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CONTENTS

DOCUMENT REVISION SHEET

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A1	All	Initial Release	
B1	All	Spoornet Redraft	
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11	All	Document update as recommended by Wabtec and NYAB/KB for fault handling, locked axle, remote brake cylinder limiting, pantograph miscompares and screen layout requirements, as well as VCB and Half-Power terminology. 4.18.3.9 and Appendix E2 Modified by Spoornet.	2007-02-14

SECTION 1: INTRODUCTION

1.1 SCOPE

Spoornet will introduce ECP-WDP on certain trains, starting with Coallink's coal export line, and later spreading to other lines. Spoornet envisages that the Coallink implementation will become a standard throughout Spoornet.

ECP and WDP systems for Spoornet shall therefore meet the interoperability requirements of the AAR S-4200 series specifications. In addition, the Spoornet Rolling Stock shall require ECP and/or WDP features beyond the limitations of the AAR specifications. For the purpose of this document, the WDP additional features are identified as "Spoornet-Specific Extensions for WDP". The ECP additional features will be documented in a separate specification and identified as "ECP Interoperability Information and Requirements for Spoornet Rolling Stock".

This document therefore describes:

Current Locomotives

- The 11E, 7E, & class 37 Spoornet locos, specifically relating to WDP implementation (the first revision of this document concentrates on 25kV locos. 3kV loco information will be added as needed).

Future Locomotives

- The 19E & class 40 diesel Spoornet locos, specifically relating to WDP implementation (the first revision of this document concentrates on 25kV locos. 3kV loco information will be added as needed).
- Interoperability issues to be considered on each implementation of WDP locomotives
- The Spoornet –Specific Extensions

The interoperability requirements detailed here are limited to the interaction of locomotives communicating on the ITC Network utilizing "Echelon PL-20 Technology" via the WDP communication messages.

1.2 APPLICABLE DOCUMENTS

In the event of conflict between the AAR S-4200 series documents and the contents of this specification, the contents of this specification shall be considered a superseding requirement.

In the event of conflict between this document and the specification for a new implementation on a different loco class, the conflict shall be identified as an issue for Spoornet to resolve.

Ref	Document Title	Document Number	Custodian
1	Performance Requirements for Electronically Controlled Pneumatic (ECP) Cable-Based Freight Brake Systems	S-4200, version 3.0 revised 2004	AAR
2	Performance Specification for ECP Brake System Cable, Connectors and Junction Boxes	S-4210, version 1.1 revised 2002	AAR
3	Performance Specification for ECP Brake DC Power Supply	S-4220, version 2.0 revised 2002	AAR
4	Intra-Train Communication Specification For Cable-Based Freight Train Control Systems	S-4230, version 3.0 revised 2004	AAR

5	Performance Requirements for ITC Controlled Cable-Based Distributed Power	S-4250, version 2.0 revised 2004	AAR
6	ECP Interoperability Information and Requirements for Spoornet Rolling Stock	H3.1-TMO 0016	Spoornet

1.3 COMMON TERMS

Consist - A contiguous series of locomotives, which may be controlled as a unique group. Locomotive consists can be either Lead consists or Remote consists. Lead consists contain the Lead locomotive and any Trail locomotives that are coupled to it and controlled via the conventional MU connector and pipes. Remote consists contain one ITC Controlled unit and any trail locomotives that are coupled to it and controlled via the conventional MU connector and pipes. Nominally, consists are separated by some number of freight wagons. However, this definition allows back-to-back multiple consists made of single locomotives provided the MU connector and pipes are not mated between each.

Consist Designator - A letter designation (A, B, C, D, E) which identifies the location of the consist in the train. The "A" consist is always the lead consist; the "B" consist is the next closest to the front of the train, the "C" consist is the next closest after B, and so forth.

Conventional Lead Unit - The locomotive positioned at the front of a train from which the operator drives. This unit is responsible for generating conventional mode commands to conventional trail locomotives.

Conventional Trail Unit - A locomotive physically coupled in a consist, but not the conventional lead unit, ITC Controlled unit nor ITC Monitored unit. Conventional Trail units receive commands via the MU electrical cables and pneumatic hoses.

Dynamic Brake Command - Commands generated by the dynamic brake controller, consisting of dynamic brake set-up, dynamic brake step 1, step 2, etc. Dynamic brake is also known as Electric or Rheostatic Brake on electric locos.

Fence - The boundary or boundaries within the train between independently controlled locomotive groups, which shall allow the locomotive throttle and dynamic brake to be operated independently of the ITC Lead locomotive via a separate controller function. A fence shall only be placed between complete consists that are separated by wagons i.e. a fence may not be set between back-to-back consists.

Freight Car - Railroad car (wagon) designed to carry freight by rail.

Group - A contiguous series of locomotives that are operating synchronously.

Half Power Half of the available power is cut out (equivalent to single-bridge operation).

Independent Control - Independent Control permits traction and dynamic braking control of one or more Remote consists independent of the ITC Lead unit.

ITC Controlled Unit - A locomotive in a train that is not the lead locomotive and is controlled by signals sent to it by the lead unit through the ITC communication network.

ITC Lead Unit - The locomotive positioned at the front of a train from which the operator drives. This unit must be in communication with all ITC Controlled locomotives operated in WDP mode via the ITC communication network. This unit is responsible for generating commands to and receiving information from other ITC equipped locomotives.

ITC Monitored Unit- An ITC equipped, MU Controlled, locomotive that provides status information to the ITC Lead unit via the ITC communication network.

Linked - The ITC Lead unit has established a communications path to an ITC Controlled or ITC Monitored unit and is transmitting commands to and receiving status information from the remote units.

Locomotive (Loco) - A self-propelled unit of railroad equipment designed to be used in train service for moving other railroad rolling equipment (i.e. locomotives, freight cars)

Logical Consist - A contiguous series of locomotives, which may be controlled as a unique group. Logical consists can be either Lead consists or Remote consists. Lead consists contain the Lead locomotive and any Trail locomotives that are coupled to it and controlled via the conventional MU connector and pipes. Remote consists contain one ITC Controlled unit and any trail locomotives that are coupled to it and controlled via the conventional MU connector and pipes. Two or more Logical consist can be coupled together to form a Physical Consist. No MU connector and MU pneumatic hoses may be coupled between adjacent Logical Consists

MU Controlled Unit - A locomotive physically coupled by the MU electrical connector and MU pneumatic hoses in a consist, but not the ITC Lead nor ITC Controlled unit. A MU controlled locomotive must be equipped with an ITC communications through-cable at a minimum.

MU T/L Red fault Red Fault is collective fault signal from any locomotive in a train consist, and is displayed on an ITC Lead or Conventional Lead locomotive. A Red Fault indicates a loss of tractive or electric braking effort (electric brake effort is also known as Rheostatic or dynamic braking).

MU T/L Yellow fault - Yellow Fault is a collective fault signal from any locomotive in a train consist, and is displayed on an ITC Lead or Conventional Lead locomotive. A Yellow Fault warns the operator of marginal operating conditions that may lead to a loss of Tractive or electric braking effort.

Physical Consist - This definition is specific to adjacent consist operation which allows back-to-back multiple consist operation provided the MU connector and pipes are not mated between each. A physical consist is a contiguous series of locomotives which contain multiple logical consists that are mechanically coupled together, but are not controlled via the conventional MU connector and pipes. A physical consists can be established as the lead consists or a remote consists. Physical consists may contain two or more Logical Consists.

Remote Consist - A consist of locomotives remotely located within a train which is being controlled and/or monitored by the ITC Lead WDP system via the ITC communication network.

Slimkabel - A portable controller used by the operator of the lead locomotive to control trailing locomotives that are not MU compatible. Spoornet also used a “Slimkabel “.to switch trailing DE locomotives in an all DE consist to IDLE for fuel saving.

Synchronous Control - WDP system control where the input commands at the lead locomotive are duplicated at all ITC Controlled, ITC Monitored and/or MU Controlled locomotives in the train.

System Mode - Identifies the overall state of the WDP system, establishing the operational relationship between the locomotive consists.

Soft-key Function that is provided by the WDP system and as a button on the WDP screen but is not available as hardware key on the locomotive**.**

Throttle Command - Commands generated by the throttle controller, consisting of Idle (also known as Switching, or notch S, Throttle step 1 (Notch 1), throttle step 2 (Notch 2), etc.

Traction Mode - Commands generated by the throttle controller or the dynamic brake controller

Train - A combination of locomotive(s), consist(s) and/or freight wagon(s), physically coupled together.

Unit Mode - Identifies the local state of individual ITC Controlled locomotives, where these locomotives can be set to a more restrictive state than that of the lead.

Unlinked – ITC Lead LCM is not in control of the ITC Controlled or ITC Monitored unit.

Wagon - Freight car

1.4 COMMON ABBREVIATIONS

AAR - Association of American Railroads

BCP - Brake Cylinder pressure [kPa]

BPP - Brake Pipe Pressure [kPa]

BP Flow - Brake Pipe flow [psid]

CCD - Car Control Device

DE - Diesel Electric Locomotive

EAB/EBR - Electronic Air Brake System / Electronic Brake Rack - A conventional locomotive pneumatic air brake control system that is controlled by a microprocessor based system.

ECP - Electrically Controlled Pneumatic Brake system as defined in AAR specifications S-4200 and S-4230.

EE - Electric Locomotive

EOT - End of Train Device

ER - Equalizing Reservoir pressure [kPa]

HEU - Head End Unit – Module used as the controller in an ECP brake system as defined in S-4200. Resides in the lead locomotive of a train.

IDM - Identification Module

ITC - Intra Train Communications (ITC) system specifically designed for ECP freight braking and WDP locomotive control as defined in AAR S-4200 series specifications.

km/h Kilometres per Hour

kPa - Kilo-Pascal

LCM - The Locomotive Control Module (LCM) is the communication/control device that interfaces the individual locomotive control/monitor systems to the ITC communication network. The LCM shall also control any ITC Locomotive Control System MMI.

MCB - Main Circuit Breaker (other name for VCB)

MMI Man-Machine Interface that provides the input control, feedback display and alarm mechanisms to the train operator.

MRP - Main Reservoir pressure [kPa]

MU - Multiple Unit, controlled via the inter-locomotive electrical cable and pneumatic hoses.

Psid - Pounds per Square Inch – Differential

REMB - Red Emergency Mushroom Button

T/L - Train-line

VCB - Vacuum Circuit Breaker (other name for MCB)

WDP - Wired Distributed Power, The equipment within a train used to operate distributed power in conjunction with the ECP Brake System via the ITC cable that runs the length of the train.

SECTION 2: GENERAL OPERATING INFORMATION

2.1 LOCOMOTIVE CLASSES: INTEROPERABILITY

Spoornet operates various classes or types of electric and diesel-electric locos: All locos fitted with ECP-WDP shall be interoperable via the ITC Network unless specifically ordered otherwise. The WDP system shall be capable of inter-operating with mixed trains of diesel and/or electric loco consists. Consists consisting of different types of electric locomotives must also be capable to operate together.

The conventional interoperability of locos not fitted with ECP-WDP is as follows:

2.1.1 Diesel-Electric Locos

2.1.1.1 All diesel-electric classes are interoperable via a standard AAR 27-pin coupler.

2.1.1.2 Diesel-electric and electric locos are not interoperable via conventional MU cables.

2.1.1.3 The Class 38-000 is unique in that it can be powered by diesel or electrically via 3kV dc. The 38-000 is interoperable with all other DE locos via the conventional MU cables, but is not interoperable with any electric locos.

2.1.1.4 A diesel-electric can be driven from the driving cabs of certain electric locos through the addition of special adapters and separate operating controls (the "Slimkabel").

2.1.2 Electric Locos

2.1.2.1 Electric locos are powered from 3kV dc, 25kV ac or 50kV ac sources.

2.1.2.2 Electric and diesel-electric locos are not interoperable via conventional MU cables.

2.1.2.3 Electric locos are divided into numeric classes followed by a descriptive letter "E". Different numeric classes are not interoperable via conventional MU cables, unless specifically recorded otherwise.

2.1.2.4 Each class is further subdivided depending on manufacturer and delivery period. The subdivisions within a class are interoperable via conventional MU cables.

2.1.2.5 For example:

- Class 7E, 7E1, 7E2 and 7E3 electric locos are interoperable via conventional MU cables.
- Class 14E, 14E1 electric locos are interoperable via conventional MU cables.
- Class 7E's are not interoperable with class 14E's via conventional MU cables.
- Class 11E's are not interoperable with class 7E's via conventional MU cables.

2.2 ELECTRIC LOCOS: SPECIAL CONTROL REQUIREMENTS

The electric locos require special controls for the pantograph, VCB and auxiliaries (also called "blowers"). They also have a Red Emergency Mushroom Button (REMB) to quickly isolate the electrical power system. 25kV locos have a Single Bridge function (also known as Half Power) to limit maximum power, while some 3kV locos have a 2/3 Power command.

The following table describes how different electric loco classes achieve this control:

Loco Class	Control type
11E Upgrade	**Single-switch**: A single, manually operated Power On/Off switch initiates automatic Panto Up/Down and VCB Close/Open. The Power On/Off, REMB and Half Power commands are transmitted to trailing locos on a network. Auxiliaries (Blowers) on individual locos start automatically when required i.e. when tractive or braking effort is demanded.
7E and 10E type locomotives	**Multi-switch**: Separate, manually operated Panto Up/Down, VCB Close/Open and Auxiliary On/Off switches operate individual MU trainlines. Auxiliaries must be manually switched on before power can be requested.
All ac locos	To prevent multiple, simultaneous transformer inrush currents on the same supply, VCB Close initiates a sequential closing of VCB's within a consist.
All	REMB opens VCB/MCB and lowers panto on the complete consist
All	• If the Reverser of the lead loco is in neutral, then only that particular loco reacts to the switch commands Panto Up/Down and VCB Open/Close. Auxiliaries On or Off will operate in the trailing locos. • If the Reverser is in Forward or Reverse, then all the locos in a consist react to switches operated on the lead loco. • If the Reverser is in Forward or Reverse in the lead loco: then Panto, VCB and Auxiliaries can not be operated from a trailing locomotive The trainwide pantograph control cannot occur unless/until the ITC lead reverser is positioned in the forward or reverse direction.

2.3 SPOORNET'S DIESEL ELECTRIC LOCOS: SPECIAL CONTROL REQUIREMENTS

All Spoornet's Diesel Electric locomotive are equipped with a consist wide **engine stop function**. On the drivers desk is a red button called STOP. When this button is pressed trainline no. 3 goes high (74 V) and trainlines no.'s 12, 7 and 15 go low (0 V). This button is also mechanically locked in position and must be reset by pressing the black button below it.

When the REMB function is activated on the Electric locomotives the engine stop function must be activated on trailing WDP diesel locomotives. Should the Diesel locomotive be the Leading ITC locomotive and the engine STOP is activated then it should activate the REMB function on the WDP system.

For the DP propose this status of the trainlines should be maintained for at least 120 seconds to ensure that all the **Diesel engines have stopped rotating**. If this time is too short, engines that are still rotating may restart by themselves.

Upon receipt of an engine stop command from the ITC lead unit, the ITC-controlled diesel locomotive shall enforce a local consist engine stop command for a minimum of 120 seconds and until the lead engine stop command is terminated. The ITC-controlled diesel locomotive shall set the MU trainlines to command engine stop to the trailing locomotives within it's remote consist.

2.4 LOCO – WDP INTERFACE

The WDP system shall provide an interface between the ITC network and the local locomotive control system.

Depending on locomotive type, any of the following may be necessary:

2.4.1 Trainline interface, in which the WDP must read and control the signals present on the trainlines (these signals may be analogue or digital),

2.4.2 Local discrete signal interface, in which the WDP must read and control discrete signals not available on the trainlines or network (these signals may be analogue or digital),

2.4.3 Network or bus interface, in which the WDP must send and receive relevant signals over a network.

SECTION 3: WDP SYSTEM

3.1 WDP GENERAL

3.1.1 The WDP System for Spoornet Rolling Stock shall comply with the AAR S-4250 Performance Specification for ITC Controlled Cable-Based Distributed Power Systems with Spoornet-Specific Extensions identified within this document.

3.1.2 The WDP system shall be capable of interoperating with mixed trains of Spoornet diesel and electric powered locomotives.

3.1.3 When operating in mixed train configurations, where both electric and diesel locomotive consists co-exist; the train-wide control capability shall be governed by the ITC Lead on-board control capability (i.e.. Train-wide pantograph controls are not currently available on a diesel locomotive). For conditions such as this, the DP system shall provide the control mechanism for individual remote consists to overcome these control inadequacies. A Soft-key should be provided to lower and raise the pantographs on a per consist basis. Lead electric locomotives shall provide pantograph trainwide and consist control. Lead diesel locomotives shall provide only pantograph consist control.

3.2 WDP SPOORNET-SPECIFIC EXTENSIONS: AAR FEATURES NOT REQUIRED

3.2.1 Unless otherwise stated in this document or in a particular tender/order/contract, it shall be assumed that all AAR features are required.

3.2.2 The following AAR WDP Features are presently not required

- ITC Monitored Mode
- Computer-aided Multi-Group Control
- Fuel Saver Mode
- Winter Isolate Mode
- Slow Speed Control
- Quick Charge Control
- Individual Remote Consist Sanding Control
- Some MU General Alarms (Dynamic Brake Warning, Ground Fault Relay)

3.2.3 An AAR feature and corresponding communications path that is not required may be inactive, but must not be changed to perform a different function to that originally intended by the AAR specification. Spoornet does not wish to destroy a feature that may be required at a later stage. These features shall be set to inactive and reserved for future consideration.

3.2.4 This does not prevent linking of a Spoornet-Specific Extension to an AAR feature e.g. we may specify that the AAR feature “Engine Stop” must be activated by the “REMB Active” bit in the Spoornet-Specific Extensions.

3.3 WDP SPOORNET-SPECIFIC EXTENSIONS: NON-AAR FEATURES REQUIRED

The following non-AAR additions are required for proper interoperation of Spoornet Rolling Stock, and are described in detail in Section 4, together with a Command and Event Summary:

3.3.1 Sequential Panto Up/VCB Close

3.3.2 Remote Locomotive Manual Pantograph Control

3.3.3 Neutral Section Indication

3.3.4 Remote Locomotive VCB Status

3.3.5 Remote Locomotive Half-Power

3.3.6 Display lead and remote unit load

3.3.7 Display Throttle/Dynamic Brake Command

3.3.8 Skip adjacent consist to set “WDP” Fence location

3.3.9 Electric Release

3.3.10 Remote consist brake cylinder pressures

3.3.11 REMB / Engine stop control

3.3.12 Screen Layouts

3.3.13 Display lead and remote unit brake pipe flow in psid units

3.3.14 Locomotive Reporting Mark and type

3.3.15 Locomotive Static Information

3.3.16 Display remote consist wheel slip, wheel slide or locked rotor / axle alarm

3.3.17 Spoornet Specific Miscompare Requirements

3.3.18 Remote Locomotive Fault Handling, Acknowledgement and Reset

SECTION 4: DETAILED SPOORNET-SPECIFIC EXTENSIONS

4.1 SEQUENTIAL PANTO UP/VCB CLOSE

4.1.1 Electric locomotives

4.1.1.1 To prevent accumulated transformer inrush currents, the VCB's are closed sequentially in a conventional consist of AC locos i.e. the local locomotive control system forces the VCB's to close one at a time, usually by way of timers. This must also occur in a WDP train i.e. one VCB must close at a time in a train.

4.1.1.2 Train-wide Panto Up Control

4.1.1.2.1 The lead pantograph system shall provide the Panto Up command to the ITC Lead system to convey the operator's requested "Panto Up" command to remote locomotives within the train. This command shall be transmitted sequentially by the ITC Lead unit to all ITC Controlled units as a consist command to allow only one consist to initiate its "Panto Up and VCB Closed" process at a time. This, with the local consist control described above, will limit the load on the catenary to one loco at a time.

4.1.1.2.2 The local pantograph system shall manage the "Panto Up" operation within the consist. Following the receipt of the "Panto Up" command, the pantograph system shall close the "Vacuum Circuit Breaker" (VCB) on each locomotive within the consist in a sequential manner. Upon completion of each consist "Panto Up and VCB Closed" process; the pantograph system shall forward this status to the local WDP system.

4.1.1.2.3 Upon receipt of the "Panto Up and VCB Closed" status from the lead pantograph systems, the ITC Lead system shall then transmit the "Pantograph Up" command to the "B" consist ITC Controlled unit in the train.

4.1.1.2.4 Upon receipt of the "Panto Up and VCB Closed" status from the "B" Consist ITC Controlled unit, the ITC Lead system shall then transmit the "Panto Up" command to the "C" Consist ITC Controlled unit in the train. This process will continue, until the ITC Lead unit has commanded "Panto Up" to all ITC Controlled units within the train.

4.1.1.2.5 In the case of a Diesel Electric Consist, the Diesel locomotive will always reply with "VCB Closed" status and "Pantograph up and VCB closed" status.

4.1.1.2.6 If the "Pantograph up and VCB closed" status is not received after 35 seconds of command to a particular consist, the lead LCM shall continue the sequence to the next consist.

4.1.1.2.7 Refer to Appendix A1.1, for the timing as implemented on the 11E and appendix A1.2 for the 7E timing.

4.1.1.3 Train-wide sequential Panto Up/VCB shall be executed from an ITC lead electric loco having panto control capability.

4.1.2 Diesel Electric Locomotive

When a Diesel Electric locomotive is an ITC lead unit, it must provide the capability to raise/lower the pantograph of individual electric locomotive consists in a train. The system must ensure that at least 22 seconds has expired between each panto up command of the different consists. A Soft key is to be provided on the Diesel Electric locomotive to control this function.

4.2 REMOTE LOCOMOTIVE MANUAL PANTOGRAPH CONTROL

On a single-switch controlled locomotives such as 11E's (see clause2.2), Power On initiates an automatic consist start-up sequence that raises the panto and closes the VCB. The opposite occurs with Power Off. Blowers switch on when the master controller is moved, and switch off again some time after the master controller returns to off. On multi-switch controlled locos such as 7E's, discrete switches and trainlines control panto, VCB and blowers.

In WDP operation, only the Panto Up/Down commands will be transmitted on the ITC network (to all ITC Controlled units). The local ITC Controlled WDP system must supply the required logic to control the local pantograph system correctly. Upon receipt of the Panto Up/Down command, the ITC Controlled will be responsible to transmit this signal to trailing locomotives and execute the required, Panto Up/Down, VCB Open/Closed and Auxiliary On/Off switching, if required. The desired control in WDP is therefore as follows (for brevity, 11E's and 7E's are used as examples of single and multi-switch interoperability):

4.2.1 On initial train set-up, each consist will be started manually as if in non-WDP operation. A set procedure then establishes ITC network communication to control the train.

4.2.2 On an ITC Lead 11E, the WDP system will receive a panto up command from the VCU, which will be used to command all ITC Controlled units to initiate a panto up and VCB close process (subject to sequential VCB closure at the lead).

4.2.3 On an ITC Controlled 11E, the ITC network command Panto Up/Down will activate the local Power On/Off switch via a signal that is transmitted from the IPM to the VCU.

4.2.4 On an ITC Lead 7E, the WDP system will read the local VCB Close/Open switch and translate this into an ITC network command Panto Up/Down to all ITC Controlled units (subject to sequential VCB closure at the lead).

4.2.5 On an ITC Controlled 7E, the ITC network command Panto Up/Down will activate the local control as follows:

4.2.5.1 Panto Up will activate the local Panto Up trainline, and then VCB Close. When the Throttle command exceeds 5%, the Blowers trainline must be energised, and then the Throttle command can be applied. The Blowers trainline must only be de-energised five minutes after the Throttle command returns to zero/off.

4.2.5.2 Panto Down must energise the VCB Open trainline, and then energise the Panto Down trainline.

4.2.6 For all locos in consist with, or train lined with the leading loco (i.e. lead and all remotes)

4.2.6.1 If the Reverser is in neutral, the Panto Up/Down command will not be broadcast over the ITC network.

4.2.6.2 If the Reverser is in Forward/Reverse, the Panto Up/Down command will be broadcast over the ITC network.

4.2.7 When the consists are split into a Front and a Back Group for independent operation, independent mode Pantograph control shall not be provided. Pantograph control shall be provided as Train-wide or individual consist control. Additionally, the REMB command will be train-wide only. Group control not required

4.2.8 In pantograph consist control mode, the reverser interlock logic shall not be provided

4.2.8.1 The principle of sequential VCB closing must apply i.e. the ITC Lead must send the Panto Up command to each consist in turn.

4.2.9 The local pantograph systems command up and down via a momentary switch. Therefore, the Pantograph Up and Down commands transmitted by the WDP System to each ITC Controlled unit on the ITC Network shall be transmitted in the form of a six second pulse.

4.3 NEUTRAL SECTION INDICATION

4.3.1 The driver of an ECP/DP train must be informed when each consist in the train enters neutral section mode. A consist is considered to be in neutral section mode from the time the first locomotive in that consist enters a neutral section until the last locomotive in that consist exists the neutral section. This signal will be sent from the locomotive control system to the LCM in each ITC controlled locomotive. Indication to the driver will be achieved by posting the alarm indication with the consist designator. (See appendix F)

4.4 REMOTE LOCOMOTIVE VCB STATUS

4.4.1 Spoornet operates various classes or types of electric locos fitted with high voltage circuit breakers. They include “Vacuum Circuit Breaker”, “Main Circuit Breaker” and “High Speed Circuit Breaker”. For the purpose of this specification, “Vacuum Circuit Breaker” shall be used universally to specify the requirements for this function.

4.4.2 110V on the local VCB trainline indicates that at least one VCB within that consist is open. The ITC Controlled unit shall read this trainline and relay this information to the ITC Lead unit for display on the WDP Operators Screen.

4.4.3 Locos with a network rather than a trainline or discrete signal interface, shall receive this command via the local network interface.

4.4.4 This signal can also be used to indicate that the VCB Close sequence within a consist is complete.

4.4.5 Note that the driver also uses the VCB status indication on the WDP Operators Screen:

4.4.5.1 To know whether the VCB closed sequence within a consist is complete.

4.4.5.2 To know whether a consist is traversing a neutral section (the indication will flicker as each loco passes through the neutral section). This indication may or may not be seen on the operator screen depending upon train speed and upon message timing.

4.4.6 The ITC controlled diesel shall default the reported VCB status to the lead as **not** “VCB Open“ to prevent an incorrect ITC Lead alarms.

4.5 REMOTE LOCOMOTIVE HALF-POWER

4.5.1 Spoornet operates various classes or types of electric locos fitted with reduced power capability. They include “Half-Power”, “Single Bridge” and “2/3 Power”. For the purpose of this specification, “Half Power” shall be used universally to specify the requirements for any of these reduced power control types.

4.5.2 The ITC Lead electric locomotive shall read the local Half Power command. This command shall be transmitted by the ITC Lead unit to all ITC Controlled units as a train-wide command. Following the receipt of the Half Power command, the local ITC Controlled propulsion system shall initiate Half Power operation on each locomotive within the consist.

4.5.3 The ITC Controlled unit shall read the local Half Power propulsion status. The ITC Controlled unit shall use this information for local Half Power command verification, as well as to relay this information to the ITC Lead unit. The ITC Lead unit shall display the half power status on the WDP Operations Screen. The status shall be displayed to the operator in the form of a Half Power alarm indicating consist effected. This alarm shall indicate to the driver that he/she is not in normal mode. The Throttle/ Dynamic Brake command and tractive effort (load) shall be displayed unconditioned.

4.5.4. If a separate Half Power command and status signal is not available, the ITC Controlled unit shall use the local command signal to return the local Half Power status. This will verify that the command has been applied.

For example: the 7E has a trainline to command Half Power, but no separate trainline to indicate that Half Power is operating. The WDP systems will energize this trainline to command Half Power. The WDP system will also read this train line. If the trainline is energized, the Half Power status will be returned as active.

4.5.5. The ITC controlled diesel will always report its Half Power status as inactive.

4.5.6. An ITC Lead diesel locomotive will not be capable to command a train-wide Half-Power.

4.6 DISPLAY LEAD AND REMOTE UNIT LOAD

4.6.1 The WDP screen on the ITC Lead shall display the load of the ITC Lead and each ITC Controlled unit in the train, in the form of a percentage.

4.6.2 The ITC Lead and each ITC Controlled unit shall read the local traction motor current. This value will be divided by the rated continuous traction motor current and expressed as a percentage. This percentage shall be relayed to the ITC Lead, which shall display this value on the WDP screen as Load. See annexure E.

4.6.3 The displayed Load resolution shall be 1%. Leading zeros are not required. With present locomotives the Load display will therefore normally be in the region of 0% to 200%, but the Load field on the display shall allow a minimum of four digits to allow for future changes (e.g. to total consist kN).

4.6.4 The reported load shall be transmitted to the ITC Lead using the current ITC Network WDP Remote Status Message (0, 36) field for Throttle/Dynamic Brake Tractive Effort. This information shall be transmitted in the form of a percentage as stated above in lieu of the standard AAR format of pounds.

4.7 THROTTLE/DYNAMIC BRAKE COMMAND

- Different locomotive classes have different numbers of “notches” to demand throttle (e.g. Spoornet Diesel Electric Locomotives = 1 to 8). All Spoornet Electric locomotives fall into the Continuous notch category. Although the master controller sector plates on these locomotives have definite notch positions, they are only cosmetic.
- All Spoornet Electric and Diesel Electric locomotives have continuous notch control in Dynamic/Rheostatic Braking.

Therefore:

4.7.1 The WDP System shall be capable of inter-operating locomotive classes equipped with “Notched” propulsion control systems and “Continuous” (or “Inter-Notch”) propulsion control systems. The “Notched” propulsion control system operation is based on transmitting and receiving discrete command steps or “Notches” for Throttle and Dynamic Brake commands. The “Variable” propulsion control system operation is based on transmitting and receiving a variable percentage (1% resolution from 0% to 100%) for Throttle and Dynamic Brake commands. The WDP system shall also be capable of inter-operating with differing number of incremental steps of throttle or dynamic brake control. (i.e. 0 to 100%, or 8 steps). All Spoornet locomotives operate in Dynamic brake from 0 to 100%.

4.7.2 The ITC Lead unit shall transmit the Throttle / Dynamic Brake command as received from the local propulsion system to the ITC Controlled units in the form of a percentage as specified by AAR Specification S-4250. It shall be the responsibility of the ITC Controlled unit to translate these commands into a form acknowledgeable by the local propulsion system. In principle, when converting variable percentage commands to notched commands, the ITC Controlled unit shall select the nearest distinct notched command. (i.e. If 53% is received by a 8 step system, the ITC Controlled unit shall select “Notch 4”). The WDP system shall set the Throttle/Dynamic Brake command per the translation table provided in Appendix C.

4.8 ADJACENT (Back-to-Back) CONSIST OPERATION

4.8.1 Spoornet wishes to use the ITC network to effectively MU electric/Electric/Diesel electric locomotive classes that are not interoperable via conventional MU cables. This means that two consists made up of different locomotive classes will be placed back-to-back, but without the conventional MU cables and pipes coupled. Brake pipe and ITC network will be coupled through. This shall result in a physical consist of locomotives which includes more than one logical consist. Each consist will contain an ITC Controlled unit.

4.8.2 It must not be possible for the driver to place the WDP Fence between the back-to back logical consists. The system must automatically skip adjacent consists.

4.8.3 The locomotive road number shall be used to identify electric and diesel WDP-controlled locomotives within a physical consist. The locomotive road number shall be obtained from the locomotive reporting mark. Refer to Locomotive reporting mark requirements.

4.9 ELECTRIC RELEASE

4.9.1 The lead air brake system shall provide the current “Electric Release” command to the ITC Lead unit to convey the operator’s requested “Electric Release” command to remote locomotives within the train. The ITC Lead unit shall transmit this command to all ITC Controlled units in the train. Following the receipt of the “Electric Release” command, the local air brake system shall initiate “Electric Release” operation on each locomotive within the consist.

4.9.2. ITC controlled locomotives that are not equipped with brakes that have an “Electric Release” position shall respond to an Electric Release command from the ITC network by releasing the locomotive consist brakes except when an automatic brake emergency application is in progress. In this case it should follow the brake cylinder pressure of the lead ITC locomotive. Electric release is a Bail-Off function where the Brake Cylinder pressure will recover when command is cancelled.

4.10 REMOTE CONSIST BRAKE CYLINDER PRESSURES

4.10.1 When any automatic service brake application, penalty brake application or an emergency brake application is made, the brake cylinder pressure of the locomotives in all remote consists shall be limited to a maximum of 200kPa. The independent brake control shall not be governed by this requirement.

4.11 REMB / ENGINE STOP CONTROL

4.11.1 This local REMB switch can be operated from any electric locomotive in the train, whether ITC lead, MU Trail, ITC Controlled or conventional MU. The ITC Lead electric and ITC Controlled electric units shall monitor the output of this switch continuously. The unit detecting this signal shall immediately relay an REMB Active command to the ITC Lead. The ITC Lead (electric or diesel) shall command Panto Down and Engine Stop train-wide (both lead and remote consists, whether Front or Back Group).

4.11.2 The local Engine Stop switch can be operated from the ITC lead diesel-electric locomotive only. Then, the ITC lead diesel unit shall monitor the output of this continuously. The ITC Lead diesel shall command Panto Down and Engine Stop train-wide (both lead and remote consists, whether Front or Back Group).

4.12 SCREEN LAYOUTS

See appendix F

4.13 DISPLAY LEAD AND REMOTE BRAKE PIPE FLOW

4.13.1 The WDP screen on the ITC Lead shall display BP Flow of the ITC Lead and ITC Controlled units in psid units. The operator's display shall perform the translation from scfm as identified within the AAR spec to psid units as required by Spoornet.

4.13.2 The displayed BP Flow range shall be from 0.0 to 10.0 psid with a resolution of 0.1 psid (LSB-0.1).

4.14 LOCOMOTIVE REPORTING MARK AND TYPE

4.14.1 The WDP locomotive reporting mark shall be as shown below. The wagon reporting mark is specified in document H3.1 (ECP Interoperability Information and Requirements for Spoornet Rolling Stock.

positions	1	2	3	4	5	6	7	8	9	10	11
	L	K	E	E	1	1	0	0	1		
	L	W	D	E	3	4	5	0	1		
	L	K	D	H	0	7	0	0	1		

- **Position 1:** Designate "L" for locomotive.
- **Position 2:** Designate "K" for Knorr locomotive ECPB/WDP equipment or "W" for Wabtec locomotive ECPB/WDP equipment.
- **Positions 3 to 4:** Designate "EE" = Electric-Electric Locomotive; or "DE" = Diesel Electric Locomotive; or possible in future "DH" = Diesel Hydraulic Locomotive.
- **Positions 5 to 9**: Designate Spoornet normal Locomotive numbers that will never have more than 5 numeric digits necessary. The first two numeric digits identifying the locomotive class type (i.e. 07, 11, 10, etc.) and the last three numeric digits identifying the locomotive ID number.
- **Position 10:** Not used
- **Position 11:** Reserved

4.14.2 The WDP locomotive type shall be as shown below.

Current Locomotives

Spoornet Locomotive Type	ECP Locomotive Type Designator
11E	11E0
7E	07E0

Spoornet Locomotive Type	ECP Locomotive Type Designator
7E1	07E1
7E2	07E2
7E3	07E3
7E4	07E4
7E5	07E5
7E6	07E6
10E1	10E1
10E2	10E2
37000	3700
34200	3420
34600	3460
34800	3480
RBCT Shunter GE	RBGE
RBCT Shunter GM	RBGM

Future Locomotives

Spoornet Locomotive Type	ECP Locomotive Type Designator
19E	19E0
40000	4000

4.15 Locomotive Static Information

- Refer to appendix E

4.16 DISPLAY REMOTE CONSIST WHEEL SLIP, WHEEL SLIDE OR LOCKED ROTOR ALARM

Locked axles cause serious consequential damage. Spoornet drivers are therefore trained to take appropriate action if a locked axle is suspected. The first indication of a possible locked axle is continuous wheel slip. Therefore:

4.16.1 On locomotives with only a Wheel slip signal:

The ITC Controlled unit must read the local Wheel slip signal and transmit this event to the ITC Lead for display as a Wheel slip alarm on the WDP Operations screen. The alarm shall only be displayed while the Wheel slip signal is present.

4.16.2 On locomotives with Wheel slip and Wheel slide signals:

The ITC Controlled unit must read both the local Wheel slip and Wheel slide signals to transmit this event to the ITC Lead for display as a Wheel slip alarm on the WDP Operations screen. The alarm shall only be displayed while the Wheel slip/slide signal is present.

If a wheel slide continues longer than 5 seconds the ITC controlled unit must transmit a Locked Axle or Rotor signal to the ITC lead for display as a Locked Axle on the WDP Operations screen. Refer to Fault Handling (sect. 4.18) for additional requirements.

4.16.3 On locomotives with a Locked Axle or Locked Rotor signal that does not also trigger a continuous wheel slip signal:

4.16.3.1 The ITC Controlled unit must read the local Locked Axle or Rotor signal and transmit this event to the ITC Lead for display as a Locked Axle on the WDP Operations screen. Refer to Fault Handling (sect. 4.18) for additional requirements.

4.16.3.2 The ITC Controlled unit shall ignore any additional wheel slip signals.

4.17 SPOORNET SPECIFIC MISCOMPARE REQUIREMENTS

The following paragraphs address the miscompare requirements for the Spoornet-Specific Extensions.

4.17.1 Half Power Miscompare

If the “Half Power” status indicates that it is an invalid or uncommanded state after five (5) seconds of a command, the ITC Controlled unit shall identify the event to the ITC Lead unit to alert the operator with a ‘Half Power Miscompare’ Alarm. The ITC Lead unit shall continue to command the desired Half Power and traction settings.

4.17.2 Pantograph Miscompare

The ITC Controlled unit shall detect pantograph miscompares and, if active, report them to the ITC Lead unit. Pantograph miscompare detection shall be a function of the local pantograph system status for a given locomotive application.

If the pantograph system status indicates that it is in an invalid or uncommanded state after thirty-five (35) seconds of an up command, the ITC Controlled unit shall identify the event to the ITC Lead unit. The ITC Lead unit shall alert the operator with a “Pantograph-Up Miscompare” event and a “VCB Open” Alarm. The ITC Lead unit shall continue to command the desired Pantograph setting.

If the pantograph system status indicates that it is in an invalid or un-commanded state after five (5) seconds of a "Down" command, the ITC-controlled unit shall identify the event to the ITC lead unit to alert the operator with a “Pantograph Down Miscompare” event. The ITC lead unit shall continue to command the desired pantograph setting.

If the pantograph “Down” had been commanded and a pantograph down miscompare occurs, the ITC lead unit should apply a penalty brake application. The recovery of this penalty will occur following the correction of the miscompare.

4.18 REMOTE LOCOMOTIVE FAULT HANDLING, ACKNKOWLEDGEMENT AND RESET REQUIREMENTS

Due to improved fault reporting mechanisms available on modern locomotives, Spoornet requires improved fault reporting from remote locomotives using a set of predefined fault codes to be displayed to the driver as a text message, i.e. an improvement to simply transmitting a red or yellow fault indication.

4.18.1 In the case of locomotives not fitted with digital control systems, each electric ITC Controlled unit shall read the local locomotive Red Fault and/or Yellow Fault indication from the train lines. The ITC Controlled unit shall relay this information to the ITC Lead unit as a standard fault code (as a “Unknown Red fault” or “Unknown Yellow fault”, as defined in appendix D4). The ITC Lead unit shall display this information on the WDP Operations Screen. Red and Yellow faults may be transmitted on WDP Beacon (0,36) as described in section 5.2.2 to assist in detecting active faults, however the lead LCM should not display duplicate notifications.

4.18.2 The ITC Lead and ITC Controlled diesel locomotive shall use the Red MU alarm to display the #2 MU T/L Alarm.

4.18.3 In case of locomotives fitted with digital fault monitoring systems and network based MU cables, the following is required.

4.18.3.1 Remote fault reporting and remote resetting, as a DP function, involves the transmitting of faults from ITC controlled locomotives to the ITC lead locomotive, the display thereof on the DP screen and provides the driver with the ability to reset faults on remote consists.

a. The DP fault reporting and resetting system is therefore only responsible for handling faults reported from ITC controlled locomotives.

b. Fault reporting and remote resetting of any faults which occur on the lead consist will not be handled by the DP system.

c. This system is independent of the existing DP MU alarms reported in the alarm bar of the DP screen.

4.18.3.2 **(Info only)**- When a fault occurs on any locomotive in a remote consist, that fault code is transmitted to the ITC controlled locomotive via the locomotive MU bus (the locomotive control system).

4.18.3.3 **(Info only)** - The control system in that ITC controlled locomotive will map those faults into universal ITC fault codes (refer to Appendix D).

4.18.3.4 The control system will transmit those universal ITC fault codes (Appendix D) together with the locomotive position in the consist (e.g. 1, 2, 3, etc) where the fault occurred to the DP system as and when they arise. There is no prioritising or queuing of faults within the control system.

4.18.3.5 The DP system is responsible for queuing and transmitting these faults to the ITC lead locomotive and guaranteeing receipt thereof. Prioritisation of faults is not required within the DP system.

a. The DP system shall provide the ability to queue at least 16 faults per ITC controlled locomotive

4.18.3.6 The ITC lead locomotive will receive the fault information and provide suitable displays on its DP screen.

a. The faults shall be received as rapidly as possible without the driver having to interact with the screen.

b. The faults are displayed in the sequence which they are received.

c. The driver shall be alerted to the presence of a new fault by the flashing of a fault indicator “light” on all driving DP screens. The light will not be visible when there are no unacknowledged faults and will flash with a white background with black writing when there is at least one unacknowledged fault.

d. The fault indicator light shall continue flashing as long as there is at least one unacknowledged fault present. (Acknowledgement is defined in paragraph 14.8.3.8 of this document).

e. The driver can call up the list of all received faults (including the new faults) by pressing a button. This button will always be available to the driver.

4.18.3.7 New faults will be displayed with a different colour background compared to other faults which have already been acknowledged.

a. The most recently received fault will be displayed at the top of the fault log.

b. Upon entering the remote fault log screen, the most recently received unacknowledged fault will automatically be selected.

c. When the "Acknowledge" button is pressed, the next most recently received unacknowledged fault will automatically be selected.

d. The system shall be able to display at least 99 faults.

4.18.3.8 In order to change the status of a new fault to an acknowledged fault, a fault must be acknowledged by the driver.

a. Each fault shall be individually acknowledged by pressing the acknowledge button.

b. An acknowledge function shall only change the colour of the background of the displayed fault and is only local to the screen.

c. When there are no unacknowledged faults, a Driver's Reset button will become available to the driver.

4.18.3.9 When the Driver's Reset button is pushed, the remote reset command shall be broadcast to all ITC controlled locomotives and an appropriate event indicating that a Driver's Reset was commanded shall be stored in the fault log.

a. All ITC controlled locomotives will transmit this command to the locomotive control system.

b. **(Info only)-** This command will be further distributed throughout the consist by the locomotive control system. Each individual locomotive control system will attempt to reset all active faults. Faults which cannot be reset will remain active on the locomotive control system.

c. Any queued faults which are in the process of being transmitted to the ITC lead locomotive shall still be transmitted irrespective of the reset command.

1. It is understood that it is possible for a fault to be reset before it has been displayed on the DP screen in the ITC lead locomotive. It is important that in such a rare situation, that the fault code is still transmitted.

4.18.3.10 **(Info only)-** Faults at ITC controlled locomotives which remain active after a reset will be re-transmitted to the DP system at that consist as a new fault and will be handled accordingly by the DP system.

4.18.3.11 **In this section, "Info only"** comments provide information about functions which are not considered part of the DP remote fault reporting and resetting functions.

4.19 COMMAND SUMMARY

The following table shows how Spoornet-specific commands can be applied i.e. Train-wide, per Group, per Consist, or per ITC Monitored unit.

Table 1 – Train Control Features

Control Function	**Train-Wide Control** ITC Controlled Electric Loco	**Train-Wide Control** ITC Controlled Diesel Loco	**Group Control** ITC Controlled Electric & Diesel locos	**Consist Control** ITC Controlled Electric & Diesel locos	**Unit Control** ITC Monitored (Note 2) Electric & Diesel locos
Half Power/Single-Bridge	Yes	No	n/a	n/a	n/a
Pantograph-Up	Yes	No	n/a	Yes (Note 1 and 3)	n/a
Pantograph-Down	Yes	No. Except if REMB active	n/a	Yes (Note 1 and 3)	n/a
Electric Release	Yes	No	n/a	n/a	n/a
Remote Reset	Yes	Yes	n/a	n/a	n/a
Fault Acknowledge	Yes	Yes	n/a	n/a	n/a

Note:

1. The Pantograph-Up/Down command gives the operator the ability to raise/lower the pantographs on any remote consist by transmitting a command to a pre-selected ITC Controlled Locomotive.
2. ITC Monitored mode is not required
3. A software key to be provided to perform this function on the Diesel locomotives.

4.20 SPOORNET SPECIFIC EXTENSION - EVENT SUMMARY

The following table shows how Spoornet-specific Events are handled:

Table 2 – Status Response Summary

No.	System Event	Remote Action Electric Loco	Remote Action Diesel Loco	Lead Action	Remote Status Flag	Remote Exception	Exception Priority
1.	**VCB Status**	Detect and report	n/a	Warn Operator	Yes	No	n/a
2.	**Panto Up & VCB Closed Status**	Detect and report	n/a	Sequence Panto Up cmd. to next consist	Yes	No	n/a
3.	**Half Power Status**	Detect and report	n/a	Identify status	Yes	No	n/a
4.	**Half Power Miscompare**	Detect and report	n/a	Warn Operator	Yes	No	n/a
5.	**Pantograph Up Miscompare**	Detect and report	n/a	Warn Operator	Yes	No	n/a
6.	**Pantograph Down Miscompare**	Detect and report	n/a	Warn Operator and initiate an ECP penalty brake application	Yes	No	n/a
7.	**REMB**	Detect and report	n/a	Warn Operator and command Pantograph Down and Engine Stop to all units	Yes	No	n/a
8.	**MU Yellow Alarm**	Detect and report	n/a	Warn Operator	Yes	No	n/a
9.	**MU Red Alarm**	Detect and report	Detect and report	Warn Operator	Yes	No	n/a
10.	**Fault status of locomotive changed**	Transmit fault code to ITC lead	Transmit fault code to ITC lead	Warn Operator and allow Operator to acknowledge and reset.	Yes	No	n/a
11.	**Locked axle on lead consist**	n/a	n/a	Warn Operator	n/a	n/a	n/a
12.	**Locked axle on remote consist**	Detect and report	Detect and report	Warn Operator	Yes	No	n/a

Section 5: ITC NETWORK COMMUNICATION REQUIREMENTS

5.1 GENERAL MESSAGING REQUIREMENTS

The ECP and WDP systems for the Spoornet Rolling Stock shall be compliant with AAR S-4230 Intra-Train Communications Specification for Cable-Based Freight Train Control Systems with the Spoornet-Specific Extensions as identified within this section. The following clauses identify the messaging requirements for the Spoornet-Specific WDP Extensions.

The ECP messaging requirements are documented within the “ECP Interoperability information and Requirements for Spoornet Rolling Stock” specification.

5.2 WDP SPOORNET-SPECIFIC EXTENSION MESSAGES

Messages defined within this section identify the AAR message modifications required to communicate the Spoornet-Specific Extensions. These modifications shall utilize the Railroad Specific Data Fields of the DP Beacon and DP Remote Status messages as indicated.

Changes to these messages and the way they are interpreted may only be made after approval from Spoornet and incorporation in this specification.

5.2.1 WDP BEACON (0, 35)

Source: *LCM Lead*

Dest: *LCM Remotes*

Msg Type: *Explicit*

Msg Code: *0x00*

Priority: *Yes*

Message Rate: *1 Hz*

Service Type: *UNACKD*

Addressing: *BCAST*

Data Size: *16, 21, 26, 31 or 36 bytes*

Description: *This message is broadcast from the lead LCM to the trail and remote LCMs to command the remote DP equipment and provide a poll for remote locomotive status information.*

Field Name	Size	Value/Range (Resolution)	Default	Notes
RAILROAD SPECIFIC DATA – Field 1 (Spoornet-Specific Extensions)	*1*	*Bit 0: 1=Half Power Cmd.* *Bit 1: 1=Pantograph-Up Cmd.* *Bit 2: 1=Pantograph-Down Cmd.* *Bit 3: 1= Electric Release* *Bit 4: 1=Driver Reset* *Bits 5-7: Not Used*	*0* *0* *0* *0* *0* *0*	*F.* *F, L.* *F, L.* *F* *F* *F*
RAILROAD SPECIFIC DATA – Field 2 (Spoornet-Specific Extensions)	*1*	*Not Used*	*0*	*F.*
RAILROAD SPECIFIC DATA – Field 3 (Spoornet-Specific Extensions)	*1*	*Not Used*	*0*	*F*

Note:

F. These fields are reserved per AAR S-4230 for definition by each specific railroad customer. It is intended to support the potential need for railroads that don't normally interchange equipment to assign bits in the DP Beacon message that are specific to their operation (i.e. pantograph, dump-door control, etc.).

L. The Pantograph Up command and the Pantograph Down command transmitted by the ITC Lead WDP System to each ITC Controlled shall be transmitted in the form of a six (6) second pulse (i.e. six (6) consecutive command beacons). The ITC controlled unit shall detect the next new pantograph up command or pantograph down command upon receipt of a state change with in the command beacon to the active state.

5.2.2 DP REMOTE STATUS (0, 36)

Source: LCM Remote Message Rate: When Requested

Dest: *LCM Lead* *Service Type:* *UNACKD*

Msg Type: *Explicit* *Addressing:* *UNICAST*

Msg Code: *0x00* *Data Size:* *22 bytes*

Priority: *No*

Description: *This message is sent from a Trail or Remote LCM to the Lead LCM to provide remote status. This message is sent in response to the DP Beacon or DP Remote Status Query.*

The reported load shall be transmitted to the ITC Lead using the current ITC Network WDP Remote Status Message (0, 36) field for Throttle/Dynamic Brake Tractive Effort. This information shall be transmitted in the form of a percentage in lieu of the standard AAR format of pounds.

Field Name	***Size***	***Value/Range (Resolution)***	***Default***	***Note***
RAILROAD SPECIFIC DATA –Field 1 *(Spoornet-Specific Extensions)*	*1*	*Bit 0: 1=Half Power Active* *Bit 1: 1=VCB Closed* *Bit 2: 1=Pantograph-Up & MCB Closed* *Bit 3: 1=Half Power Miscompare* *Bit 4: 1=Pantograph Up Miscompare* *Bit 5: 1=REMB Request Active* *Bit 6: 1=MU Yellow Alarm Active* *Bit 7: 1= MU Red Alarm Active*	*0* *0* *0* *0* *0* *0* *0* *0*	*B2, H.* *B2, H.,J* *B2, H.,J* *B2, H.* *B2, H.* *B2, H.* *B2, H.* *B2, H.*
RAILROAD SPECIFIC DATA –Field 2 *(Spoornet-Specific Extensions)*	*1*	*Bit 0: 1=Electric Release Active* *Bit 1: 1=Locked Axle Detected* *Bit 2: 1=Consist is in a Neutral Section* *Bit3: 1=Pantograph Down Miscompare* *Bit 4: Not Used* *Bits 5-7: Remote Locomotive Position Reporting Universal Fault Code* *<u>Value:</u>* *0 = Unknown* *1 = ITC Controlling Remote Locomotive* *2-7 = MU Unit Position In Consist Relative To ITC Controlling Remote*	*0* *0* *0* *0* *0* *0*	*C2, H.* *B2, H.* *B2, H.* *B2, H.* *H.* *B2, H, K.*
RAILROAD SPECIFIC DATA – Field 3 *(Spoornet-Specific Extensions)*	*1*	*ITC Universal Fault Code:* *0-254 = Refer to ITC Universal Fault Codes, Appendix D*	*0*	*B2, H, K.*

<u>Notes:</u>

B2. Refer to AAR Standard S4230, WDP Remote Status, Note B.

C2. Refer to AAR Standard S4230, WDP Remote Status, Note C.

H. This field is reserved per AAR S-4230 for definition by each specific railroad customer. It is intended to support the potential need for railroads who don't normally interchange equipment to assign bits in the DP Remote Status message that are specific to their operation (i.e. pantograph, dump-door control, etc).

J. For diesel locomotives, the default for these bits shall be set to 1.

K. The ITC universal fault code and the corresponding remote locomotive position shall be transmitted by the ITC Controlled WDP System to the ITC Lead as received from the locomotive control system (or equivalent). This information shall be transmitted to the ITC Lead for a minimum of five (5) consecutive status messages and then may be cleared and/or replaced by a new fault code as provided by the locomotive control system. The ITC lead unit shall detect the next new fault code and associated position upon receipt of a fault code change within the status message.

5.3 EXCEPTION CODES FOR SPOORNET-SPECIFIC EXTENSIONS

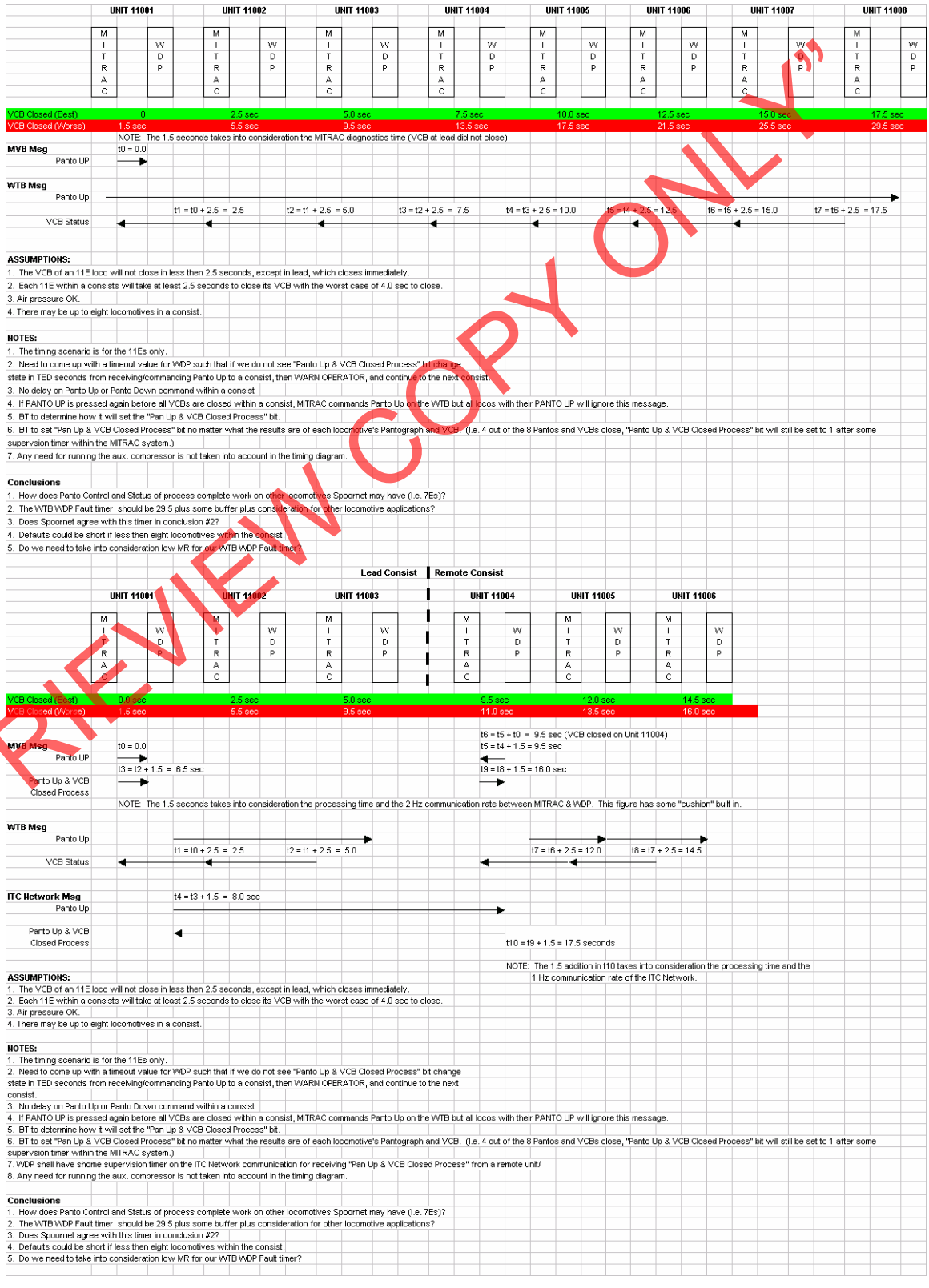
There are currently no Spoornet Specific Extension exception messages for WDP required. The system developers may transmit the remote locomotive fault message described in section 4.14 and Appendix D1 as exception codes if desired.

APPENDIX A: VCB SEQUENTIAL

A1 TIMING AND COMMANDS

A1.1 11E ELECTRIC LOCOMOTIVES

The timing as implemented on the 11E locomotive is shown in document below.



Notes:

In no case will more than 6 x 11E locomotives be allowed in a consist when working a train. (Note: This is not a WDP functional requirement, but noted here for reference.)

From the above timing diagram it will take 6 x 11E locomotives in the worse case 21.5 seconds to close all of their VCBs.

A1.2 CLASS 7E LOCOMOTIVES

The sequential PANTO UP/VCB CLOSE, on the 7E class locomotives functions as follow:

First step is to lift the pantographs of the locomotives by pressing the PANTO UP SWITCH.

Step two is to close the VCB by pressing the VCB CLOSE SWITCH. The leading locomotive will then close its VCB and send a command to the second locomotive to close its VCB. After the second locomotive has performed this function it will relay it to the next locomotive inline.

Should any of the locomotives not close its VCB, it will not relay the VCB CLOSE command to the next locomotive. None of the locomotives following this locomotive will close their VCB's. No time out is provided.

Only when all the VCB's on that consist have been closed, will train line B3 go LOW. See 7E MU train lines description.

APPENDIX B: MU CONTROL DESCRIPTIONS

B1 CLASS 7E ELECTRIC LOCOMOTIVE MU TRAINLINE DESCRIPTIONS

The Class 7E locomotives interface to the locomotive control systems via TWO MU Train lines (A cable and B cable). Cable A is fitted with a Green Receptacle while cable B is fitted with a GREY Receptacle. A number of cable B's train lines are screened.

The following table identifies the specific controls signals for the MU Trainlines for the Class 7E Locomotive

CABLE A (Green)

TL No.	Trainline Description	Acronym	Notes	Type	DP - MU Interface
A1,A2	Plus 110V		110V Battery Power Line	discrete	Yes
A3	Multiple Traction		Direction Handle in FORWARD or REVERSE (A3 = 110V) - Lead/Trail Setup - Trail loco automatically realize they are trail. Lead commands 110V, Trail sense 110V.	discrete	Yes
A4	Forward		Direction Handle in FORWARD (A4 = 110V)	discrete	Yes
A5	Reverse		Direction Handle in REVERSE (A5 = 110V)	discrete	Yes
A6	Motor Contactors		MC Handle in NOTCH S through 14 (A6 = 110V) - Sets up traction motors to allow traction - Use for PCS.	discrete	Yes
A7	Blower Off		Blower Motors Off (A7=110V) (Note 1)	discrete	Yes
A8	Blower On		Blower Motors On (A8=110V) (Note 1)	discrete	Yes
A9	Pantograph Up		Pantograph Up (A9 = 110V) (Note 1)	discrete	Yes
A10	Pantograph Down		Pantograph Down (A10 = 110V) (Note 1)	discrete	Yes
A11	PCB On		VCB On (A11 = 110V) (Note 1)	discrete	Yes
A12	PCB Off		VCB Off (A11 = 110V) (Note 1)	discrete	Yes
A13	Sanding		Manual Sanding ON (A13 = 110V)	Discrete	Yes
A14	Second Thyristor Bridge Off		Second Thyristor Bridge cut-out - Half Bridge Command when ON (A14 = 110V)	discrete	Yes

TL No.	Trainline Description	Acronym	Notes	Type	DP - MU Interface
A15	Rheostatic Brake		Rheostatic Brake ON (A14 = 110V)	discrete	Yes
A16	Loco Air Brake Off		Loco Air Brake Disabled "Electric Release" (A16 = 110V)	discrete	Yes
A17	Vacuum Train Brake		Through Cable for multiple operation with vacuum locomotives	discrete	No
A18,A19	Minus Battery		110V Battery Return Power Line	discrete	Yes

CABLE B (Grey)

TL No.	Trainline Description	Acronym	Notes	Type	DP - MU Interface
B1	Required Value		Notch Position Signal Variable Frequency 500 to 5500 Hz. Square wave. 150 V rms	analogue	Yes
B2	Shield Continuation of B1		Used with B5 & B6		No
B3	Indication PCB		VCB OFF (B3 = 110V)	discrete	Yes
B4	Indication Neutral Section		Neutral Section when (B4 = 110V) Each loco lead/trail senses enter and exit NS and independently applies power to TL-B4	discrete	Yes
B5,B6	Shield		Shield connection for B2& B10	analog	No
B7	Indication Wheel Slip		Wheel Slip Detected (B7 = 110V)	discrete	Yes
B8	Release (Vacuum Brake)		(B7 = 110V)	discrete	No
B9	Required Value		Notch Position Signal Variable Frequency 500 to 5500 Hz Square wave 150 V rms	analog	Yes
B10	Shield Continuation of B9		Used with B5 & B6		No
B11	Compressor On		Main Compressor ON (B11 = 110V)	discrete	No
B12	Indication Alarm		Red Light Fault ON (B12 = 110V)	discrete	Yes
B13	Indication Warning		Yellow Light Warning ON (B13 = 110V)	discrete	Yes
B14 – B17	Spare				
B18, B19	Inter-Locomotive data transmission		Used by the fault monitoring and remote reset system.	Data	No

Notes:

Note1. When Pantograph Up command is executed the Start-up sequence should be: Panto-UP - Close VCB

B2 CLASS 11E ELECTRIC LOCOMOTIVE MU TRAINLINE DESCRIPTIONS

The Class 11E WDP system interfaces to the locomotive control systems via a MVB communications interface. The following table identifies the specific control signals.

TL No.	Trainline Description	Acronym	Notes	Type	DP - MU Interface
n/a	Forward	n/a	Command and Status info	Discrete	Yes
n/a	Reverse	n/a	Command and Status info	Discrete	Yes
n/a	Throttle Reference	n/a	Command and Status info	Discrete	Yes
n/a	Motoring State	n/a	Command and Status info	Discrete	Yes
n/a	Dynamic Brake State	n/a	Command and Status info	Discrete	Yes
n/a	Half Power	n/a	Command and Status info	Discrete	Yes
n/a	Pantograph Up	n/a	Command Only	Discrete	Yes
n/a	Pantograph Down	n/a	Command Only	Discrete	Yes
n/a	VCB Status	n/a	Status Only	Discrete	Yes
n/a	Pan Up & VCB closed	n/a	Status Only	Discrete	Yes
n/a	REMB Pan Down Request	n/a	Command Only	Discrete	Yes
n/a	Max Armature Current	n/a	Status Only	Analog	Yes
n/a	Locked Axle Status	n/a	Status Only	Discrete	Yes
n/a	Continuous Slip Status	n/a	Status Only	Discrete	Yes
n/a	Red Fault Alarm	n/a	Status Only	Discrete	Yes
n/a	Yellow Fault Alarm	n/a	Status Only	Discrete	Yes
n/a	Manual Sanding	n/a	Command and Status info	Discrete	Yes
n/a	Consist is passing a Neutral Section	n/a	Status Only	Discrete	Yes
n/a	Pantograph Up status	n/a	Status Only	Discrete	Yes
n/a	Fault Code	n/a	Status	Analog	Yes
n/a	Locomotive position within consist reporting fault code	n/a	Status	Analog	Yes

B3 CLASS 37 DIESEL-ELECTRIC LOCOMOTIVE MU TRAINLINE DESCRIPTIONS

The Class 37 locomotives interface to the locomotive control systems via the MU Trainlines The following table identifies the specific controls signals for the 27-Pin MU Trainlines for the Class 37 Locomotive.

TL No.	Trainline Description	Acronym	Notes	Type	DP - MU Interface
1	Wheel Slide	SW	Wheel Slide Detected (1 = 74V)	discrete	Yes
2	Alarm Signal	SG	Red MU Alarm (2 = 74V)	discrete	Yes
3	Engine Speed	DV	"D" Governor Solenoid (D Valve) (3 = 74V)	discrete	Yes
4	Negative (B-)	N	74V Battery Return Power Line	discrete	Yes
5	Spare			discrete	No
6	Generator Field/Motoring	GF	Main Alternator, Throttle Command (6 = 74V)	discrete	Yes
7	Engine Speed	CV	"C" Governor Solenoid (C Valve) (7 = 74V)	discrete	Yes
8	Forward	FO	Direction Handle in FORWARD (8= 74V)	discrete	Yes
9	Reverse	RE	Direction Handle in REVERSE (9 = 74V)	discrete	Yes
10	Wheel Slip	WS	Wheel Slip Detected (10 = 74V)	discrete	Yes
11	Spare			discrete	No
12	Engine Speed	BV	"B" Governor Solenoid (B Valve) (12 = 74V)	discrete	Yes
13	Positive Control	PC	Control Circuits and Fuel Pump (13 = 74V)	discrete	Yes
14	Spare			discrete	No
15	Engine Speed	AV	"A" Governor Solenoid (A Valve) (15 = 74V)	discrete	Yes
16	Spare			discrete	No
17	Dynamic Brake Set-Up	B	DB Set-up (17 = 74V)	discrete	Yes
18	Shunting		(18 = 74V)	discrete	No
19	Hump Control Relay		(19 = 74V)	discrete	No
20	Hump Control		Tbd (20 = 74V)	discrete	No
21	Humping Control (variable resistor)		Tbd (21 = 74V)	Analog	No
22	Compressor	CC	Air compressor control (22 = 74V)	discrete	No
23	Sanding	SA / MS	Manual Sanding ON (23 = 74V)	discrete	Yes

TL No.	Trainline Description	Acronym	Notes	Type	DP - MU Interface
24	Dynamic Brake Demand Control	XB	Analog Dyn. Brake Excitation/ Set Spd. (24 = 0V – 74V)	analog	Yes
25	Dynamic Brake	BG	DB Active (25 = 74V)	discrete	Yes
26	Steam Vehicle Control(+)		(26 = 74V)	discrete	No
27	Steam Vehicle Control (-)		(27 = 74V)	discrete	No

B4 Description of the J-function on Spoornet's Electric Locomotives

The purpose of the J-system is to give the driver a choice to lower his locomotive brake cylinder pressure when an Emergency application occurs. The locomotives have a brake ratio much higher than the wagons and an emergency application will create high in train buff forces.

The J-system functions as follow:

Note:

The J-System controls the locomotive's conventional emergency brake cylinder pressure as a function of pantograph control. When the pantograph is raised (i.e. pantograph pressure is charged above 680 kPa) and the brake pipe pressure is low (i.e below 200 kPa), the J-system allows full the emergency brake cylinder pressure limit (i.e. 250 kPa), irrespective of the handle position for independent or automatic handles.

If the system is in emergency and then electric release becomes active, the system then allows brake cylinder to be reduced to a low pressure (i.e. 140kPa).

If electric release is active at the time of the emergency, then electric release becomes inactive and the brake cylinder will build to full emergency pressure (i.e. 250 kPa). If the electric release is de-activated and then re-activated, the brake cylinder pressure will again reduce to the lower pressure (i.e. 140 kPa).

If the pantograph is lowered (it is low pantograph pressure) the J System becomes inactive. The brake cylinder pressure will build up as required by the automatic brake handle or independent brake handle setting. The maximum Brake Cylinder Pressure will be limited to 350kPa. If electric release is then activated, the brake cylinder pressure is reduced to 0 kPa until the electric release is inactive, at which time the brake cylinder pressure is allowed to increase back to the lower pressure.

In DP remote mode, the emergency and penalty brake cylinder pressures will be a function of the DP System commands to limit the brake cylinder pressure to a predefined value.

The independent brake cylinder pressure control operates independently of the J-System, DP System, electric release and bail control.

APPENDIX C: THROTTLE/DYNAMIC BRAKE TRANSLATION TABLE

C1. TRANSLATION DESCRIPTION

The following table identifies the ITC Network Throttle and Dynamic Brake commands requirements for the various Spoornet Throttle/Dynamic Brake controllers:

C1.1 Powering

Continuous Notch	**8 Notch ITC Lead**	**8 Notch ITC Controlled**
Idle = 0%	Idle = 0%	Idle = 0%
Full range = 1% to 100%	Notch 1= 12.5%	3% to 16% = Notch 1
	Notch 2 = 25%	16.5% to 29% = Notch 2
	Notch 3 = 37.5%	29,5% to 41 = Notch 3
	Notch 4 = 50%	41,5% to 54% = Notch 4
	Notch 5 = 62.5%	54,5% to 66% = Notch 5
	Notch 6 = 75%	66,5% to 79% = Notch 6
	Notch 7 = 87.5%	79,5% to 91% = Notch 7
	Notch 8 = 100%	91,5% to 100% = Notch 8

- All Spoornet Electric locomotives fall into the Continuous notch category. The master controllers of these locomotives do have definite notch positions but they are only cosmetic.
- All Spoornet Diesel Electric locomotive classes have only 8 notches in powering

C1.2 Dynamic/Rheostatic Braking

All Spoornet Electric and Diesel Electric locomotives Rheostatic/Dynamic brake is CONTINUOUS NOTCHING from 1% to 100%.

DP Beacon Command	Local ITC controlled Diesel response	Local ITC controlled Electric response
DB mode active and 0%	DB Set-up	Idle
DB mode active and full range = 1% to 100%	DB brake command 1% to 100%	DB brake command 1% to 100%

APPENDIX D: UNIVERSAL FAULT CODES ON ITC NETWORK

The table below shows the fault codes that will be transmitted on the ITC Network More fault codes will be added as required.

Red Code	Description	Note
ITC-F01	Auxiliary Power Supply System Failure	
ITC-F02	Brake System Fault	
ITC-F03	Electronic Cubicle Overheating	
ITC-F04	Line Voltage too high	
ITC-F05	Line Voltage too low	
ITC-F06	Locked Axle Bogie 1	
ITC-F07	Locked Axle Bogie 2	
ITC-F08	Main Power Converter Cooling System Failure	
ITC-F09	Main Power Converter Failure	
ITC-F10	Operator Error Fault	Including Overspeed
ITC-F11	Rheostatic Brake Failure Bogie 1	
ITC-F12	Rheostatic Brake Failure Bogie 2	
ITC-F13	Speed Measurement System Fault B1	
ITC-F14	Speed Measurement System Fault B2	
ITC-F15	Traction / Braking Contactor Failure	
ITC-F16	Locomotive Control System Fault	
ITC-F17	Traction Motor Blower Failure B1	
ITC-F18	Traction Motor Blower Failure B2	
ITC-F19	Traction Motor Failure B1	
ITC-F20	Traction Motor Failure B2	
ITC-F21	Traction Motor Field Circuit Failure	
ITC-F22	Transformer Cooling System Failure	
ITC-F23	Transformer Fault	
ITC-F24	Transformer Overheated	
ITC-F25	Transformer Primary Overload Failure	
ITC-F26	Transformer Traction Overload Failure	
ITC-F27	Transformer Auxillary Overload Failure	
ITC-F28	Loss of communications between locos	
ITC-F29	Main Primary Circuit Breaker Fault	
ITC-F30	Signal System Interference	
ITC-F31	Excessive Wheelslip - Motors cut out	
ITC-F32	Earth Switch Fault	
ITC-F33	Drivers Reset for one or more subsystems is locked out	
ITC-F34	Unknown Red Fault	
ITC-F35	Diesel Alternator Failed	
ITC-F36	Spare	
ITC-F37	Spare	
ITC-F38	Spare	
ITC-F39	Spare	
ITC-F40	Spare	
ITC-F41	Spare	
ITC-F42	Spare	
ITC-F43	Spare	
ITC-F44	Spare	
ITC-F45	Spare	
ITC-F46	Diesel Engine Overheated	Diesel

ITC-F47	Engine Fault	Diesel
ITC-F48	Low Oil Pressure	Diesel
ITC-F49	High Crankcase Pressure	Diesel - Non Resettable
ITC-F50	Spare	
ITC-F51	Spare	
ITC-F52	Spare	
ITC-F53	Spare	
ITC-F54	Spare	
ITC-F55	Spare	
ITC-F56	Spare	
ITC-F57	Spare	
ITC-F58	Spare	
ITC-F59	Spare	
ITC-F60	Spare	
ITC-F61	Spare	
ITC-F62	Spare	
ITC-F63	Spare	
ITC-F64	Spare	
ITC-F65	Spare	
ITC-F66	Spare	
ITC-F67	Spare	
ITC-F68	Spare	
Yellow Code	**Description**	**Note**
ITC-F69	Battery Charging Fault	
ITC-F70	Brake System Warning	
ITC-F71	Electronic Cubicle Overheating	
ITC-F72	Main Power Converter Cooling System Warning	
ITC-F73	Main Power Converter High Temperature Warning	
ITC-F74	Operator Error Warning	
ITC-F75	Remote Input/Output Module Fault	
ITC-F76	Traction Motor Temperature Warning B1	
ITC-F77	Traction Motor Temperature Warning B2	
ITC-F78	Transformer Cooling System Warning	
ITC-F79	Transformer High Temperature Warning	
ITC-F80	Ventilation Blower Fault	
ITC-F81	Main Primary Circuit Breaker Warning	
ITC-F82	Ground Fault	
ITC-F83	Circuit Breaker Tripped	
ITC-F84	MVB Communication Error	
ITC-F85	Compressor Fault	
ITC-F86	Low Battery Voltage	
ITC-F87	Train Speed Calculation Error	
ITC-F88	Track Magnet Receiver Failure	
ITC-F89	Electronic Cubicle Temperature sensor failed	
ITC-F90	Unknown Yellow Fault	
ITC-F91	Spare	
ITC-F92	Spare	
ITC-F93	Spare	
ITC-F94	Spare	
ITC-F95	Spare	
ITC-F96	Spare	
ITC-F97	Spare	

ITC-F98	Spare	
ITC-F99	Spare	
ITC-F100	Spare	
ITC-F101	Spare	
ITC-F102	Spare	
ITC-F103	Spare	
ITC-F104	Spare	
ITC-F105	Spare	
ITC-F106	Spare	
ITC-F107	Spare	
ITC-F108	Spare	
ITC-F109	Spare	
ITC-F110	Spare	
ITC-F111	Spare	
ITC-F112	Low Turbo Pressure	Diesel
ITC-F113	Warm Engine	Diesel
ITC-F114	Spare	
ITC-F115	Spare	
ITC-F116	Spare	
ITC-F117	Spare	
ITC-F118	Spare	
ITC-F119	Spare	
ITC-F120	Spare	
ITC-F121	Spare	
ITC-F122	Spare	
ITC-F123	Spare	
ITC-F124	Spare	
ITC-F125	Spare	
ITC-F126	Spare	
ITC-F127	Spare	
ITC-F128	Spare	

APPENDIX E: LOCOMOTIVE STATIC INFORMATION

E1 7E, 7E1, 7E2, 7E3, 7E4, 7E5, 7E6 Locomotive Details

Field Name		*Value Units*	*Desired Value*	*Note*
VEHICLE REPORTING MARK		ASCII Text	Refer to sect. 4.14.1	
LOCOMOTIVE TYPE		ASCII Text	Refer to sect. 4.14.2	
LOCOMOTIVE LENGTH		UNITS IN Meters	18.43	
NOMINAL MASS		MASS IN kg	125500	
NUM AXLES			6	
NOMINAL WHEEL DIAMETER		UNITS IN mm	1220	
NET BRAKE RATIO DEFAULT		UNITS IN %	12.6	
BP PRESSURE SET POINT		UNITS IN kPa	620	
SUPPRESSION APPLICATION		UNITS IN %	100	
LOW BATTERY FAULT THRESHOLD		UNITS IN vdc	80	
LOW BATTERY FAULT CLEAR THRESHOLD		UNITS IN vdc	90	
Normal independent BC pressure range		UNITS IN kPa	0 to 350	
Minimum application BC pressure (10%)		UNITS IN kPa	70	
Full Service application BC pressure (100%)		UNITS IN kPa	225	
Emergency application BC pressure (120%)		UNITS IN kPa	250	
Continuous traction motor current (100%)		UNITS IN Amps	635	
Motor Current 1 Hour rating (107%)		UNITS IN Amps	680	
Starting Motor Current (139%)		UNITS IN Amps	882	

E2 11E Locomotive Details

Field Name		*Value Units*	*Desired Value*	*Note*
VEHICLE REPORTING MARK		ASCII Text	Refer to sect. 4.14.1	
LOCOMOTIVE TYPE		ASCII Text	Refer to sect. 4.14.2	
LOCOMOTIVE LENGTH		UNITS IN Meters	20.43	
NOMINAL MASS		MASS IN kg	170000	
NUM AXLES			6	
NOMINAL WHEEL DIAMETER		UNITS IN mm	1220	
NET BRAKE RATIO DEFAULT		UNITS IN %	12.6	
BP PRESSURE SET POINT		UNITS IN kPa	620	
SUPPRESSION APPLICATION		UNITS IN %	100	
LOW BATTERY FAULT THRESHOLD		UNITS IN vdc	80	
LOW BATTERY FAULT CLEAR THRESHOLD		UNITS IN vdc	90	
Normal independent BC pressure range		UNITS IN kPa	0 to 350	
Minimum application BC pressure (10%)		UNITS IN kPa	70	
Full Service application BC pressure (100%)		UNITS IN kPa	225	
Emergency application BC pressure (120%)		UNITS IN kPa	250	
Continuous traction motor current (100%)		UNITS IN Amps	815	
Motor Current 1 Hour rating (106%)		UNITS IN Amps	865	
Starting Motor Current (144%)		UNITS IN Amps	1170	

E3 37000 Locomotive Details

Field Name		*Value Units*	*Desired Value*	*Note*
VEHICLE REPORTING MARK		ASCII Text	Refer to sect. 4.14.1.	
LOCOMOTIVE TYPE		ASCII Text	Refer to sect. 4.14.2	
LOCOMOTIVE LENGTH		UNITS IN Meters	19.20	
NOMINAL MASS		MASS IN kg	125000	
NUM AXLES			6	
NOMINAL WHEEL DIAMETER		UNITS IN mm	1016	
NET BRAKE RATIO DEFAULT		UNITS IN %	12.6	
BP PRESSURE SET POINT		UNITS IN kPa	620	
SUPPRESSION APPLICATION		UNITS IN %	100	
LOW BATTERY FAULT THRESHOLD		UNITS IN vdc	50	
LOW BATTERY FAULT CLEAR THRESHOLD		UNITS IN vdc	60	
Normal independent BC pressure range		UNITS IN kPa	0 to 350	
Minimum application BC pressure (10%)		UNITS IN kPa	70	
Full Service application BC pressure (100%)		UNITS IN kPa	350	
Emergency application BC pressure (120%)		UNITS IN kPa	420	
Continuous traction motor current (100%)		UNITS IN amps	520	
Motor Current 1 Hour rating (105%)		UNITS IN amps	545	
Starting Motor Current (%)		UNITS IN amps	≈ 642	

APPENDIX F: SCREEN LAYOUTS

SPOORNET – TECHNOLOGY MANAGEMENT			
File Ref:	Standardised Screen Layouts For EAB, ECP, WDP and RDP		Document no: RSE/TE/TMO/0015
			Document Rev no:
Compiling officer:	D. Hansen	Signature:	Issue date: 25/10/2006
Assistant compiling officer:	W. Vorster	Signature:	
Approving officer:	J.M. Mulder	Signature:	Page 1 of 5

CONTENTS PAGE

1. SCOPE

This document covers the brake screen layout on Spoornet locomotives for the following modes:

- Air brake mode (EAB)
- Electrically controlled pneumatics mode (ECP)
- Wired distributed power mode (WDP)
- Radio distributed power mode (RDP)

2. DECISION

Spoornet has taken the decision to standardise the layout of the EAB, ECP, WDP and RDP screens, and has approved the screen layout as below, as 97 of these screens are already fitted or in the process of being fitted to Spoornet locomotives on the COALline and Ore line. Mitsui (MARS) who have a contract to supply 19E locomotives for the COALline, and are the preferred bidders for the 15E locomotives on the Ore line will also use this same layout.

It has therefore been agreed that all screens fitted to Spoornet locomotives will have the layout as depicted in the figures 1 - 4 below. This decision was taken to reduce the possibility of confusion when footplate personnel change from one class of locomotive to another, and to eliminate driver error by ensuring the information shown on the screens is all in the same areas irrespective of supplier.

3. SCREEN LAYOUTS

3.1 Electronic Air brake

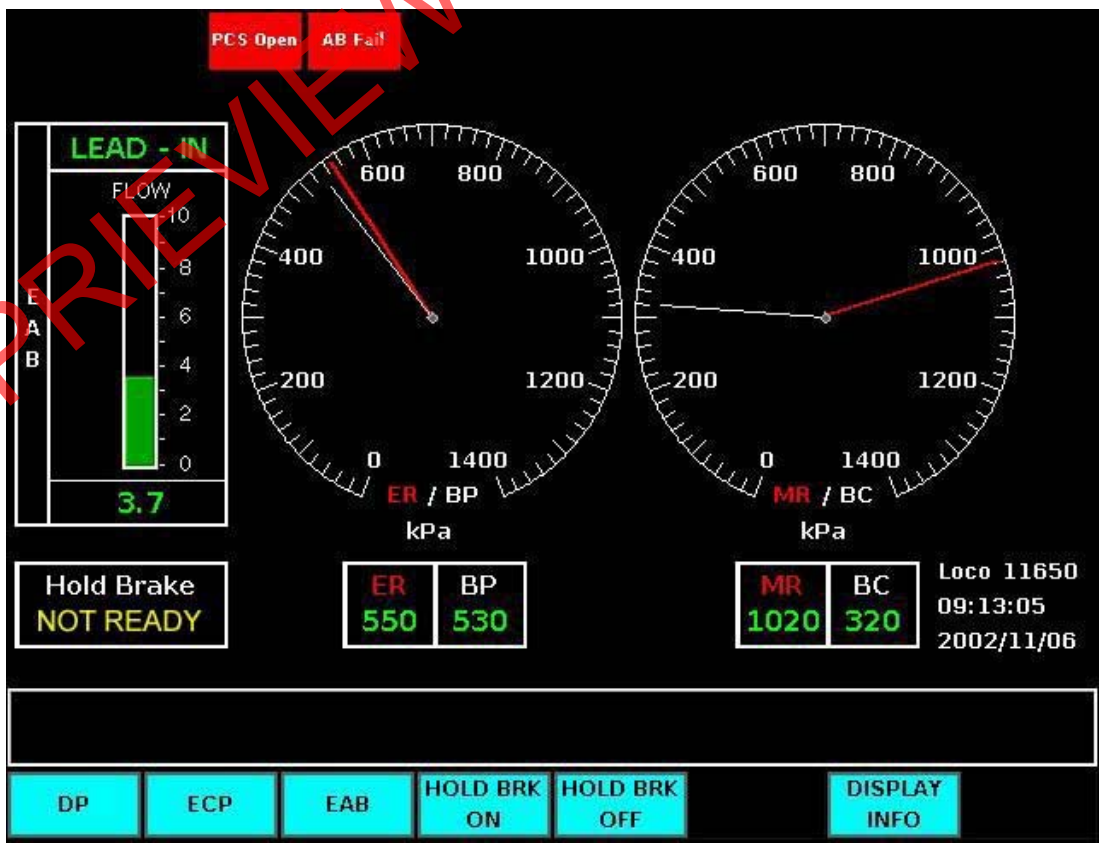


Figure 1: Air brake screen (EAB)

3.2 Electronic controlled pneumatic Brake system

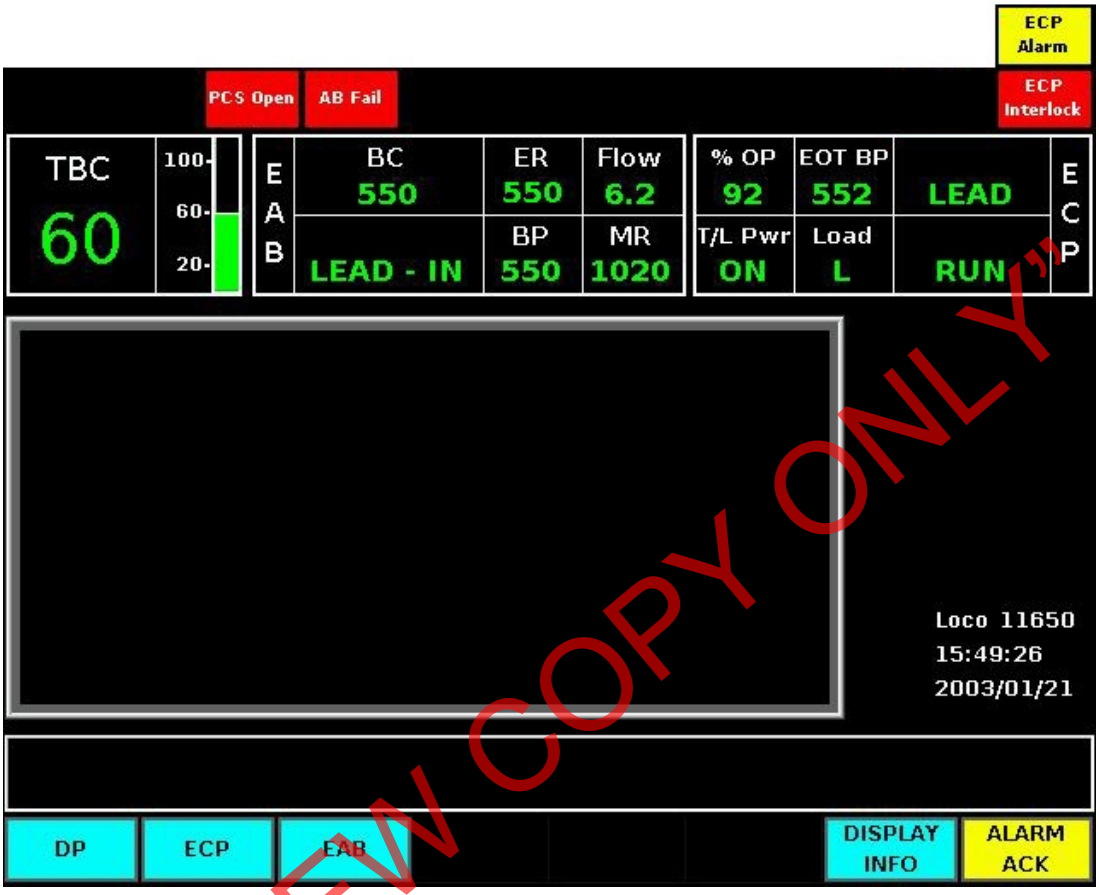


Figure 2: Electronic Controlled Pneumatic brake system (ECP)

3.3 Wired distributed power

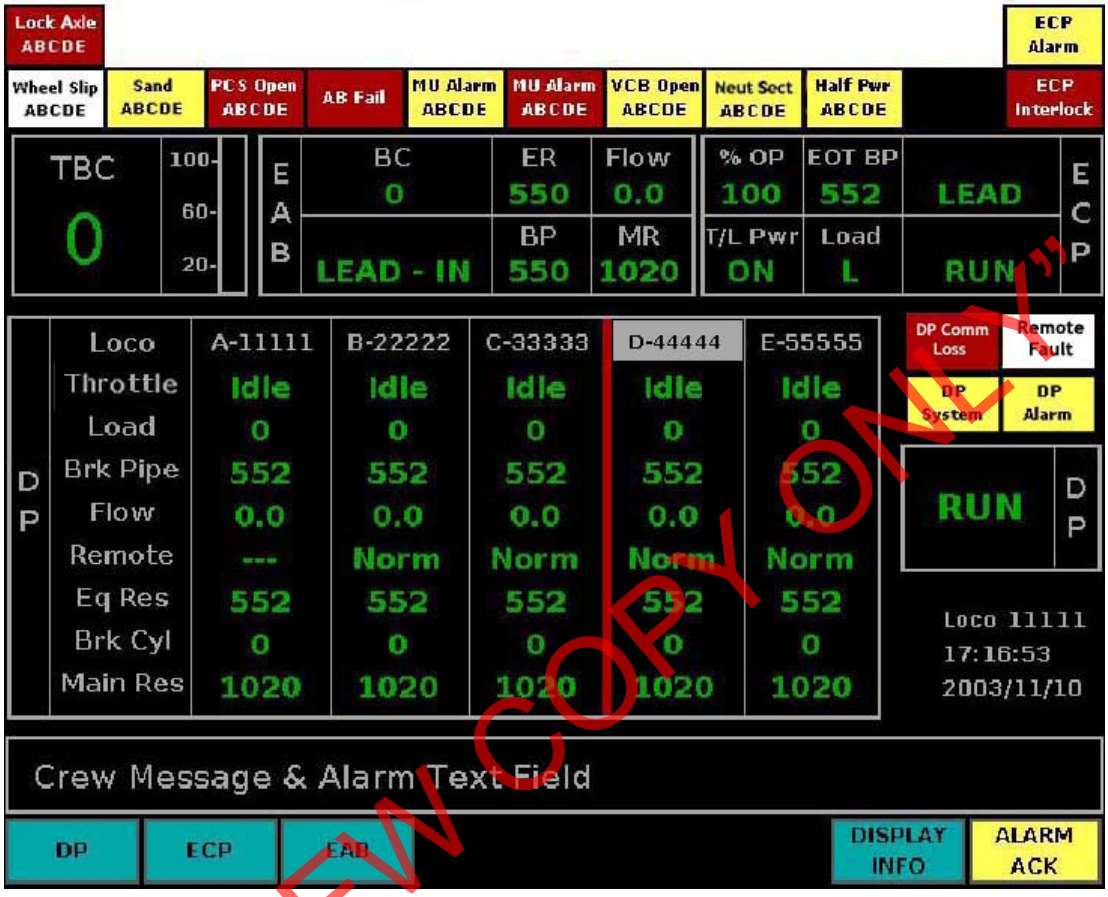


Figure 3: Wired Distributed Power (WDP)

3.4 Radio Distributed Power

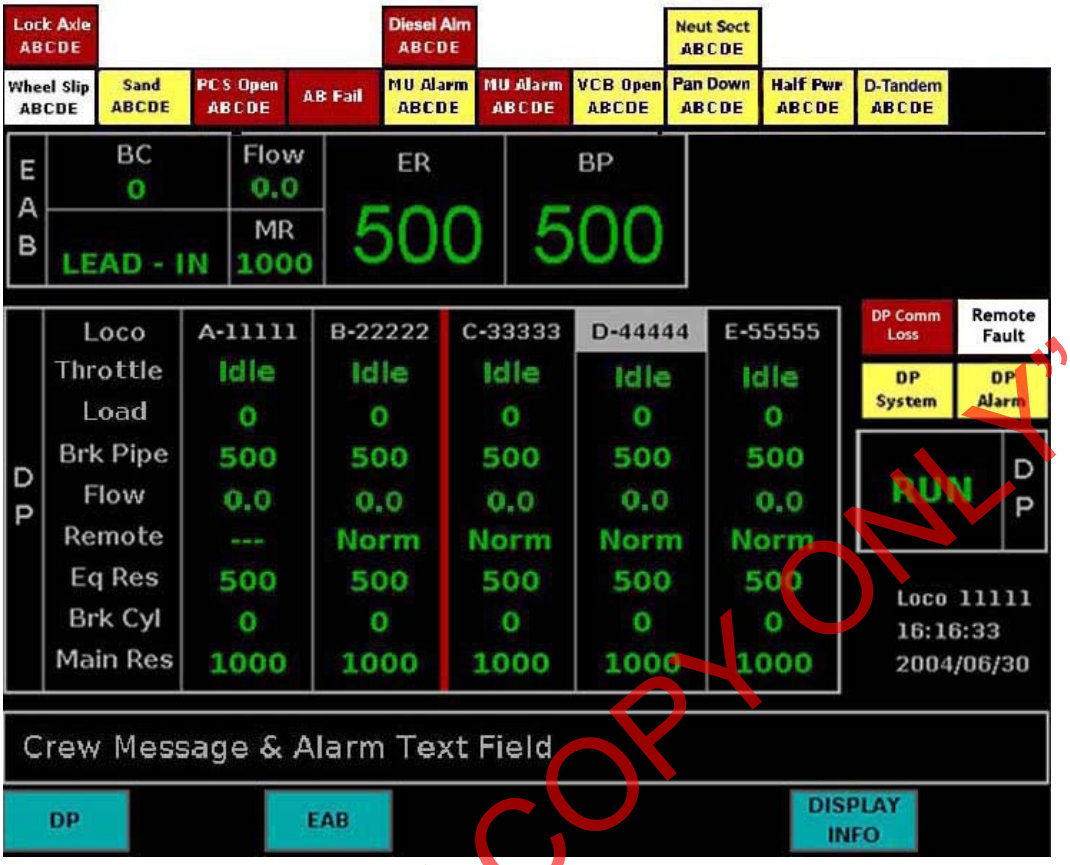


Figure 4: Radio Distributed Power (RDP)

End of Document