.4.3 Voice Generator

The voice generator shall provide a "press-to-talk" signal to the radio prior to the commencement of the voice output. It is recommended that a delay of 500 msec to 1 sec be used between these two events to allow stabilisation of the transmitter and portable receiver before the message begins.

2.8.4.4 Broken Squelch

The system shall also be capable of sensing broken squelch resulting from carriers down to a level of 0.3 micro volts from the Antenna feeder. This will be used to key radio and delay radio transmission from detector system for up to 20 seconds. When clear air waves are sensed and/or 20 seconds has elapsed the transmission will be sent. The message shall be sent at least twice.

2.8.4.5 Installation of Radio and Antenna

Installation of the radio, antenna and feeder cable shall be carried out by personnel experienced in this type of work.

2.8.4.6 Radio Base

The radio base shall be of a type approved by the Department of Transport and Communications and shall be capable of a transmitter output of 25 Watts.

2.8.4.7 Radio Transmitter

In addition to clause 5.6, the radio transmitter shall also conform to the following specification as a minimum:

- Transmit Power Rating: Continuously Rated for 25 Watts Output at 45o C.
- Power Level input: Automatic Voltage level control for 10.8 to 16Vdc.
- Protection: Automatic protection against antenna mismatch
- Deviation: +/- 5kHz maximum
- Residual FM Noise: - 50dB
- Distortion: 2.5% maximum
- Audio Response: + 1dB,-8 dB relative to +6dB per octave pre-emphasis 300 to 3000Hz
- Spurious Emission: <2.5 Micro Watts

The transmitter shall be programmed to transmit on the frequency 450.05 MHz with CTCSS tone (sub audible) of 173.8 Hz.

The antenna shall be a unity gain type so that the radiated power is limited to 43 Watts EIRP, and shall be mounted with vertical polarisation at a height between 3 and 10 metres above ground level.

2.8.4.8 Coverage Tests

Formal coverage tests are to be conducted with documented signal strength measurements vs. track kilometrage for the area in which radio reception is required. The Communications Engineer shall approve the proposed transmitter location and signal strengths. Full coverage in the area where messages will be sent and received is required.

2.8.5 Digitised Voice Message Format

The digitised voice message is to be in the following format:

2.8.5.1 Signal Frequency

The system shall be capable of producing a continuous 450.05MHz signal (modulated with 1000 Hz tone) to adjust the radio's deviation and modulation.

2.8.5.2 Transmitted Messages

Immediately after the "press-to-talk" delay, the system will transmit, twice as a minimum requirement the following messages:

Condition	Message Spoken
No Defects Detected	"CRN Slip Detection System"
	"Location"
	"Kilometreage XXX.X" (Selecting all zeros will suppress kilometreage annunciation).
	"Track Name" to be supplied for each location (if double track installation).
	"Slip Site Clear" "Repeat ""Slip Site Clear"
	"Location"
	"Out"
With Defects	"CRN Slip Detection System"
	"Location"
	"Kilometreage XXX.X" (Selecting all zeros will suppress kilometreage annunciation).
	"Track Name" to be supplied for each location (if double track installation).
	"Stop, Stop Slip Detected" "Repeat' "Stop, Stop Slip Detected".
	"Location"
	"Out"

2.8.6 System Testing

The Signal Engineer is to fully functionally test the system prior to commissioning. A formal test plan is to be produced and all testing results are to be fully documented and certified as completed. The Signal Engineer is to store this document in a secure location after commissioning.

2.8.7 Maintenance Instructions for Digitised Voice Equipment

Full details of the maintenance required by the digitised voice system shall be obtained from the manufacturer.

In addition, any parts of the system that have been redundantly wires shall be independently tested to ensure the equipment if fully functional. (This should be done by removing any fuses or disconnect links in each leg in turn and testing the system operation through the other leg).

2.8.8 Operations Instruction

The procedures for drivers, signallers and train controllers are detailed in Appendix 2.

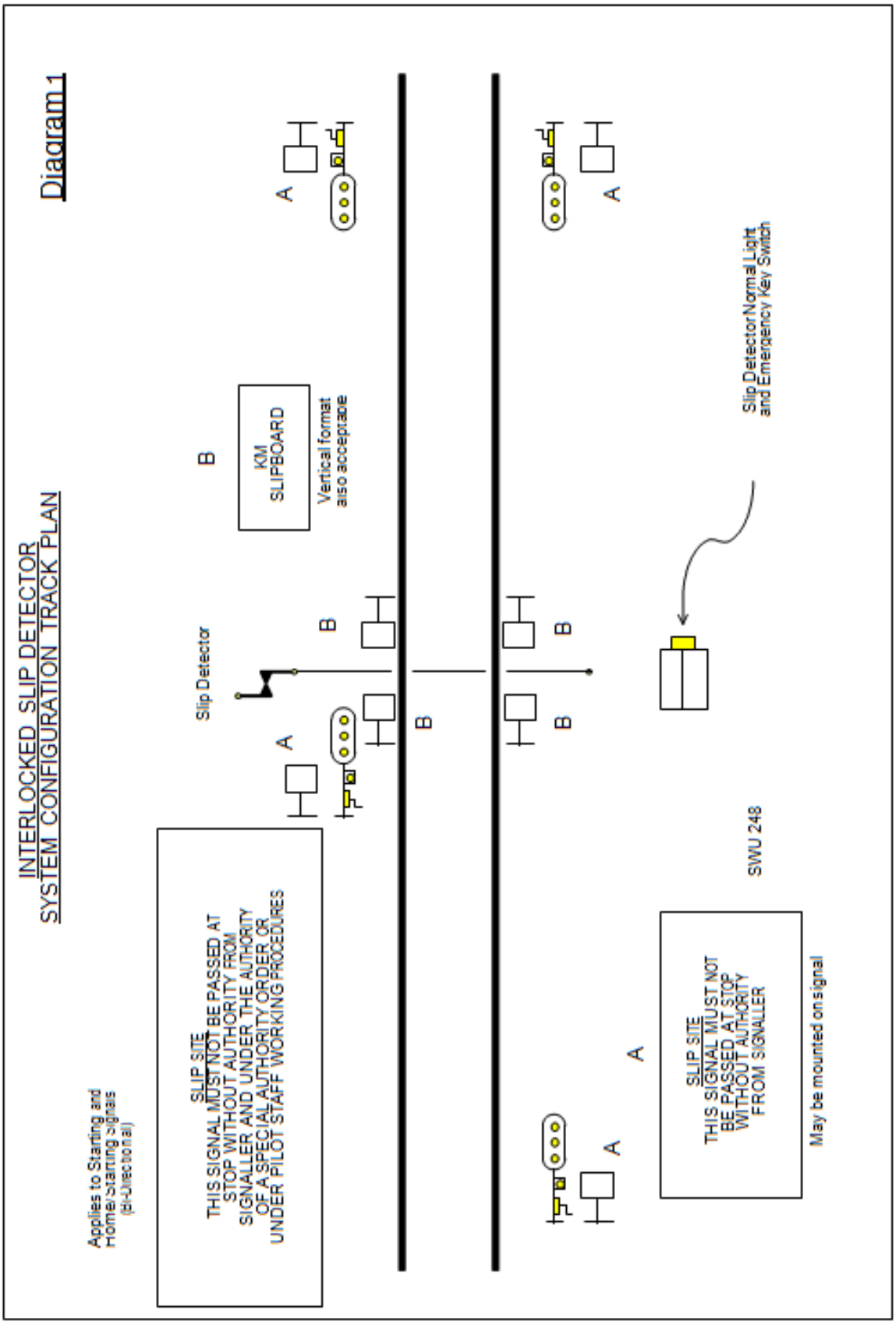


Diagram 1
INTERLOCKED SLIP DETECTOR
SYSTEM CONFIGURATION TRACK PLAN
Applies to Starting and Home/starting signals (Bi-Directional)
SLIP SITE
THIS SIGNAL MUST NOT BE PASSED AT STOP WITHOUT AUTHORITY FROM SIGNALLER AND UNDER THE AUTHORITY OF A SPECIAL AUTHORITY ORDER OR UNDER PILOT STAFF WORKING PROCEDURES
Slip Detector
KM SLIPBOARD
Vertical format also acceptable
Slip Detector Normal Light and Emergency Key Switch
SWU 248
SLIP SITE
THIS SIGNAL MUST NOT BE PASSED AT STOP WITHOUT AUTHORITY FROM SIGNALLER
May be mounted on signal
A
B

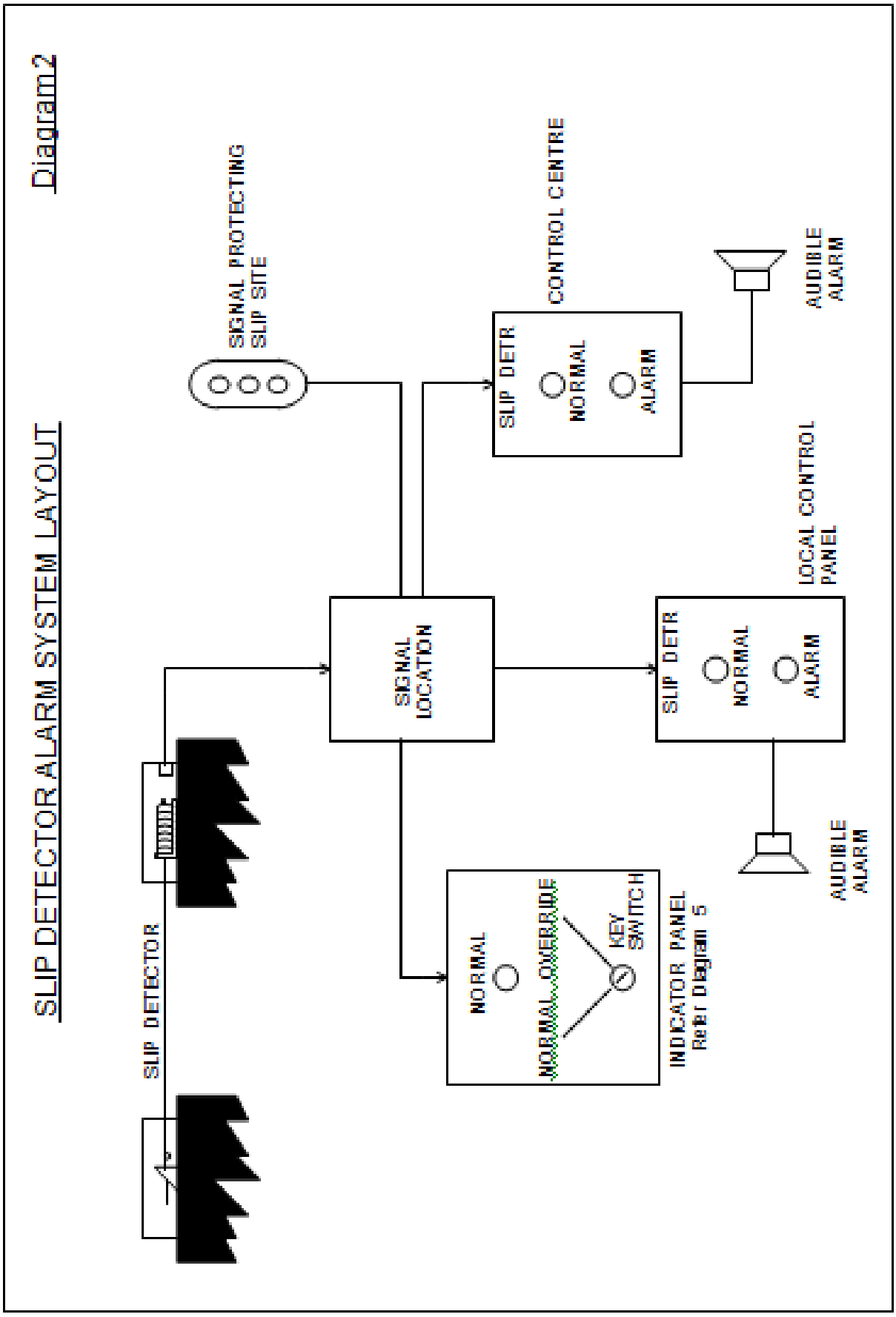
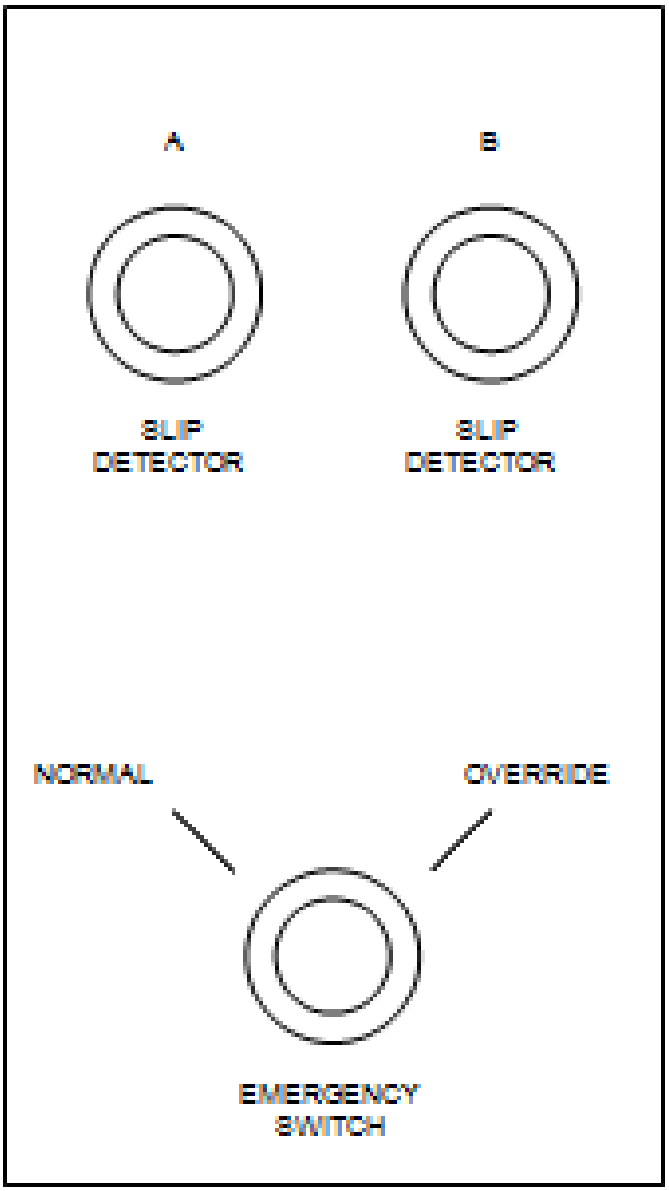


Diagram2
SLIP DETECTOR ALARM SYSTEM LAYOUT
SIGNAL PROTECTING SLIP SITE
CONTROL CENTRE
SLIP DETR
NORMAL
ALARM
AUDIBLE ALARM
LOCAL CONTROL PANEL
SIGNAL LOCATION
SLIP DETR
NORMAL
ALARM
AUDIBLE ALARM
SLIP DETECTOR
NORMAL
NORMAL...OVERRIDE
KEY SWITCH
INDICATOR PANEL
Refer Diagram 5

SLIP DETECTOR EMERGENCY SWITCH TEMPLATE

Diagram 5



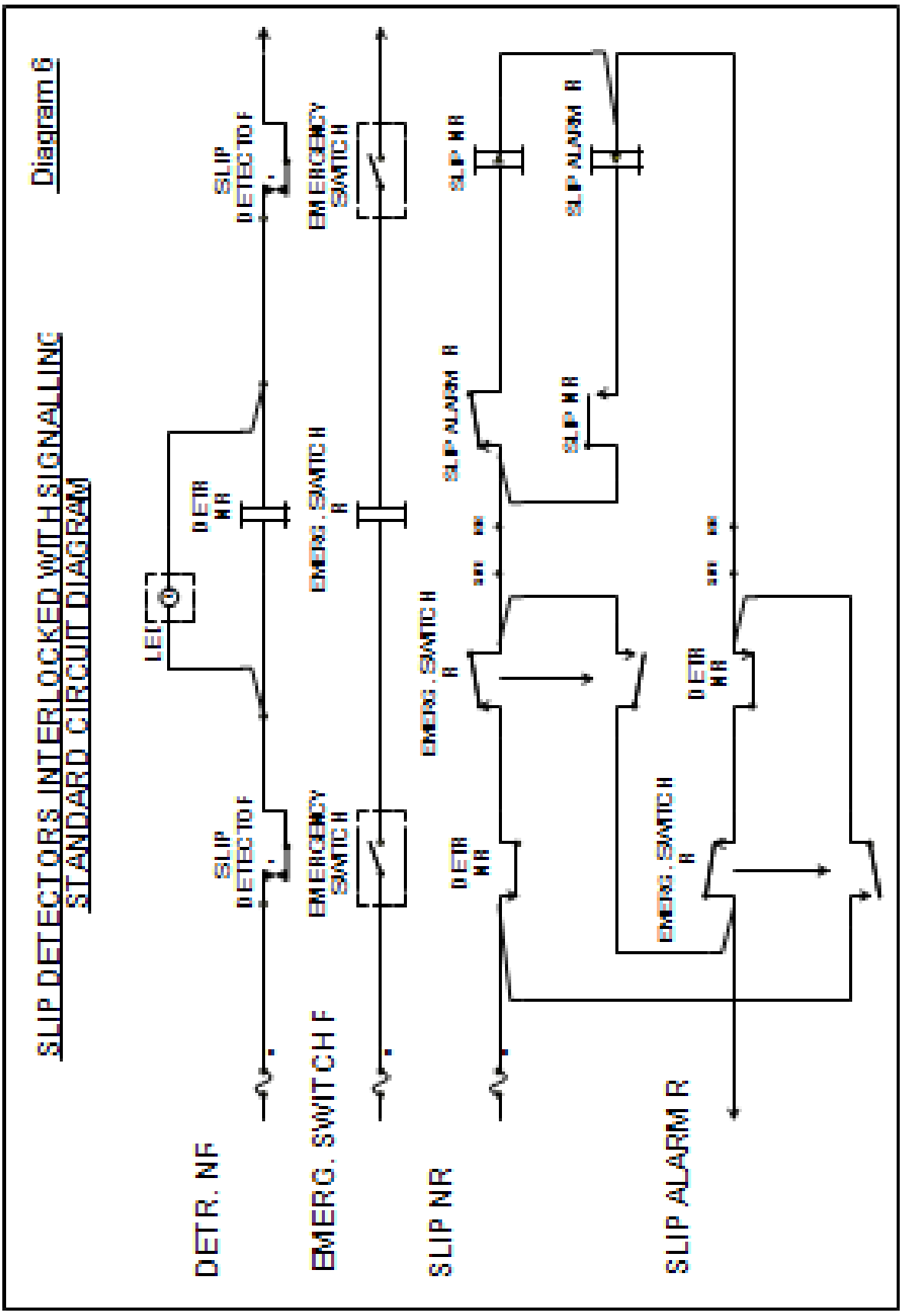


Diagram 6
SLIP DETECTORS INTERLOCKED WITH SIGNALLING
STANDARD CIRCUIT DIAGRAM
DETR. NF
EMERG. SWITCH F
SLIP NR
SLIP ALARM R

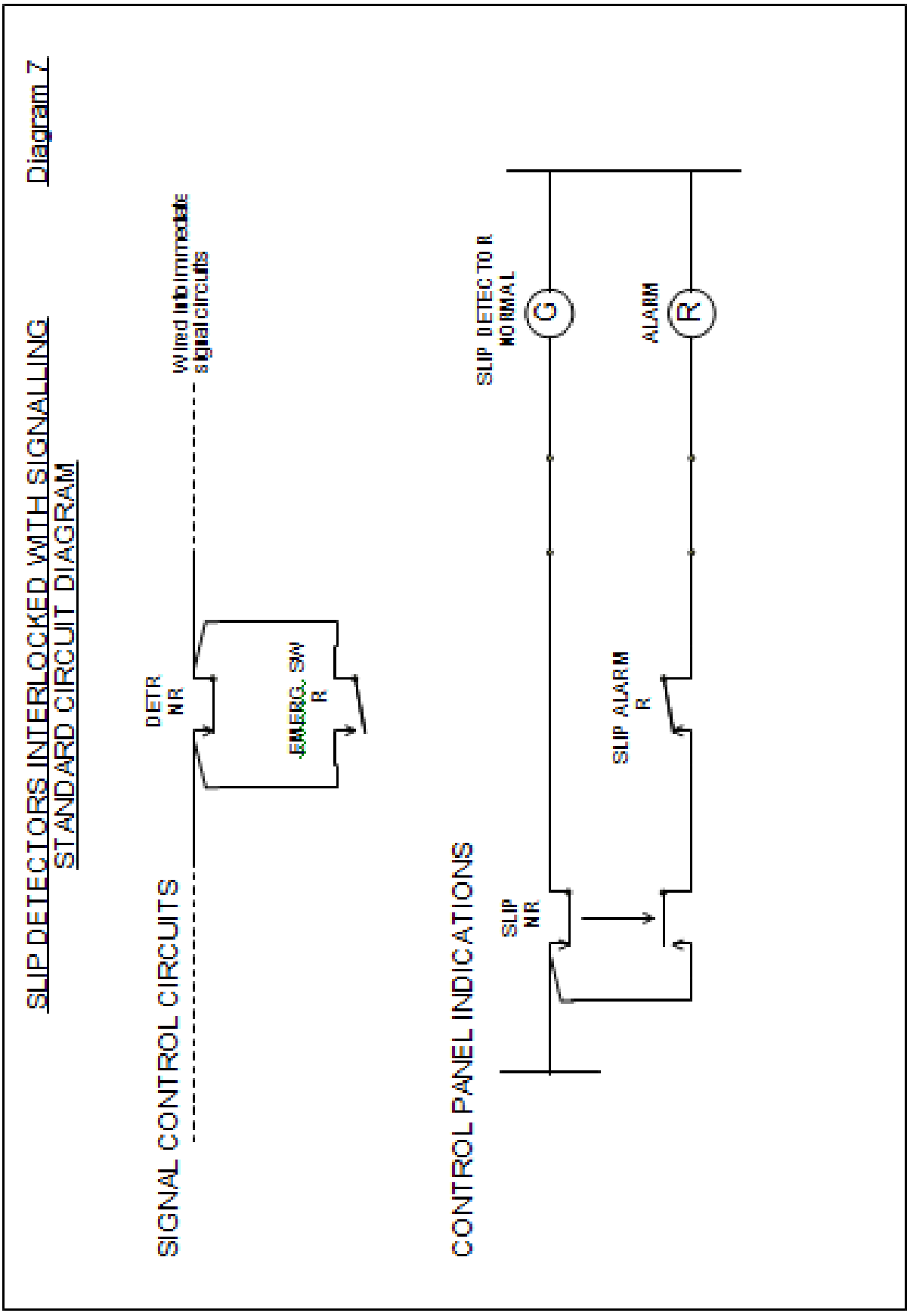


Diagram 7
SLIP DETECTORS INTERLOCKED WITH SIGNALLING
STANDARD CIRCUIT DIAGRAM
Wired into immediate signal circuits
SIGNAL CONTROL CIRCUITS
DETR NR
EMERG. SW R
CONTROL PANEL INDICATIONS
SLIP DETEC TO R NORMAL
G
ALARM
R
SLIP ALARM R
SLIP NR

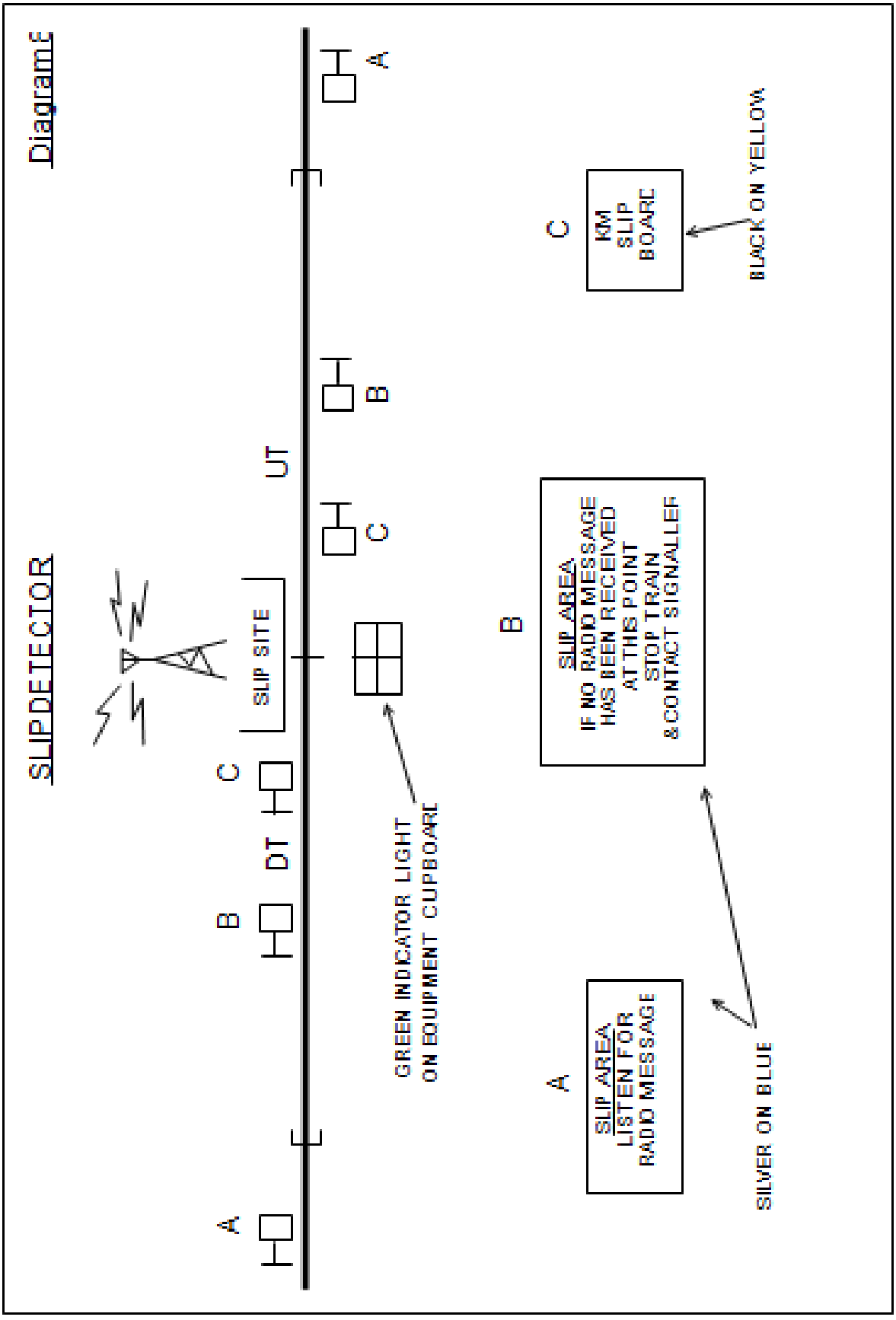


Diagram
SLIP DETECTOR
A
B
C
UT
SLIP SITE
C
B
DT
B
A
GREEN INDICATOR LIGHT
ON EQUIPMENT CUPBOARD
B
SLIP AREA
IF NO RADIO MESSAGE
HAS BEEN RECEIVED
AT THIS POINT
STOP TRAIN
&CONTACT SIGNALLER
C
KM
SLIP
BOARD
BLACK ON YELLOW
A
SLIP AREA
LISTEN FOR
RADIO MESSAGE
SILVER ON BLUE

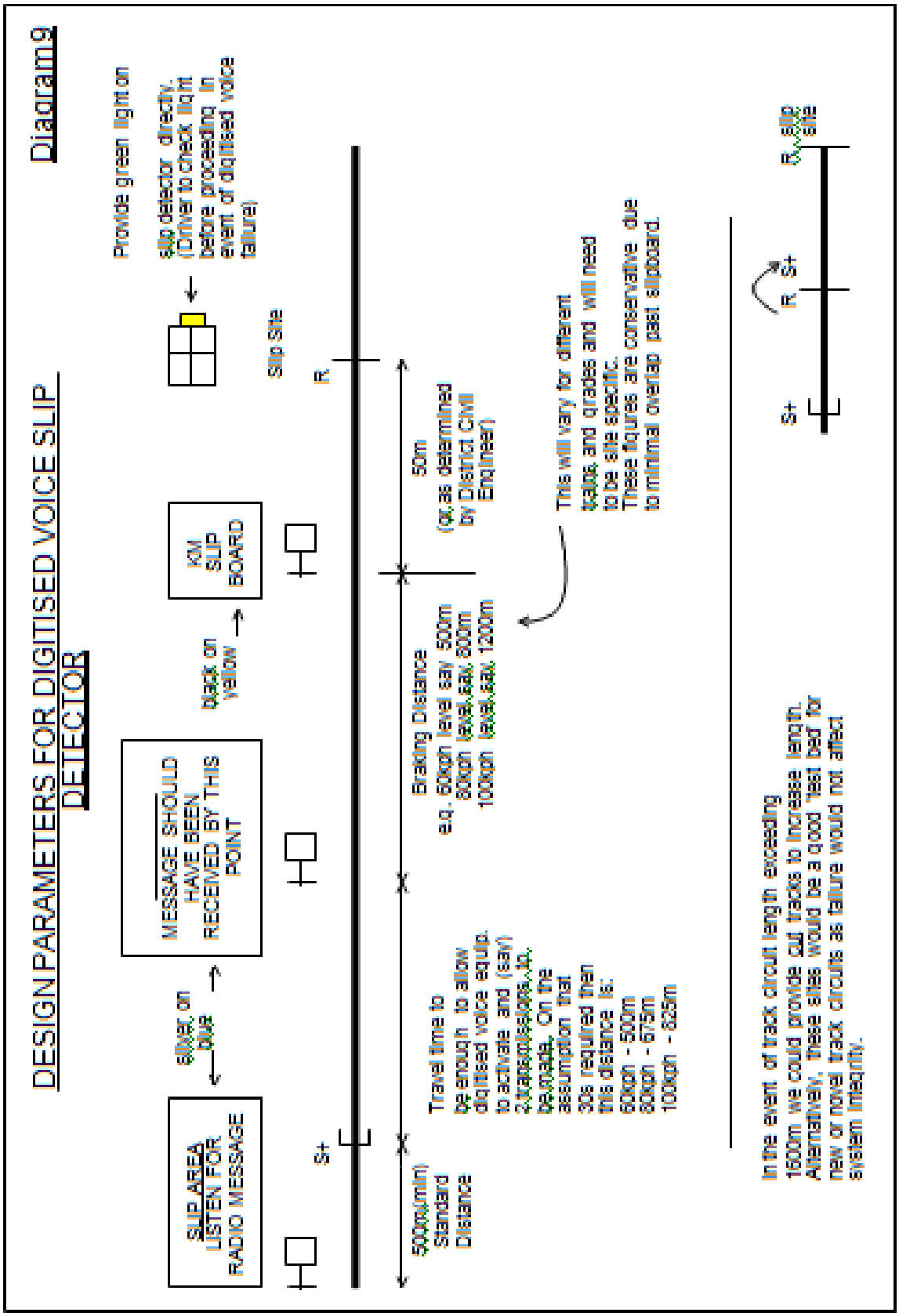


Diagram9
DESIGN PARAMETERS FOR DIGITISED VOICE SLIP DETECTOR
Provide green light on
slip detector directly. (Driver to check light before proceeding. In event of digitised voice failure)
Slip Site
R
KM SLIP BOARD
Black on Yellow
MESSAGE SHOULD HAVE BEEN RECEIVED BY THIS POINT
Yellow on Blue
SLIP AREA LISTEN FOR RADIO MESSAGE
S+
500m/min) Standard Distance
Travel time to be enough to allow digitised voice equip. to activate and (say) 2 transmissions to be made. On the assumption that 30s required then this distance is: 60kph - 500m 80kph - 675m 100kph - 825m
Braking Distance e.g. 60kph level say 500m 80kph level say 800m 100kph level say 1200m
50m (or as determined by District Civil Engineer)
This will vary for different trains and grades and will need to be site specific. These figures are conservative due to minimal overlap past slipboard.
In the event of track circuit length exceeding 1600m we could provide cut tracks to increase length. Alternatively, these sites would be a good test bed for new or novel track circuits as failure would not affect system integrity.
R
S+
R slip site
S+

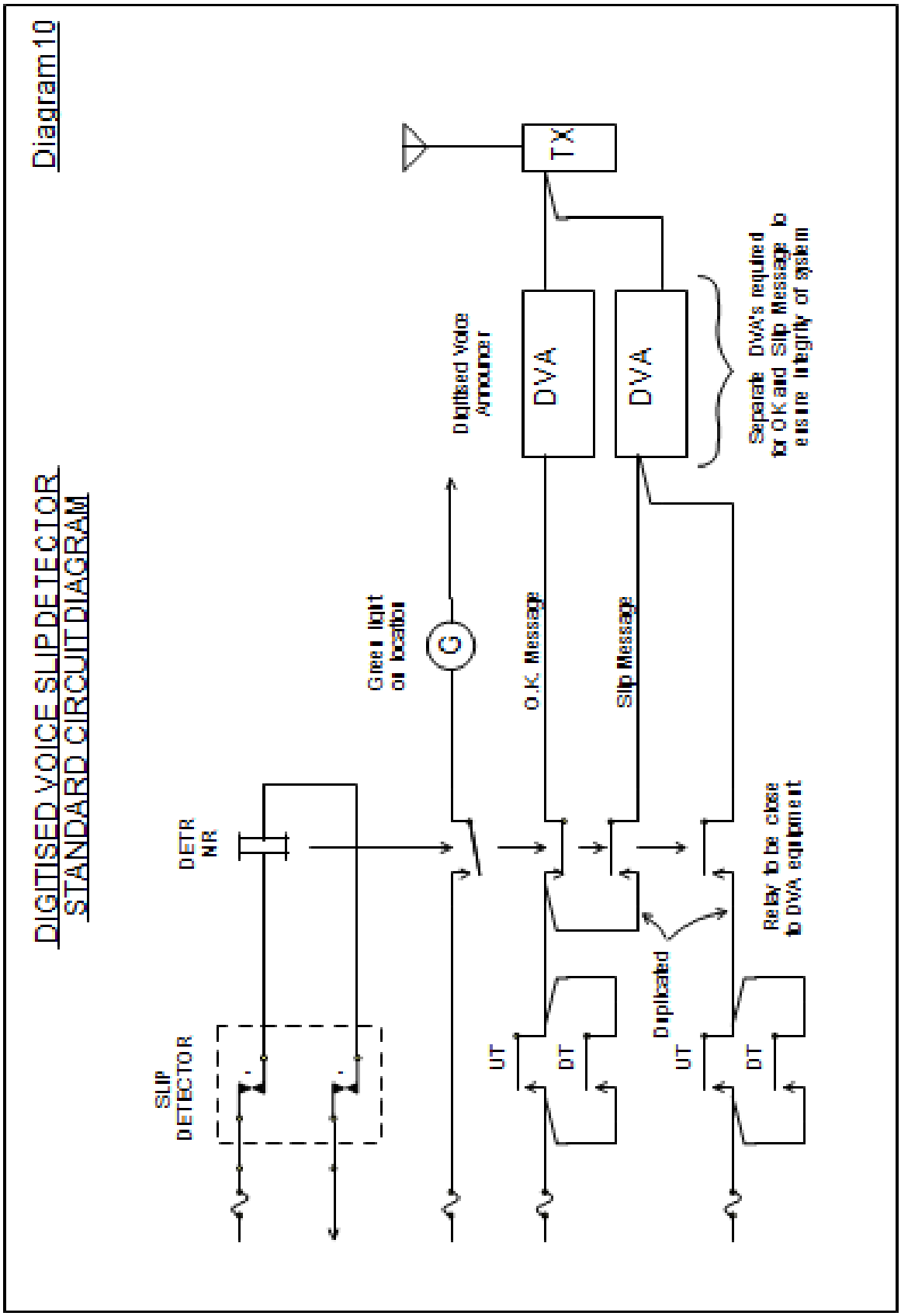


Diagram 10
DIGITISED VOICE SLIP DETECTOR
STANDARD CIRCUIT DIAGRAM
TX
Digitised Voice Announcer
DVA
DVA
Green light on location
G
O.K. Message
Slip Message
DETR NR
SLIP DETECTOR
UT
DT
Duplicated
UT
DT
Relay to be close to DVA equipment

3 Dragging Equipment Detectors

Dragging equipment detectors are utilised to detect the presence of dragging equipment such as brake hoses, defective brake gear or dragging chains that may cause derailment or have other safety implications.

Detectors can be of two types:

- Frangible bar
- Automatic reset

It is preferred that the automatic resetting type always be installed.

For remote installations, the automatic reset version is necessary to avoid callouts.

3.1 Dragging Equipment Detectors Indicated to the Network Control Centre

3.1.1 General Operation

The preferred method is to indicate the dragging gear detector to the controlling signal box. Either type of detector may be utilised for this. On detection of dragging equipment a red light is to illuminate and an audible alarm sound in the signal box. A push button is provided to cancel the audible alarm and reset the detector.

A facility is provided in order to test the alarm by pulling the button.

3.1.2 System Configuration

No special signage is required for the installation. However, consideration is to be given as to how the signaller will contact the train, and additional train radio facilities may be required.

3.1.3 Circuit Design

Dragging equipment detectors are classed as non-vital indication equipment.

Circuits must be in accordance with the standard arrangement shown in Diagram 2

Note: - All instances of use of cable cores, etc, must be advised, to permit updating of the appropriate analysis sheets in the circuit book. No part of the system is to be directly connected to any vital signalling power supply.

All wiring is to be a distinctive colour (blue) and kept separate from any wiring associated with vital signalling.

Where track circuit occupancy is used to prevent false alarms with automatic resetting detectors, then a formal design is required.

3.1.4 Documentation

Each system installed is to be fully documented and certified as installed to the design documentation by the Signal Engineer.

All documentation is to be on A3 paper to similar standards as described in Standard Specification CRN SC 006 for circuit books.

3.1.5 System Testing

The Signal Engineer is to fully functionally test the system prior to commissioning. A formal test plan is to be produced and all testing results are to be fully documented and certified as completed. The Maintenance Signal Engineer is to store this document in a secure location after commissioning.

3.1.6 Operations Instructions

The procedures for drivers, signallers and train controllers are detailed in Appendix 3.

3.2 Digitised Voice Dragging Equipment Detectors

Digitised voice systems are used in remote areas. In these circumstances the automatic resetting variety is required.

3.2.1 General Operation

The system is activated when the train approaches the detector by means of a track circuit. Should the train pass the site and no defect is detected the system will report to the driver via the train radio that no defects were detected. Should a defect be reported the system will prompt the driver to stop and check the train. Signs are erected to ensure that the driver has his radio on in anticipation of a message and to advise him of the latest point where he should have received a message.

Should a message not be received the driver should not stop his train, but continue on and report the failure of the equipment to the control officer or signaller at the next convenient location.

3.2.2 System Configuration

The system shall be configured as shown on Diagram 3. Notice boards shall be silver on blue background.

3.2.3 Documentation

Each system installed is to be fully documented and certified as installed to the design documentation by the Signal Engineer.

All documentation is to be on A3 paper to similar standards as described in Standard Specification CRN SC 006 for circuit books.

3.2.4 Digitised Voice Equipment and Radios

3.2.4.1 Digitised Voice Equipment

The digitised voice equipment is considered non-vital and accordingly to ensure system integrity a minimum of two inputs must be utilised to provide a clear indication for the slip detectors. It is preferred that the Digitised Voice Recorder requires an absence of input to initiate the defect message. This is to ensure that, as far as is practical, the system is designed in accordance with fail safe principles.

Where the equipment requires an active input to initiate the defect message, the field equipment shall be configured to operate a relay in the normal (safe) condition. When an unsafe or fault condition exists, the relay is to drop away and provide the active input to the digitised voice recorder. When this arrangement is provided the following details must be incorporated:

- The controlling relay shall be mounted physically as close as is practically possible to the digitised voice recorder.
- At least two drop contract of the relay are to be used to provide the inputs to the digitised voice recorder.
- These two inputs are to be wired through independent circuits (including fusing, wiring and terminations) to ensure that the system is fully redundant.
- During functional testing the system should be thoroughly assessed as to the output that can be expected with the various combinations of inputs that could occur under fault (either open or short circuit) conditions. Any result that tends to decrease the safety integrity of the system shall be protected against by additional insulation, separation of duplication of wiring, or other methods as may be deemed appropriate.

The digitised voice equipment shall have the digitised voice message stored on an EPROM or similar. Systems where the message may be lost during power outages (of any duration) or an internal system fault should not be accepted. The equipment is to be provided with adequate lightning and surge protection. Solar powering may be considered for the equipment whereby the system is powered up on the train approach. Where mains supply is available, back up supplies or batteries are not required, unless desired due to the unreliability of the mains supply. If this occurs it may be necessary to provide a supply indicator over the digitised voice system.

The following radio requirements are to be met:

- The audio levels between the voce generator and the radio's audio input shall be matched and set at 0dBm.

3.2.4.2 Voice Generator

The voice generator shall provide a "press-to-talk" signal to the radio prior to the commencement of the voice output. It is recommended that a delay of 500 msec to 1 sec be used between these two events to allow stabilisation of the transmitter and portable receiver before the message begins.

3.2.4.3 Broken Squelch

The system shall also be capable of sensing broken squelch resulting from carriers down to a level of 0.3 micro volts from the Antenna feeder. This will be used to key radio and delay radio transmission from detector system for up to 20 seconds when clear airwaves are sensed and/or 20 seconds has elapsed the transmission will be sent. The message shall be sent twice.

3.2.4.4 Installation of Radio and Antenna

Installation of the radio, antenna and feeder cable shall be carried out by personnel experienced in this type of work.

3.2.4.5 Radio Base

The radio base shall be of a type approved by the Department of Transport and Communications and shall be capable of a transmitter output of 25 Watts.

3.2.4.6 Radio Transmitter

In addition to clause 5.6, the radio transmitter shall also conform to the following specification as a minimum:

- Transmit Power Rating: Continuously Rated for 25 Watts Output at 45o C.
- Power Level input: Automatic Voltage level control for 10.8 to 16Vdc.
- Protection: Automatic protection against antenna mismatch
- Deviation: +/- 5kHz maximum
- Residual FM Noise: - 50dB.
- Distortion: 2.5% maximum
- Audio Response: + 1dB,-8 dB relative to +6dB per octave pre- emphasis 300 to 3000Hz
- Spurious Emission: <2.5 Micro Watts

The transmitter shall be programmed to transmit on the frequency 450.05 MHz with CTCSS tone (sub-audible) of 173.8 Hz.

The antenna shall be a unity gain type so that the radiated power is limited to 43 Watts EIRP, and shall be mounted with vertical polarisation at a height between 3 and 10 metres above ground level.

3.2.4.7 Coverage Test

Formal coverage tests are to be conducted with documented signal strength measurements vs. track kilometrage for the area in which radio reception is required. The Communication Engineer shall approve the proposed transmitter location and signal strengths. Full coverage in the area where messages will be sent and received is required.

3.2.5 Digitised Voice Message Format

The digitised voice message is to be in the following format:

3.2.5.1 Signal Frequency

The system shall be capable of producing a continuous 450.05MHz (modulated with 1000Hz tone) to adjust the radio's deviation and modulation.

3.2.5.2 Transmitted Messages

Immediately after the "Press-to-talk" delay, the system will transmit, twice as a minimum requirement the following messages:

Condition	Message Spoken
No Defects Detected	“CRN Drag Detection System”
	“Location”
	“Kilometreage XXX.X” (Selecting all zeros will suppress kilometreage annunciation).
	“Track Name” to be supplied for each location (if double track installation).
	“No Defects” “Repeat” “No Defects”
	“Location”
	“Out”
With Defects	“CRN Drag Detection System”
	“Location”
	“Kilometreage XXX.X” (Selecting all zeros will suppress kilometreage annunciation).
	“Track Name” to be supplied for each location (if double track installation).
	“Stop, Stop Drag Detected” “Repeat’ “Stop, Stop Drag Detected”.
	“Location”
	“Out”

3.2.6 System Testing

The Signal Engineer is to fully functionally test the system prior to commissioning. A formal test plan is to be produced and all testing results are to be fully documented and certified as completed. The Maintenance Signal Engineer is to store this document in a secure location after commissioning.

3.2.7 Operation Instructions

The procedures for drivers, signallers and train controllers are detailed in Appendix 4.

3.3 Dragging Equipment Detectors Integrated with other Monitoring Systems

In some cases it may be advantageous to integrate the dragging equipment into other systems such as a hot box detector. In this case the equivalent functionality shall be provided together with additional information that may be available such as axle number, vehicle number, etc.

3.4 Maintenance Procedures

The Dragging Equipment Detectors shall be subject to maintenance procedures as laid down in the Technical Maintenance Plan:

3.5 Dragging Equipment Detector Drawing and Parts List

H1-180182-001 NORMALLY CLOSED

H1-180182-002 NORMALLY OPEN

Reference Drawing 102137-000

Item No.	HPN	QTY	Description	Modern
	200254-001	1	Detent Slide Assembly	H1-200254-001
2	H1-005166-001	1	Detent Spring	H1-005166-001
3	13230-001	2	Jam Nut 5/8-18	01022957
4	121050-001	1	Switch Mounting Plate	H1-121050-001
5	200272-001	1	Pivot Contact Linkage Assembly	H1-200272-001
5a	(21322-001)	(1)	Arm Pivot	H1-021322-001
5b	(13241-306)	(1)	5/16” E Snap Ring	01025581
5c	(20059-001)	(1)	Connecting Rod Shift	H1-020059-001
5d	(13244-002)	(2)	1/4 20 Self-Locking Nut	01022888
5e	(13239-001)	(1)	Connecting Rod	H1-013239-001
5f	(13561-000)	(4)	1/4” Ramp Washers	01023156
6	200270-001	1	Pivot Conact Assembly (Universal)	H1-200270-000
6a	(21123-000)	(1)	Clip, Channel	H1-021123-000
6b	(13036-001)	(1)	Square Head Bolt 14-24 X 3/4 lg.	H1-013139-003
6c	(121217-001)	(1)	Pivot Contact Blade	H1-121217-001
6d	(13243-001)	(2)	Button Head Screw 10-24 X1/2	01023900
6e	(13079-001)	(1)	Clamp Nut 14-24 AAR	73-10707
6f	(13074-001)	(1)	Flat Washer AAR	73-10708
6g	(22274-003)	(1)	Universal Pivot Contact Block	H1-022273-004
6h	(13033-008)	(2)	#10 Lockwasher	01023132
7	200271-001	1	Stationary Contact Assembly	H1-200271-001
7a	(13036-002)	(1)	Square Head Bptj 14-24 X 1 5/32	73-10709
7b	(121219-002)	(1)	Stationary Contact Blade	H1-121219-002
7c	(22271-002)	(1)	Stantionary Contact Block	H1-022271-002
7d	(13074-000)	(2)	Flat Washer AAR	73-10708
7e	(13079-001)	(1)	Clamp Nut AAR 14-24	73-10707
7f	(13073-001)	(1)	Binding Nut AAR 14-24	73-10706
8	32196-001	1	AAR Two Terminals	H2-250084-002
9	13094-004	4	Socket Head Cap Screw 1/4-20 X 3/4	01020036
10	13074-000	6	Flat Washer AAR #14	73-10708
11	13079-001	2	Clamp Nut AAR	73-10707
12	13073-001	4	Binding Nut AAR	73-10706
13	12609-003	2	4” Wire Assembly	H1-012609-004
14	13242-001	1	Socket HCS 5/16 X 3/4 lg.	01020282
15	32215-001	1	3/4” Pipe Nipple Short	
16	H1-031035-002	2	Gasket Only	H1-031035-002
17	H1-022446-001	1	Box Assembly	H1-022446-001
18	H1-021346-003	1	Box Cover	H1-021346-003
19	13561-001	8	5/16 Ramp Washers	01023165
20	13244-001	4	Self lock nuts 5/16-18	010229011

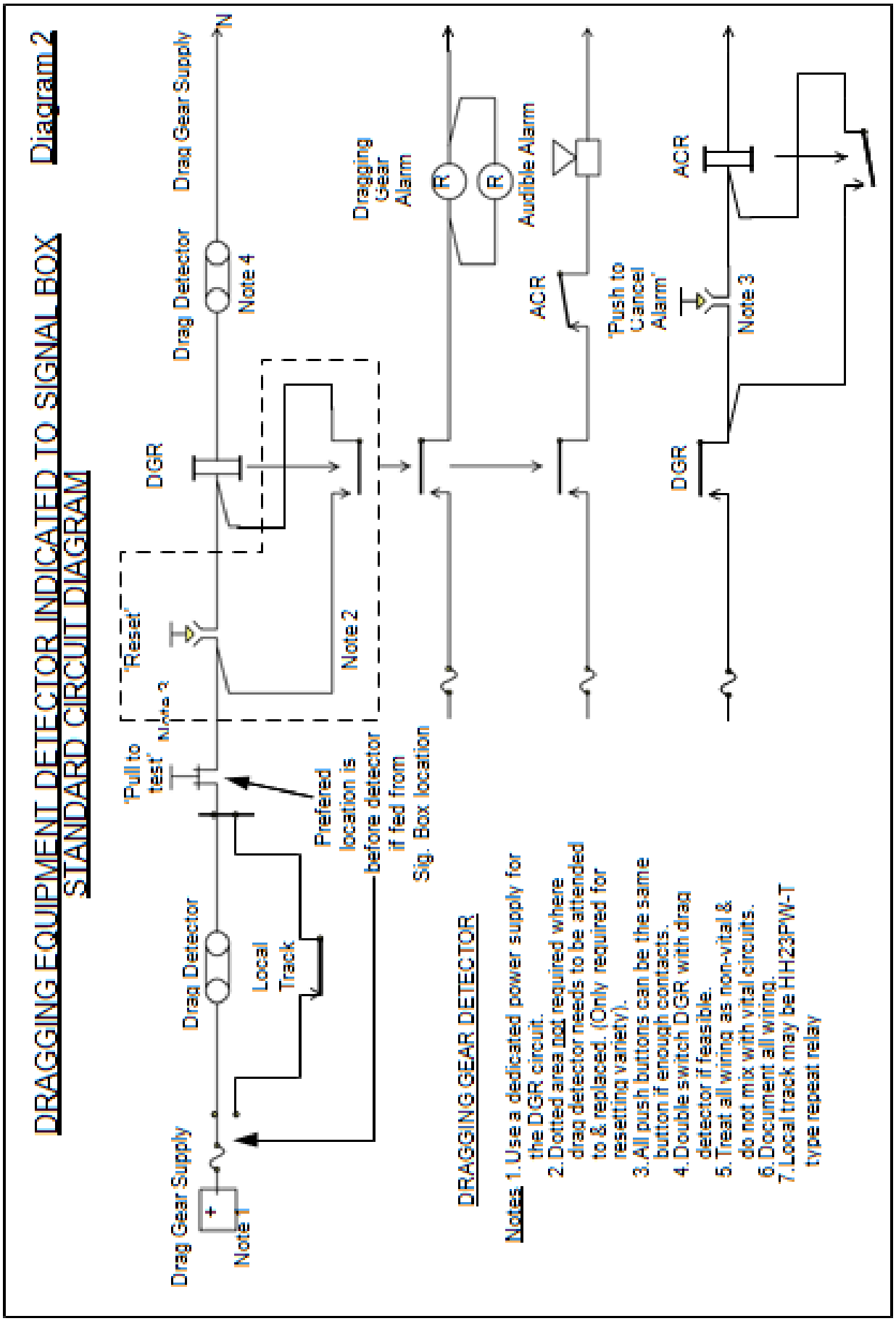
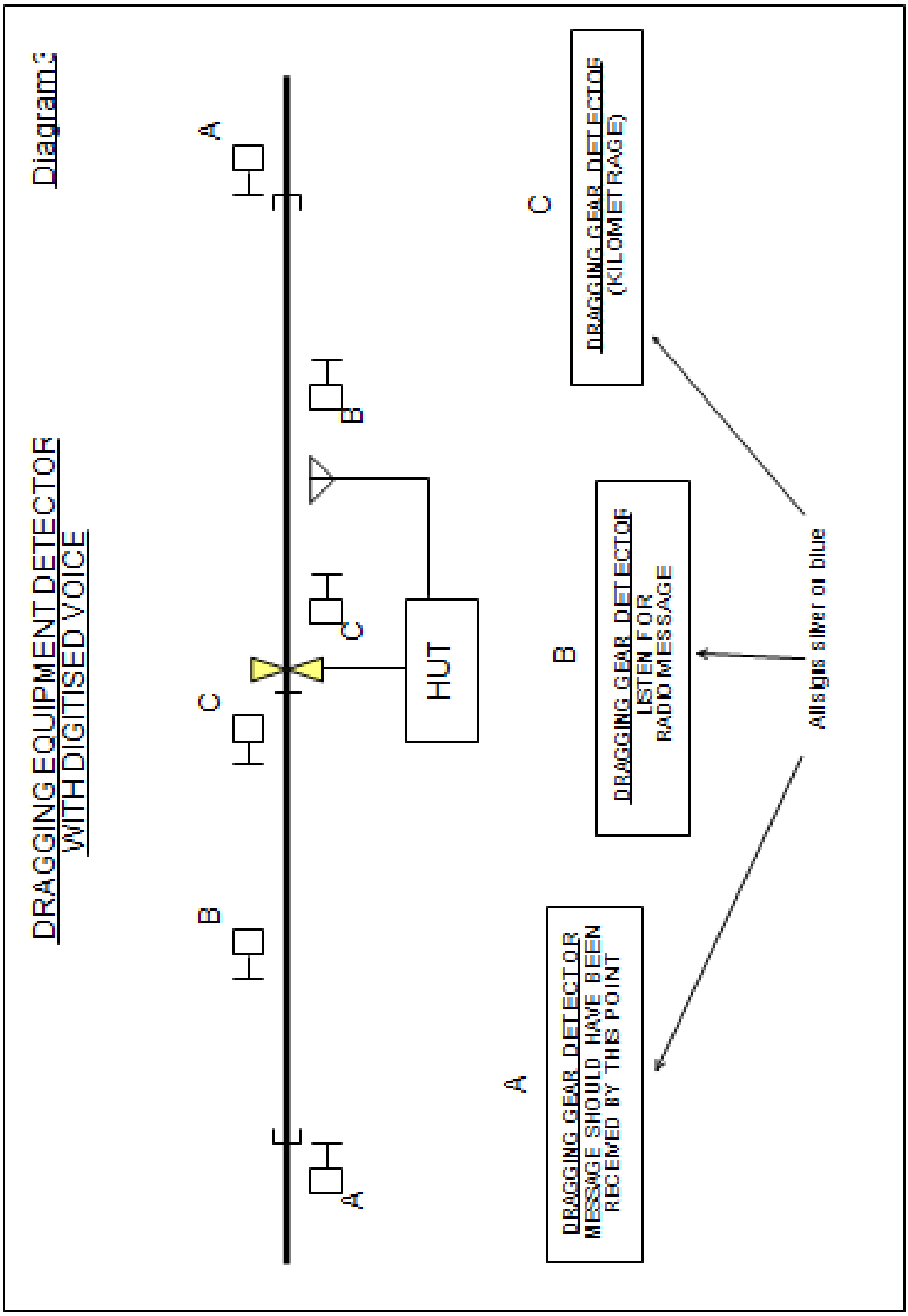


Diagram 2
DRAGGING EQUIPMENT DETECTOR INDICATED TO SIGNAL BOX
STANDARD CIRCUIT DIAGRAM
N
Drag Gear Supply
Drag Detector
Note 4
Dragging Gear Alarm
R
R
Audible Alarm
ACR
"Push to Cancel Alarm"
ACR
Note 3
DGR
DGR
"Reset"
Note 2
"Pull to test"
Note 3
Prefered location is before detector if fed from Sig. Box location
Drag Detector
Local Track
Drag Gear Supply
Note 1
DRAGGING GEAR DETECTOR
Notes 1. Use a dedicated power supply for the DGR circuit.
2. Dotted area not required where drag detector needs to be attended to & replaced. (Only required for resetting variety).
3. All push buttons can be the same button if enough contacts.
4. Double switch DGR with drag detector if feasible.
5. Treat all wiring as non-vital & do not mix with vital circuits.
6. Document all wiring.
7. Local track may be HH23PW-T type repeat relay

Diagram 3

DRAGGING EQUIPMENT DETECTOR
WITH DIGITISED VOICE



4 Rainfall Monitors

4.1 Introduction

This system was developed by Signal Engineering for the use of Civil Engineering. The requirement was to produce a device which would accurately and continuously measure the rainfall and produce alarms when a preset rainfall rate was exceeded. Alarms were to be displayed by indicator lights on a civil panel on site and also indicated on the local and remote control panels in signalled areas, Diagram 1.

4.2 Operation

Rainfall is collected in a standard tipping bucket water gauge graduated to 1mm bucket tips. The water gauge has magnetic reed switches which operate at each tip of the water buckets. Each tip therefore corresponds to 1mm of rainfall and one pulse is sent on the lead in wires to a programmable controller.

In the programmable controller the tipping bucket pulses are counted by two sets of counters, one set to operate on a 15 minute cycle and the other set on an 8 hour cycle. The programmable controller will produce indications at two rainfall rates for each timed cycle. The first is the "Warning" indication which occurs at 15 mm for the 15 minute cycle and 50mm for the 8 hour cycle. The second is the "Alarm" indication which occurs at 20mm for the 15 minute cycle and 100mm for the 8 hour cycle.

In order to maintain accuracy each timed cycle consists of multiple timers starting a set period apart. The 15 minute cycle consists of 5 timers operating three minutes apart. The 8 hour cycle consists of 8 timers one hour apart.

As each timer completes its cycle it is automatically reset which will cancel any indication it may have produced. In this way the indications will be continuously updated every three minutes in the 15 minute cycle and each hour in the 8 hour cycle.

4.3 System Arrangements

4.3.1 Signalling Panel Indications

The indications in the Network Operations Centre consist of a yellow and red light labelled "Warning" and "Alarm" respectively. These will light and extinguish automatically whenever a preset rainfall rate is exceeded during a timed cycle.

4.3.2 Civil Panel Indications

At the site of the rainfall collector an indicator panel, Diagram 2, is provided for the Civil employees. This has the same indication lights as the Operations Control Panel plus four additional lights. These four additional lights will hold the monitor warning or alarm conditions as the civil employee may not attend the site before the monitor lights automatically cancel. These additional lights are labelled "15min Warn, 15min Alarm, 8 hour Warn", "8 hour Alarm."

The civil panel has a reset button to clear the held indications. The reset will only clear them when both of the monitor lights are extinguished. This prevents the cancelling of held indications while a hazardous rainfall period exists and ensures that the full range of indications are recorded for that particular rainfall period. Following the automatic cancelling of the monitor alarms the held indications should be noted and reset as soon as possible to ensure accuracy in recording any further rainfall.

4.3.3 Maintenance Reset

This key switch located on the civil panel will reset all counters and extinguish all indications. This is only to be used when performing maintenance on the system and after testing the indications by tipping water into the rainfall collector. Unless reset the indications would remain on for up to 8

hours. This is undesirable as the system would be unusable until the indications were clear again which would be when the last hour timer resets.

The maintenance reset should not be used in rainy weather and especially not if a monitor light is on as all data held from the previous 8 hours is lost.

4.3.4 Maintenance

The only routine maintenance required is cleaning. The following items should be checked regularly for cleanliness:

- Catch filter
- Siphon
- Interior of bucket
- Top of bucket
- Shaft and screw pilots
- All insect screens

4.4 Testing Procedure

Prior to any testing of the system advise the signaller or train controller that tests are in progress.

The system should be tested to ensure it is operating correctly and accurately. This is done by pouring a measured amount of water into the rainfall collector and noting the indication lights.

The water quantities are as follows:

- 471ml (equivalent to 15mm rainfall)
- 624ml (equivalent to 20mm rainfall)
- 1570ml (equivalent to 50mm rainfall)
- 3140ml (equivalent to 100mm rainfall)

Initially the test should be done with 624ml poured slowly into the collector. This should be sufficient to bring up first the 15 min Warning and then the 15 min Alarm lights. While waiting (15 minutes) to check that the auto reset works and the monitor lights extinguish check the indications at the Operations Control Centres. When the monitor lights extinguish press the reset button to reset the held indications. The maintenance reset key should be turned to reset any 8 hour counters which have been incremented.

Then slowly pour 3140 ml of water into the collector to check the 8 hour indications. Naturally the 15 min indications will come on again prior to the 8 hour indications. Check with the local control centre that all indications are correct, reset with the maintenance key and then check that all indication lights are out. (As these will take 8 hours to automatically reset it is not necessary to wait for the monitor lights to extinguish.)

When all testing is finished advise the control centre that the system is back in use.

4.5 Circuit Design

Circuit Design is to be as shown on Diagram 3.

Note:-All instances of cable cores, TDM channels, etc must be advised, to permit updating of the appropriate analysis sheets in the circuit book. No part of the system is to be directly connected to any vital 50v signalling power supply.

All wiring is to be a distinctive colour (blue) and kept separate from any wiring associated with vital signalling, if wired in a vital signalling location.

4.6 Documentation

Each system installed is to be fully documented and certified as installed to the design documentation by the Signal Engineer.

All documentation is to be on A3 paper to similar standards as described in Standard Specification CRN SC 006 for circuit books.

4.7 System Testing

The Signal Engineer is to fully functionally test the system prior to commissioning. A formal test plan is to be produced and all testing results are to be fully documented and certified as completed. The Maintenance Signal Engineer is to store this document in a secure location after commissioning.

4.8 Operations Instructions

The procedures for Signallers and Train Controllers are to be included in Local Appendices. The Illawarra line description is typical and is attached as Appendix 6.

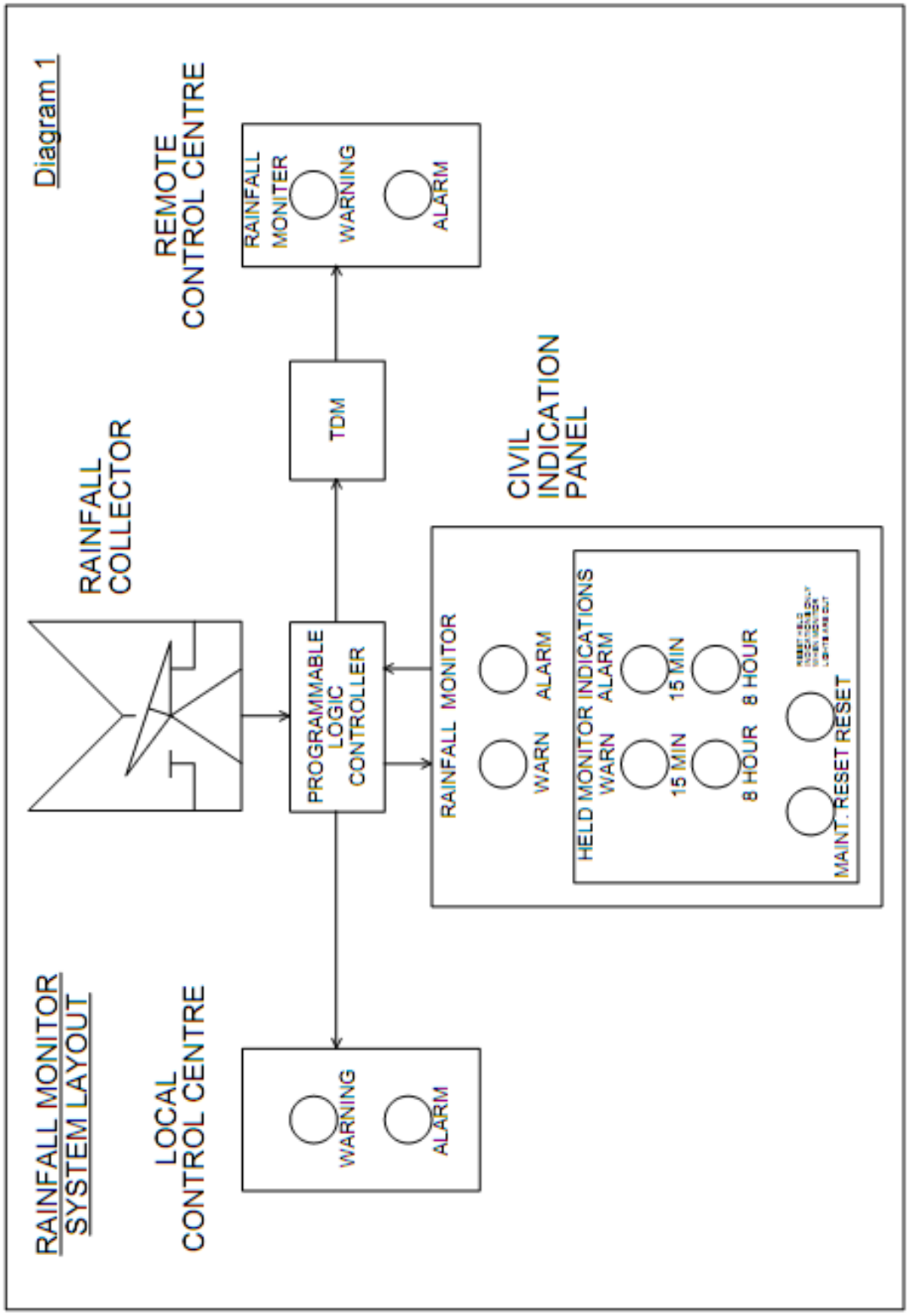
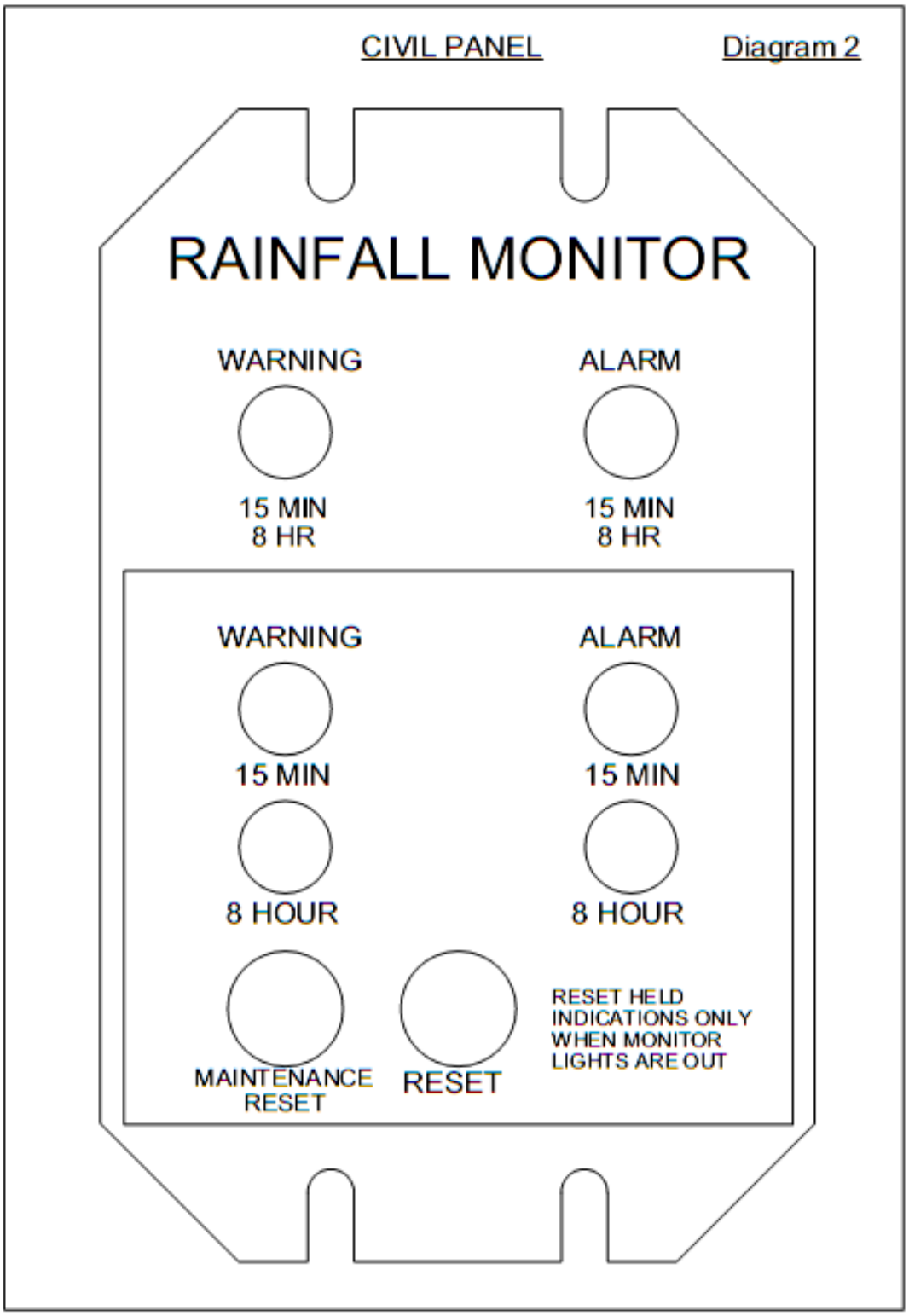


Diagram 1
RAINFALL MONITOR SYSTEM LAYOUT
REMOTE CONTROL CENTRE
RAINFALL MONITER
WARNING
ALARM
TDM
RAINFALL COLLECTOR
CIVIL INDICATION PANEL
PROGRAMMABLE LOGIC CONTROLLER
RAINFALL MONITOR
WARN
ALARM
HELD MONITOR INDICATIONS
WARN
ALARM
15 MIN
15 MIN
8 HOUR
8 HOUR
MAINT. RESET
RESET
LOCAL CONTROL CENTRE
WARNING
ALARM


CIVIL PANEL
Diagram 2
RAINFALL MONITOR
WARNING
ALARM
15 MIN
8 HR
15 MIN
8 HR
WARNING
ALARM
15 MIN
15 MIN
8 HOUR
8 HOUR
MAINTENANCE RESET
RESET
RESET HELD INDICATIONS ONLY WHEN MONITOR LIGHTS ARE OUT

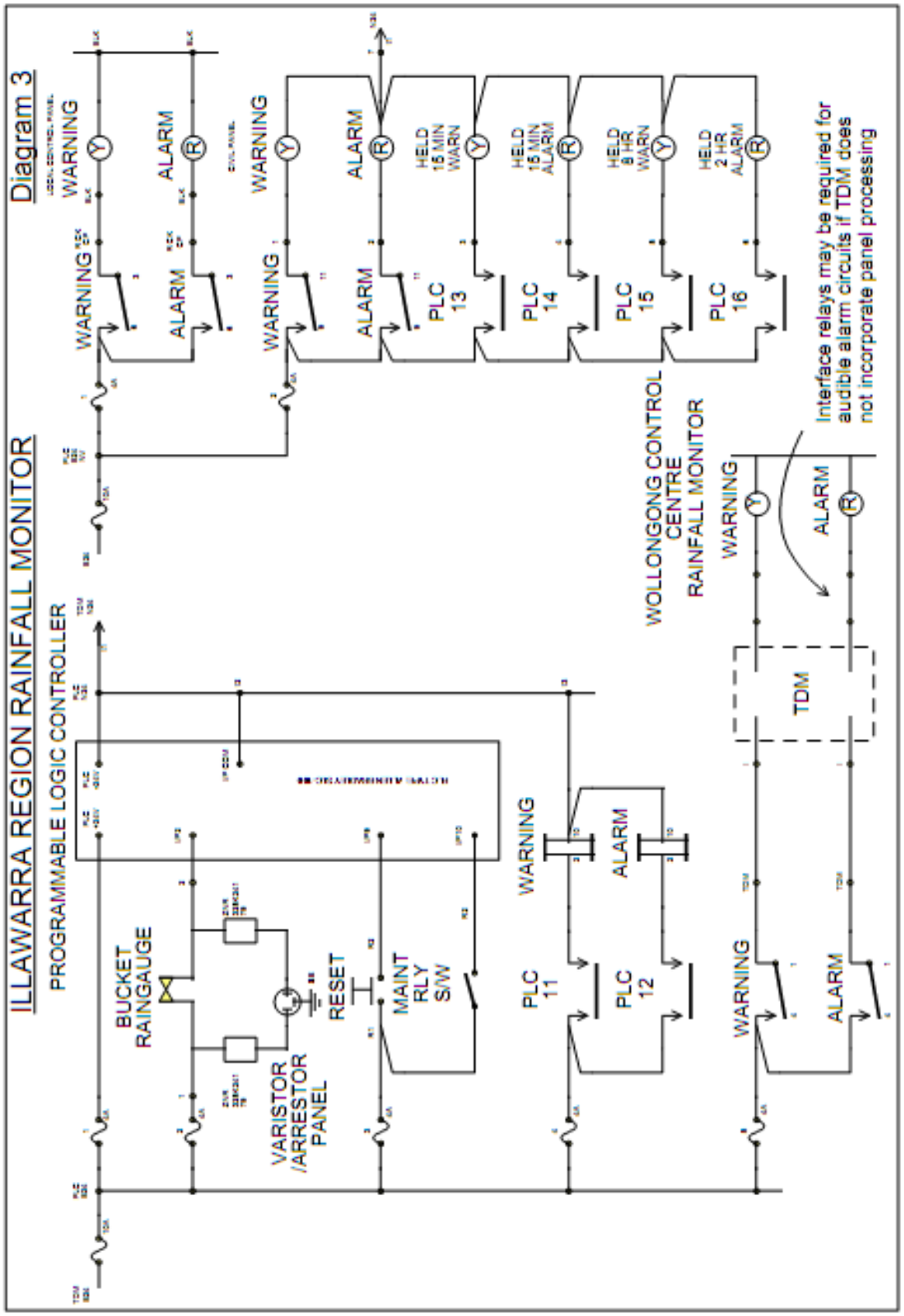


Diagram 3
ILLAWARRA REGION RAINFALL MONITOR
PROGRAMMABLE LOGIC CONTROLLER
WARNING
ALARM
WARNING
ALARM
HELD 15 MIN WARN
HELD 15 MIN ALARM
HELD 9 HR WARN
HELD 2 HR ALARM
PLC 13
PLC 14
PLC 15
PLC 16
WOLLONGONG CONTROL CENTRE RAINFALL MONITOR
Interface relays may be required for audible alarm circuits if TDM does not incorporate panel processing
TDM
BUCKET RAINGAUGE
RESET
MAINT RLY S/W
VARISTOR /ARRESTOR PANEL
PLC 11
PLC 12

5 Hot Box Detectors

5.1 Introduction

Hot box detectors are used to detect axle bearings that are in the process of self-destruction. The systems employ special trackside detection systems that detect the oncoming train and then systematically check each axle box, on both sides of the train. Data is processed by a microprocessor housed in an equipment hut beside the track. Trains are warned either by digitised voice equipment if the site is remote; or by the signaller advising the driver over the train radio.

Direct interconnection into the signalling system is not favoured for these types of systems.

The system can operate a PC at a remote site in order to store data for future reference and provide other remote monitoring functions.

5.2 General System Requirements

Diagrams 1& 2 show the general system arrangements.

Care needs to be taken to locate hot box detectors on relatively level and straight track and in locations where trains will not have been under braking for a continuous period, nor only recently commenced their journey.

The manufacturer or contractor must be consulted and given an assurance that the equipment proposed is satisfactory for the site.

Hot Box Detection Systems shall include the following:

- Trackside detection equipment, scanner, transducers, junction boxes, cables, proximity switches, mounting hardware, protection ramps etc.
- Processing System - Self contained equipment to convert raw data from the sensors to an output form suitable to the Purchaser.
- Wayside Hut for housing of electronic equipment.
- Remote equipment at signal box, including modems, personal computers and printers.

5.2.1 Stand Alone Alarm Analysis

Stand alone alarm analysis is required. Bearing discrimination or averaging techniques capable of providing separate absolute and differential (or ratio) alarms for roller bearings or car side averaging techniques is required. Separate alarming criteria for friction bearings must be adjustable. The system shall discriminate between axle box roller bearings and compact package roller bearings, and provide separate alarming criteria (adjustable).

5.2.2 Alarm Types

Each of the types of alarms, (either for hot box, warm journal or dragging equipment (future addition), shall have adjustable numbers of each alarm type, that are able to be held in memory awaiting the train complete passing of the detector site, before relaying defect information to train crew.

5.2.3 Detector Self-Test

The detector shall be equipped with a system self test, capable of verifying the integrity of the equipment prior to each train passage, and be capable of indicating any faults detected. The system shall self check periodically to ensure the detector to be in proper operating condition.

5.2.4 Transducer Usage

Train presence, advance start, and directional information are to be derived from transducers. No overlay track circuit or connection to existing signalling will be provided, nor will one be

accepted to accomplish these functions. System advance start transducers will enable inspection of the first axle of a train.

5.2.5 Detector Capabilities

The detector shall be capable of bi-directional operation. Direction of train travel is to be stored as part of the train data.

5.2.6 Digitised Voice used on Double Track Systems

Where digitised voice is in use, a double track system shall be interconnected so as to prevent both systems attempting to transmit simultaneously. This is commonly termed "double track handshaking."

5.2.7 Axle Counters

Axle count shall be from the Front of a train. In addition total axle count will be available through switch activation or software control to be spoken as part of message format with leading zero suppression.

5.2.8 Ambient Air Temperature

The ability to record and report the outside ambient temperature with a resolution of one degree Celsius is required.

5.2.9 Detector Equipment

The detector equipment will have non-volatile memory storage, enough for 50 trains or 20,000 axles. Peak journal heat, inter axle time data, time and date (non-volatile clock), direction, speed of train (entering and exiting), total axle count and ambient temperature in degrees Celsius will be stored in non-volatile memory and shall be capable of being retrieved by software control either locally or from a remote site.

5.2.10 Alarms

The system(s) shall be capable of giving an audible and visual alarm to the remote site(s), when a defect is detected, Diagram 2.

5.2.11 Additional Capabilities

In addition to being able to retrieve stored train data from memory, the following additional capabilities will be supported by software control:

- Alarm level adjustments. All adjustable parameters specified in this document must be able to be set/reset/adjusted through software control.
- *List all train in memory
- * List trains with defects in memory
- ** Download all data for a specified train in memory
- **Download alarms for a specified train(s) in memory
- General Diagnostics
- Forced out of service (by operator - software)
- Forced digitised voice disable (by operator - software)
- Train Identification (I.D.) Number entered by signaller
- All data shall be capable of being downloaded onto floppy diskettes, in IBM compatible format.

* List of trains to include:

Site name, Date and Time, Sequence Number, Train I.D. Number, Direction, Speed, Axle Count, Number of Defects, Number of Errors

** Downloaded data shall include:

Site Name, Sequence Number, Train I.D. Number, Date and Time, Direction, Speed entering, Speed exiting, Axle Count, Distance or Time between each axle, Car Number (if car side averaging algorithm is used), individual axles will be marked with type of alarm (if alarmed), ambient temperature, peak heat in Degrees Celsius above ambient for each side.

The downloading capability shall be via dial-up modem from either the detector site or the remote site.

5.2.12 Cabling

All cables are to be installed in accordance with Signalling Standard Specification CRN SC 021. All buried cables must be inspected and approved by the Superintendent prior to backfilling.

5.2.13 Trackside Equipment Protection

Protective ramps of hot dip galvanised steel shall be provided to protect trackside equipment.

5.3 Equipment Requirements

5.3.1 General Requirements

This section sets for the general requirements and standards for HBD Systems, employing current microprocessor based technology.

5.3.2 Termination of Wiring

All wiring interconnecting the various assemblies of the system shall employ mass-terminated cables, using standard connectors which plug in/out without tools other than a screwdriver or AAR terminal wrench. All terminal posts and wiring connections involving high voltage AC and DC circuits shall be insulated.

5.3.3 Printed Circuit Boards

Printed circuit boards shall be retained by vibration resistant latches. Circuits shall be immune to electrical noise and components selected for long life and reliability. Space requirements for this equipment shall be minimised, as shall be power consumption and maintenance.

5.3.4 Contractors Responsibilities (System Characteristics)

The Contractor is to include a complete description of the operation and characteristics of the proposed system to permit a comparative evaluation. Plans, catalogues, photos and other references to clearly illustrate the proposed apparatus are to be included.

5.3.5 System Capabilities

The system shall be capable of processing heat signals generated from the axle bearings of all engines and cars operating over the CRN network.

5.3.6 System Design

The system shall be designed in such a way that heat signal from engine traction motors, steam engines, locomotives or any heat source other than the axle bearings on any engine or car, will not cause false alarm conditions.

5.3.7 Access to Signalling Locations

It must be noted that signalling locations have restricted access and may only be opened by authorised signalling personnel

5.3.8 System Installation Requirements

The system shall be capable of being installed and function correctly on all major lines of the CRN network which comprises a mixture of:

- Timber sleepers
- Concrete sleepers
- 53 Kg Rail
- 60 Kg Rail

The maximum speed of trains on the CRN network is 180 Km/hr

5.3.9 Gradients

The Contractor is to note that there are some locations within the CRN network where Gradients are up to 1:40 rising and falling and curves down to 200m radius are encountered.

5.3.10 Contractors Responsibilities (Site Acceptability)

The Contractor is to examine the quality of the track at the preferred/proposed sites and advise if additional work is required to provide effective and reliable operation of the Hot Box Detector equipment.

5.3.11 Signal Standards

Signal Standards Specification No.CRN SE 001 for electronic systems shall be complied with.

5.4 Power Supply

5.4.1 Equipment Requirements

The equipment is to be suitable for use on electrified railways at 1500V DC or 25KV AC.

The equipment shall be immune to noise, induced voltages, and other environmental aspects common to electrified railways.

5.4.2 Operating Voltage Requirements

Power supplies are reticulated at 120V + 10% at 50 Hz and supplied by council authorities at 240vAC 50 Hz or higher voltages. In some cases back-up supplies are provided via emergency changeover contractors or motor generator or motor alternator sets. Primary battery back-up is provided in some cases where equipment is fed at low voltage DC.

There are major sections where the electrical power supply is by primary batteries.

The tenderer is to provide details of the power supply requirements of the equipment.

This is to include the voltage requirement and current requirements and the permitted variations.

5.4.3 Power Supply Backup

Where power supplies are provided at 240V AC 50Hz, emergency backup is not normally available.

120V AC supplies may be backed up but if the backup is supplied by motor generator or motor alternator, there may be a loss of electrical power supply for up to 1 minute. Where remote equipment is in use, electrical power supply may be lost at either end independently.

It is a requirement that the hot box equipment shall function as continuously as possible. In particular, on restoration of electrical power supply, or during short power interruptions of less than 1 second, the equipment shall not require resetting or other operator interference, but shall automatically restore to full functionality, without any loss of information.

5.4.4 Electrical Requirements

Isolating transformers are required when taking supply from vital 120 V signalling mains, or for any supply in the electrified areas.

All equipment and MEN earthing is to be common on the equipment side of the isolating transformer.

All wiring is to be in accordance with AS3000 and Inspection and Test Certificates are required.

5.5 Equipment Hut

5.5.1 General

Sighting of all HBD electronic processing equipment bungalows shall be subject to approval.

5.5.2 Installation Requirements

Equipment bungalows shall be supplied and installed by the Contractor to Specification CRN SC 022.

5.5.3 Electrical Supply

The Contractor shall supply one (1) general purpose (GP) 240V 50 Hz outlet in each equipment bungalow room where 240V is available.

5.5.4 Telephones

Provision shall be made for maintenance telephones which may be of the automatic magneto, common battery or direct line type. The maintenance telephone will be provided by the Purchase for installation by the Contractor.

5.6 Notice Boards

Notice boards shall be as required in Appendix 5. Details of the wording required on boards are in the System Configuration diagrams.

5.7 System Configuration for Digitised Voice

Diagram 3 shows the general system arrangements.

5.7.1 Radio Communications Requirements

5.7.1.1 Audio Levels

The audio levels between the voice generator and the radio's audio input shall be matched and set at 0dMm.

5.7.1.2 Voice Generator

The voice generator shall provide a "press-to-talk) signal to the radio prior to the commencement of the voice output. It is recommended that a delay of 500msec to 1 sec be used between these two events to allow stabilisation of the transmitter and portable receiver before the message begins.

5.7.1.3 Broken Squelch

The system shall also be capable of sensing broken squelch resulting from carriers down to a level of 0.3 micro volts from the Antenna feeder. This will be used to key radio and delay radio transmission from detector system for up to 20 seconds. When clear air waves are sensed and/or 20 seconds has elapsed the transmission will be sent. The message shall be sent twice.

5.7.1.4 Installation of radio and Antenna

Installation of the radio, antenna and feeder cable shall be carried out by personnel experienced in this type of work.

5.7.1.5 Radio Base

The radio base shall be of a type approved by the Department of Transport and Communications and shall be capable of a transmitter output of 25 Watts.

5.7.1.6 Radio Transmitter

In addition to clause 5.6, the radio transmitter shall also conform to the following specification as a minimum:

- Transmit Power Rating: Continuously Rated for 25 Watts Output at 45o C.
- Power Level input: Automatic Voltage level control for 10.8 to 16Vdc.
- Protection: Automatic protection against antenna mismatch
- Deviation: +/- 5kHz maximum
- Residual FM Noise: - 2.5% maximum
- Audio Response: + 1dB,-8 dB relative to +6dB per octave pre-emphasis 300 to 3000Hz
- Spurious Emission: <2.5 Micro Watts

5.7.1.7 Transmitter Frequency

The transmitter shall be programmed to transmit on the frequency 450.05MHz with CTSS tone (sub-audible) of 173.8 Hz.

5.7.1.8 Antenna Specifications

The antenna shall be a unity gain type so that the radiated power is limited to 43 Watts EIRP, and shall be mounted with vertical polarisation at a height between 3 and 10 metres above ground level.

5.7.1.9 Coverage Test

Formal coverage tests are to be conducted with documented signal strength measurements vs. track kilometrage for the area in which radio reception is required. The Authorities Communications Engineers shall approve the proposed transmitter location and signal strengths. Full coverage in the area where messages will be sent and received is required.

5.7.1.10 Digitised Voice Recorder

It is preferred that the Digitised Voice Recorder requires an absence of input to initiate the defect message. This is to ensure that, as far as is practical, the system is designed in accordance with fail safe principles.

Where the equipment requires an active input to initiate the defect message, the field equipment shall be configured to operate a relay in the normal (safe) condition. When an unsafe or fault condition exists, the relay is to drop away and provide the active input to the digitised voice recorder. When this arrangement is provided the following details must be incorporated.

- The controlling relay shall be mounted physically as close as is practically possible to the digitised voice recorder.
- At least two drop contract of the relay are to be used to provide the inputs to the digitised voice recorder.
- These two inputs are to be wired through independent circuits (including fusing, wiring and terminations) to ensure that the system is fully redundant.
- During functional testing the system should be thoroughly assessed as to the output that can be expected with the various combinations of inputs that could occur under fault (either open or short circuit) conditions. Any result that tends to decrease the safety integrity of the system

shall be protected against by additional insulation, separation of duplication of wiring, or other methods as may be deemed appropriate.

The digitised voice equipment shall have the digitised voice message stored on an EPROM or similar. Systems where the message may be lost during power outages (of any duration) or an internal system fault should not be accepted.

5.7.2 Digitised Voice Capabilities

5.7.2.1 System Requirements

The system shall be capable of producing a continuous 450.05 MHz signal (modulated with 1000Hz tone) to adjust the radio's deviation and modulation.

5.7.2.2 Defect Detection

Upon arrival at the detector site, inspection shall begin and continue until the entire train has passed the site. If during inspection a defect is detected, a 450.05MHz signal (modulated with 1000Hz tone) will be immediately transmitted. Tone duration to be switch selective from 1 to 4 seconds with 0.5 second increments. This tone will be repeated upon each successive defect detected.

5.7.2.3 Transmitted Messages

Immediately after train has passed the detector, the system will transmit, twice as a minimum requirement the following messages:

Condition	Message Spoken
No Defects Detected	“CRN Rolling Inspection System”
	“Location”
	“Kilometreage XXX.X” (Selecting all zeros will suppress kilometreage annunciation).
	Total Axles (If switch active)
	“Track Name” to be supplied for each location (if double track installation).
	“No Defects” “Repeat” “No Defects”
	“Location”
	“Out”
With Defects	“CRN Rolling Inspection System”
	“Location”
	“Kilometreage XXX.X” (Selecting all zeros will suppress kilometreage annunciation).
	Total Axles (If switch active)
	“Track Name” to be supplied for each location (if double track installation).
	“First Hot Box Left/Right Side Axle XXX”.
	“Second Hot Box Left/Right Side Axle XXX”.
	“Stop Your Train Immediately & Inspect Your Train”
	“Repeat”
	“First Hot Box Left/Right Side Axle XXX”.
	“Second Hot Box Left/Right Side Axle XXX”.
	“Stop Your Train Immediately & Inspect Your Train”
	“Location”
	“Out”

With Excessive Defects	"CRN Rolling Inspection System" "Location" "Kilometreage XXX.X" (Selecting all zeros will suppress kilometreage annunciation). Total Axles (If switch active) "Track Name" to be supplied for each location (if double track installation). "First Hot Box Left/Right Side Axle XXX". "Second Hot Box Left/Right Side Axle XXX". (Message to continue through system set limits). "Excessive Alarms" (Check train starting at first spoken alarm). "Stop Your Train Immediately & Inspect Your Train" "Location" "Out"
Integrity Failure in Hot Box Detector.	"CRN Rolling Inspection System" "Location" "Kilometreage XXX.X" (Selecting all zeros will suppress kilometreage annunciation). Total Axles (If switch active) "Track Name" to be supplied for each location (if double track installation). "Integrity Failure "Please Advise Control" "Repeat" "Integrity Failure "Please Advise Control". "Location" "Out"

The talking capabilities of the system shall be capable of being expanded and added to.

5.8 Operation Procedures for Hot Box Detectors

These are referred to in Appendix 7.

5.9 Test Documentation

The Contractor is to prepare and submit a comprehensive test plan for the installation.

The test plan is to cover but not necessarily limited to the following: Site installation including:

- Cable continuity and insulation resistance tests.
- All tests as required on the Electrical Test Certificate.
- Software functionality tests.
- Hardware Functionality Tests

Full systems Tests including Diagnostic and Communications.

Test documentation shall use ITF forms from Specification CRN SC 012 where appropriate.

Defect lists shall be produced and corrective action signed off when completed.

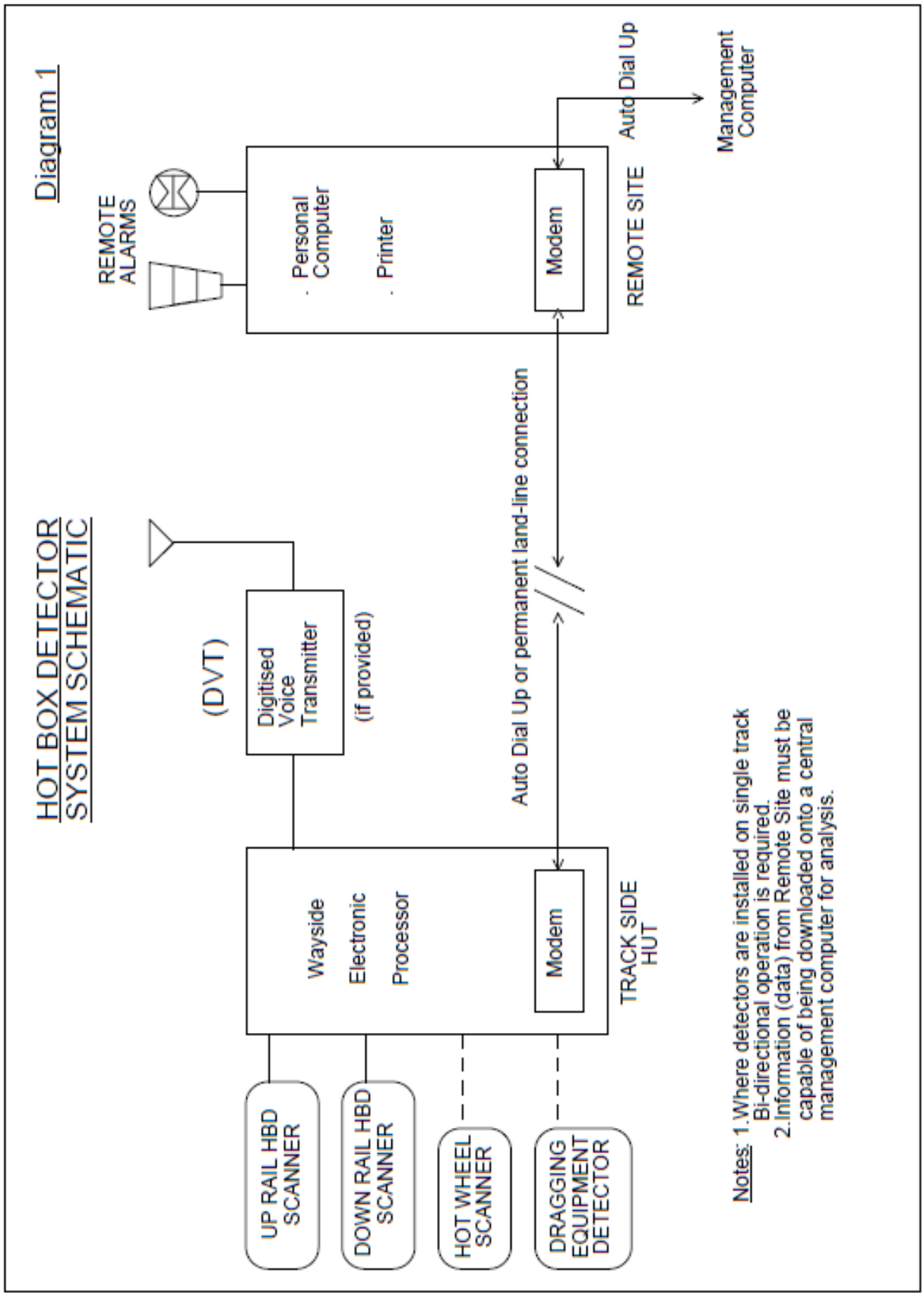


Diagram 1
HOT BOX DETECTOR
SYSTEM SCHEMATIC
REMOTE ALARMS
Personal Computer
Printer
Modem
REMOTE SITE
Auto Dial Up
Management Computer
(DVT)
Digitised Voice Transmitter
(if provided)
Auto Dial Up or permanent land-line connection
Wayside Electronic Processor
Modem
TRACK SIDE HUT
UP RAIL HBD SCANNER
DOWN RAIL HBD SCANNER
HOT WHEEL SCANNER
DRAGGING EQUIPMENT DETECTOR
Notes: 1.Where detectors are installed on single track Bi-directional operation is required.
2.Information (data) from Remote Site must be capable of being downloaded onto a central management computer for analysis.

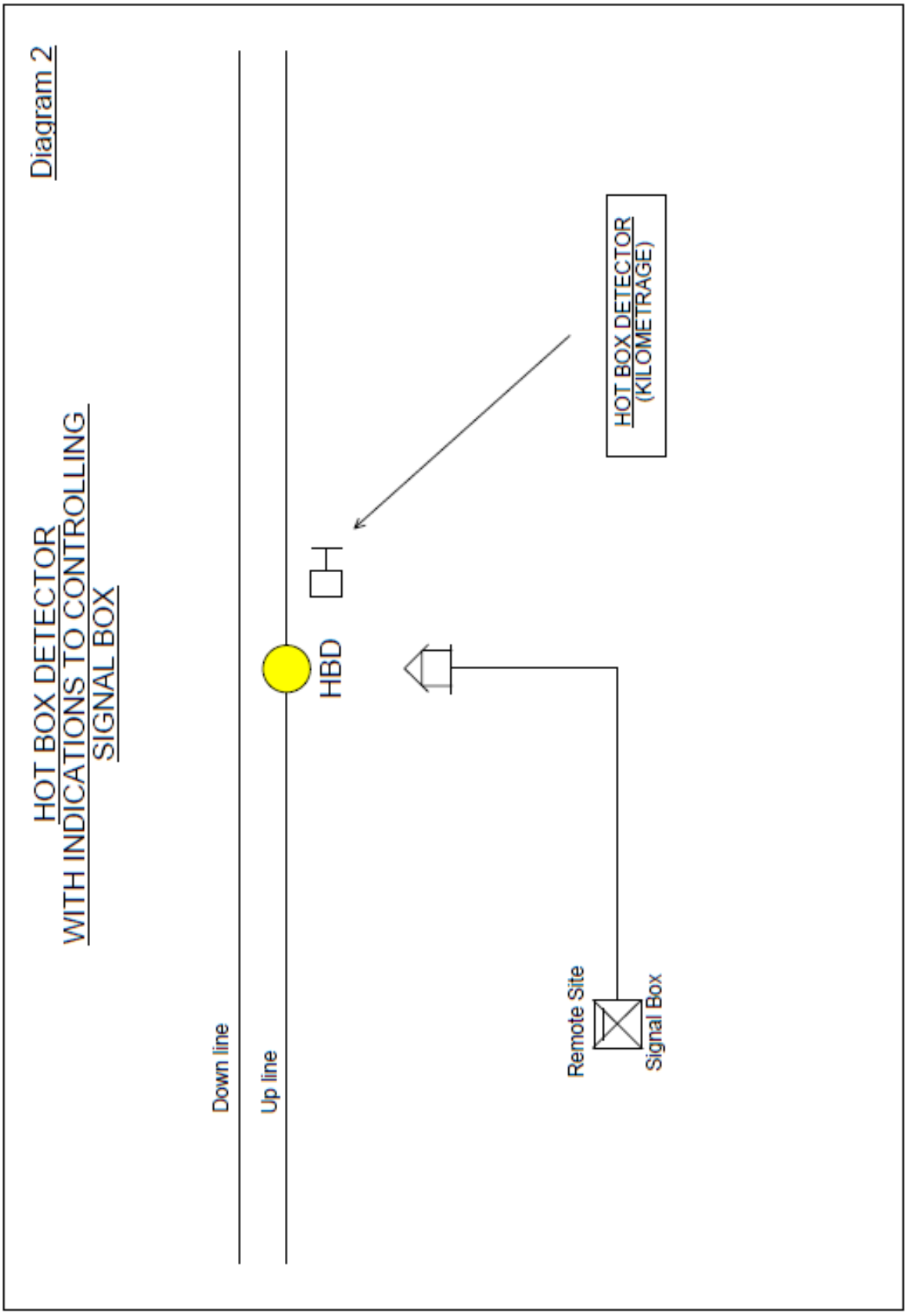


Diagram 2
HOT BOX DETECTOR
WITH INDICATIONS TO CONTROLLING
SIGNAL BOX
HOT BOX DETECTOR
(KILOMETRAGE)
HBD
Down line
Up line
Remote Site
Signal Box

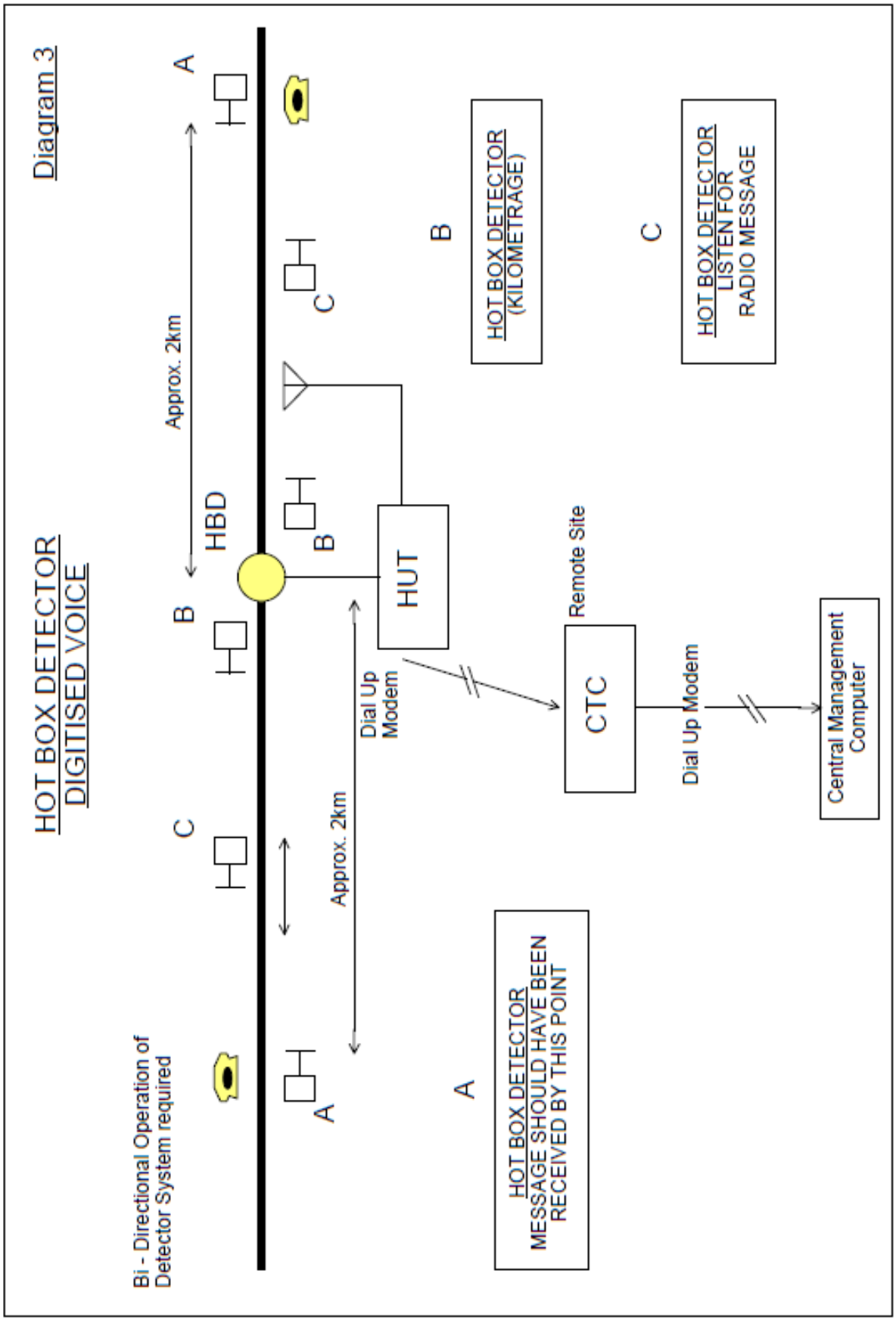


Diagram 3
HOT BOX DETECTOR
DIGITISED VOICE
A
B
C
HBD
Approx. 2km
Approx. 2km
HUT
Dial Up
Modem
Remote Site
CTC
Dial Up Modem
Central Management
Computer
HOT BOX DETECTOR
(KILOMETRAGE)
HOT BOX DETECTOR
LISTEN FOR
RADIO MESSAGE
HOT BOX DETECTOR
MESSAGE SHOULD HAVE BEEN
RECEIVED BY THIS POINT
Bi - Directional Operation of
Detector System required

Appendix 1 Operations Instructions for Interlocked Slip Detectors

Description

i) Embankment slip detectors are provided to detect embankment movement and are interlocked with the immediate protecting signals which will return or remain at stop when a slip is detected.

ii) The immediate protecting signals interlocked with the slip detectors are fitted with an instruction plate inscribed as follows:

Automatic, Accepting, Outer Home, Home and Shunting Signals.

"SLIP SITE
THIS SIGNAL
MUST NOT
BE PASSED AT
STOP
WITHOUT
AUTHORITY
FROM
SIGNALLER"

Home/Starting and Starting Signals

"SLIP SITE
THIS SIGNAL MUST NOT BE PASSED AT
STOP WITHOUT AUTHORITY FROM SIGNALLER
AND UNDER THE AUTHORITY OF A SPECIAL
AUTHORITY ORDER OR UNDER
PILOT STAFF WORKING PROCEDURES"

iii) Slip notice boards, rectangular in shape with black lettering on a yellow background are located on either side of the potential slip site and identify the site by the kilometrage to the nearest 100 metres.

Indicator Box

iv) A locked indicator Box is provided at each slip site. A green lamp(s) displayed inside the box indicates that the slip detector, or detectors in the case of multiple detectors at a particular slip site, are normal.

A key locked emergency switch labelled "Normal" and "Override" is provided for use by the Signal Electrician when a detector fails or during equipment maintenance, testing and adjustment.

v) A locked telephone is provided adjacent to each Indicator Box providing direct communication with the controlling signal box, i.e. Wollongong Signalling Complex during normal working or to the local control panel when in local working.

Lamp Indications

vi) Each slip is indicated on the Main Control Panel and on the applicable local control panel as follows:

- Green light indicates - Slip detector(s) normal
- Red light indicates - Embankment slip or slip equipment failure
- Both lamps extinguish - Emergency switch in "Override" position indicates

An audible alarm is also given when a slip is detected, (i.e. embankment movement detected). In these circumstances, the green light is extinguished and the red light is illuminated.

vii) Maintenance, Testing and Adjustment

All maintenance, testing and adjustment of slip detectors will be jointly carried out by nominated Civil and Signal Representatives.

To permit normal operation of the immediate protecting signals during maintenance, etc. the Signal Electrician after first notifying the Area Controller can turn the key locked emergency switch to the "Override" position and must return that switch to the "Normal" position before leaving the slip site.

The Area-Controller is to be advised of each operation of the key locked emergency switch, all tests and adjustments and must record such emergency switch operation, tests and adjustments in the Train Register Book or other book provided.

viii) Procedures When Slip Detected

When a slip is detected by the extinguishing of the green lamp and the illumination of the red lamp, the Area Controller or the signaller operating the local control panel when local working is in operation is to immediately contact the Emergency Civil and Signal personnel to attend the site.

All trains must be stopped from traversing the slip site until the line has been certified safe for traffic by the Civil Engineer or other Authorised Representative.

Trains must not be permitted to pass the immediate protecting signals at stop when a slip is detected without the permission of:

- The Area Controller when normal remote control of signalling is in operation
- The signaller operating the local control panel when local working is in operation, and only then as prescribed in Clause (xiv).

ix) Slip Detector Failure

Should a defective slip detector(s) or associated equipment cause a failed condition to be indicated and the line has been certified as safe for traffic by the Civil representative, the Civil and Signals representatives will then book out of use the Slip Detector(s) on a S.W.F. Infrastructure Booking Authority (IBA) form NRF 003 after which the Signal Electrician can turn the key locked emergency switch to the "Override" position to permit normal operation of the immediate protecting signals.

In the event that a slip detector(s) is required to be booked out of use for an extended period the matter is to be reported to the Maintenance Manager

x) Slip Detector Damaged or No Longer Required

When a written request is made one or more damaged or redundant slip detector(s) at a slip site can be booked out of use and disconnected by the Signal Electrician provided the remaining slip detector(s) have been certified in writing as sufficient for that slip site.

xi) Remote Control Failure

Should failure of the system controlling a remote interlocking occur or conflicting indications occur between the protecting signal/s indication on site and its associated repeater in the Remote Control Panel, the instructions contained in Clause (viii) above must be carried out immediately regardless of the slip detection indication(s) being displayed for that interlocking in Wollongong Control Panel.

Local control working of the above remote interlocking must be introduced as soon as possible.

xii) Local Control

When local control of a remote interlocking is in operation the slip detector indication(s) associated with that interlocking displayed on the Remote Control Panel are to be disregarded until control of that interlocking is again restored to remote operation.

xiii) Section/Train Failure Order/Pilot Staff or Pilot Working

When any of the above emergency systems of working are in operation and a slip is detected, or any loss of Slip Detector indications occurs on the Control Panel in use at the time, the instructions contained in Clause (viii) above must be carried out.

xiv) Passing of Signals Protecting a Slip Site

The movement of trains past any fixed signals at Stop which protect a slip site may only be permitted on the authority of the signaller and in accordance with instructions on the inscription plate.

The driver must, in all circumstances, contact the signaller to establish that there is no indication of a land slip prior to proceeding.

The signaller must, in all circumstances before authorising a movement past the relevant signals, check the slip indications on the panel.

Refer Weekly Notice 30, 1990.

Appendix 2 Operations Instructions for Digitised Voice Slip Detector

Drivers approaching the site should have their train radios switched on.

A sign with silver lettering on a blue background worded:

"SLIP AREA - LISTEN FOR RADIO MESSAGE" is placed on the approach to the site to remind drivers to have their radios on.

The system will repeat its message at least 2 times. The transmission will advise the site name and location and the message being one of the following:

“SLIP SITE CLEAR”	Drivers may proceed normally.
STOP STOP SLIP DETECTED	Drivers should bring their train to a stand clear of the slip site and advise Control of the circumstances.

The slip site is marked, in each direction, by retro-reflective yellow signs with black lettering worded: "(Name) SLIP BOARD."

A second board with silver lettering on a blue background is worded: "SLIP AREA - IF NO RADIO MESSAGE HAS BEEN RECEIVED BY THIS POINT STOP TRAIN AND CONTACT SIGNALLER."

If no message is received, the driver should bring his train to a stand clear of the slip site and advise the Signaller at (location) of the circumstances.

The Signaller, when contacted by a train at the slip site should ascertain the circumstances from the driver.

Should a slip have been detected, the signaller should call out the Track Supervisor. Authority to permit the train to continue can only be given by the relevant civil engineering officer.

Should no message have been received the signaller should contact the Signal Electrician (location) to attend. Drivers are to be instructed to inspect the indicator light on the equipment location at the slip site. If a green light is showing, drivers may proceed normally. Otherwise drivers are to cautiously approach the site, prepared to bring their train to a stand clear of any obstruction. The train may proceed through the slip area if it can be ascertained that the area is safe. (Specific sites may have more specific requirements).

In the event that the equipment is to be taken out of service, the civil, signal and operations representations are to formally book out the equipment on an Infrastructure Booking Authority (IBA) form NRF 003.

The Civil Engineer (location) is required to protect the line, when the equipment is out of use, according to his determination of the circumstances.

When booked out of use, the two approaching notice boards are to be obscured. Trains entering the section are to be advised that the equipment is out of service and of any special arrangements that are in place.

Testing of the equipment will be performed regularly by the track supervisor or signal electrician. Results of the tests are to be advised to the Signaller at (location) for recording in the Train Register Book.

Appendix 3 Operations Instructions for Dragging Equipment Detectors Indicated to Signal Box

Description:

A red indicator light inscribed “Dragging Equipment” and a pushbutton inscribed “Pull to Test/Push to Cancel Alarm” and an audible alarm are included on the indicator diagram in the (location) Signal Box.

When Dragging Equipment is detected, an audible alarm will sound until depressed by the Signaller and a red light will be illuminated.

Procedures when Dragging Equipment is Detected

When Dragging Equipment is detected, the train driver is advised by the Signaller.

The Driver shall:

- Following notification of the alarm bring the train to a stand by normal application of the train braking system.
- Inspect the train to determine any dragging equipment.
- Secure the dragging equipment in its correct position.
- Confer with the Signaller and advise the cause of the problem and resultant action.

The Signaller shall:

On receiving an alarm, contact the train driver by radio or telephone and:

- Suppress the audio/visual alarm.
- Advise the driver that the Dragging Equipment Detector has been activated.
- Stop the following trains until the problem has been rectified.
- Ensure appropriate “GENL” telegram giving all details is prepared and dispatched.

A daily test of the warning light must be carried out by pulling the pushbutton and ensuring the warning light is illuminated and the alarm sounds. Results of this test are to be recorded in the Train Register Book and the Signal Electrician advised of any defects noted.

Appendix 4 Operations Instructions for Digitised Voice Dragging Equipment Detectors

Description:

Upon entering the dragging equipment detection area, the train will activate an appropriate message which will be broadcast on the train radio. A noticeboard inscribed: "DRAGGING GEAR DETECTOR, LISTEN FOR RADIO MESSAGE" will be provided at the entrance to the dragging equipment detection area.

If on traversing the dragging equipment detection area, no dragging equipment is detected, another appropriate message will be broadcast on the train radio. Similarly, a noticeboard inscribed: "DRAGGING GEAR MESSAGE SHOULD HAVE BEEN RECEIVED BY THIS POINT" will be provided approximately 1500 - 2000 metres beyond the location of the detector.

If no train radio message is received at the entrance or exit ends of the drag detector are, this would indicate that a fault has occurred in the radio system and Train Control is to be advised accordingly.

When dragging equipment is detected by the external equipment, or if a wagon is derailed, an appropriate message will be broadcast on the train radio.

The train must be brought to a stand as soon as possible, the rolling stock examined and the defect rectified.

If the fault cannot be readily rectified, it may be necessary for the affected rolling stock to be placed in a siding to permit the train to continue.

A 'GENL' telegram must be sent for instances when the dragging equipment detector is activated.

Appendix 5 Notice Boards

Notice Boards shall be a minimum of 900mm x 900m with the actual size and shape dependent on the text requirements. Lettering shall be Class 1 Scotchlite, white retro-reflective type E to AS1744, minimum 125mm high on a blue retro-reflective Class 1 Scotchlite background. The notice board shall be located / installed so that it does not infringe on the track structure gauge.

The precise location of all notice boards shall be subject to approval.

The boards shall be of aluminium with suitable bracing.

Appendix 6 Operations Instructions for Rainfall Monitors

Description:

Rainfall monitors are provided in the Waterfall - Wollongong area to monitor and measure the rate of rainfall and produce alarms when a preset rainfall rate is exceeded.

Lamp Indications:

Each rainfall monitor site is indicated on the Local Main Control Panel and on the applicable local control panel by two 'Rainfall Monitor' lamps labelled "Warning" and Alarm" respectively.

Warning Indication - a steady yellow lamp indicating both 15 minute or 8 hr warning condition.

Alarm Indication - a steady red lamp indicating both a 15 minute or 8 hour alarm condition.

Audible Alarm - an audible alarm is given whenever a rainfall monitor lamp is illuminated or extinguished.

Site Equipment

A locked Civil Indication Panel is provided at each rainfall monitor site and 6 rainfall monitor lights are indicated as follows:

Two 'Rainfall Monitor' lamps labelled "Warning" and "Alarm" respectively.

Warning Indication - a yellow lamp for 15 min. or 8 hr Warning condition.

Alarm Indication - a red lamp for 15 min. or 8 hr Alarm condition.

Four additional "Held Rainfall Monitor Indication" lamps are also provided and are labelled:

- Warning - 15 min.
- Warning - 8 hour
- Alarm - 15 min.
- Alarm - 8 hour

These lamps will retain the monitor warning and alarm conditions until cancelled by a push button switch labelled "Reset".

A key switch labelled "Maintenance Reset" is also provided to reset the Rainfall Monitor System after maintenance and testing.

Procedures When a Rainfall Monitor 'WARNING' Indication Is Exhibited

Area Controller/Signaller

When a rainfall monitor warning light is illuminated the Area Controller/Signaller (or the personnel operating a local panel) must:

- Advise the Emergency Civil Officer that a warning condition exists at the respective rainfall monitor/s site/s.
- Contact the Regional Operations Representative or on-call Representative and advise of the situation.
- Record the occurrence in the Train Register Book or other book provided.

Civil Representative

The civil Emergency personnel must:

- Inform the Maintenance Manager or representative.
- Call out the appropriate authorised civil personnel to inspect the area concerned. Prior to any inspection of the track and area, the Civil representative must check the warning indication

panel at the rainfall monitor site to check whether a 15 minute or 8 hour warning condition exists, and

- If a 15 minute warning condition exists, as a first priority concentrate on whether the culverts in the area are coping with the rainfall runoff
- In an 8 hour warning exists, as a first priority check whether the track is in danger due to land slip
- Advise the Area Controller/Signaller and/or local control panel whether or not the line is safe for trains
- Reset the held rainfall monitor indications when the rainfall monitor lamps go out.
- Procedures When a Rainfall Monitor 'ALARM' Indication Is Exhibited

Area Controller/Signaller

When a rainfall monitor alarm light is illuminated the Area Controller/Signaller (or the personnel operating a local panel) must:

- Stop all trains that are in the rainfall monitor coverage area.
- Stop any trains from entering the rainfall monitor coverage area.
- DO NOT permit trains in the rainfall monitor coverage area to proceed until it has been certified safe by an appropriate authorised civil representative.
- Place and keep blocking facilities on all applicable levers.
- Advise the Train Controller.
- Advise the Civil Emergency Officer that an alarm condition exists and that all trains in the area have been stopped.
- Advise the Regional Operations Representative or stand-by Representative of the situation.
- Record the occurrence in the Train Register Book or other book provided.

Civil Representative

- The Civil Emergency officer must.
- Advise the Maintenance Manager or civil representative.
- Call out the appropriate authorised civil personnel to inspect the area concerned. Prior to any inspection of the track and area, the civil representative must check the warning indication panel at the rainfall monitor site to ascertain whether a 15 minute or 8 hour alarm condition exists.
- Inspect the area concerned.
- Advise the Area Controller/Signaller and/or local control panel whether or not the line is safe for trains.
- Remain on duty while the rainfall alarm condition exists.
- Reset the held rainfall monitor indications when the rainfall monitor lamps go out.

Testing and Adjustment

All rainfall monitors are required to be tested monthly or otherwise as specified by the Civil Engineer.

The Area Controller must be advised of all tests and record such tests in the Train Register Book or other book provided.

Failure of Remote Control System

In the event of failure of the system controlling a remote interlocking where a Rainfall monitor is installed personnel at the Control Centre must advise the Emergency Civil Officer that:

- A failure of the remote control/indication system has occurred.
- Rainfall monitor location/s affected.

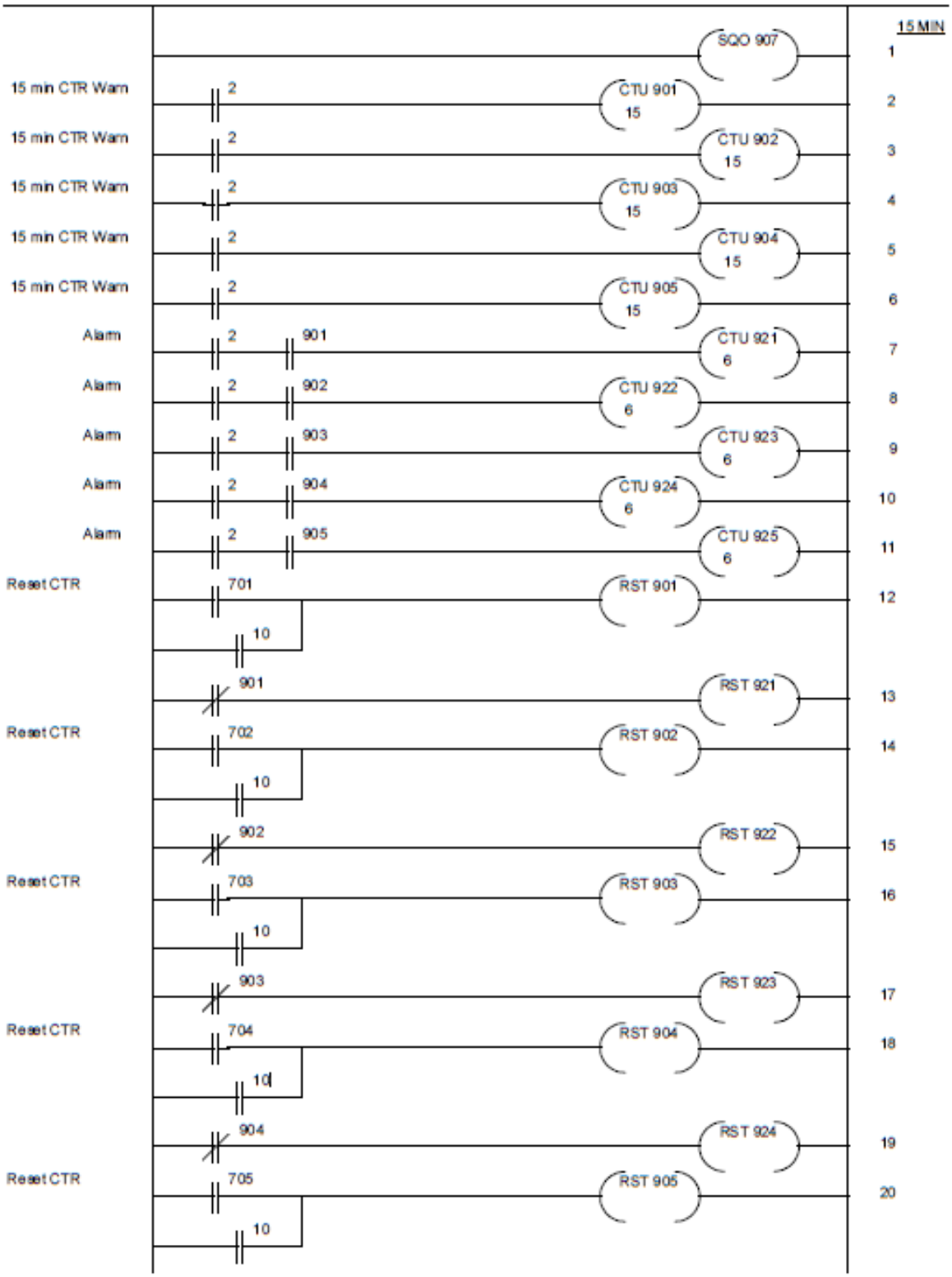
The Civil Emergency Personnel must:

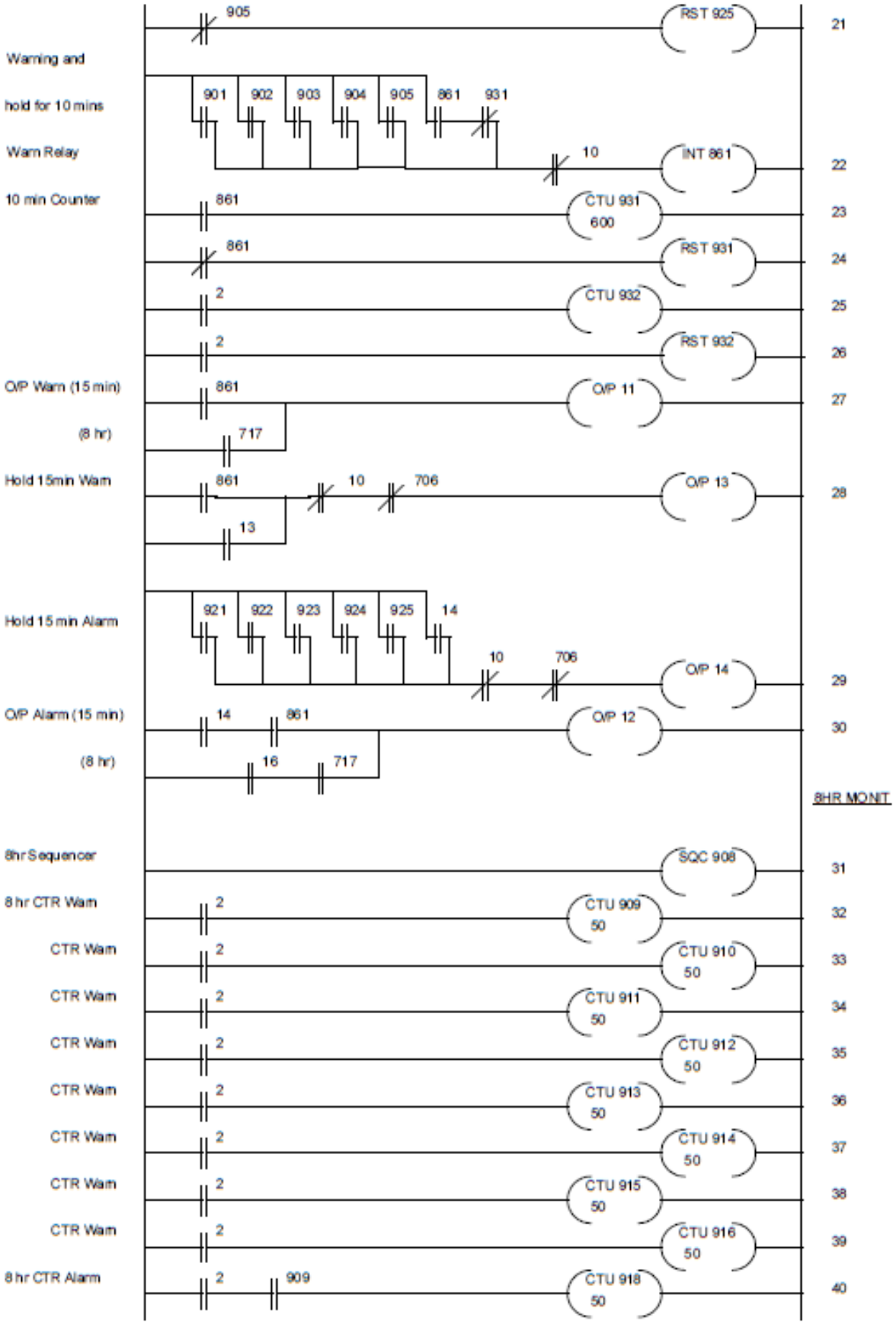
- Advise the Maintenance manager or civil representative.

The District Civil Engineer must:

- Make appropriate alternative arrangements.

Rainfall Monitoring Program Listing




905
RST 925
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Warning and
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905
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931
Warn Relay
10
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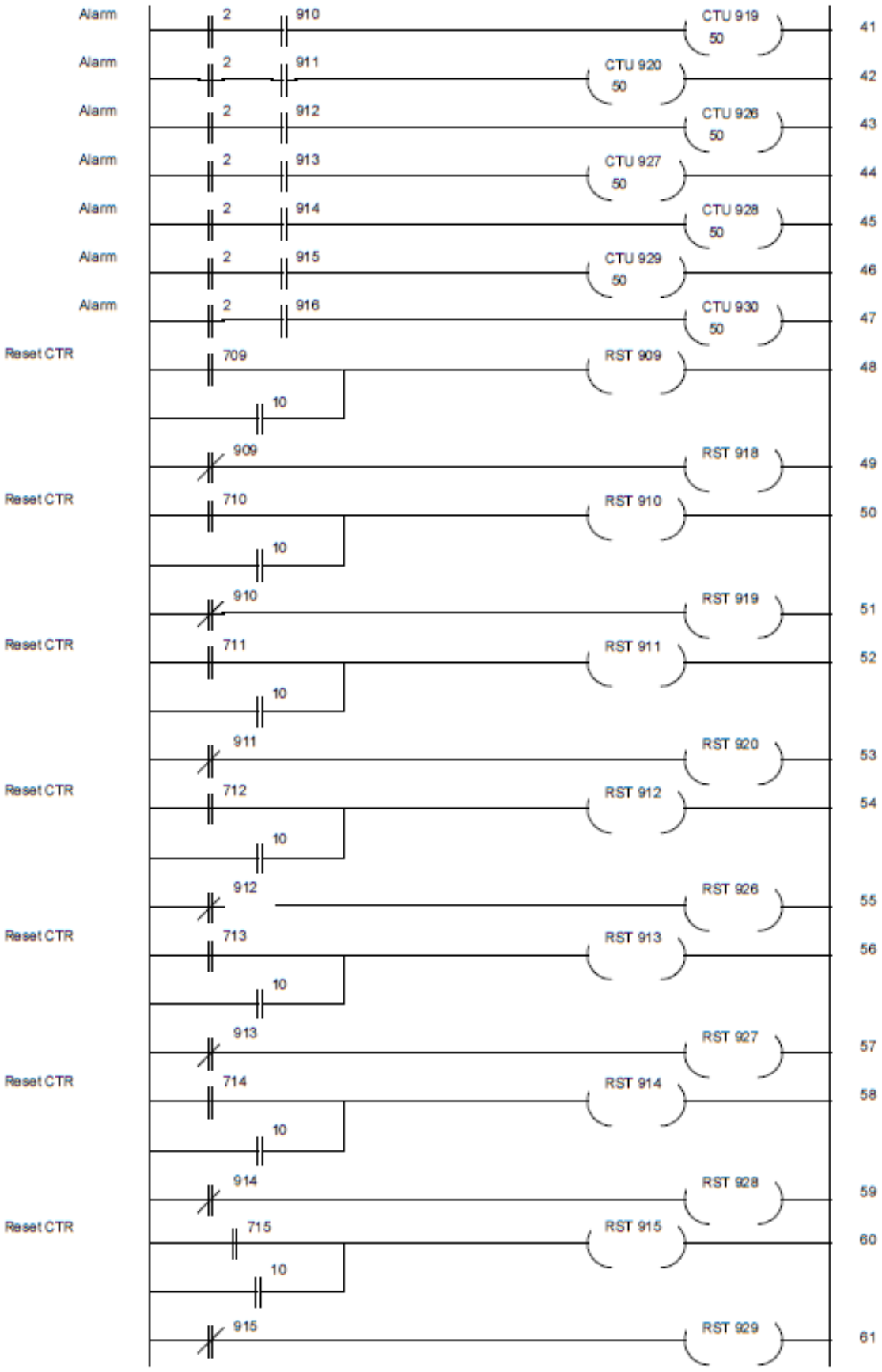
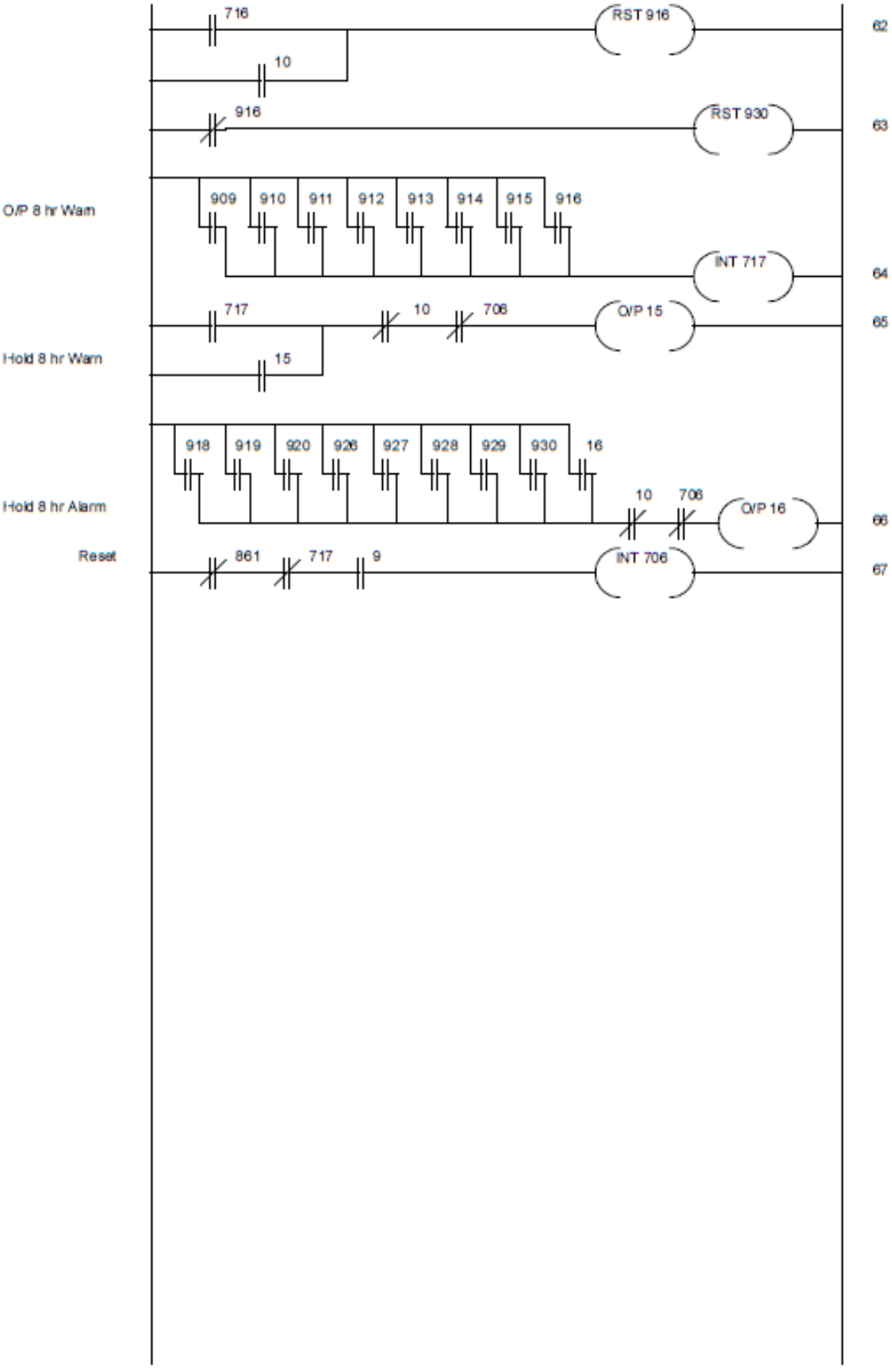
22
10 min Counter
861
CTU 931
600
23
861
RST 931
24
2
CTU 932
25
2
RST 932
26
O/P Warn (15 min)
861
O/P 11
27
(8 hr)
717
Hold 15min Warn
861
10
706
O/P 13
28
13
Hold 15 min Alarm
921
922
923
924
925
14
10
706
O/P 14
29
O/P Alarm (15 min)
14
861
O/P 12
30
(8 hr)
16
717
8HR MONIT
8hr Sequencer
SQC 908
31
8 hr CTR Warn
2
CTU 909
50
32
CTR Warn
2
CTU 910
50
33
CTR Warn
2
CTU 911
50
34
CTR Warn
2
CTU 912
50
35
CTR Warn
2
CTU 913
50
36
CTR Warn
2
CTU 914
50
37
CTR Warn
2
CTU 915
50
38
CTR Warn
2
CTU 916
50
39
8 hr CTR Alarm
2
909
CTU 918
50
40


Alarm
2
910
CTU 919
50
41
Alarm
2
911
CTU 920
50
42
Alarm
2
912
CTU 926
50
43
Alarm
2
913
CTU 927
50
44
Alarm
2
914
CTU 928
50
45
Alarm
2
915
CTU 929
50
46
Alarm
2
916
CTU 930
50
47
Reset CTR
709
RST 909
48
10
909
RST 918
49
Reset CTR
710
RST 910
50
10
910
RST 919
51
Reset CTR
711
RST 911
52
10
911
RST 920
53
Reset CTR
712
RST 912
54
10
912
RST 926
55
Reset CTR
713
RST 913
56
10
913
RST 927
57
Reset CTR
714
RST 914
58
10
914
RST 928
59
Reset CTR
715
RST 915
60
10
915
RST 929
61


716
RST 916
62
10
916
RST 930
63
O/P 8 hr Warn
909
910
911
912
913
914
915
916
INT 717
64
717
10
706
O/P 15
65
Hold 8 hr Warn
15
918
919
920
926
927
928
929
930
16
10
706
O/P 16
66
Reset
861
717
9
INT 706
67

15 MIN TIMER

SEQUENCER INSTRUCTION DATA FORM

SEQUENCER CLASSIFICATION: ☐ -(SQI)- ☑ -(SQO)-

ADDRESS: 907

☑ TIME DRIVEN ☐ EVENT DRIVEN

GROUP NUMBER: 16

BIT ADDRESS DATA										PROGRAM CODE		PRESET VALUES				
		B				A										
Bit Addresses →		708	707	706	705	704	703	702	701	Data B	Data A					
Mask Data		0	0	0	1	1	1	1	1	1	F					
Step Data →	0								1	0	1			2		
	1								0	0	0	1	7	8	0	
	2							1		0	2			2	0	
	3								0	0	0	1	7	8	0	
	4						1			0	4			2	0	
	5								0	0	0	1	7	8	0	
	6					1				0	8			2	0	
	7								0	0	0	1	7	8	0	
	8				1					1	0			2		
	9								0	0	0	1	7	8	0	
	10															
	11															
	12															
	13															
	14															
	15															
	16															
	17															
	18															
	19															
	20															

8 HR TIMER
PART 1
SEQUENCER INSTRUCTION DATA FORM

SEQUENCER CLASSIFICATION: ☐ -(SQI)- ☑ -(SQO)-

ADDRESS: 908

☑ TIME DRIVEN ☐ EVENT DRIVEN

GROUP NUMBER: 17

BIT ADDRESS DATA										PROGRAM CODE		PRESET VALUES			
		B				A									
Bit Addresses →		716	715	714	713	712	711	710	709	Data B	Data A				
Mask Data →		1	1	1	1	1	1	1	1	F	F				
Step Data →	0								1	0	1			2	0
	1									0	0	9	0	0	
	2									0	0	9	0	0	
	3									0	0	9	0	0	
	4									0	0	9	0	0	
	5							1	0	0	2			2	
	6									0	0	9	0	0	
	7									0	0	9	0	0	
	8									0	0	9	0	0	
	9									0	0	9	0	0	
	10						1	0	0	0	4			2	
	11									0	0	9	0	0	
	12									0	0	9	0	0	
	13									0	0	9	0	0	
	14									0	0	9	0	0	
	15					1	0	0	0	0	8			2	
	16									0	0	9	0	0	
	17									0	0	9	0	0	
	18									0	0	9	0	0	
	19									0	0	9	0	0	
	20				1					1	0			2	

8 HR TIMER
PART 2
SEQUENCER INSTRUCTION DATA FORM

SEQUENCER CLASSIFICATION: ☐ -(SQI)- ☑ -(SQO)-

ADDRESS: 908

☑ TIME DRIVEN ☐ EVENT DRIVEN

GROUP NUMBER: 17

BIT ADDRESS DATA									PROGRAM CODE		PRESET VALUES			
	B				A									
Bit Addresses →	716	715	714	713	712	711	710	709	Data B	Data A				
Mask Data →														
Step Data →														
21									0	0	9	0	0	
22									0	0	9	0	0	
23									0	0	9	0	0	
24									0	0	9	0	0	
25			1						2	0			2	
26									0	0	9	0	0	
27									0	0	9	0	0	
28									0	0	9	0	0	
29									0	0	9	0	0	
30		1							4	0			2	
31									0	0	9	0	0	
32									0	0	9	0	0	
33									0	0	9	0	0	
34									0	0	9	0	0	
35	1								8	0			2	
36									0	0	9	0	0	
37									0	0	9	0	0	
38									0	0	9	0	0	
39									0	0	9	0	0	
40														

ADDRESS	USE	RUNG		ADDRESS	USE	RUNG
901	15 min CTU W	2		701-705	15 min RST	1
902	15 min CTU W	3		709-716	8 hr RST	23
903	15 min CTU W	4		706	EXT Reset	45
904	15 min CTU W	5		707		
905	15 min CTU W	6		708		
906		19				
907	15 min SQO	1		717	Warn 8 hr	40
908	8 hr SQO	23				
909	8 hr CTU W	24				
910	8 hr CTU W	25				
911	8 hr CTU W	26		861	15 min Warn	12
912	8 hr CTU W	27		862		
913	8 hr CTU W	28		863		
914	8 hr CTU W	29				
915	8 hr CTU W	30				
916	8 hr CTU W	31				
917				1		
918	8 hr Alarm CTR			2	Pulse i/p	
919	8 hr Alarm CTR			3		
920	8 hr Alarm CTR			4		
921	15 min Alarm CTR			5		
922	15 min Alarm CTR			6		
923	15 min Alarm CTR			7	Acc Reset	
924	15 min Alarm CTR			8		
925	15 min Alarm CTR			9	EXT Reset i/p	
926	8 hr Alarm CTR			10	IND Reset i/p	
927	8 hr Alarm CTR			11	Warn o/p	17
928	8 hr Alarm CTR			12	Alarm o/p	20
929	8 hr Alarm CTR			13	15 min Warn	18
930	8 hr Alarm CTR			14	15 min Alarm	21
931	10 min Warn hold	13		15	8 hr Warn	41
932	CNTR.	14		16	8 hr Alarm	43

Appendix 7 Operating Instructions for Hot Box Detectors

Description:

Hot box detectors (HBD) are provided to detect hot axle boxes on trains. The equipment transmits or relays alarms when a hot box is detected by two methods, depending on location as follows:

Hot box detectors located at (location) relay alarm signals to the signal box. The signaller then warns the train driver through the train radio system or signal telephone.

Hot box detectors located at (location) transmit alarms via digitised voice through the train radio system direct to the train driver. An alarm is also relayed to the CTC Centre, Broadmeadow.

Drivers operating trains in these locations must always have the train radio system switched on to receive digitised voice alarm messages.

Telephones and signs endorsed "Hot Box Detector, Message Should Have Been Received By This Point" are located approximately 2 kilometres on either side of the (location) detectors where digitised voice is used.

Hot box detectors are located as follows: (list of locations)

Computerised audio and visual alarms are provided in (location) signal boxes, and also in the CTC Centre.

When a hot axle box is detected a bell will sound and a red flashing light will operate until suppressed by the signaller or Train Controller.

The hot box detector counts the vehicle axles form the front of the train as it passes and the axle number on which the hot axle box is detected is indicated in the signal box and/or the CTC Centre, by digital display.

A printout showing the sequential number of the train, direction of travel and time is also provided.

If a HBD equipment failure alarm is activated the Signal Electrician is to be called to attend.

Drivers of trains passing HBD equipment while it is out of order should be advised, if possible.

GENL telegram to be prepared and despatched.

Procedures when a Hot Box Is Detected

When a hot box is detected the driver of the train locomotive is warned by radio via digitised voice or by the signaller.

The Driver must:

- If the warning is received by digitised voice, bring the train to a stand at "Message Should Have Been Received By This Point" board by normal application of the train brake system and communicate with the Train Controller, CTC Centre, Broadmeadow by the telephone provided:
- If the warning is received from the signaller by radio, bring the train to a stand by normal application of the train brake system;
- Assess the condition of the hot axle box or boxes and establish the course of action to be adopted.
- Confer with the Signaller and/or Train Controller on course of action to be adopted;
- If the hot axle box is considered safe to continue the journey, travel at reduced speed to a siding or location where the vehicle(s) can be detached;
- If the hot axle box is considered to be in an unsafe condition, arrange for the wagon to be examined by a mechanical officer or detach the wagon immediately.

The Signaller must:

On receiving an audio/visual alarm and when trains have passed clear of the HBD equipment, contact the train locomotive driver by radio or telephone and:

- Suppress the audio/visual alarm;
- Warn the driver that the hot box detector has activated;
- Inform the driver of the axle number(s);
- Stop following trains until the condition of the axle box or boxes has been established;
- Confer with the driver and the Train Controller, CTC Centre, on course of action to be adopted;
- Ensure appropriate "GENL" telegram giving details is prepared and despatched.

The Train Controller must:

On receiving an audio/visual alarm and/or telephone message that a hot box detector has activated, communicate with the driver and/or signaller by telephone or radio and:

- Suppress the audio/visual alarm;
- Assess the information provided by the driver or signaller;
- If required, alert emergency services and arrange for the train or defective vehicle to be cleared from the section;
- Ensure that appropriate "GENL" telegram is prepared and despatched.