

Automatic Routesetting Reference

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**Published and issued by
Network Rail
40 Melton Street
LONDON
NW1 2EE**

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Amendment Record

Issue	Date	Description
4	29/10/1999	Converted to Word format by AEA Technology Rail. Same as issue 3, except for incorporating Appendices A, B and C in issue 3 into the current document as sections 9, 10 and 11. No other changes made.
4.1	22/09/2000	Sections 6.2.13.3 and 10.2.3 amended for IECC Upgrade 002.
5	16/04/2003	<p>Railtrack and BR amended to Network Rail.</p> <p>Sections 1 and 3.3 amended in accordance with SAO-IEC-D10.</p> <p>Sections 1, 3, 4 and 10 SSI Data Preparation Guide ELS-DOC-3080 and sections thereof amended to RT/SSI/8003.</p> <p>Section 2 BR Research replaced by IECC Help Desk.</p> <p>New sections 6.1.9 (SAW), 6.4.2.5 (SPV), 6.4.2.6 (SSG), 6.5.3.3 (ADJ) and 6.13.12 (SIS) added for parameters required by IECC SPAD Alarm.</p> <p>Section 6.4.2.3 (SBR) amended to highlight the importance of subroute definitions to SPAD monitoring.</p> <p>Section 5.1 (signals) amended to introduce SAW fields.</p> <p>Sections 5.5, 6.4 (track circuits) amended to introduce SPAD monitoring only data.</p> <p>Section 5.11 (ARS subarea) amended to introduce adjacent subarea data.</p> <p>Section 6.2 amended to include caution on last route in DRTE file in accordance with SCS-IEC-D29.</p> <p>Sections 7.2.2 and 8.6 cross-references amended in accordance with SAO-IEC-D12.</p> <p>Section 9 SPAD Alarm data added to Ayton Junction example.</p> <p>Section 10.6.7 amended in accordance with SAO-IEC-R100.</p> <p>SDS amended to DIS/SDS.</p> <p>'He' amended to 'the signaller' or 'the signal engineer' as appropriate.</p> <p>'Will be' amended to 'is' or 'are' as appropriate.</p>
5.1	24/07/2003	Section 7.4.5 - Reference number list for error 220 updated.

Author Approved Date Authorised Date

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I Introduction

Automatic Route Setting (ARS) is a system used within a railway signalling and control centre to assist the signaller by performing functions such as setting routes for trains and monitoring the state of the railway.

In general ARS is installed as a subsystem within an Integrated Electronic Control Centre (IECC). ARS is also installed as part of the Waterloo resignalling scheme where interface processors are used to provide an IECC-like interface to ARS.

The ARS software has been written in a general way with the intention of using the same software package in a series of implementations. At an implementation in a particular area, the operation of the ARS software is guided by tables of fixed data held in the ARS Processor memory which define the geographical and operating characteristics of that area. These tables are set up by the ARS data preparation procedures described in this document.

It should be noted that a small number of area-dependent features are handled by the use of area-dependent program code. Methods for identification of such features are described in the ARS Guide to Specification of Operating Requirements SAO-IEC-TG-7.

This document describes how ARS data is prepared. It is assumed that the user is an engineer who is able to interpret signalling plans, Train Descriptor (TD) stepping tables and block schematics. The user should be familiar in broad terms with the functions performed by the ARS system, as described in the ARS Requirements Specification RT/E/S/10120 or, in more detail, in the ARS Functional Specification ARS/FS/1.

Because of the dependence of ARS on the signalling interlocking system to provide it with information on signalling states, some familiarity with the working of Solid State Interlocking (SSI) is desirable; a suitable reference for this is the SSI Interlocking Data Preparation Guide RT/SSI/8003. Similarly, because of the dependence of ARS on a train describer system to provide it with train position information, some familiarity with the working of a train describer working to specification BR 800 is desirable.

Section 2 of this user guide discusses the nature of ARS data preparation in general terms and is intended to give an understanding of why this approach was adopted. Section 3 discusses the source documents which contain information required by ARS. Section 4 defines the formats of the ARS data files. Section 5 defines the objects, such as signals, berths or locations, for which ARS data is required, and section 6 defines all of the data items which may be specified for each class of object. Section 7 describes how the ARS data files are processed by a data preparation program into the required form. Section 8 describes one method for using the source documents to prepare the data files, but other approaches are possible.

Section 9 gives an example of ARS data for a small hypothetical area. Section 10 discusses particular aspects which need more detailed attention.

2 Principles Of ARS Data

The role of the fixed data within the ARS system is rather different to the role of fixed data in other processor-based signalling systems such as SSIs or train describers. These systems are strongly event driven and the data defines the action required following any given event. For example, in a train describer, the data defines that when a given track circuit becomes occupied at a time when a given route is set, then a given step should be generated. Similarly within an SSI, the data defines that when a given panel request is received certain checks should be made and if they are satisfied then certain actions should be taken. This approach has not been adopted by ARS because the ARS actions are more complex and would require a prohibitive amount of data to define in this way.

ARS operates in a different way. It is supplied by the SSI with signalling change-of-state information, by the train describer with TD step, cancel and interpose messages and by the Timetable Processor with train timetable information. ARS uses all this information to maintain a model of the current state of the area of railway under its control. It then applies algorithms to the model to determine whether any output is required. For example, the routesetting function determines whether a panel route request should be sent to the SSI and the signaller alarm function determines whether an alarm should be sent to the Flexible Display Subsystem (DIS) / Signaller's Display System (SDS) for display to the signaller. These functions are defined in the ARS Functional Specification ARS/FS/1.

In order to operate in this way, ARS requires fixed data to interpret its input and control the function algorithms.

ARS requires data which relates the various signalling items together and relates them to the TD berths and timetable locations. For example, for each route data is required to define the entry and exit signals, the track circuits in the route and any location the route extends past. For each signal the corresponding TD berth, if any, is defined. This data enables ARS to perform correlations between the states of the various items which are similar to those made by the signaller, in many cases automatically, as the signaller observes the state of the railway area displayed on the DIS/SDS workstation or panel.

ARS data which controls the function algorithms includes data defining the operating requirements of the route setting function. This data includes weighting factors for the various classes of train. However, the fixed data contains no other information relating to particular train descriptions or sets of train descriptions. All of the information required concerning a particular train is supplied to ARS by the Timetable Processor and is handled within ARS as variable timetable data. This avoids the need to repeat the ARS data preparation process whenever the Train Planning Offices change their allocation of train descriptions to train services, or when the pattern of the train service in the area changes.

As part of the routesetting function in ARS, there is a prediction process which estimates the future movement of a train. Because of the large number of factors involved, many of which could not be readily made known to an ARS system, no attempt is made to calculate an accurate solution of the train's equations of motion. Instead, an interpolation method is used which is based on the train's current delay against its timetable and its planned timings at later

locations on its path. Investigations have shown that this approximate method is suitable for use by ARS.

The prediction process requires a small amount of additional data e.g. minimum stop time at each location, joining allowance, headways for routes within the area. This data may again be of an approximate nature and typical average values should be used when specific data is not available. In addition there is currently no facility to provide ARS with information on Temporary Speed Restrictions.

The data on route lengths and distances of locations along routes is also used indirectly in the interpolation method and therefore approximate values are sufficient. It is not essential to ensure that all route lengths are accurate to the nearest metre.

An attempt has been made to assist integration of the systems within the IECC by designing the ARS data defining the signalling interface to be compatible with the SSI data. SSI identity files are required by the ARS data preparation program to set up the ARS data which interprets the change of state messages received from SSI. It was originally hoped that ARS and SSI could use common identifiers for routes, signals, track circuits etc. However this has been found to be impractical because :

- SSI, ARS and other IECC subsystems have all been developed with slightly different rules for length of identifiers and for the valid characters within identifiers.
- names which are suitable for the signal engineers are not necessarily suitable for display to the signaller as part of alarm messages.
- ARS identifiers must be unique within the IECC, whereas SSI identifiers need only be unique within the interlocking.
- IECC identifiers must follow a consistent naming convention.

Therefore a translation from SSI to ARS identifiers is now required as part of ARS data preparation. This may be done manually or else by means of an “aliasing” utility.

ARS also requires data defining the conditions for route availability which is similar in form to certain data contained in the SSI PFM and PRR data files. This is supplied to ARS in the form of SSI-like data files which are similar in structure to the SSI data files, and in some cases can be quite easily set up by editing the SSI data files.

The greater part of the ARS data consists of the relations between the ARS data objects and parameters defining the functions performed on them. For this data the “if-tests-then-commands” structure of the SSI data files was not considered quite appropriate. Instead a simple ARS language based on keywords has been developed, as described in section 4. This language does not provide the full generality of SSI but is sufficiently flexible for ARS purposes. The use of default values for keywords allows for upwards compatibility. As new features are added to ARS and new keywords introduced to define the data required, existing data will still be valid to configure an ARS system which does not exercise those new features.

The structure of the fixed data areas within the ARS processor itself is defined in the ARS Processor Data Areas Specification ARS/DS/1. However, these data areas structures are designed for efficient access by a real-time computer system. The role of the ARS data preparation program is to create these structures from the ARS data files. In order to do this the following processes are used :

- Numbering. All references to ARS objects in the data files are by the object identifier or name. The data preparation program allocates internal ARS numbers to the objects and then converts the object names to numbers.
- Inversion. To allow efficient real-time access, the ARS processor holds some information in 2 forms e.g. all routes from each signal and entry signal for each route. To avoid the engineer having to set up redundant data, the ARS data files only allow him to define the entry signal for each route. The data area defining the routes from each signal is automatically derived by the data preparation program using an inversion process.
- Transformation. Some of the more complex data area structures within the ARS processor are automatically derived by the data preparation program from simpler information set up in the data files. For example, the information set up on track circuits in route and in route overlap is used to derive the list of conflicting routes.

This approach reduces the effort required by the engineer in setting up the ARS data files, but disadvantages are that it is more difficult to understand the effect of each data item on the operation of the system, and that it is therefore more difficult to test the correctness of each data item. Section 6 of this document briefly explains the effect of each data item and gives guidance in its use. However, it is recognised that this will not cover every possible situation which may arise throughout the Network Rail network and queries on situations which do not appear to be covered by this guide should be referred to the IECC Help Desk, AEA Technology Rail, Derby.

Each ARS computer unit contains, as well as the ARS applications software, the following utility software :

- NDS Network and Duplication Services.
- NCS Network Communication Services.
- RCM Remote Control and Monitoring.
- SSIC SSI Communications Controller.

The fixed data required by these utilities is prepared as part of the IECC Service Data, not as part of ARS data, and so is outside the scope of this document. However the following linkages should be noted :

- IECC subsystem names should be the same in the Service data and the ARS link detail data.
- SSI flags which correspond to ARS sub-areas, TRTS indications or remote links must be declared the same in the Service data and in the ARS flag detail data.
- the order in which the interlockings are defined in the ARS link detail data must be the same as the order in the Service data.

3 Source Documents

3.1 SIGNALLING SCHEME PLAN

The signalling scheme plan defines the position of signals, track circuits and points with respect to the track layout. The plan is drawn to scale in the direction of the railway line, although different scales may be used in complex junction areas or large stations. Signals and points are numbered. Track circuits may be numbered or identified by letters.

The following information relevant to ARS can be obtained from the signalling plan.

Signal

- aspects displayable by the signal.
- track circuit preceding the signal.
- overlaps.
- reduced overlaps.
- direction.
- automatic/controlled.

Track circuit

- adjoining track circuits.

It is usually possible to determine the routes from each signal from the signalling plan, although this should be confirmed against the SSI data or control tables. The following route data can then be obtained :

- entry signal.
- exit signal.
- track circuits in route.
- track circuits in route overlap.
- route length.
- distance to any location the route extends past.

3.2 SSI FILES

The structure of the SSI interlocking data files is defined in the SSI interlocking data preparation guide RT/SSI/8003.

The SSI identity files list the various classes of signalling object considered by the SSI interlocking processor. For each interlocking area, the following identity files exist:

SIG signals
PTS points
ROU routes

TCS	track circuits
FLG	flags
ELT	elapsed timers
QST	panel requests.

The signals, points, routes, track circuits and flags identity files together define the allocation of the SSI memory area used to supply ARS with information about signalling states. All of the information in these files is potentially relevant to ARS although in most cases there will be some identities which do not affect ARS operation e.g. split track circuits, distant signals.

Elapsed timer information is not available to ARS, so the elapsed timer file is not usually relevant to ARS.

Panel requests relevant to ARS are ARS route requests and requests to enable and disable ARS sub-areas. Other types of panel request do not affect ARS operation.

The SSI data files define the functions performed on the identities by the interlocking processor. For each interlocking area, the following data files exist :

MAP	map data to allow a search to be carried out for an approaching train.
PFM	conditions for each set of points to be free to move.
IPT	data for processing information received in input telegrams from the trackside equipment.
PRR	data used to evaluate a panel request.
FOP	data used when carrying out regularly scheduled flag operations.
OPT	data used when preparing information to be transmitted in output telegrams to the trackside equipment.

Of these data files, the most relevant to ARS are the PFM and PRR files as these include data which forms part of the ARS route availability conditions.

The PFM file contains two data entries for each set of points within the area. For points Pnnn these are :

*PnnnN tests \

*PnnnR tests \

which define the conditions for the points to be free to move to the normal position, and for the points to be free to move to the reverse position.

Normally the conditions will be that all track circuit over the points are clear and all subroutes over the points in the opposite direction are free. However the conditions may be more complex if there are swinging overlaps, flank protection or fouling point protection.

It will be seen in section 4 that the PFM file format is very similar to that of the ARS points free to move detail file. Providing that the tests are all included in the subset of SSI tests recognised by ARS, and that there are no “or” conditions, then the data is identical.

The PRR file contains one data entry for each panel request available in the interlocking. For panel request Qnnn this takes one of two forms, depending whether the request is conditional or unconditional.

*Qnnn commands .

*Qnnn if tests then commands \ .

In the case of an route request the conditional form is almost always used. The tests include :

- a test that the technician has not barred the route. In SSI terminology this is known as a test for “route available”, but this is not at all the same thing as the route available state in ARS.
- tests that all points along the route are controlled in the correct direction or free to move to that direction.
- where there are opposing routes over the the same lie of the points, tests that opposing subroutes are free.
- tests that no possession or isolation reminders have been applied to the entry signal or to the exit signal.

For an ARS route request there is an additional test that all ARS sub-areas which contain the route are on. Otherwise the tests are the same as for the corresponding manual route.

The commands include :

- set the route.
- lock all subroutes along the route.
- control all points along the route to the correct position.
- clear the entry signal button pulled bit.

The commands for an ARS route request are identical to those for the corresponding manual route.

Because of the similarity in the entries for ARS and manual route requests, the recommended form of the PRR data makes use of the SSI “carry-out-tests/commands-at” structure @. e.g.

*QRnnn@Rnnn .	/ manual request
*QARnnn if sub-area tests then @Rnnn \ .	/ ARS request
*Rnnn if tests then commands \ \	/ common tests
	/ and commands

Each route's entry in the ARS route availability detail file, described in section 4, is obtained by taking the common tests from the SSI PRR data entry, removing the test for route barred by technician (which is handled implicitly by ARS) and then adding additional ARS tests. In order to prevent oversetting of the route by ARS, tests for track circuits in route clear should be added. Note that these tests will usually match up with the subroute lock commands in the PRR file command list.

The remaining SSI data files are of less significance to ARS data. However the SSI data defines completely the behaviour of the interlocking, and therefore certain other data items could be obtained from them although they are more readily obtained elsewhere. This is explained in the appropriate places in section 6.

3.3 SIGNALLING CONTROL TABLES

Signalling control tables are the means by which the signal engineer defines the functions the interlocking is required to perform. The practice is to produce these tables first and then produce the SSI data from them.

A discussion of control tables is given in “Railway Signalling” by O S Nock.

The control tables define the routes which are provided in the interlocking area. The exit signal for each route is defined. Where there is more than one class of route (main, warning, calling-on) between the same entry and exit signals then each route is shown.

The control tables include signal aspect control information for both controlled and automatic signals. Occasionally where standard signalling would not provide adequate braking distance for all trains (perhaps because the line speed has been increased since the signal siting was arranged) then non-standard aspect controls are required e.g. signal shows double yellow when next signal shows double yellow.

The control tables also include information about the conditions needed for release of a signal overlap.

Where ARS data preparation is being performed by a team with no signal engineering experience, it is recommended that the Signal Engineer should extract the route, aspect and overlap information from the control tables and supply it in a simple tabular form.

3.4 TRAIN DESCRIBER BLOCK SCHEMATIC

The train describer block schematic shows, in diagrammatic form, the berths contained within the area and the steps which occur between them. Because the schematic retains the geometry of the track layout, and in most cases the berth names are equivalent to main signal numbers, the schematic may be easily compared with the signalling scheme plan to determine where all of the berths are situated.

The train describer block schematic is produced by the Signal Engineer when a conventional train describer system is to be installed. In the case of an IECC, where the train describer function is performed by the DIS/SDS system, it is strongly recommended that an equivalent document should be produced.

Any berths with dual addresses may be easily determined from the schematic, as may any ripple or shuttle steps.

3.5 TRAIN DESCRIBER STEPPING TABLES

The train describer stepping tables complement the block schematic. They define all of the steps performed by the train describer and the conditions which trigger each step.

Various formats have been used. Section 14 of specification BR 800 describes a recommended format for train describer data. Please refer to the DIS/SDS data preparation user guide for a description of stepping data within DIS/SDS.

The stepping tables may be used to confirm those steps which are controlled (triggered by the occupation of a track circuit) and to interpret any unusual stepping controls.

3.6 ARS LOCATIONS AND TIMING RULES

This document serves as a specification of the timetable data which is set up by the Train Planning Offices on the national Train Service Database and which is then supplied via the IECC Timetable Processor to ARS. It consists of 3 main sections :

- location TIPLOC codes.
- timing rules.
- coding rules.

A location is a place where trains may be timed, which includes all stations and also important junctions. The timetable data received by ARS from the Timetable Processor associates each timing with a location code known as a TIPLOC code. This code may contain up to 7 characters and is an abbreviated form of the location name which is usually recognisable if not pronounceable.

The timing rules will define :

- that all trains which stop at a location will be timed there.
- which trains which pass each station will be timed there.
- which trains which pass each junction will be timed there.

The coding rules will define :

- the platform codes to be used at each station. Usually if any trains are given a platform code then all trains will be, although non-stop trains may not be.
- the path and line codes to be used at each location. At some locations a path and/or a line may be specified for all trains. At other locations path and/or line may only be specified for certain trains e.g. those which change line at that location.

The recommended structure of the ARS Locations and Timing Rules document is explained in the ARS Guide to Specification of Timing Rules.

Even though some of the information contained is available elsewhere e.g. in the national TIPLOC code list or the DoO standard line codes document, it is considered essential that the ARS Locations and Timing Rules document is produced and maintained. It is essential that the Train Planning Offices, the Signal Engineer and the Timetable Processor users are all working to a common set of rules. This document provides a convenient way of summarising those rules relevant to ARS and hence of identifying any changes which are relevant to ARS.

It should be noted that changes will occur from time to time e.g. TIPLOC codes may change as stations are renamed because of business considerations. Each such change will require an ARS data update. If changes to the locations and timing rules are made without an ARS data update then, quite simply, ARS will not work with the new timetable. This problem has already occurred twice.

3.7 ARS OPERATING SPECIFICATION

This heading covers various information on the operating requirements for ARS in the given area which should be discussed and agreed with representatives of those concerned i.e. the Zone Operating Manager and the Area Operations Manager.

For some schemes, the term “ARS operating parameters” has been used for this information.

The recommended structure of the ARS Operating Specification is explained in the ARS Guide to Specification of Operating Requirements. This will consist of a number of tables which will contain information required for data preparation. In some cases it may also contain a specification of area-dependent requirements which cannot be met simply by data preparation and therefore require area-specific code to be developed. Such developments are not part of the ARS data preparation activity with the exception of logical condition data for route-changing strategies involving route reminders on the alternative path (see section 6.2.19).

As part of their Data Preparation Questionnaire DPR/DQ/3, Sema have designed standard forms for the specification of the operating data tables. Since these forms reflect the structure recommended in the Guide they are useful but not essential.

3.8 BOUNDARY INFORMATION

The area of railway over which ARS sets selected routes and performs its monitoring functions is known as the ARS control area. However, in order to do this, ARS requires information from a larger area commonly known as the ARS Data Collection area. The factors affecting the extent of the Data Collection Area are discussed in section 10.2. In general the Data Collection area will include the strike-in berths, strike-out berths and outgoing boundary diverging junctions which are specified in the ARS Operating Specification.

The Data Collection area may well include adjacent junctions or other railway areas which are not covered by the other source documents such as the signalling scheme plan and the Train Descriptor Block Schematic. In this case additional information on these boundary areas is required.

The minimum level of information would consist of :

- a clear sketch of the track layout, showing signal positions. Distances between signals should be shown, as should distances between this area and a fixed point within the ARS control area and on the main signalling plan.

Platform numbers or line names should also be shown.

- an extract from the Train Descriptor Block Schematic, showing those steps which occur within the boundary area which will be made available to ARS.

4 ARS Data Formats

4.1 ARS INPUT FILE SCHEME

The ARS Input Files, i.e. the ARS data files which are the input to the ARS Data Preparation Program, are made up of three classes of file.

The first class is SSI identity files. For each interlocking in the ARS area, the following SSI identity files are also used as ARS input files :

- SIG signals
- PTS points
- ROU routes
- TCS track circuits
- FLG flags (includes subroutes, suboverlaps and latches)
- QST panel requests.

The second class is SSI-like files. These files contain data used by ARS to maintain its model of route availability. For each interlocking in the ARS area, the following SSI-like files are used :

- DPM points free to move
- DRA route availability
- DLC logical conditions.

It will be seen that for some interlockings either or both of the DPM and DLC files may be empty. For example, on the Waterloo ARS implementation a route available latch is provided in the interlocking and so neither DPM nor DLC is required.

The third class is ARS detail files. These files contain data for the whole of the ARS area. There is one detail file of each of the following types :

- DSIG signal detail
- DRTE route detail
- DRLS release detail
- DTCT track circuit detail
- DFLG flag detail
- DBER berth detail
- DSTP TD stepping detail
- DLOC location detail

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- DINS key location insertion rules
- DRLE key location line/path rules
- DSEG inter-location path segment detail
- DPER timetable period detail
- DMIS miscellaneous detail
- DLNK link detail.

4.2 SSI IDENTITY FILES

The SSI identity files are defined and discussed in the SSI interlocking data preparation guide RT/SSI/8003. This section summarises the relevant details. A more formal definition is given in section 11. Some examples are given in section 9.

Each identity file consists of a list of the identity names of the identities of that type contained in the interlocking. Each identity name consists of a sequence of printable characters, subject to certain restrictions explained below.

Blank lines may be used to increase the readability of the data.

The / character at the start of a line indicates that the whole line up to and including the new-line character is a comment. The / character elsewhere on a line immediately after a space character indicates that the remainder of the line up to and including the new-line character is a comment.

The remaining lines each contain one or more identity names. Successive names on the same line are separated by 1 or more spaces or commas, so therefore the names cannot contain embedded spaces or commas. The carriage-return character is also considered as a separator, so names cannot be split over 2 or more lines.

SSI imposes the following restrictions on the SSI identity names :

- (a) The first character of the name must be as follows :

S	signals
P	points
R	routes
T	track circuits
U	subroutes
O	suboverlaps
L	latches
Q	panel requests.

- (b) Names of points, signals and track circuits can be up to 10 characters long. Other names can be up to 20 characters long. All characters within the name are significant to the SSI data compiler.
- (c) (Comma (,) and embedded space are not allowed in names.

Further restrictions are imposed by ARS.

- (d) Except for panel requests, only the first 8 characters of the names are significant to ARS. If longer names are used then the additional characters will be discarded. Thus

for example 2 route names differing in the ninth character only would not be distinguished by ARS and an error would be reported by the data preparation program.

- (e) In the case of panel requests 10 characters are significant to ARS. Panel request names should be derived from the corresponding route or latch name in the following way :
- ARS route request for route Rxxx is QARxxx.
 - Enable request for sub-area with status latch LARSxS is QARSxP.
 - Disable request for sub-area is QXARSxP.
- (f) Semi-colon (;) full-stop (.) back-slash (\) equals (=) and star(*) are not allowed in names. An error would be reported by the data preparation program if these characters were found in a name.
- (g) Open-bracket (()) and close-bracket ()) are allowed in names but must be matched. The matching may occur anywhere in the name and not necessarily in the ARS-significant part. For example, QAR593(3M/4S) is allowed although the ARS-significant part of the name is QAR593(3M/ .

It should be noted that other IECC subsystems also impose restrictions on names. For example, DIS/SDS does not allow any brackets in names. Therefore, as described in section 2, it is now usual for IECC subsystems to use different identifiers from those used in the SSI identity files. Therefore a translation from SSI to IECC identifiers is required as part of ARS data preparation. This may be done manually or else by means of an “aliasing” utility.

4.3 SSI-LIKE FILES

The SSI data files are defined and discussed in the SSI Interlocking Data Preparation Guide RT/SSI/8003. The SSI-like files used in ARS take a similar form, but only a subset of the full SSI language is allowed. This section summarises the relevant details. A more formal definition is given in section 11. Examples are given in section 9.

Blank lines and comment lines are used as described in section 4.2.

The remainder of each file consists of a list of entries each representing a condition. Each entry consists of a condition name, a list of tests and a terminator character \.

The DPM file contains two entries for each set of points within the area. For points Pnnn these entries have condition names *PnnnN and *PnnnR and they define the conditions for the points to be free to move to the normal position, and for the points to be free to move to the reverse position.

The DRA file contains one entry for each route allocated to ARS operation in the area. For route Rnnn this entry has condition name *Rnnn and it defines the conditions for the route to be considered available for ARS to set it.

In both the DPM and DRA files, the tests in the test list are combined by means of the AND operator which is represented by comma (,) . Where SSI data shows tests combined by means of the OR operator, it is necessary to explicitly define these using ARS logical conditions.

The DLC file contains one entry for each logical condition required. Each logical condition has a name commencing with a C and the corresponding entry in the DLC file has name

commencing *C. Each logical condition is either an AND condition, with tests combined by means of the AND operator (.), or else an OR condition, with tests combined by means of the OR operator which is represented by bar (|). Conditions involving both types of operator are not allowed : where such conditions arise they must be split into appropriate component conditions.

Logical conditions may also be necessary when the SSI data uses test qualifiers not implemented in ARS, e.g.

/ condition for Pnnn cdn (points controlled and detected N)

*CPnnnnCDN Pnnn cn , Pnnn dn \

Each test in the test list consists of an SSI identity name and a test qualifier, separated by one or more spaces.

The tests implemented in ARS are :

Tnnn o	/Track circuit occupied
Tnnn c	/Track circuit clear
Rnnn s	/Route set
Rnnn xs	/Route not set
Unnn l	/Subroute locked
Unnn f	/Subroute free
Onnn l	/Suboverlap locked
Onnn f	/Suboverlap free
Lnnn s	/Latch set
Lnnn xs	/Latch not set
Cnnn t	/ARS logical condition true
Cnnn f	/ARS logical condition false
Pnnn cn	/Points controlled N
Pnnn xcn	/Points not controlled N
Pnnn cr	/Points controlled R
Pnnn xcr	/Points not controlled R
Pnnn dn	/Points detected N
Pnnn xdn	/Points not detected N
Pnnn dr	/Points detected R
Pnnn xdr	/Points not detected R
Pnnn cnf	/Points controlled N or free to go N
Pnnn cfn	/
Pnnn xcfn	/Points not controlled N nor free to go N
Pnnn xcfn	/

Pnnn crf	/ Points controlled R or free to go R
Pnnn cfr	/
Pnnn xcrf	/ Points not controlled R nor free to go R
Pnnn xcfr	/

The logical condition tests may be used anywhere in the DRA and DPM files. However, in the DLC files, a logical condition test may only be used in the same interlocking file as that where the logical condition is defined, and the definition must come before the test.

4.4 ARS DETAIL FILES

The ARS detail files make use of a simple but flexible language as described below. A more formal definition is given in section 11. Examples are given in section 9.

Blank lines and comment lines are used as described in section 4.2 above.

The remainder of each file consists of a list of entries where each entry defines the data relating to one ARS object.

Each entry consists of an object name and a list of data items. The object name is separated from the list by at least one space, the data items are separated by semi-colon(;) and the entry is terminated by full-stop(.). If there are no data items associated with the object then the full-stop may immediately follow the object name.

Each data item is of the form keyword = keyword-data .

There are 4 types of keyword :

- single-value keyword. In this case keyword-data is a single value which may be a whole number, a name or an alphanumeric code.
- repeated-value keyword. In this case keyword-data is a list of single values separated by comma(.). If there are no values applying to the keyword then the list is empty and the data item is of the form keyword =
- group keyword. In this case keyword-data is a group which consists of a list of data items, separated by semi-colon (;). The group is enclosed in brackets. The data items within the group are of the form subkeyword = subkeyword-data. Subkeywords may themselves be single-value or repeated-value but may not be group or compound i.e. only one level of brackets is allowed.
- compound keyword. In this case keyword-data is a list of groups of values separated by comma(.). If there are no groups of values applying to the keyword then the list is empty.

The keywords and subkeywords used in the various detail files are described in section 6. It should be noted that in each detail file certain keywords are classed as mandatory and the data preparation program will report an error if any entry does not contain that keyword. Other keywords are optional and if any entry does not contain an optional keyword then a default value will be supplied by the data preparation program. Default values are specified in section 6.

Detail files DSTP, DINS, DRLE, DSEG, DPER and DMIS contain entries which do not directly correspond to the ARS data objects defined in section 5. In this case each entry starts with a pseudo-object name which is not used in ARS, but is useful for reference purposes during data preparation.

These pseudo-object names must have the following first characters :

- DSTP J
- DINS I
- DRLE K
- DSEG P
- DPER W
- DMIS M

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5 ARS Data Objects

Much of the fixed data within ARS consists of data items which are associated with the ARS data objects. These objects include signalling objects such as routes, TD objects such as berths and timetable objects such as locations.

An attempt has been made to achieve some compatibility between ARS and the systems to which it is connected. Thus, ARS signalling objects are similar to SSI objects, ARS berth objects are similar to TD berths and ARS locations are similar to Train Service DataBase (TSDB) locations. This section briefly describes each type of object, explains any differences in its use by ARS and discusses how the objects of that type which are relevant to a particular ARS implementation may be determined.

The area of railway over which ARS sets selected routes and performs its monitoring functions is known as the ARS Control Area. However, in order to do this, ARS requires information from a larger area commonly known as the ARS Data Collection Area. Some guidelines for determining the objects required in the Data Collection area are given in this section. A fuller discussion together with examples is given in section 10.2.

5.1 SIGNALS

Within an SSI signal identities are assigned to each of the following signal types :

- controlled main signal. This signal is capable of displaying a red aspect and one or more of the proceed aspects yellow, double yellow and green. A proceed aspect is only displayed when a route is set from the signal.
- shunting signal. This signal is capable of displaying a red aspect or a clear aspect. The clear aspect is only displayed when a route is set from the signal.
- automatic signal. This is a signal capable of displaying a red aspect and one or more of the proceed aspects yellow, double yellow and green. There are no SSI routes from the signal and the aspect displayed will be red if the section to the signal in advance is occupied or a proceed aspect depending on the aspect of the signal in advance if the section is clear. The signal may be restored to red by means of a lineside occupation switch or by the signaller's emergency replacement button. Prior to 1990, emergency replacement buttons were not provided for all automatic signals, although this has now become standard practice.
- semi-automatic signal. This is similar to an automatic signal but may additionally be restored and held at red whilst a ground frame in the section is released.
- repeater signal (also known as distant signal). This signal is not capable of displaying a red aspect. The aspect which is displayed depends on the aspect of the signal in advance.

SSI identities are not assigned to :

- subsidiary signal. This is similar to a shunting signal but is fixed below a controlled main signal and shares its identity.
- banner repeater. This signal repeats the aspect of a main signal which has an inadequate sighting distance. However, an SSI identity is assigned to a fibre-optic type banner repeater, as described in the SSI Data Preparation Guide.

Within one SSI interlocking, fringe signals just outside the interlocking area which affect the aspect sequencing of signals in the interlocking area are also given identities which thus may duplicate their identities in the adjacent interlocking.

In the case of a searchlight signal, a conventional signal identity and two special identities are defined. The lamp proved and aspect code bits in the signal memories allocated to those extra identities are used to show the current detected aspect of the signal and the aspect code to be used for sequencing to the signal in rear. See SSI Data Preparation Guide for more details.

ARS signal objects are the controlled main, shunting, automatic and semi-automatic signals within the ARS Data Collection Area.

No information on repeater signals or on banner repeater signals of any type is required by ARS, so these signals are not considered as ARS objects.

Signal identities provided for fringe function purposes are not usually considered as ARS objects.

The extra identities associated with searchlight signals are not considered as ARS objects.

In addition ARS signals include certain signals which are not SSI signals :

- in areas where Route Relay Interlocking is used instead of SSI, the aspect control of automatic signals is done as a lineside function and not as a function of the central interlocking, and therefore aspect information is not available for these signals. Such signals should be shown as AUT = T in the signal detail file.
- where routes outside the ARS control area are required as ARS route objects (as explained below in section 5.3), then each route must have an entry signal as an ARS object. In most cases aspect information will not be available for these signals as they may be controlled from an adjacent interlocking. Such signals should also be shown as AUT = T in the signal detail file.
- where there are routes into terminal station platforms, or into sidings, then there may be no route exit signal within the SSI signals. However, if a berth is provided for the platform or siding and a TD step to that berth is provided for trains entering the platform or siding, then an ARS signal object must be provided for the route exit signal. This enables ARS to correlate the route with the berth. (for such signals the data items described in section 6.1 should be set as follows: AUT=T, TCN, BER and DIR as usual, ASP is meaningless and any valid value may be used.)
- dummy fixed red signals, used internally by ARS, typically for through sidings in order to prevent further routesetting for the train by ARS until the train description has passed the signal.

An entry in the signal detail file should be provided for each ARS signal object. Such entries do not require a SAW field (as described in 6.1.9). If a SAW field is included, its value should be 0 as SPAD monitoring cannot be carried out at these signals.

5.2 POINTS

Within an SSI points identities are assigned to all sets of points within the area, including trap points, which are controlled from the signalling centre. Identities are not assigned to points worked by ground frames.

ARS points objects are the SSI points within the ARS control area. Specifically, they are those points for which points tests are specified in the route availability DRA and logical condition DLC files. For each such set of points, the points free to move file DPM should contain a free to go normal condition and a free to go reverse condition.

All points data relevant to ARS is included in the SSI-like files so there is no separate points detail file.

5.3 ROUTES

Within an SSI route identities are assigned to all signalled routes within the area. (In this document, a signalled route is also referred to as a controlled route and is defined as a route from a controlled main signal or shunting signal).

There are four classes of signalled route :

- main route, between 2 main signals where a full overlap in advance of the exit signal is provided.
- warning route, between 2 main signals where a reduced overlap or no overlap is provided.
- calling-on route, between 2 main signals where a track circuit in the section is already occupied. A subsidiary signal is cleared in this case.
- shunting route, from a shunting signal.

Main, calling-on and shunting routes also include routes into terminal station platforms.

Where there is a main route and also a warning route or calling-on route or both between the same pair of signals then a separate route identity is assigned to each class of route. Similarly, where there are alternative routes of the same class via different points and crossovers, separate route identities are used. However, alternative overlaps do not require separate route identities.

In certain circumstances it is necessary to define routes which pass by one or more intermediate shunting signals between the main entrance and exit signals. In this case the intermediate signals are operated in a special manner known as preset mode. This requires an additional preset route identity to be provided for each route which requires an intermediate signal to be preset. Full details of this are given in the SSI Data Preparation Guide.

A route identity is also assigned to each ground frame release.

ARS route objects include all of the SSI routes in the ARS Control Area except for the preset shunt routes and the ground frame releases.

ARS route objects also include “automatic routes” where an automatic route is defined as leading from an automatic signal or semi-automatic signal to the signal in advance. These routes are shown as AUT = T in the route detail file.

There will be additional routes required within the ARS Data Collection area on the approaches to the ARS Control area. Routes will be required from the location prior to the ARS “strike-in” berth on the particular line. If interlocking information is not available for these routes then they should be shown as $AUT = T$. If these routes are actually controlled routes over a junction then no exit signal should be specified in the route detail file in order to prevent incorrect chaining in ARS. See section 10.2 for further explanation of this.

An entry in the route detail file should be provided for each ARS route object.

An entry in the route availability file DRA should be provided for each route allocated to ARS operation ($ALO = T$).

5.4 RELEASES

Within SSI releases are considered as routes, as described in section 5.3.

ARS release objects are therefore those SSI route objects which correspond to releases within the ARS control area.

Specifically, they are those releases for which route tests are specified in the points free to move DPM, route availability DRA and logical condition DLC files.

Similarly, any additional preset route identities, for which route tests are specified in the DPM, DRA or DLC files, are classed as ARS release objects.

An entry in the release detail file should be provided for each release object.

5.5 TRACK CIRCUITS

Within SSI track circuit identities are assigned to all track circuits within the area that are displayed to the signaller. In some cases a track circuit displayed to the signaller is split into a number of sections for various purposes in the SSI interlocking processor e.g. signal approach locking, or where there is a long track circuit which has to be split into sections because of the physical limitation of the track circuit equipment. In these cases additional track circuit identities are assigned to each track circuit section which requires independent consideration.

Track circuit identities are also assigned to track circuits in adjacent interlockings which are required to be considered in this interlocking for purposes such as signal aspect sequencing, signal approach locking etc.

ARS track circuit objects are in general those track circuits within the ARS control area that are displayed to the signaller.

Split track circuits are not required unless track circuit tests are specified for them in the SSI-like files. Even in this case, however, track circuit monitoring data should only be prepared for split track circuits if they are separately displayed to the signaller. Fringe track circuits are not required.

Most of the track circuit data required by ARS is specified within the SSI-like files and within the detail files corresponding to other ARS objects. The track circuit detail file is only used to provide data for the track and SPAD circuit monitoring functions. If both of these functions are not required then the file is empty. Otherwise an entry should be provided for each track circuit for which monitoring is required. There are SPAD monitoring only data items that can be

used in the track circuit detail file where SPAD monitoring is required but regular track circuit monitoring is not.

5.6 SUBROUTES

Within an SSI, subroute identities are assigned to each signalled path across a track circuit in a signalled route. Subroutes are not defined for sections of track such as automatic sections where no signalled routes have been allocated.

There is a naming convention for subroutes, which is fully explained in the SSI Data Preparation Guide. Basically, for a track circuit named Txxx, each end of the track circuit is allocated a letter, starting from the 12 o'clock position on the signalling plan and proceeding clockwise. The subroute is then defined by the letters corresponding to the entry and exit points e.g. UxxxCA would be the subroute from the C end to the A end.

ARS subroute objects are those SSI subroutes in the ARS control area.

Specifically, they are those subroutes which either :

- have subroute tests specified in the points free to move DPM, route availability DRA and logical condition DLC files.
- are specified for track circuit monitoring purposes in the track circuit detail file.

Therefore, for implementations such as Waterloo where the route availability conditions do not involve subroutes and where track circuit monitoring is not required, no subroute objects are required.

All subroute data relevant to ARS is included in the SSI-like files and the track circuit detail file so no entries in the flag detail file need to be made for subroutes.

5.7 SUBOVERLAPS

Within an SSI, suboverlap identities are assigned to each signalled path across a track circuit which forms part of the overlap of a signalled route.

ARS suboverlap objects are those SSI suboverlaps in the ARS control area.

Specifically, they are those suboverlaps which have suboverlap tests specified in the points free to move DPM, route availability DRA and logical condition DLC files or which are specified in the DSIG file SOL data.

All suboverlap data relevant to ARS is included in the SSI-like files or the signal detail file, so no entries in the flag detail file need to be made for suboverlaps.

5.8 LATCHES

Within an SSI latches are used for miscellaneous purposes. Those latches representing TRTS, signal E buttons, ARS sub-areas and rings are handled separately by ARS as described below. In an RRI interface processor, latches may also be used to give the status of remote links, as described below.

An ARS latch object is an SSI latch which does not fall into one of these separately handled categories but which is required for determining route availability i.e. a latch test is specified in the points free to move DPM, route availability DRA and logical condition DLC files.

All latch data relevant to ARS is included in the SSI-like files, so no entries in the flag detail file need to be made for latches, but an entry may optionally be made using the LAT keyword to confirm that the latch is required in ARS.

5.9 TRTS (TRAIN READY TO START)

An ARS TRTS object is an SSI latch which represents a TRTS indication within the ARS control area.

An entry in the flag detail file is required for each TRTS to define the corresponding signal.

5.10 E BUTTON (AUTOMATIC SIGNAL EMERGENCY REPLACEMENT BUTTON)

An ARS E button object is an SSI latch which represents a signal emergency replacement button for an automatic signal which is an ARS signal object.

ARS only requires a latch if signal aspect information for the signal is not available from the interlocking. Automatic signals fully under SSI control, as described in the SSI Data Preparation Guide, should have signal aspect information and so no latch is required. Automatic signals partially under SSI control, or in RRI areas, may require a latch.

An entry in the flag detail file is required for each such E button to define the corresponding signal.

5.11 ARS SUBAREA

The ARS control area is divided up into a number of ARS sub- areas which may be switched on or off independently by the signaller. Each ARS route is contained in one or more ARS sub-areas and ARS may only set that route when all of the ARS sub- areas containing it are on. This is checked both in ARS and in SSI.

When a route is cancelled by the signaller, ARS switches off the sub-areas containing the route in order not to set any further routes in the neighbourhood which may interfere with the signaller's handling of what may be an emergency. In order to provide this facility for all controlled routes, any non-ARS controlled routes should also be allocated to the ARS sub-areas.

Track circuits are allocated to ARS sub-areas for the purpose of determining whether track circuit monitoring alarms should be suppressed.

Within an SSI, three latch identities are required for each ARS sub-area, as described in the SSI Interlocking Data Preparation Guide. These are the key latch, processor latch and status latch.

An ARS sub-area object is associated with the SSI ARS sub-area status latch.

An entry in the flag detail file should be made for each ARS sub-area object. These entries include data that defines which subareas are adjacent, used when a SPAD alarm is raised and ARS is required to turn off adjacent subareas.

5.12 RINGS

Rings are not used in SSI interlockings, but are used where Route Relay Interlocking (RRI) interface processors are provided. They provide a way of resolving contention between manual and ARS route setting. The ARS control area is divided into a number of rings. When the signaller is setting route on a ring the ring status latch is set to indicate to ARS that it may not request another route on that ring.

An ARS ring object is a ring for which a status latch is provided in the interface processor.

An entry in the flag detail file should be made for each ring specifying the RGL keyword.

5.13 LINKS

Links include :

- direct links from ARS to other processors via the signalling or information networks. The other processors will include SSIs, DIS/SDSs, ISM, GWS and TTP. The link to the duplicate ARS unit is also considered as a direct link.
- private link to the ARS data logger.
- remote links. These are links between other processors where the link status is significant to ARS.

In the standard IECC, there is only one type of remote link, which is the link between DIS/SDS and SSI. ARS must not set route in any interlocking when the DIS/SDS link to that interlocking is down, because the signaller can neither see what ARS has done nor operate any signalling control (except all signals on). The ARS design no longer prevents ARS setting any route in the workstation area if any link from DIS/SDS to an SSI is down. This has been found to be too restrictive particularly during stageworks and the ARS design in this has been changed. When a link from DIS/SDS to an SSI is down, routesetting is only prevented in that particular SSI.

In the Wimbledon (WARS) ARS, there are two further types of remote link. The remote link from the Network Interface Processor (NIP) to the Train Describer (TD) is treated by ARS as a DIS/SDS remote link. The remote links from the Signalling Control Processor (SCP) to the Panel Processor, the SCP to the Remote Interlocking Control Processor and from the Panel Processor to the Remote Interlocking Indications Processor are each represented by a bit within the SCP memory, which is known as a remote link status latch.

If any of these remote links are down then ARS is prevented from setting any route in that interlocking. An entry in the flag detail file is required for each remote link status latch.

All direct, private and remote links are ARS link objects and each should have an entry in the link detail file.

5.14 BERTHS

A berth is a location where a train description may be displayed by the Train Descriptor and is normally associated with a signal. Each berth either contains a train description or else is empty.

Each berth has a 4 character name which is usually, but not always, numeric. Some Train Descriptors allow the use of an alternative berth name for a berth : this is used for example on bi-directional track where steps from the berth in one direction will generate step messages containing the normal berth name and steps in the other direction will generate step messages containing the alternative berth name.

Within ARS the 4 character name is prefixed by B.

ARS berth objects are those TD berths within the ARS Control Area. Alternative berth names are not considered as defining separate berth objects.

However copy berths, berths used solely for the generation of alarms by DIS/SDS, and berths used solely to provide an early transmission facility to adjacent signalboxes, should not be ARS berth objects.

Additional berths will be required within the ARS Data Collection area on the approaches to the ARS Control Area. This is because ARS does not consider trains as active until they have passed a strike-in point, which is defined in terms of a step between two berths. The following factors should be considered when determining how far in rear of the Control Area to set the ARS strike-in point :

- since ARS will not set route for a train until it is active, trains should not be running on restrictive aspects as they strike-in.
- since ARS will not make allowance in its regulation at junctions for trains until they are active, a longer run from the strike-in point should be allowed on faster or main lines to prevent ARS ignoring an approaching fast line train and setting route for a slower train on a slow or branch line which has struck-in.
- ARS will not make any allowance for connections unless the train which is waited for is active when the train which waits arrives at the location where it waits.
- ARS will not make any allowance for joining moves unless the train which joins is active when the train which it joins to arrives at the joining location.

See section 10.2 for further discussion of this. Note that the mandatory sequence feature of ARS is an exception to the general rule in that ARS will maintain mandatory sequences even when the first train is not active when the second train arrives at the sequence limiting berth.

Additional berths will also be required leading away from the ARS Control Area. Once the train has passed all of the ARS routes on its path, and no further monitoring of its progress by ARS is required, then it can be removed from the active trains list. This is done as the train passes a strike-out point which is again defined as a step between 2 berths. In order to allow for a missed step message, 2 berths could be provided on each line out of the ARS Control Area, but this is only recommended for installations such as Wimbledon (WARS) where the Train Descriptor covers a larger area than the ARS Control Area.

In order to obtain correct regulation over lines leading out of the ARS control area which are used by different train services, it is necessary for ARS to predict the movement of trains on

these lines as far as the next junction where the train sequence may be changed. As ARS predictions are always made on the basis of steps into berths, additional berths should be defined corresponding to these diverging junctions. Unlike the other berths discussed above, these berths are internal to ARS and no TD step messages are received concerning them. These berths are therefore known as dummy berths and should be shown as DUM = T in the berth detail file. See section 10.2 for further discussion of this.

An entry in the berth detail file should be provided for each ARS berth object (including, therefore, the ARS dummy berths).

An entry in the TD step detail file should be provided for each step between ARS berths i.e. excluding clearouts, copy steps, steps used for generation of alarms and steps used to provide early transmission to adjacent signalboxes. There will be no steps to or from ARS dummy berths.

Additional entries in the TD step detail file may be required for “geometrical steps”, which are discussed in section 6.7.5.

5.15 LOCATIONS

A Train Service DataBase (TSDB) location is a place where the trains may be timed by the Train Planning Office (TPO). Locations will include stations and important junctions.

(Note that the term “location” has a totally different meaning within the SSI documentation, where it relates to trackside SSI equipment.)

Each location has a 7 character name known as a TIPLOC code.

Additional locations may be introduced within the IECC Timetable Processor, e.g.

- sidings where ARS operation is required.
- limit-of-shunt or other places where trains reverse.
- places where trains may be held on the running line.

The additional locations also have 7 character names and these should be added to the ARS Locations and Timing rules document, if not already specified there.

An ARS location object is a location at which train timing information may be obtained from the Timetable Processor. ARS locations therefore include both the TSDB locations and the additional Timetable Processor locations.

ARS locations include :

- locations within the ARS Control area.
- locations within the ARS Data Collection area, from the location in rear of the strike-in point on each line to the location in advance of the strike-out point on each line.
- further locations specified in the ARS Locations and Timing rules discussed in section 3.7.
- a location corresponding to each dummy berth.

An entry in the location detail file should be provided for each ARS location.

Files DINS (key location insertion rules), DRLE (key location line/path rules) and DSEG (inter-location path segment detail) contain entries for pairs of locations. These files are discussed further in section 10.1.

5.16 TIMETABLE PERIODS

An ARS timetable period object is a period of the day for which a timetable file may be supplied from the Timetable Processor to ARS. The day is usually divided into 2 periods of 12 hours.

Originally ARS was designed to allow for more than 2 periods per day, but this is now not recommended because :

- use of 2 periods allows a full 24 hour timetable to be retained in ARS, which can be useful if the Timetable Processor fails on Tuesday-Friday.
- more than 2 periods could cause process scheduling problems within the Timetable Processor.

An entry in the timetable period detail file should be made for each timetable period, in order to define its start and end times etc.

6 ARS Data Items

6.1 SIGNAL DETAIL

6.1.1 ASP

Aspects Displayable.

type	single-value
range	1-7
default	4
description	<p>1 = 1 aspect displayable (dummy fixed red signal)</p> <p>2 = 2 aspects displayable</p> <p>3 = 3 aspects displayable</p> <p>4 = 4 aspects displayable</p> <p>5 = 4 aspects displayable, but double yellow is displayed when the signal in advance is displaying double yellow.</p> <p>6 = 4 aspects displayable, but double yellow is displayed when two signals in advance are displaying double yellow.</p> <p>7 = 4 aspects displayable, but double yellow is displayed when three signals in advance are displaying double yellow.</p>
source	signalling scheme plan. Signals for which value 5 or more applies may be determined from the signalling control tables, or else from the aspect sequence data for the signal in the SSI OPT data file.
effect	Used in the route requirement calculation to deduce aspects displayed by signals ahead and thus determine if the train has enough route set. ARS will consider setting further route if there is now only one green signal ahead of the train. Therefore, this data item can be used to implement a non-standard requirement e.g. 2 green signals, by specifying more aspects than actually exist!

6.1.2 TCN

Berth Track Circuit.

type	single-value
range	track circuit name or blank entry
default	mandatory
description	This item defines the track circuit occupied by the front of a train standing at the signal. In the case of sidings or other non-track circuited areas a blank entry is required.

source	signalling scheme plan.
effect	Used in the track circuit monitoring function. If the signal is clear at the time that the berth track circuit becomes occupied, then the signal is considered as clear-to-pass and no check is made on the aspect displayed at the time the next track circuit is occupied. This is because the signal red and track circuit occupied state changes may be received from SSI in either order. If a blank entry is specified, then the signal is considered as clear-to-pass at all times.

6.1.3 SOL

Suboverlaps.

type	repeated-value
range	suboverlap name
default	blank entry
description	This item defines any suboverlaps across the track circuit in advance of the signal which are specified in the SSI data and may be locked when a route is set to the signal. Where the signal overlap extends over more than one track circuit, then suboverlaps across these further track circuits may be specified in SSI but these are not required here.
source	signalling scheme plan and SSI FLG identity file.
effect	Used in regulation strategies to detect cases where a route which has been set for train A has locked an overlap and a route required for train B which conflicts with that route in its overlap is therefore not available for that reason.

6.1.4 RTB

Running time to berth track circuit.

type	single-value
range	0-1250 (seconds)
default	0
description	This item is required when there is a conflict in the overlap of the signal. It is the typical time taken between passing the previous signal and occupying the berth track circuit of this signal, for a train braking to a stop at this signal. It is intended that this should be derived by experience of likely driver behaviour, rather than by precise calculation using braking curves.
source	operating parameters
effect	Used in regulation strategies predictions, together with ORT (section 6.1.5), to estimate when the signal overlap will be released.

6.1.5 **ORT**

Overlap release time.

type	single-value
range	0-1250 (seconds)
default	0
description	This item is required when there is a conflict in the overlap of the signal. It is the time between occupation of the berth track circuit and release of the overlap when the train is stopped at the signal.
source	signalling control tables, or from the SSI FOP data file
effect	Used in regulation strategies predictions, together with RTB (section 6.1.4), to estimate when the signal overlap will be released.

6.1.6 **DIR**

Direction.

type	single-value
range	D = down U = up
default	mandatory
description	This item defines the direction of the trains to which the signal applies.
source	traditionally the two directions on a stretch of railway are known as down and up, and are shown as such on the signalling scheme plan. In many schemes the down signals will be given odd signal numbers and the up signals even signal numbers. At triangular junctions, or more complex layouts, a consistent scheme should be adopted with discontinuities only at junctions.
effect	This is part of the data defining the geometry of the area for the routes set for trains model. It enables the model to detect when a train has reversed direction.

6.1.7 **AUT**

Automatic signal in non-SSI area.

type	single-value
range	T = true F = false
default	F
description	This item is true when no information on the signal aspect is available to ARS from the interlocking. For areas controlled by SSI, aspect information is available for both controlled and automatic signals. AUT = T should be specified for automatic signals in Route

Relay Interlocking areas, or outside the ARS control area, as described in section 5.1. Experience has shown that care is needed with automatic signals on the approaches to SSI areas, as these signals may not have full SSI controls and so may require AUT = T also. See section 10.8. AUT = T is also required for any automatic signal which is approach controlled, or for which special controls apply when the signal in advance is red. AUT = T should also be specified when ASP = 1, i.e for a dummy fixed red signal.

source	<p>identify automatic signals in non-SSI areas on the signalling scheme plan.</p> <p>confirm automatic signals on approach to SSI area with the Signal Engineer.</p>
effect	<p>Where AUT = T and ASP = 1 are specified then ARS assumes that the signal aspect is red.</p> <p>Where AUT = T and ASP not equal to 1 are specified then ARS assumes that the signal aspect is not red, unless the signal has an associated emergency replacement button which has been operated. However, the “train has not stepped within expected time” alarm is not given for a train approaching the signal unless the berth in advance is empty.</p>

Note that ARS will not set route beyond any automatic signal which it sees as red.

6.1.8 BER

Berth.

type	single-value
range	berth name, or blank entry
default	mandatory
description	This item defines the berth occupied by a train standing at the signal. For signals in sidings or shunting signals where no berth is provided, a blank entry should be specified.
source	signalling scheme plan and TD block schematic. In most cases the berth name will correspond to the signal name e.g. S123 BER = B0123.
effect	This is part of the data defining the geometry of the area for the routes set for trains model. It enables the model to associate a route set from the signal with a train in the berth. Care should be taken at diverging junctions in the outgoing boundary. If route set information is not available, a blank entry may be preferable - see section 10.2.

6.1.9 SAW

SPAD Alarm Workstation.

type	single-value
range	0 = No monitoring at this signal 1 = Workstation 1 only 2 = Workstation 2 only 3 = Workstation 1 and 2 only 4 = Workstation 3 only 5 = Workstation 1 and 3 only 6 = Workstation 2 and 3 only 7 = Workstation 1, 2 and 3 only
default	0
description	This field determines which signalling workstation(s) will receive SPAD alarms generated by the ARS SPAD monitoring function. It also identifies which workstations have control and notification of SPAD alarm inhibitions at the signal. Absence of this field, or a value of 0 means that the signal is excluded from SPAD monitoring.
source	DIS screen layouts, operating parameters.
effect	When a SPAD alarm is generated, up to three of the signals at which that alarm may have occurred will have this field checked and all of the workstations for those signals will receive the alarm. Similarly, when a SPAD inhibition is applied or removed (including group removal, SRI) the field is checked and all workstations listed for the signal will be informed. Blank data for a signal indicates that no SPAD are received alarms or inhibitions applied at that signal.

6.2 ROUTE DETAIL

Note that the last route in the route detail (DRTE) file must not be an ARS-settable route with an overlap. A solution is to ensure that the last route is a dummy route.

6.2.1 ENT

Entry signal.

type	single-value
range	signal name
default	mandatory entry
description	Entry signal
source	in most cases the entry signal name will correspond to the route name e.g. R123A ENT = S123. If for some reason no correspondence

with a signal name can be found, the entry signal can also be determined from the signalling control tables or from the SSI PRR data file, by identifying the Snnn clear bpull command in the route request data.

effect This data provides a link between the signal-based and route-based data in many places within ARS. For example, cancellation of a route is derived from the entry signal bpull bit becoming set.

6.2.2 EXT

Exit signal.

type single-value

range signal name or blank entry

default mandatory entry

description Exit signal For routes leading to sidings or to terminal platforms where there is no SSI exit signal, an ARS signal object may be used as described in section 5.1. For routes where there is neither an SSI exit signal nor an ARS exit signal, a blank entry should be specified.

source in many cases where the route names are allocated systematically e.g. with the suffices applying clockwise then exit signal can be determined from the signalling plan. In complex areas this should be confirmed from the signalling control tables. Sometimes the control tables show the exit button rather than the true exit signal e.g. for a route leading to a siding then the exit button may correspond to the signal which is the entry signal for routes out of that siding. In this case, a dummy signal corresponding to the exit button should be included in the ARS data. Exit signal can also be determined from the SSI OPT data file by identifying the Snnn set lp test in the output telegram data for the entry signal.

effect This is part of the data defining the geometry of the area for the routes set for trains model. It enables the model to link this route with the berth(s) associated with the exit signal.

6.2.3 ALO

Allocated to ARS flag.

type single-value

range T = true

F = false

default T

description This item defines whether the route is allocated to ARS operation or not.

source operating parameters

effect When the routesetting function detects that the next route to be set for the train is not allocated to ARS operation, no further action need be taken at that time.

Note that ARS operation cannot be achieved unless an ARS panel request is declared in the SSI QST identity file and defined in the PRR data file. When AUT = T is specified (section 6.2.16) then ALO = F must also be specified.

6.2.4 XEM

Route proving exemption flag.

type single-value

range T = true

F = false

default F

description Within ARS the route is defined as proved when both the route set bit and the entry signal aspect control bit in SSI are set. The conditions for setting the aspect control bit are defined by data within the SSI OPT data file. They usually include all points in the route detected, all track circuits in the route clear and the exit signal lamp proved. In this case the route should become proved following an ARS route request. However, for certain routes there may be additional conditions specified such as next route set. These additional conditions will not usually be met following an ARS route request. XEM = T should be specified for such routes. Complications which can arise on the approaches to an SSI area are discussed in section 10.8.

source ARS Operating Specification. The additional conditions are most likely to occur for shunting routes and perhaps routes over level crossings.

effect If route proving is not exempted then following an ARS route request ARS will output a signaller alarm if the route does not become proved within 30 seconds of becoming set provided no track circuit in the route overlap is occupied. ARS will not attempt to set further route for a train if any route ahead of the train is set but not proved and not exempted from route proving.

6.2.5 TYP

Route class.

type single-value

range M = main route
W = warning route
C = calling-on route
S = shunting route

default M

description	See section 5.3 for description of route classes.
source	main signals and shunting signals can be distinguished on the signalling scheme plan. Usually different ranges are used for the main signal numbers and shunting signal numbers. Warning routes and calling-on routes are usually identifiable by the presence of W or C in the route name suffix. Where this is not possible the route class could be obtained from the signalling control tables, or else deduced from the tests and commands specified for the route's request in the SSI PRR data file.
effect	Route class data is required by the routes set for trains model, so that it can deal with those situations where a route is "stepped up" to a route of higher class (described in the SSI Data Preparation Guide). ARS routechanging strategy will select the warning route when the overlap for the main route is not available or another train has priority there. ARS routechanging strategy will select the calling-on route into a platform where there is a planned joining move and one of the joining portions is already in the platform.

6.2.6 SBA

ARS subarea.

type	repeated-value
range	ARS subarea name
default	mandatory
description	This data item defines the ARS subareas which contain the route. Each route which is allocated to ARS (ALO = T, section 6.2.3) must be contained in at least one ARS subarea. Other controlled routes (ALO = F, AUT = F) may be allocated to ARS subareas. Automatic routes (AUT = T) should not be allocated to ARS subareas.
source	operating parameter.
effect	ARS will not request a route when any sub-area containing that route is switched off. When a route is cancelled by the signaller, ARS switches off the subareas containing the route in order not to set any further routes in the neighbourhood which may interfere with the signaller's handling of what may be an emergency. Non-ARS routes may therefore be allocated to ARS subareas in order to provide this facility. The allocation of routes to ARS subareas provides flexibility of operation of the system. It should be kept in mind that the signaller may switch a subarea off in order to perform some unusual regulation at a junction. It has been agreed that there is no need to switch off ARS sub-areas because of a signalling equipment failure, provided that signals can be maintained at red where necessary by means of signal reminder appliances.

Note that SSI also checks subarea statuses on receipt of an ARS route request, so this data is also present in the SSI PRR data file.

6.2.7 RNG

Ring.

type	single-value
range	ring latch name, or blank entry
default	blank entry
description	See section 5.12
source	Rings are not used in SSI interlockings. Rings are used in Route Relay Interlocking interface processors as follows : <ul style="list-style-type: none"> • to avoid RRI processing 2 route requests at once. • to ensure a gap of 1.5 seconds between successive route requests, as agreed by IECC Design & Engineering Group 6/5/87. These rings will be found in the RRI flag identity file.

For Wimbledon (WARS), ring allocation diagrams were originally produced by SCUK Croydon.

effect	ARS will not request a route on a ring when the ring latch indicates that the signaller is using the ring. Once ARS has requested one route on the ring, it will not request a further route on that ring until the first route has set or a 15 second timeout has expired.
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6.2.8 TCR

Track circuits in route.

type	repeated-value
range	track circuit name
default	mandatory
description	This item lists, in order, the track circuits in the route. The list will exclude the berth track circuit for the entry signal (TCN section 6.1.2) but will include the berth track circuit for the exit signal (ibid), even when the route is of the calling-on class.
source	signalling scheme plan
effect	This data is used by the Data Preparation Program to construct a table of conflicting routes, which is then used by ARS to determine whether there is a conflict between a route on the path of train A and a route on the path of train B. This data is also used directly within ARS to evaluate the extent of reverse working stretches.

6.2.9 TCO

Track circuits in route overlap.

type	repeated-value
range	track circuit name

default	mandatory
description	This item lists, in order, the track circuits in the route overlap. For routes where there are alternative overlaps, the overlap which conflicts with the fewest other routes should be selected. For routes with no separate overlap track circuit, including calling-on routes, a blank entry should be specified. A track circuit listed in TCR (section 6.2.8) should not appear in TCO for the same route.
source	signalling scheme plan
effect	This data is used by the Data Preparation Program, together with TCR, to add to the table of conflicting routes those routes which conflict in the overlap of either route or both routes.

6.2.10 TER

Terminal station route availability conditions.

type	group
default	blank entry

6.2.10.1 SIG

Home signal.

type	single-value
range	signal name

6.2.10.2 LOC

Terminal station.

type	single-value
range	location name

description This data group may be used when the route leads on to a single-line approach to a terminal station, and so ARS must not set this route for a train unless there is room in the terminal station. It may also be used for a route leading to a passing location on a single-line section, where ARS must not set this route for a train unless there is room in the passing location or the train currently at that location has route set away from it.

source	operating parameters
effect	When TER data is specified, ARS will not set the route unless either : <ul style="list-style-type: none"> there is a planned joining move at the location. a route is available from signal SIG into the location. there is a route on the train's path away from the location which is set. Location LOC must be specified in all cases.

ARS generates a signaller alarm whenever it is prevented from setting route by this reason.

6.2.11 MWT

Maximum wait time.

type	single-value
range	0-15,000 (seconds)
default	0
description	This item is specified to apply a margin to the length of time a train may be delayed at a route because the normal ARS strategy considers that another train should have priority. For certain routes, particularly routes from main lines onto branch lines, a maximum wait time for regulation purposes may be specified.
source	operating parameters
effect	When a confliction is found between train A which requires this route and train B which requires some other route, and if by giving priority to train B would imply that train A would be delayed by more than MWT, then priority is given to train A.

6.2.12 TFP

Tidal flow periods.

type	compound
default	blank entry

6.2.12.1 STT

Tidal flow period start time.

type	single-value
range	time of day HHMMSS

6.2.12.2 END

Tidal flow period end time.

type	single-value
range	time of day HHMMSS

6.2.12.3 WFR

Tidal flow period weighting factor.

type	single-value
range	0-255
description	This item is used where there are tidal flows in the traffic pattern and it is necessary to give priority to trains in a given direction during a tidal flow period.

source	operating parameters
effect	When the current time falls within a tidal flow period for the route i.e. between STT and END, then any delays incurred by a train waiting for this route are weighted by the factor WFR. The WFR weighting factors are scaled by a factor of 16 so WFR = 16 would indicate normal weighting, WFR = 32 would indicate double weighting.

6.2.13 LXR

Level crossing delay rules.

type	compound
default	blank entry

6.2.13.1 LOC

Location prior to level crossing.

type	single-value
range	location name

6.2.13.2 BER

Berth.

type	single-value
range	berth name

6.2.13.3 TCN

Track circuit.

type	single-value
range	track circuit name, or blank entry

description Where trains stop at a station prior to a level crossing and close to it, it may be a requirement to set the controlled route over the level crossing at a later time than would result from application of the usual rule which attempts to keep two green signals ahead of the train (see ASP section 6.1.1). This data item defines the rules to be applied in this case. Note that more than one rule may apply to the route.

source	operating parameters
effect	If the train stops at location LOC, then routesetting is delayed until the train reaches berth BER. If a track circuit is specified for TCN then routesetting is further delayed until that track circuit becomes occupied.

6.2.14 LEN

Route length.

type	single-value
range	0-32,767 (length units)
	Length may be specified in any convenient units, although the same units must be used for all length data i.e. LEN (section 6.2.15.2) also. The total length of routes between adjacent key locations must not exceed 32,767. Therefore suitable units are metres/yards for small areas and Dekametres/chains for larger areas.
default	mandatory
description	Length of route from entry signal to exit signal.
source	signalling scheme plan and boundary information.
effect	Route length data is used in the calculation of expected TD step times for each train. These times are calculated by linear interpolation of the planned times at the previous and next timed locations. For example, the step onto a route halfway between 2 timed locations would be expected at a time halfway between the departure or passing time at the first location and the arrival or passing time at the second location. This calculation makes the approximating assumption that the train runs at constant speed between the two timed locations. If this approximation is very inaccurate for some reason e.g. a large change in maximum line speed occurs between the locations, then the LEN values could be adjusted to compensate for this, but such cases are expected to be very rare.

6.2.15 DIS

Locations upon route.

type	compound
default	blank entry

6.2.15.1 LOC

Location upon route.

type	single-value
range	location name

6.2.15.2 LEN

Length to location.

type	single value
range	0-32,767 length units (see section 6.2.14)
description	This item defines those locations which are situated on the line of the route between the entry and exit signals. There may be a number of locations upon the route. For each LOC defines the location name and LEN defines the distance from the entry signal to the typical

position of the front of a train at rest at that location. Where the location is a station and the route exit signal is a “traditional” starting signal at the end of the platform, then sufficient accuracy is obtained by selecting the location length to be the route length. Where the location is a junction then the precise position of the location is less well defined. For ARS purposes it may usually be taken as upon the route to the signal protecting the junction, again with location length as route length. In some cases, where the route is the last route specified to ARS on a line leading out of the ARS Control Area, the next location in advance of the strike-out point will need to be specified for this route even though it is physically situated beyond the exit signal. In this case LEN (section 6.2.15.2) will be greater than route length LEN (section 6.2.14). See section 10.2.

source	signalling scheme plan
effect	This item is also used in the interpolation calculations of expected TD step times, as outlined in section 6.2.14 above.

6.2.16 AUT

Automatic route flag.

type	single-value
range	T = true F = false
default	F
description	This item is true when no route set information is available to ARS from the interlocking. AUT = T should therefore be specified for the routes from automatic signals, and for any additional routes on the approach to the ARS Data Collection area where route set information is not available, as described in section 5.3. AUT = T must not be specified when ALO = T. AUT = T must be specified for any route whose entry signal has ASP = 1, i.e the entry signal is a dummy fixed red signal.

6.2.17 QST

Panel request.

type	single-value
range	panel request name
default	blank entry
description	Normally the ARS panel request for route Rnnn is QARnnn. However in some cases this convention for naming panel requests may not be followed. This may arise if the same panel request is used for both the main route and the calling-on route.
source	SSI ROU and QST identity files.

effect ARS assumes the QARnnn convention applies, except for those routes where a different panel request name is specified using this data item.

6.2.18 RHY

Route headways.

type group

description This data item defines headway allowances, as used in the ARS strategies prediction calculations, for the route which will override the global headway allowances described in sections 6.13.4.4 to 6.13.4.7.

QSA and RHW allowances should be specified for the route when the specified signal headway applying to that route significantly differs from the signal headway generally applying in the ARS area.

PSA and SSA allowances should be specified for the route when there are special circumstances which cause significant delay to that route becoming available following the passage of a train over a conflicting route.

section 10.3 explains the use of these allowances in more detail.

source operating requirements

effect Any PSA, QSA, RHW or SSA values specified for the route override the global values specified in the THD data (see section 6.13.4) when required during the ARS strategies prediction calculations.

6.2.18.1 PSA

Route headways - simple crossing start-up allowance.

type single-valued

range -1 = No route specific data for this type
0-1800 (seconds) [specify in 5s units]

default -1

6.2.18.2 QSA

Route headways - forward working start-up allowance plus headway.

type single-valued

range -1 = No route specific data for this type
0-1800 (seconds) [specify in 5s units]

default -1

6.2.18.3 RHW

Route headways - forward working headway.

type single-valued

range	-1 = No route specific data for this type 0-1800 (seconds) [specify in 5s units]
default	-1

6.2.18.4 SSA

Route headways - reverse working start-up allowance.

type	single-valued
range	-1 = No route specific data for this type 0-1800 (seconds) [specify in 5s units]
default	-1

6.2.19 RLC

Route logical condition.

type	single-valued
range	logical condition name, or blank entry
default	blank entry
description	This item is used when area-specific route-changing strategies have been specified which include a requirement to prevent ARS selecting an alternative path containing this route when signal or points reminders have been applied.
source	ARS Operating Specification.
effect	The logical condition is used by the route-changing strategies to allow detection of reminders on alternative paths. The logical condition must be defined in the appropriate logical condition detail (dlc) file. The logical condition must return true if no reminders have been applied to the entrance or exit signals and no points reminders have been applied which prevent the setting of the route. The alternative path will be rejected by the route-changing strategies if the route exists on the alternative path and the logical condition returns false.

6.3 RELEASE DETAIL

There are no data items which are associated with releases. The release identities are listed in the release detail file, so that the ARS Data Preparation program can determine which of the SSI route identities actually represent releases rather than routes between signals.