

ARS Specification of Operating Requirements

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1 Introduction

Automatic Route Setting (ARS) is a system to be 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 will be installed as a subsystem within an Integrated Electronic Control Centre (IECC). ARS has also been installed as part of the Waterloo resignalling scheme where interface processors are used to provide an IECC-like interface to ARS.

ARS has been designed with the aim of providing a general system of widespread applicability on the Network Rail network. Nevertheless, prior to any particular implementation of ARS, a Specification of Operating Requirements should be produced by Operating staff. This will contain the information necessary to configure ARS to operate in that particular area, in the same way that the Signalling Control Tables configure the interlocking and the Stepping Tables configure the Train Descriptor.

ARS is a complex system and so information on various aspects of railway operation is required. This Guide to the Specification of ARS Operating Requirements describes the various aspects which should be considered and the items of information which should be supplied. Much of the information is in the form of data TABLES, but in some cases explanation of particular DETAILS is necessary. Any additional information or comment relevant to the ARS requirements should also be included.

Some operators may feel that the approach described in the Guide is unfamiliar and does not readily correspond to the method they would use to describe the ARS operation. In this case it may be best to first produce a document defining all of the relevant factors in more familiar terms. However, it is recommended that in all cases a document of the form defined in this Guide should ultimately be produced. This will have the following advantages :

- (1) by following the order in which the Guide discusses the relevant factors, an understanding of the way in which ARS works will be achieved.
- (2) a standard form for the specification of operating requirements will assist the Signal Engineers in determining what is required, and should produce a document which can be understood and agreed by all concerned, thereby reducing the risk of misunderstanding between the operators and signalling contractors.
- (3) considering the aspects in a fixed order should ensure that no relevant factor is omitted.

Once the Specification of Operating Requirements has been produced then the data preparers will be able to prepare the necessary data to configure the ARS system. In some cases they may find that a requirement has been specified which can only be met by a modification of the existing ARS system and in this case the Network Rail Zone in collaboration with Network Rail HQ will have to review the requirement against the modification cost.

Section 2 of this Guide describes the aspects affecting ARS train regulation and routesetting and section 3 describes those aspects affecting the train monitoring and alarm features of ARS.

Within the IECC, ARS works closely with a Timetable Processor (TTP) which supplies it with train timetable information. ARS also obtains signalling state information from the interlockings and train position information from the Train Descriptor function in the Signaller's Display System. The Signaller's Display System may be a Signalling Display Subsystem (SDS) or Flexible Display Subsystem (DIS). Section 4 covers those aspects of the interface between ARS and these other systems which need to be specified.

It is recognised that this Guide 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:

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2 ARS Routesetting Requirements

2.1 ARS CONTROL AREA

The area of railway over which ARS sets selected routes is known as the ARS Control Area.

The routes for which ARS operation is required should be listed as **Table 2.1**. This will generally include most of the routes in the area, with exceptions possibly being certain routes into non-track-circuited sections or sidings, or certain routes onto bi-directional lines.

ARS operation of reversing movements at junctions will not normally be provided. Where ARS operation is required for such reversing movements, DETAILS should be provided.

ARS converts trains' timetables from timing points, with optional path, platform and line codes, into lists of routes and berths. The data that controls this process is known as the PATH SEGMENT data. Each path segment has a start and an end location, with optional path, platform and line codes at each, and a list of routes and berths that a train with that timetable information will use.

Route Categories

Five 'categories' of route have been identified to assist in ARS data preparation, and in SSI data preparation for ARS-controlled areas. These are:

- Category 1: ARS-controlled route, frequently used by timetabled trains. ('Bread-and-Butter' to ARS) - i.e. the route appears in one or more path segments.
- Category 2: The route appears in a path segment, and is used by timetabled trains, but for operational (i.e. not safety-related) reasons, the signallers must set this route for all trains that need it. This might be for any one of a number of reasons, for example:
 - departure from a bay platform where the consequences of incorrect regulation are severe;
 - routes onto bi-directional track in the wrong direction;
 - access to a main line from a freight loop or siding.
- Category 3: Shunt routes involving reversals at junctions. If no TIPLOC is specified for the reversal movement, then trains making such a movement cannot be timetabled, and the route will not appear in the Path Segment data. If the movement is not in the timetable, then (by definition) ARS cannot set the route. However, there is no safety reason why ARS should not be able to set the route, if future details are provided of how such a train making that movement would be timetabled.
- Category 4: Routes which it would be UNSAFE for ARS to set. These are normally routes onto non-track-circuited track, where NO shunter's acceptance is provided. ARS cannot know whether an opposing movement has been verbally authorised. Routes where verbal communication is required by the Sectional Appendix may also fall into this category.

(However, departure of a freight train from a siding may require verbal communication, without which ARS will not set the route anyway: For example, the driver rings the signaller

to inform him that the train is ready to depart, the signaller then inputs the train description into the system. ARS then recognises the train, initialises it and considers it for route setting. In this case, ARS MAY set the route, because without the verbal communication, the train's description would not have appeared in the system, and ARS only sets route for trains that it can see.)

- Category 5: Routes which appear in no segment, but ARS may select by use of its route-changing strategies. This includes non-preferred routes, warner and call-on routes.

SSI Data Preparation

All the above categories of route except category 4 should have an ARS Panel Request in the SSI data. Category 3 has been included as requiring ARS facilities in the SSI. This is because instances have arisen where, long after commissioning of a resignalling scheme, the train service has altered to require frequent use of a certain turnback location. It is then simpler to change ARS ONLY to provide ARS-controlled reversals, rather than to have to change both ARS and SSI.

Preferred/Non-Preferred Route Selection

Where there are two or more routes between the same entrance and exit signals, one is classified the 'preferred' route, and the others are the non-preferred routes. The preferred route is the route that will set if both are available. There are four methods in ARS of handling these routes. These are:

- Method 1: ARS sets the preferred route if it is available. ARS never sets the non-preferred route.
- Method 2: ARS sets the preferred route if it is available. If the train's timetable has a special line or platform code at the location where the non-preferred route is required, then ARS sets the non-preferred route. (Selection by timetable)
- Method 3: ARS issues the panel request when either the preferred or the non-preferred route is available. The SSI sets the preferred route if available, or the non-preferred route otherwise. (Selection by SSI)
- Method 4: Site-specific code in ARS determines that a route has a non-preferred alternative. If the preferred route is not available, or if another train has priority over the preferred route but not the non-preferred route, then ARS selects the non-preferred route. (Selection by ARS)

All four options have benefits and drawbacks, AND impose restrictions on how the SSI data is written. These are described below.

- Method 1:

Advantages - Simple to write SSI and ARS data, and simple for operators to understand.

Disadvantages - Restricted operation. Routes are available that ARS cannot use.

Implemented at - Fenchurch Street, Tonbridge, Ashford, Shipley (Leeds North West).

- Method 2:

Advantages - Train planners can explicitly define which points a particular train will use, and can identify and avoid conflicts.

Disadvantages - Most Network Rail Zones' train planners would not know how to select this method.

Implemented at - York, Leeds (in conjunction with method 4).

- Method 3:

Advantages - Simpler SDS/DIS data - only one panel request, so no need to teach the signaller how to select the non-preferred route. (No obscure hit-areas for selecting the non-preferred route.)

Disadvantages - ARS contains a table of conflicting routes, set up by identifying the track circuits in each route. In this method, ARS 'thinks' that it's getting the preferred route, but it may be the non-preferred route that sets. This might then make the route for some other train unavailable, which ARS thought could be a parallel move.

Implemented at - Enfield Town, Marylebone

- Method 4:

Advantages - ARS is 'in control'; it can select the non-preferred route even if the preferred route is available. It would do this if it had identified a conflict with a higher-priority train, which could be made as parallel moves by setting the non-preferred route.

Disadvantages - SSI MUST provide separate panel requests for the preferred and non-preferred routes. Otherwise, ARS might think that it was setting the non-preferred route, but the preferred route sets - so the higher-priority train gets delayed.

Implemented at - Liverpool Street, Paddington, York, Leeds, Newcastle.

Methods 2 and 4 require separate panel requests in SSI so that ARS knows which route it is setting. Since the preferred route must be available for ARS to request it, the SSI processing for the ARS preferred route panel request may be common to that for the SDS/DIS panel request - which selects the non-preferred route if the preferred route is not available. The likelihood of ARS requesting the preferred route, and then the non-preferred route setting, is minimal. However, if ARS requests the non-preferred route, it MUST be the non-preferred route that sets.

ARS Sub-Areas

For operational convenience the ARS control area is divided 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 allows the signaller to switch off ARS operation for part of his area where he wishes to perform some special regulation there, and also in certain cases of signalling equipment failure. If a signal passed at danger (SPAD) is detected by the IECC SPAD Alarm, the ARS sub-area in which the SPAD has occurred and adjacent ARS sub-areas are switched off by the IECC.

It should be noted, however, that the signaller can set any route at any time and does not have to switch off an ARS sub-area before setting a route in it manually. In the unlikely event of ARS and the signaller calling for conflicting routes at the same time, the Solid State Interlocking (SSI) system will only service the request it received first, and so ensure the safety of the system.

The allocation of routes to ARS sub-areas should be listed as **Table 2.1**.

Some guidelines for allocation of routes to sub-areas are :

- (1) it should be as straightforward as possible. It is not possible to display the extent of the ARS sub-areas on IECC workstation screens. Therefore, signallers have to be trained in the extent of each area.
- (2) it is not necessary to allow for cases of signalling equipment failures. In the IECC case, when failures occur which can be protected by means of signal and/or points reminders, it is not necessary for the signaller to turn off ARS sub-areas in addition.
- (3) it is not necessary for sub-area boundaries to coincide with SSI interlocking boundaries.
- (4) however, where there are Route Relay Interlockings, the sub-areas may not cross the boundaries of these interlockings.
- (5) where there is bi-directional working between 2 workstations then each signaller should have a sub-area containing the boundary routes.
- (6) except for this case, routes on one workstation should not be in a sub-area controlled by another workstation.
- (7) when ARS operation of SIMBIDS routes is required, a sub-area containing the SIMBIDS routes into each section should be provided so that the signaller can advise all concerned that SIMBIDS operation is about to start before enabling ARS.

The information described above is held as data in both ARS and SSI systems. Therefore this information will be required earlier, and will be more costly to change, than the other information which is held as data in ARS only.

When a route is cancelled by the signaller, ARS switches off the ARS 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 the non-ARS controlled routes also, these routes should also be allocated to ARS sub-areas and listed in **Table 2.1**, although this information is not required by SSI.

ARS routesetting failure alarms and some responses to the routesetting status enquiry include an 8-character ARS sub-area name. The names to be used for each ARS sub-area in these messages to the signaller should be listed as **Table 2.2**. For technical reasons these names must start with the letter L.

2.2 ARS DATA COLLECTION AREA

In order to carry out its routesetting function in the ARS Control Area, ARS requires information on planned and actual train operation over a larger area known as the ARS Data Collection Area.

ARS will not consider a train for routesetting, or make allowance for a train when considering other trains for routesetting, until that train steps into the ARS Data Collection Area.

The ARS Data Collection area is defined in terms of "strike-in" berths, "strike-out" berths and diverging junctions beyond the area.

For areas where the ARS Control Area is the whole of the signalling centre area then the "strike-in" and "strike-out" berths will usually be the approaching and departing berths on each line at the area boundary. For areas where ARS does not control the whole of the signalling centre area, the "strike-in" and "strike-out" berths are determined as follows.