



**AUSTRALIAN RAIL TRACK CORPORATION LTD**

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**Signalling**

**Title**  
**Track Side Monitoring Equipment**

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## **LIST OF APPENDICES**

- Appendix 1: Operations Instructions for Interlocked Slip Detectors
- Appendix 2: Operations Instructions for Digitised Voice Slip Detector
- Appendix 3: Operations Instructions for Dragging Equipment Detectors indicated to Signal Box.
- Appendix 4: Operations Instructions for Digitised Voice Dragging Equipment Detectors
- Appendix 5: Notice Boards
- Appendix 6: Rainfall Monitor Major Parts Inventory
- Appendix 7: Operations Instructions for Rainfall Monitor
- Appendix 8: Operation Instructions for Hot Box Detectors

## 1. Introduction

Trackside monitoring systems can be categorised into three areas:

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.

**Category 1** devices include embankment slip or rockfall detectors.

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

**Category 2** devices include hot box detectors, dragging equipment detectors, structure gauge and high load detectors, wheel impact detectors, and train weighing systems.

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

**Category 3** 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 system
- b) By indication to a signal box to permit the signaller to take the appropriate action via the signalling or train radio
- c) By digitised voice on the driver's 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 engineers, and the procedures to be followed to ensure a consistent and acceptable installation.

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## 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) and with rockfall, 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 Microswitches to be sealed, waterproof and high quality mechanisms.

2.1.2 Two Microswitches must always be used to maintain system integrity should one fail to operate, and to double switch the detection circuit.

2.1.3 Detectors 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 The 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 must be constructed of non corrodable material (brass, stainless steel etc) and be maintained in position by a spring tension or other suitable arrangement.

2.1.6 Detectors 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 Refer to Drawings M4: 89-051A and M4: 89-065A for details. (Diagrams 3 and 4).

2.1.8 Other detection devices may be suitable for different applications (e.g. Rockfall installations) and providing they meet the functional requirements above in 2.1.1, 2.1.2, 2.1.3 and 2.1.5 and 2.1.6 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 staff 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. (Refer Diagram 3).

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. (Refer Diagram 4).

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 microswitches.

## 2.5 Maintenance

During maintenance, the correct operation of each microswitch 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 relevant Corridor Manager or nominated Signalling representative.

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 SA.4.300 form.

The Corridor Manager or nominated Signalling representative 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 ARTC.

### **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 Corridor Manager or nominated Signalling representative. (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 SA.4.300 form 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 (eg 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 SPS 03 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 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:

- a) The controlling relay shall be mounted physically as close as is practically possible to the digitised voice recorder.
- b) At least two drop contact of the relay are to be used to provide the inputs to the digitised voice recorder.
- c) These two inputs are to be wired through independent circuits (including fusing, wiring and terminations) to ensure that the system is fully redundant.
- d) 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 or 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 The audio levels between the voice generator and the radio's audio input shall be matched and set at 0dBm.

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

2.8.4.6 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 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 45° 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 : + 1 dB,-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 (subaudible) 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 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 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 Immediately after the "press-to-talk" delay, the system will transmit, twice as a minimum requirement the following messages:

### Condition

No defects detected

### Message Spoken

**"SRA SLIP DETECTION SYSTEM"**

**"location"**

**"KILOMETRAGE XXX.X"**

(selecting all zeros will suppress kilometrage annunciation)

**"Track Name" - to be supplied for each location**

(if double track installation)

With Defects

**"SLIP SITE  
CLEAR"  
"REPEAT"  
"SLIP SITE  
CLEAR" "location"  
"OUT"**

**"SRA SLIP DETECTION  
SYSTEM" "location"  
"KILOMETRAGE XXXX.X"**  
(selecting all zeros will suppress  
kilometrage 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 wired shall be independently tested to ensure the equipment is 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**

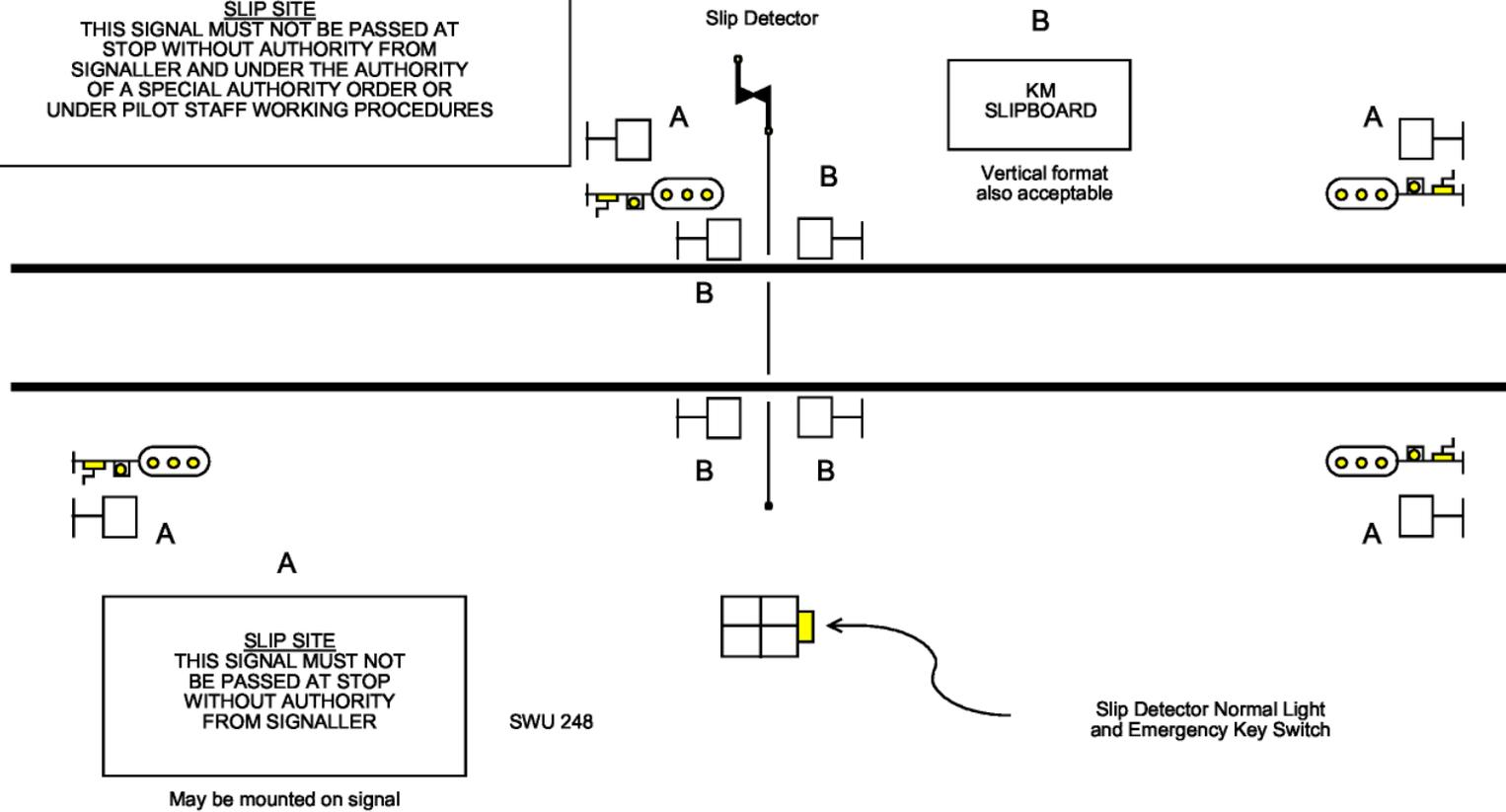
The procedures for drivers, signallers and train controllers are detailed in Appendix 2.

**INTERLOCKED SLIP DETECTOR  
 SYSTEM CONFIGURATION TRACK PLAN**

**Diagram 1**

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



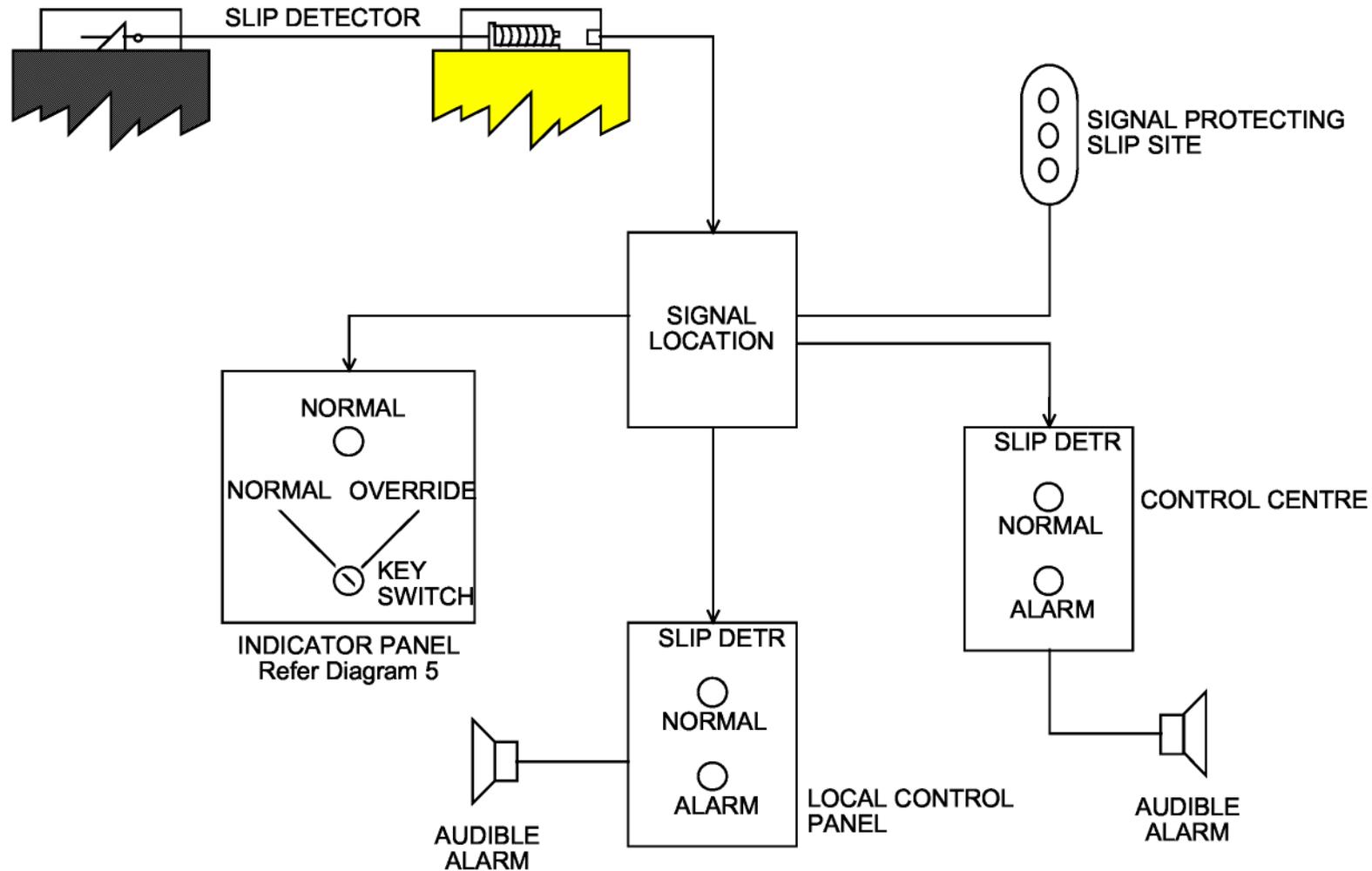
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TRACKSIDE MONITORING SYSTEMS

Rail Access Corporation

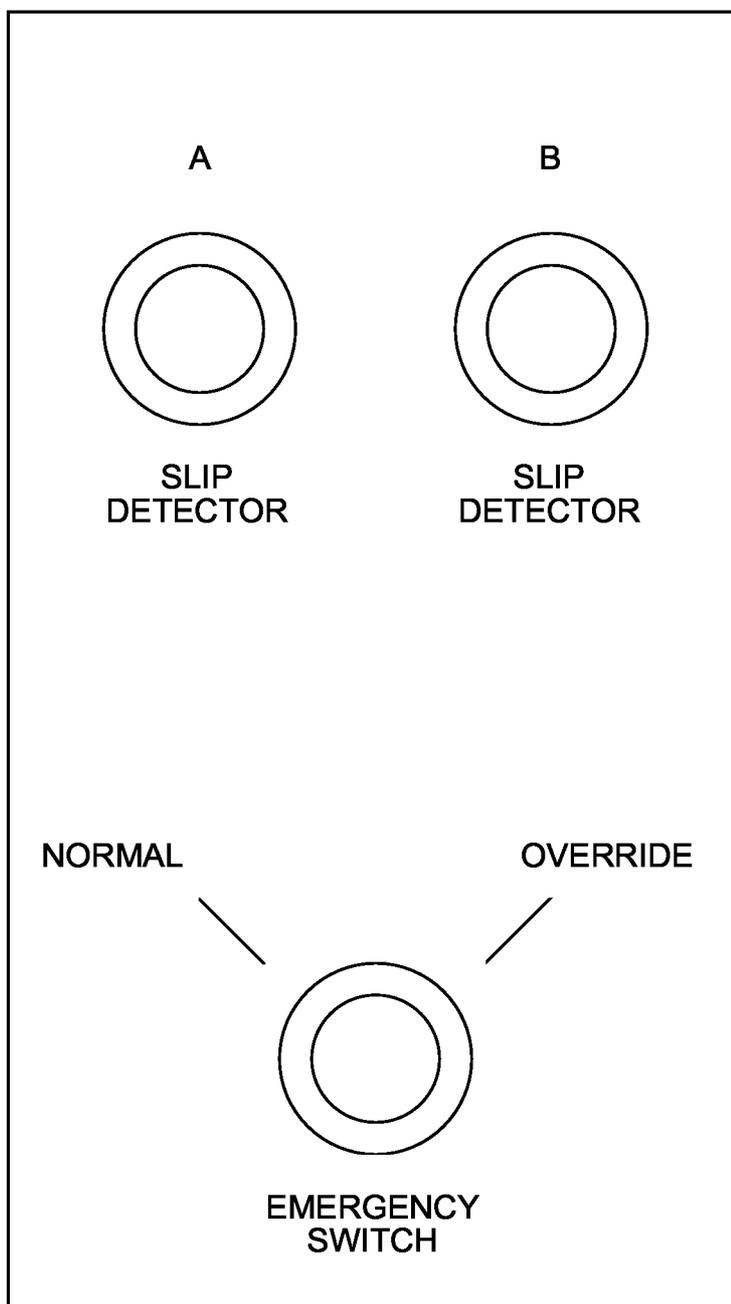
### SLIP DETECTOR ALARM SYSTEM LAYOUT

Diagram 2



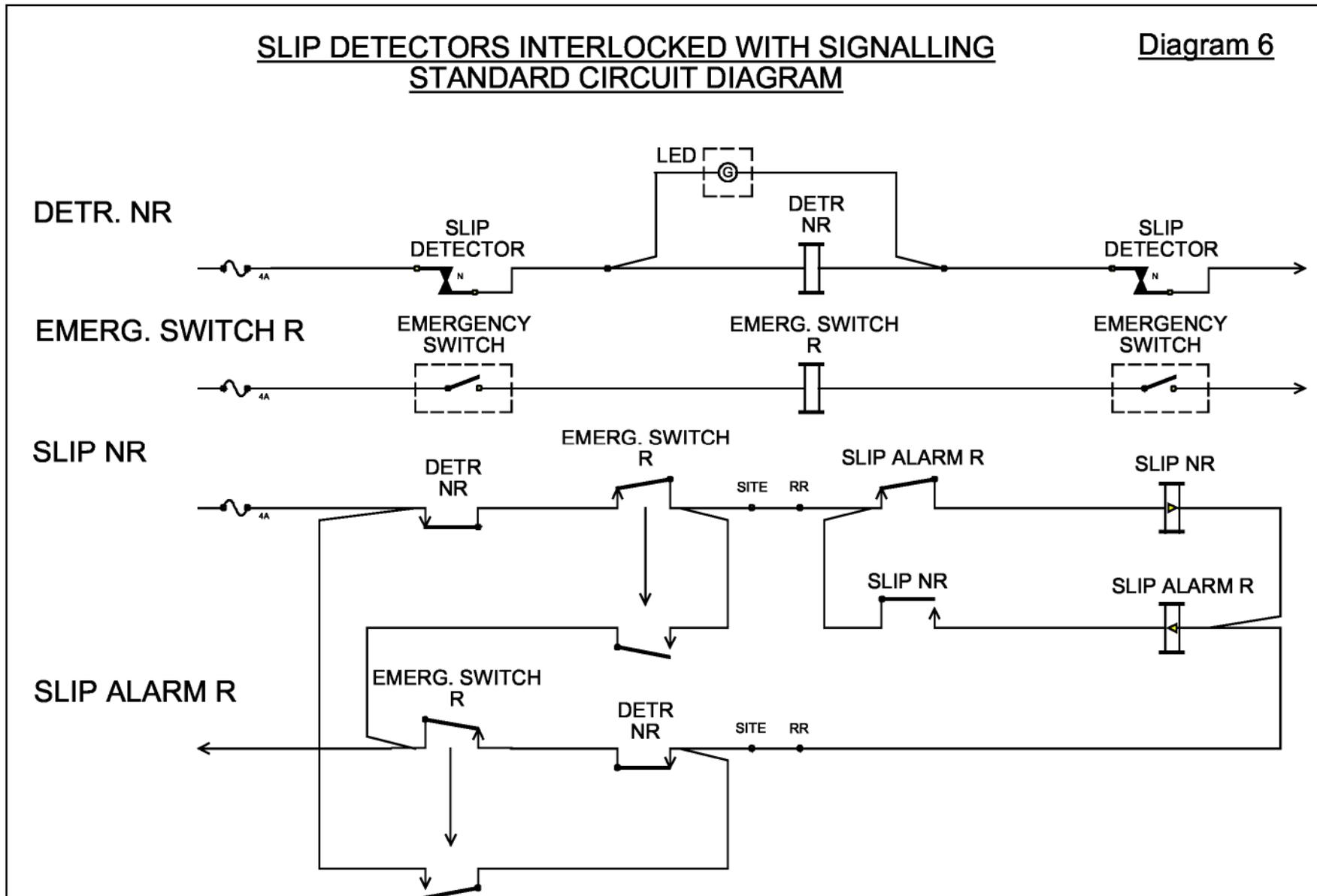
**SLIP DETECTOR  
EMERGENCY SWITCH TEMPLATE**

**Diagram 5**



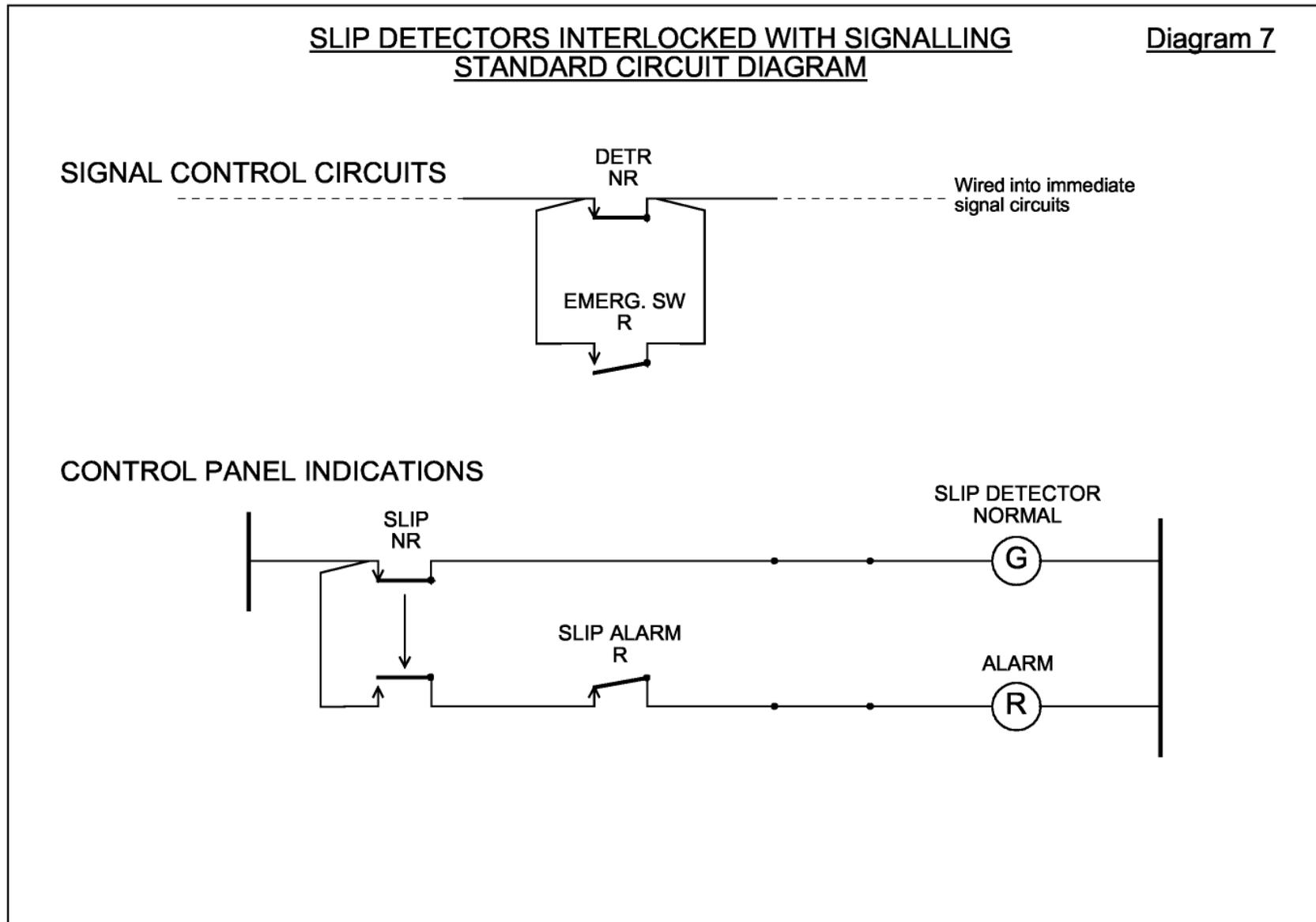
**SLIP DETECTORS INTERLOCKED WITH SIGNALLING**  
**STANDARD CIRCUIT DIAGRAM**

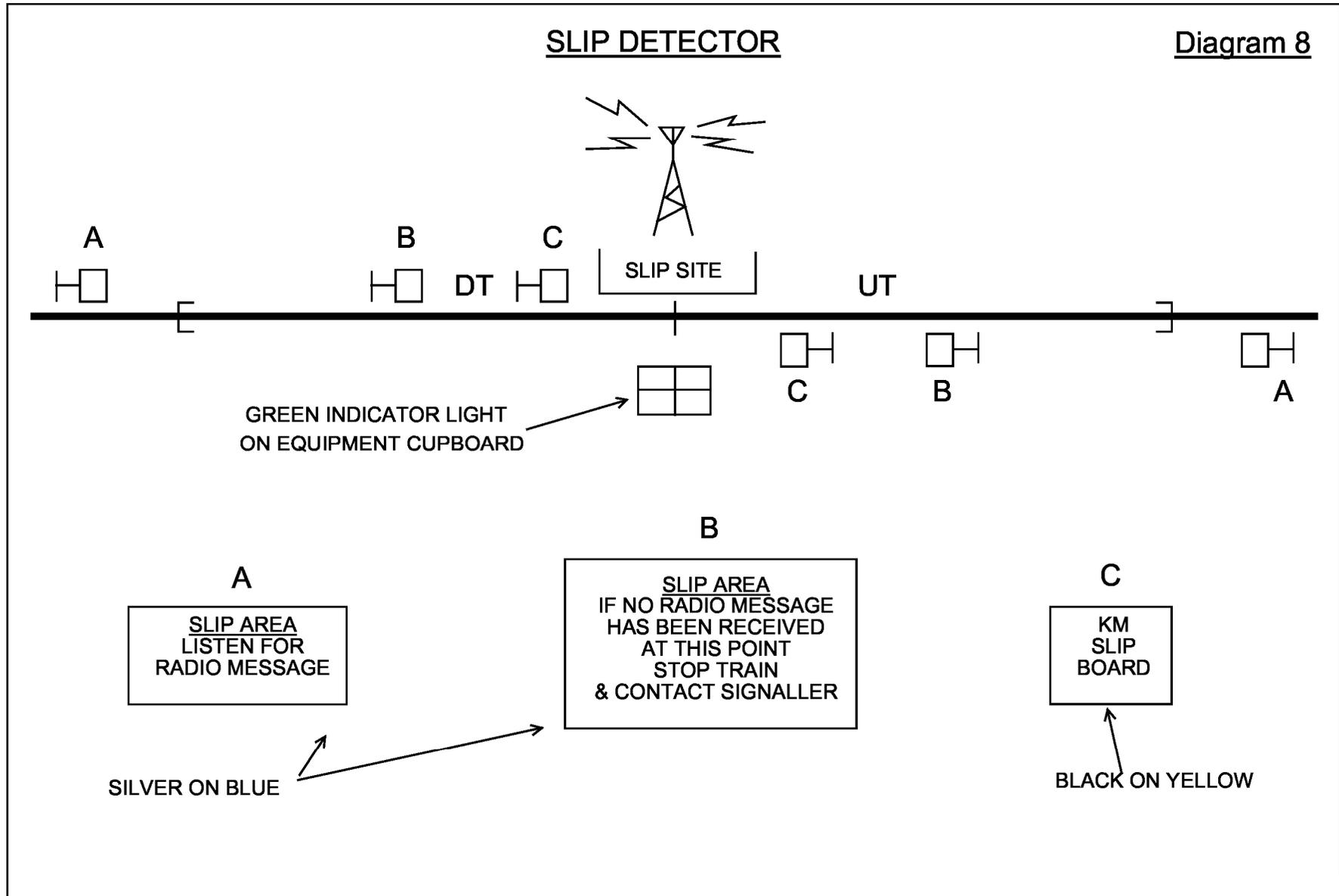
**Diagram 6**



**SLIP DETECTORS INTERLOCKED WITH SIGNALLING  
STANDARD CIRCUIT DIAGRAM**

**Diagram 7**

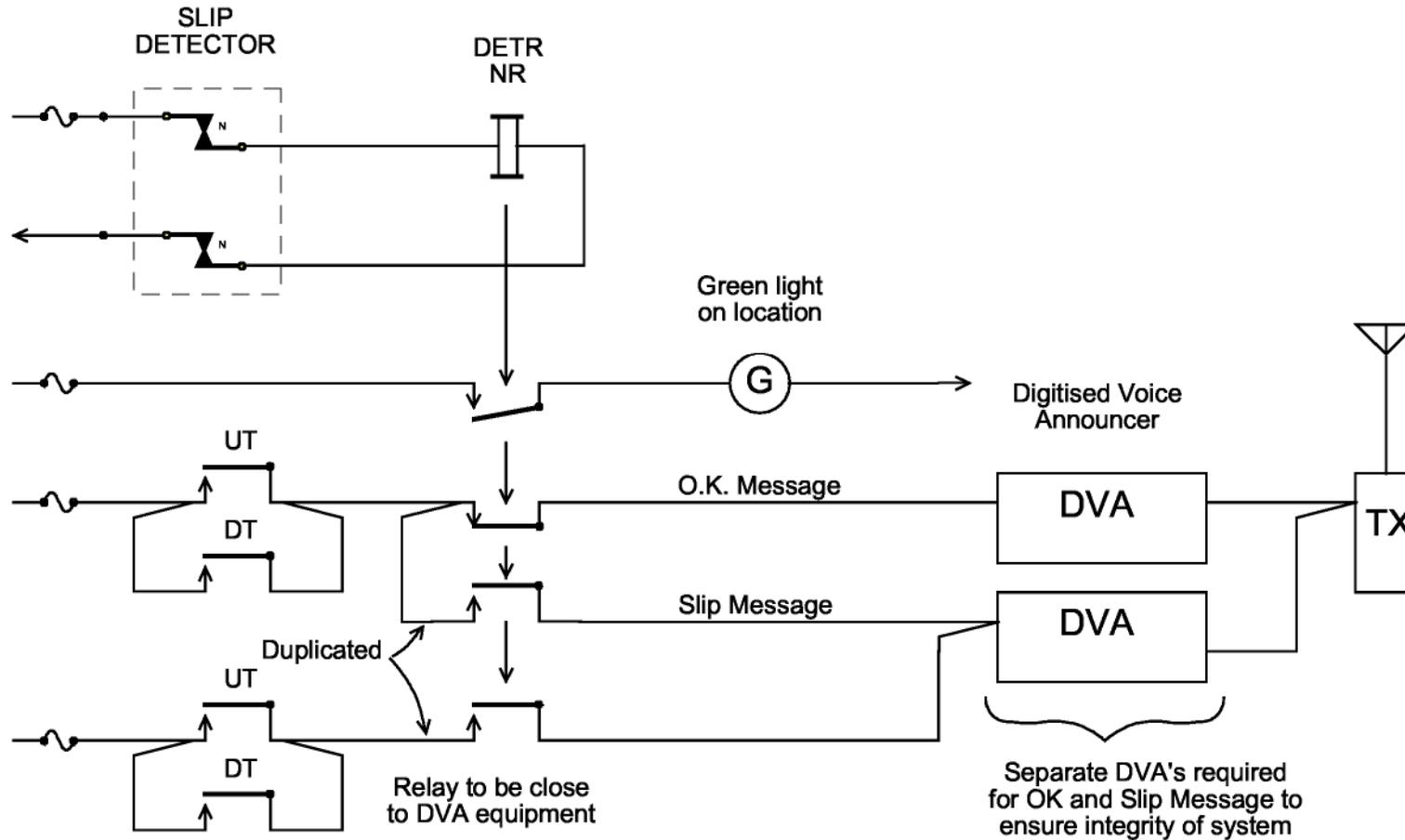






### DIGITISED VOICE SLIP DETECTOR STANDARD CIRCUIT DIAGRAM

Diagram 10



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## **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

- a) Frangible bar
- b) 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 Signal Box**

#### **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**

1. 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 SPS 03 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 his 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 SPS 03 for circuit books.

### 3.2.4 Digitised Voice Equipment and Radios

3.2.4.1 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:

- a) The controlling relay shall be mounted physically as close as is practically possible to the digitised voice recorder.
- b) At least two drop contact of the relay are to be used to provide the inputs to the digitised voice recorder.
- c) These two inputs are to be wired through independent circuits (including fusing, wiring and terminations) to ensure that the system is fully redundant.
- d) 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 or 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 voice generator and the radio's audio input shall be matched and set at 0dBm.

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

3.2.4.5 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 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 45° 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 : + 1 dB,-8 dB relative to +6dB per octave  
preemphasis 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 (subaudible) 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 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 are 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 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 Immediately after the "Press-to-talk" delay, the system will transmit, twice as a minimum requirement the following messages:

**Condition**

No defects detected

**Message Spoken**

No defects detected

**"SRA DRAG DETECTION**

**SYSTEM" "location"**

**"KILOMETRAGE XXX.X"**

(selecting all zeros will suppress kilometrage annunciation)

**"Track Name" - to be supplied for each location**

(if double track installation)

**"NO**

**DEFECTS"**

**"REPEAT"**

**"NO**

**DEFECTS"**

**"location"**

**"OUT"**

With Defects

**"SRA DRAG DETECTION**

**SYSTEM" "location"**

**"KILOMETRAGE XXXX.X"**

(selecting all zeros will suppress kilometrage 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 the following maintenance procedures:

#### **Four (4) Weekly Service**

At four weekly intervals the following work shall be carried out:

1. External visual inspection of the equipment to determine loose connections, damaged equipment, free operation of the equipment.
2. Rectification of any problems determined during the visual inspection.
3. Operate the DED manually to check switch operation.
4. Check the DED works and provides the indication to the relevant Signal Box or Control Centre.

As activation of the DED alarm is dependent upon train presence, the inspection shall include dropping the relevant track circuit.

Results of the inspection and test are to be recorded.

#### **Twenty Four (24) Weekly Service**

At intervals not exceeding twenty four weeks the following work shall be carried out:

1. Remove cover from the switch assembly and check switch assembly parts for loose connections and rectify.
2. Check
  - Detent Slide Assembly (Item No. 1)
  - Jam Nut 5/8-18 (item No. 3)
  - Pivot Contact Linkage Assembly (Item No.5)
  - Stationary Contact Assembly (Item No. 7)
  - AAR Wiring Terminals (item No. 8)

(See Diagram 1 (Drawing No. 102137-000)), and rectify loose and/or poor connections.

3. Check switch adjustment.

The DED switch assembly is set for approximately 8 degrees out of top dead centre for contact operation from the factory.

To increase or decrease contact pressure the hexagon nuts, Item 5 (Pivot contact linkage assembly) must be loosened first on sub-assembly, Item (5D),

- a. Increase tension, turn top nut counterclockwise. (Note: Made sure the the contact does not adjust past a 50%over wipe). Tighten lower nut.
- b. Decrease tension, turn top nut clockwise. Push on Pivot contact to release tension. Tighten lower nut.

4. Grease the unit as follows

- Rotate unit to the right until against stop. Grease unit until grease comes out the top of the fitting.
- Rotate unit back and forth 3 or 4 times.
- Rotate unit to the left until against stop. Grease unit until grease comes out the top of the fitting.
- Rotate unit back 3 or 4 times.

Grease unit in the normal position until grease comes out of the top of the fitting.

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## **DRAGGING EQUIPMENT DETECTOR PIVOT SWITCH ASSEMBLY**

### **DRAWING and PARTS LIST**

## **DRAGGING EQUIPMENT DETECTOR PIVOT SWITCH ASSEMBLY**

### Diagram 1

Dragging Equipment Detector Assembly Parts List

**H1-180182-001 NORMALLY CLOSED**

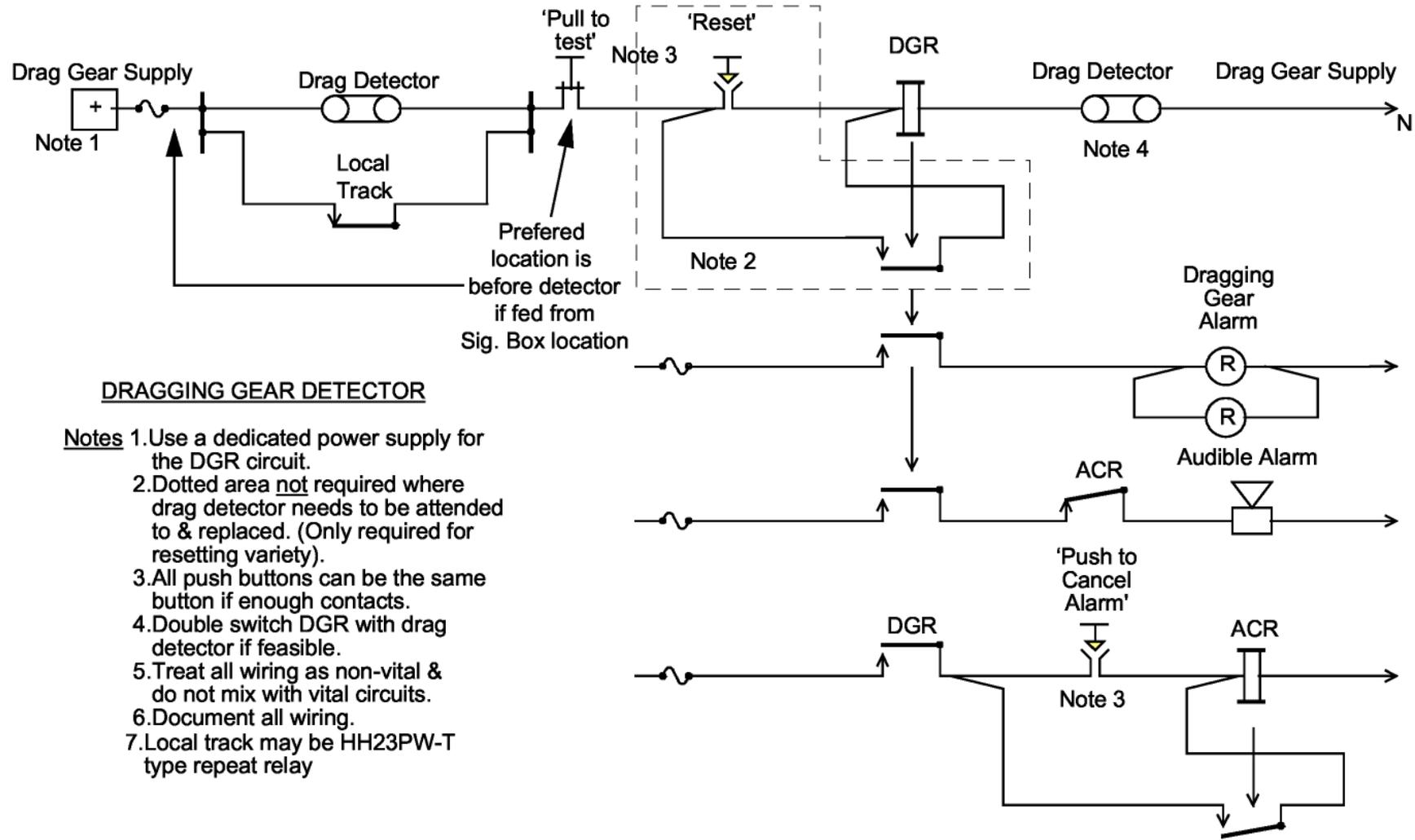
**H1-180182-002 NORMALLY OPEN**

**Reference Drawing 102137-000**

| Item No. | HPN           | QTY | Description                        | Modern         |
|----------|---------------|-----|------------------------------------|----------------|
| 1        | 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 Contact 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           | H 1-121219-002 |
| 7c       | (22271-002)   | (1) | Stationary 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      |

## DRAGGING EQUIPMENT DETECTOR INDICATED TO SIGNAL BOX STANDARD CIRCUIT DIAGRAM

Diagram 2







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## 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 1 mm bucket tips. The water gauge has magnetic reed switches which operate at each tip of the water buckets. Each tip therefore corresponds to 1 mm 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 a 8 hours 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 Operations Control Centre or local control panel 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 light are labelled "**15min Warn, 15min Alarm, 8hour Warn, 8hour 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:

- a) Catch filter
- b) Syphon
- c) Interior of bucket
- d) Top of bucket
- e) Shaft and screw pilots
- f) 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:

471 ml (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 3140ml 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

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

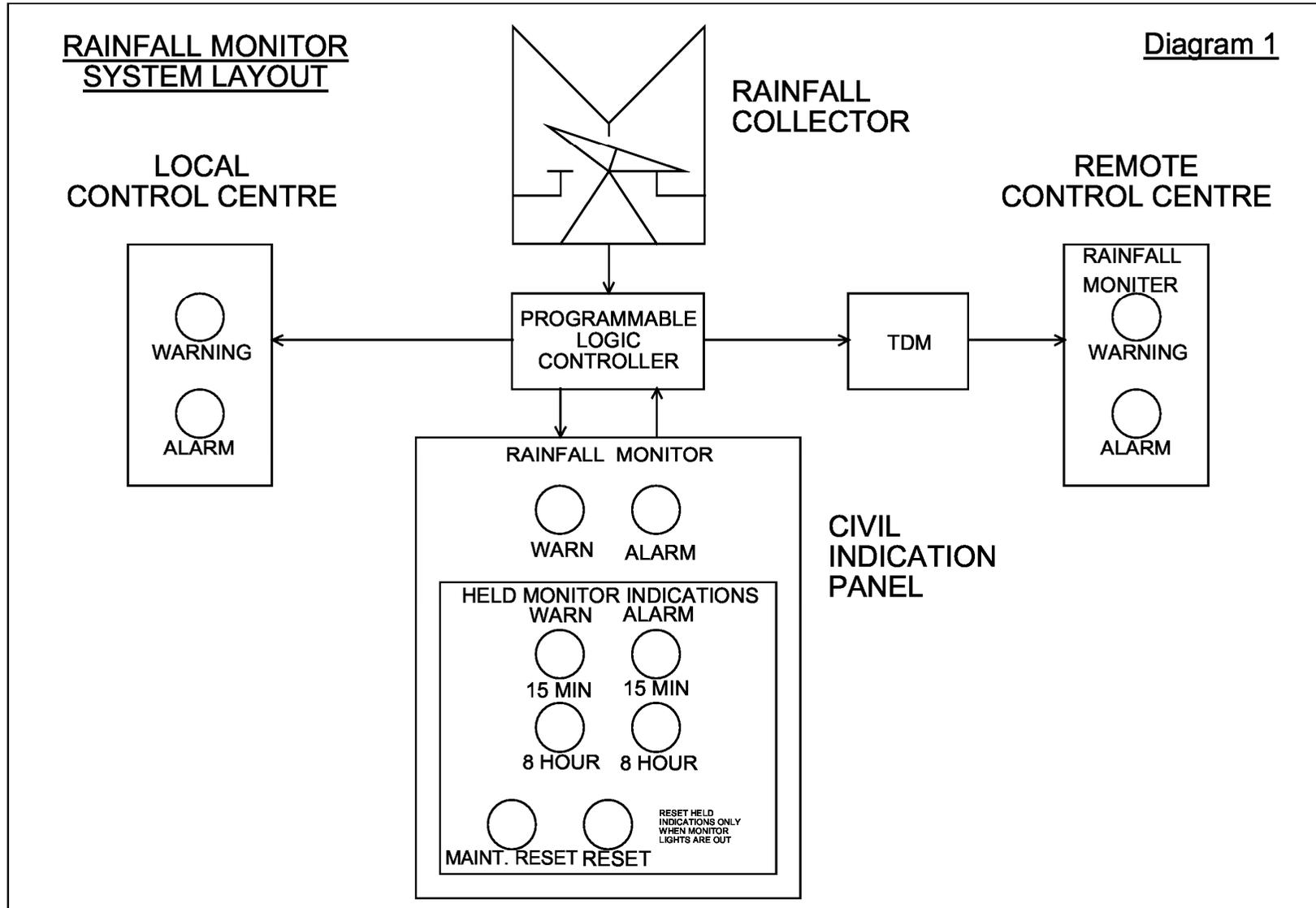
All documentation is to be on A3 paper to similar standards as described in Standard Specification SPS 03 for circuit books.

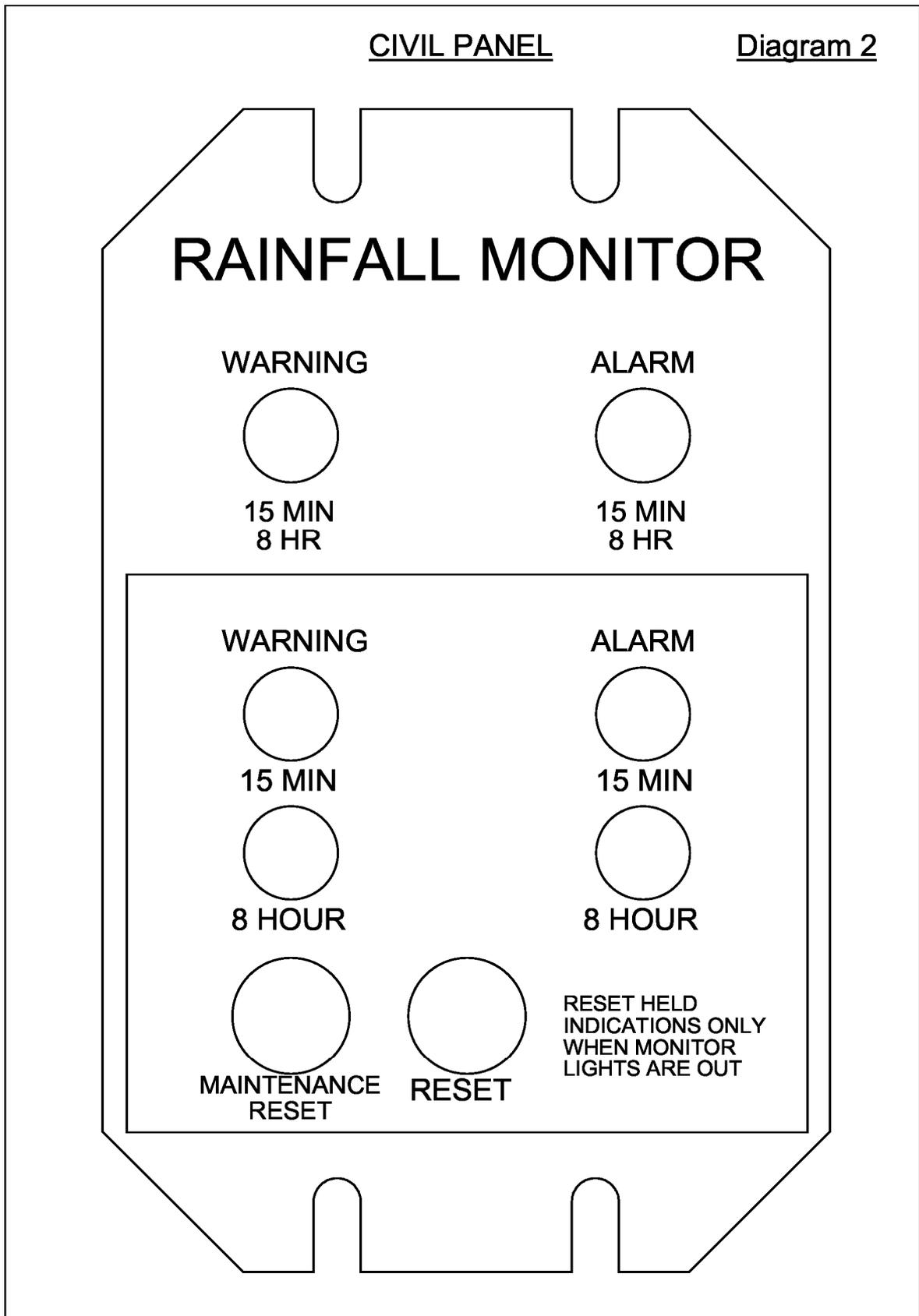
## 4.7 System Testing

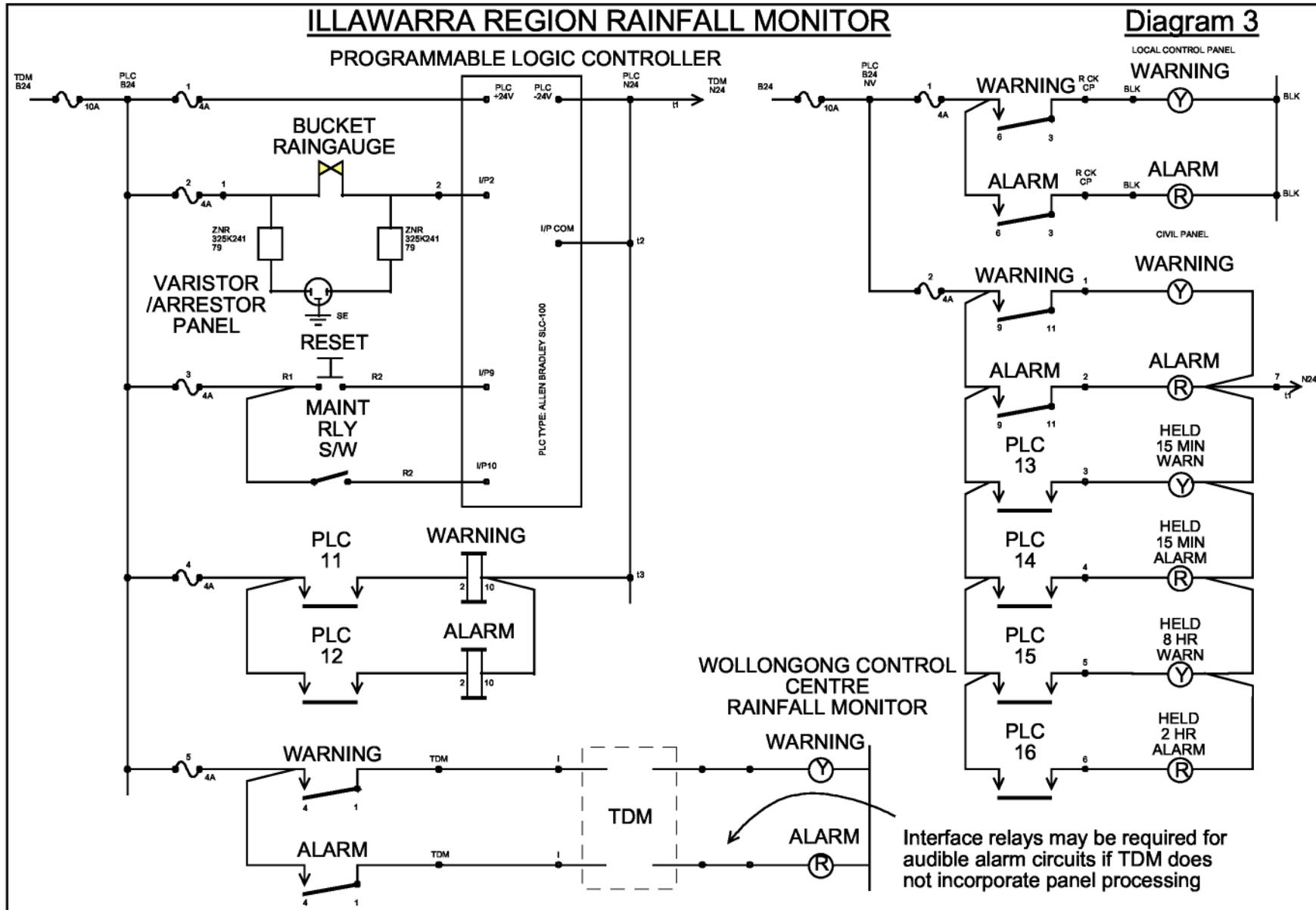
The Signal Engineer is to fully functionally test the system prior to commissioning. A formal test plan is to be produced and all testing results are to be fully documented and certified as completed. The Maintenance Signal Engineer is to store this document in a secure location after commissioning.

## **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 7.







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## **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 type 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 shows 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 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 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 trains

complete passing of the detector site, before relaying defect information to train crew.

5.2.3 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 Train presence, advance start, and directional information is 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 The detector shall be capable of bidirectional operation. Direction of train travel is to be stored as part of the train data.

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

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

1. Alarm level adjustments. all adjustable parameters specified in this document must be able to be set/reset/adjusted through software control.
  2. \* List all train in memory
  3. \* List trains with defects in memory
  4. \*\* Download all data for a specified train in memory
  5. \*\* Download alarms for a specified train(s) in memory
6. General Diagnostics
  7. Forced out of service (by operator - software)

8. Forced digitised voice disable (by operator - software)
9. Train Identification (I.D.) Number entered by signaller
10. 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 All cables are to be installed in accordance with Signalling Standard Specification SCP 21. All buried cables must be inspected and approved by the Superintendent prior to backfilling.

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

### **5.3 Equipment Requirements**

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

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

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

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

- Timber sleepers
- Concrete sleepers
- 53 Kg Rail
- 60 Kg Rail The maximum speed of trains on the railway network

is 180 Km/hr

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

5.3.10 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 Specification No. SPS 01 for electronic systems shall be complied with.

## **5.4 Railway Power Supply**

5.4.1 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 Railway power supplies are reticulated at 120V + 10% at 50 Hz and supplied by railway or 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 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 back up 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 restores to full functionality, without any loss of information.

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

5.5.2 Equipment bungalows shall be supplied and installed by the Contractor to Specification SCP 22.

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

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

5.7.1.5 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 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 : +/- 5 kHz maximum

Residual FM Noise : 2.5% maximum

Audio Response : + 1 dB, -8 dB relative to + 6dB per octave preemphasis 300 to 3000Hz

Spurious Emission : <2.5 Micro Watts

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

5.7.1.8 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 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 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.

- a) The controlling relay shall be mounted physically as close as is practically possible to the digitised voice recorder.
- b) At least two drop contract of the relay are to be used to provide the inputs to the digitised voice recorder.
- c) These two inputs are to be wired through independent circuits (including fusing, wiring and terminations) to ensure that the system is fully redundant.
- d) 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 or 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 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 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 Immediately after train has passed the detector, the system will transmit, twice as a minimum requirement the following messages:

| <b><u>Condition</u></b> | <b><u>Message Spoken</u></b>  |
|-------------------------|---|
| No defects Detected     | <b>"SRA ROLLING INSPECTION SYSTEM" "location"</b><br><b>"KILOMETRAGE XXXX.X"</b><br>(selecting all zeros will suppress kilometrage annunciation)<br><b>"TOTAL AXLES"</b><br>(if switch active)<br><b>"Track Name" - to be supplied for each location</b> (if double track installation)<br><b>"NO DEFECTS"</b><br><b>"REPEAT"</b><br><b>"NO DEFECTS"</b><br><b>"location"</b><br><b>n"</b><br><b>"OUT"</b>  |
| With Defects            | <b>"SRA ROLLING INSPECTION SYSTEM"</b><br><b>"location"</b><br><b>"KILOMETRAGE XXX.X"</b><br>(selecting all zeros will suppress kilometrage annunciation)<br><b>"TOTAL AXLES"</b><br>(if switch active)<br><b>"Track Name" - to be supplied or each location</b> (if double track installation)<br><b>"FIRST HOT BOX-LEFT/RIGHT SIDE AXLE XXX"</b><br><b>"SECOND HOT BOX-LEFT/RIGHT SIDE AXLE XXX"</b><br><b>"STOP YOUR TRAIN IMMEDIATELY &amp; INSPECT YOUR TRAIN"</b><br><b>"REPEAT"</b><br><b>"FIRST HOT BOX-LEFT/RIGHT SIDE AXLE XXX"</b><br><b>"SECOND HOT BOX-LEFT/RIGHT SIDE AXLE XXX"</b><br><b>"STOP YOUR TRAIN IMMEDIATELY &amp; INSPECT YOUR TRAIN"</b><br><b>"location"</b><br><b>"OUT"</b> |

With Excessive Defects

**"SRA ROLLING INSPECTION**

**SYSTEM" "location"**

**"KILOMETRAGE XXXX.X"**

(selecting all zeros will

suppre

ss kilometrage 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

**"SRA ROLLING INSPECTION SYSTEM"**

**"location"**

**"KILOMETRAGE XXXX.X"**

(selecting all zeros will

suppre

ss kilometrage 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 9.

## **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

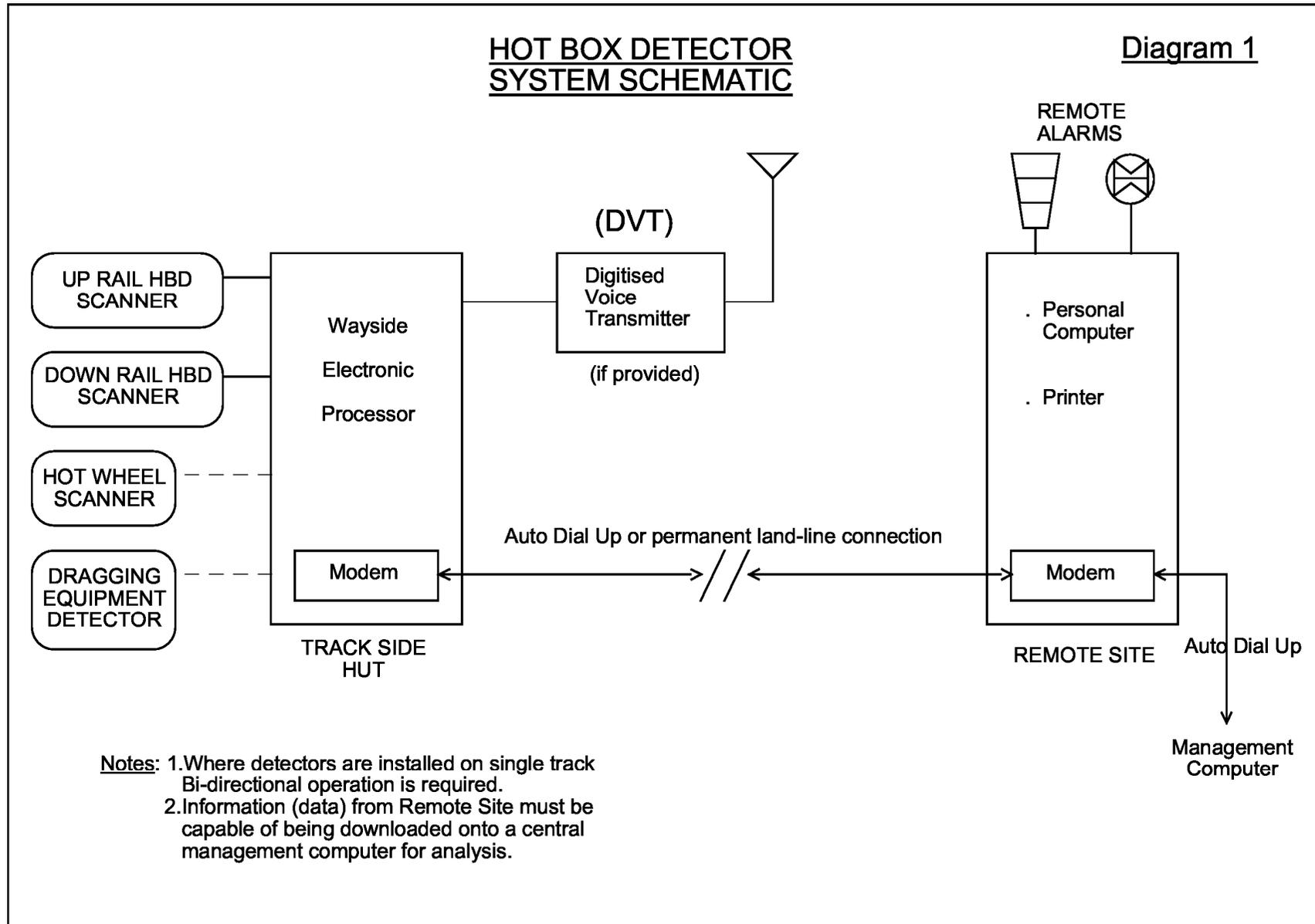
Full Systems Tests including Diagnostic and Communications.

Test documentation shall use ITF forms from Specification SCP 07 where appropriate.

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

### HOT BOX DETECTOR SYSTEM SCHEMATIC

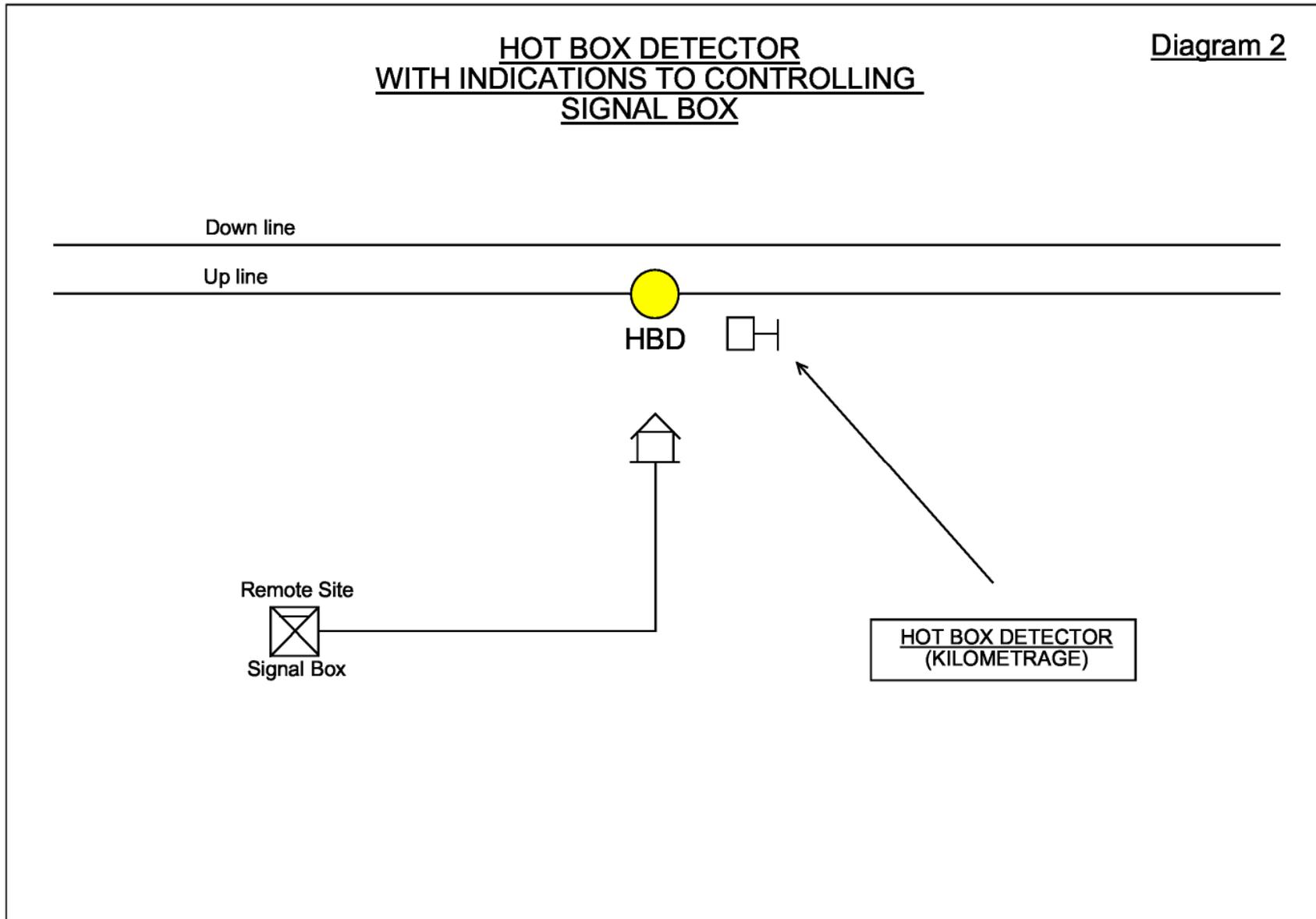
Diagram 1



**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.

HOT BOX DETECTOR  
WITH INDICATIONS TO CONTROLLING  
SIGNAL BOX

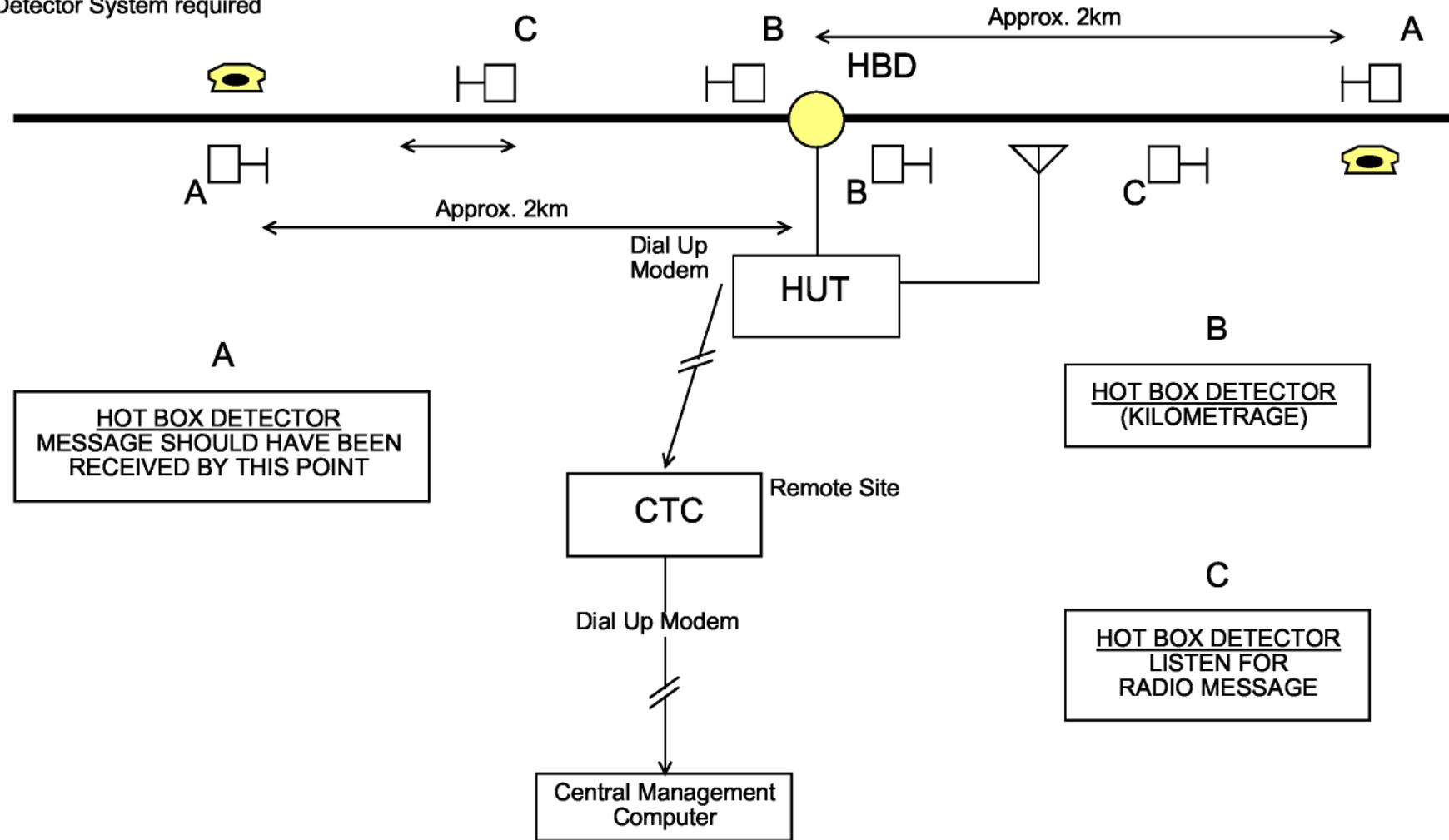
Diagram 2



### HOT BOX DETECTOR DIGITISED VOICE

Diagram 3

Bi - Directional Operation of  
 Detector System required



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# APPENDICES

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## 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, ie. 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 Corridor Manager or nominated Signalling 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 Corridor Manager or nominated Signalling representatives will then book out of use the Slip Detector(s) on a S.W.F. SA.4.300 form 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 indications(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 retroreflective 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 Corridor Manager or nominated Signalling representative.

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 SA.4.300 form.

The Corridor Manager or nominated Signalling representative (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.

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## **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.

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

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## **APPENDIX 5**

### **NOTICE BOARDS**

Notice Boards shall be a minimum of 900mm x 900mm with the actual size and shape dependent on the text requirements.. Lettering shall be Class 1 Scotchlite, white retroreflective type E to AS1744, minimum 125mm high on a blue retroreflective 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.

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## APPENDIX 6

### RAINFALL MONITOR MAJOR PARTS

#### INVENTORY Typical Suppliers

Programmable Controller  
Allan-Bradley SLC 100  
cat. 1745-LP104D5  
from Exel Control 1 Resolution  
Dr Unanderra N.S.W. 2500  
ph. 042 721922

Tipping Bucket RAIN-GAUGE  
model T.B.2 1 mm bucket  
from Hydrological Services  
P.O. BOX 332  
Liverpool N.S.W. 2170 ph. 9748 2652

Indicator Box  
WM 3215 with T handle  
from Exel Control 1 Resolution  
Dr Unanderra N.S.W. 2500  
ph 042 9721922

Indicator lights  
AP6M122R IDEC IZUMI  
CORP from Gordon  
Macdonald  
93 Auburn St  
Wollongong N.S.W. 2500  
ph 042 285544

Reset Button and Contact  
Block Telemecanique ZB2-  
BA4  
Telemecanique ZB2-BZ101  
from Stotts Industrial  
Supplies 19 Doyle Ave  
Unanderra 2500 ph 042 714004

Civil Panel  
Engraved in 6mm traffolyte

In addition an Allan-Bradley SLC Programmer (cat. 1745-PT1) and Memory Module (cat. 1745-M1) may be necessary if monitoring or altering of rainfall rates is desired.

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## APPENDIX 7

### 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

### 1. Area Controller/Signaller

When a rainfall monitor warning light is illuminated the Area Controller/Signaller (or the staff 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 Superintendent or on-call Superintendent and advise of the situation
- record the occurrence in the Train Register Book or other book provided.

### 2. Civil Representative

The civil Emergency personnel must:

- inform the Maintenance Manager or representative
- call out the appropriate authorised Civil staff 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 1. Area Controller/Signaller

When a rainfall monitor alarm light is illuminated the Area Controller/Signaller (or the staff 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 Corridor Manager or nominated Signalling 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 Superintendent or stand-by Superintendent of the situation
- record the occurrence in the Train Register Book or other book

provided. 2. Civil Representative

- the Civil Emergency officer must:
- advise the Maintenance Manager or civil representative
- call out the appropriate authorised Civil staff 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, and
- 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 Corridor Manager or nominated Signalling representative.

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:**

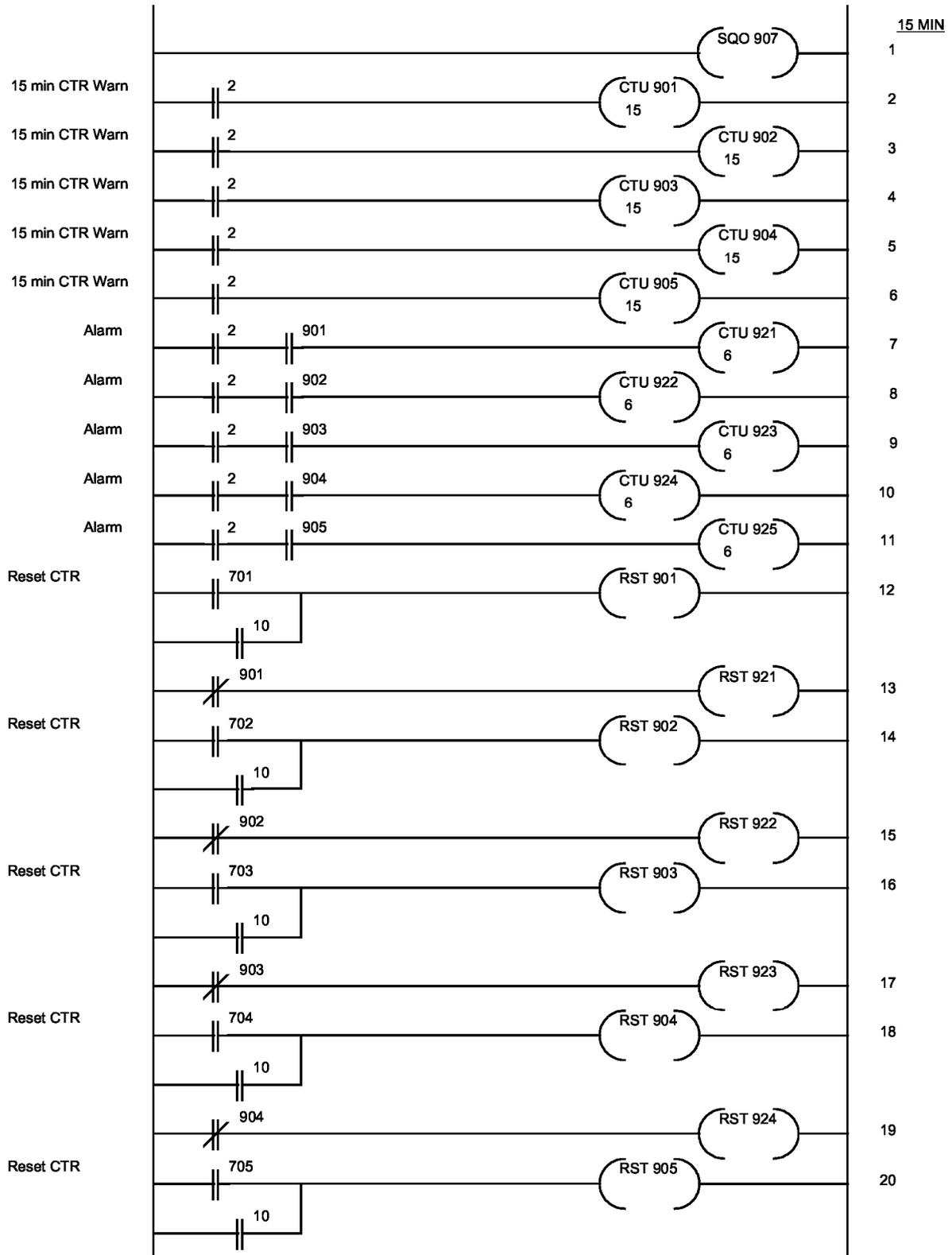
In the event of failure of the system controlling a remote interlocking where a Rainfall monitor is installed staff at the Control Centre must advise the Emergency Civil Officer that:

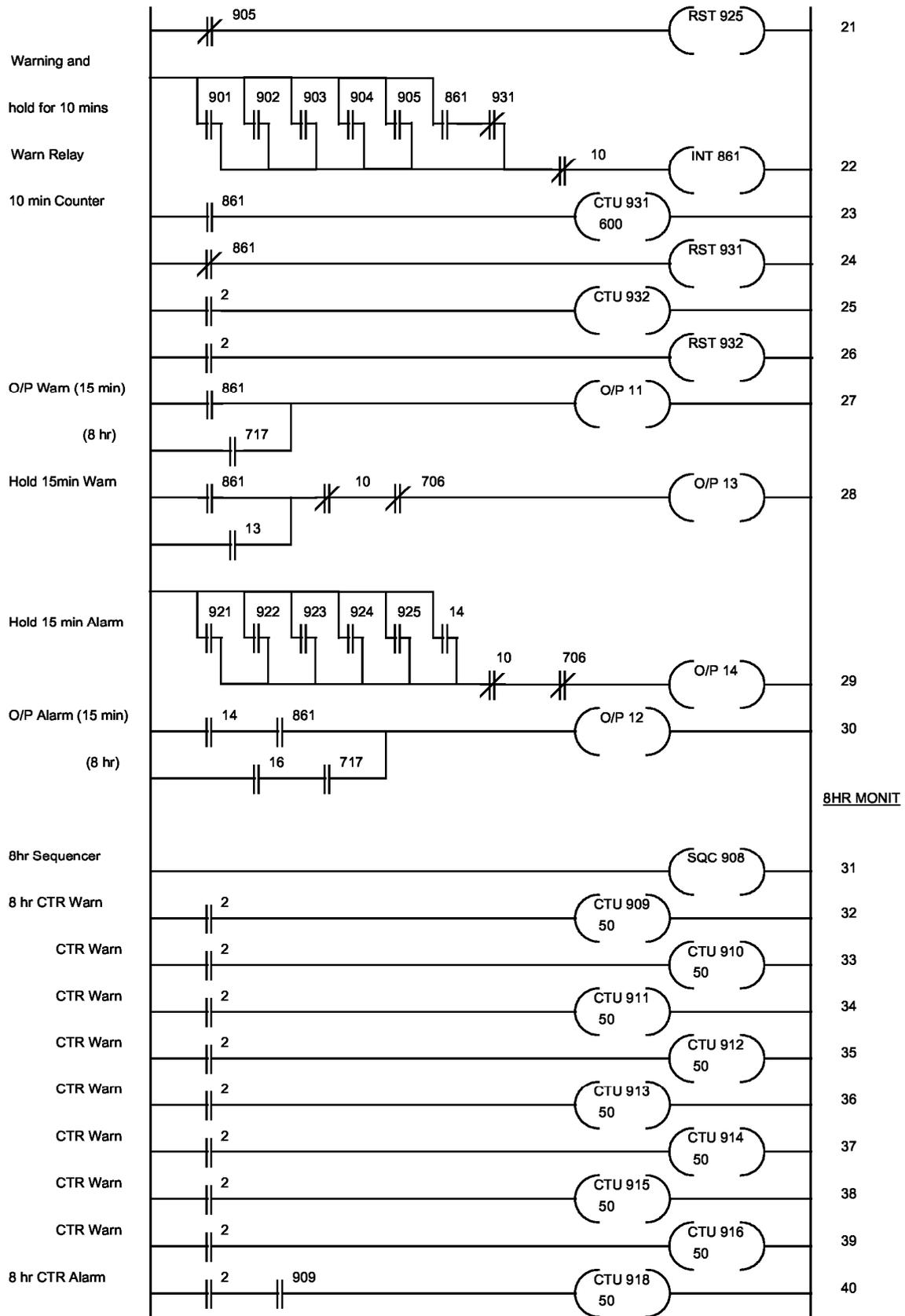
- a failure of the remote control/indication system has occurred
- rainfall monitor location/s affected

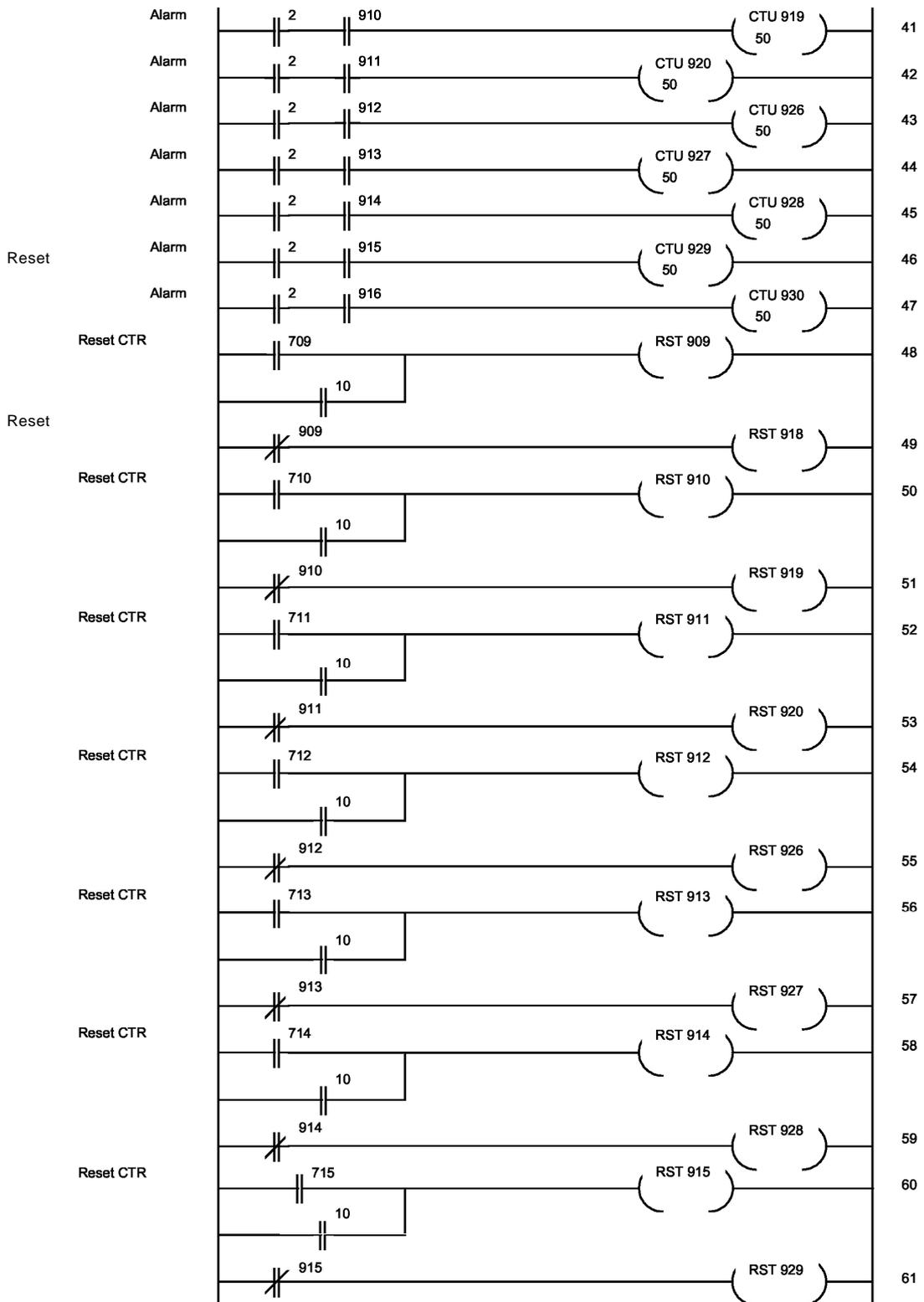
The Civil Emergency Personnel must:

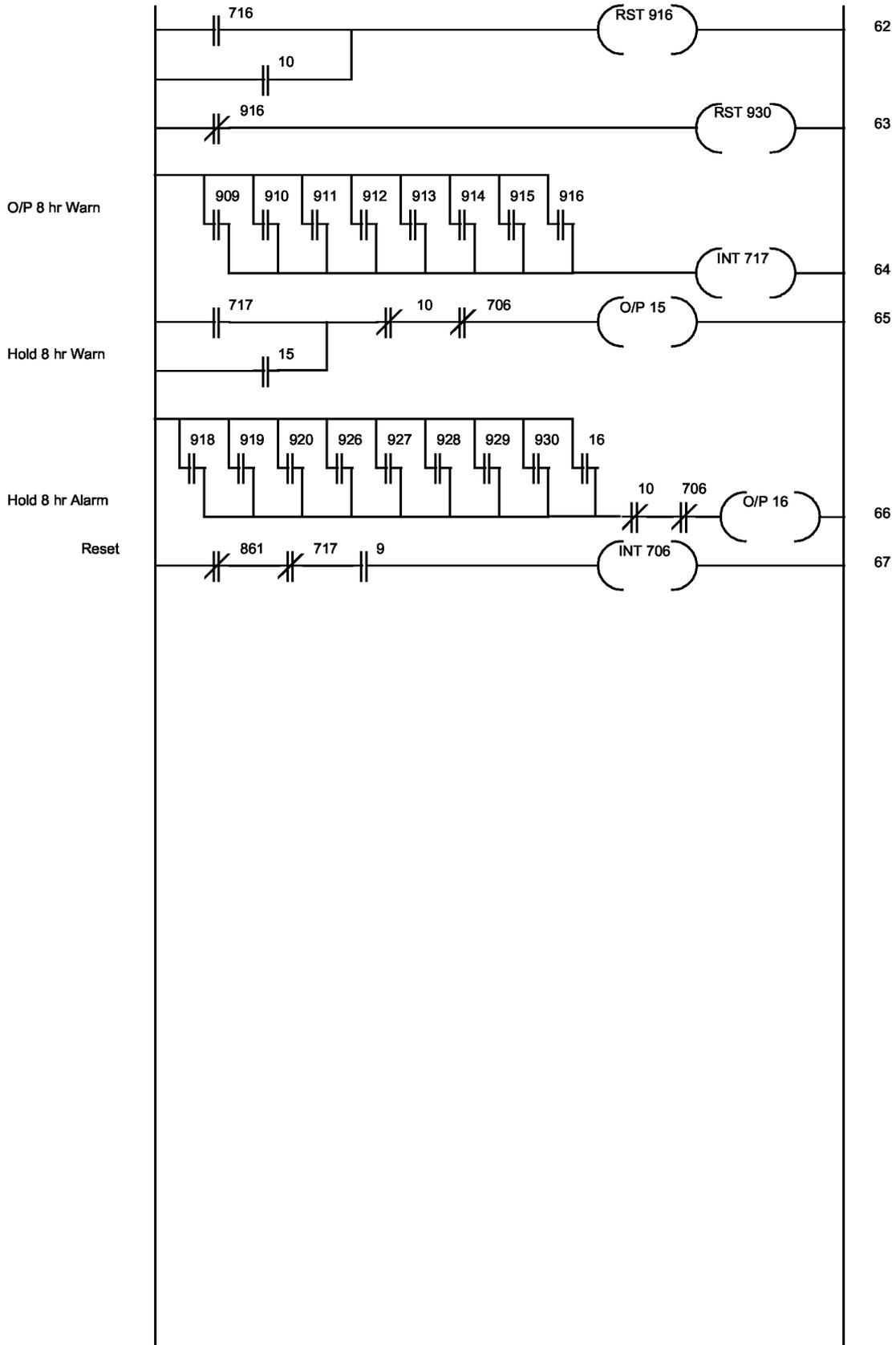
- advise the Maintenance manager or civil representative
- The District Civil Engineer must:
- make appropriate alternative arrangements.

## RAINFALL MONITOR PROGRAM LISTING









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 |   |     |
|------------------|-----|-----|-----|-----|-----|-----|-----|-----|--------------|--------|---------------|---|-----|
| Bit Addresses    | B   |     |     |     | A   |     |     |     | Data B       | Data A |               |   |     |
|                  | 708 | 707 | 706 | 705 | 704 | 703 | 702 | 701 |              |        |               |   |     |
| Mask Data        | 0   | 0   | 0   | 1   | 1   | 1   | 1   | 1   | 1            | F      |               |   |     |
| Step Data        | 0   |     |     |     |     |     |     | 1   | 0            | 1      |               |   | 2   |
|                  | 1   |     |     |     |     |     |     |     | 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      |               |   | 20  |
|                  | 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)--  
 (SQU)-

ADDRESS: 908

TIME DRIVEN  
 EVENT DRIVEN

GROUP NUMBER: 17

| BIT ADDRESS DATA           |     |     |     |     |     |     |     |     | PROGRAM CODE |        | PRESET VALU ES |   |   |
|----------------------------|-----|-----|-----|-----|-----|-----|-----|-----|--------------|--------|----------------|---|---|
| Bit Addresses<br>Mask Data | B   |     |     |     | A   |     |     |     | Data B       | Data A |                |   |   |
|                            | 716 | 715 | 714 | 713 | 712 | 711 | 710 | 709 | 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            | 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)--  
 (SQU)-

ADDRESS: 908

TIME DRIVEN  
 EVENT DRIVEN

GROUP NUMBER: 17

| BIT ADDRESS DATA           |     |                  |     |     |     |                  |     |     | PROGRAM CODE |        | PRESET VALUES |   |   |  |
|----------------------------|-----|------------------|-----|-----|-----|------------------|-----|-----|--------------|--------|---------------|---|---|--|
| Bit Addresses<br>Mask Data | 716 | 715 <sup>B</sup> | 714 | 713 | 712 | 711 <sup>A</sup> | 710 | 709 | Data B       | Data A |               |   |   |  |
| 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   |

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## APPENDIX 8

### 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 from 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.

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