APPENDIX 4.1

TECHNICAL STANDARD FOR TRAIN PATH ROUTES

The construction of the timetable and, more generally, the graphic timetables, is carried out according to the principles of a single technical standard communicated to all train path applicants (hereinafter referred to as: “applicants”).

This standard, which sets out the routing principles and referential bases (points 1 and 2 below), is composed of generic technical data, describing SNCF Réseau's strategy for the network, and specific data relating to different lines and stations, the whole standard permitting, with regard to the requests presented, the layout of train paths in the graphic timetable (Articles 3 to 7).

ABBREVIATIONS USED IN THIS DOCUMENT:

IM : Infrastructure Manager

IPCS : permanent installation of opposite direction

LC : conventional line

HSL : High Speed Line

LTV : temporary speed restriction

GOV : track occupation diagram

PC : point of conflict

PGF : general windows program

PK : kilometre post

PR : remarkable point of reference (isolated junction, passenger building, etc.)

IS : information system

THOR : layout of timetables (IS for setting up train paths)

CONTENTS

1. LAYOUT PRINCIPLES AND STANDARDS

SNCF Réseau's policy is to maximise the efficiency of the network, and thus to promote within it a maximum number of established, efficient and stable, train paths over time.

This optimisation depends on the capacity and homogeneity of fixed installations, but also on the accuracy and punctuality of the applicants' production, as well as the services in charge of maintenance, works and traffic management, online and in train stations.

The graph must show a stable network with current operations isolated from small uncertainties, but is based on the controlled industrial production by the applicants.

It must also have a minimum of calendar variations in order to preserve the readability of the customer offer, the stability of the network effects and a robustness with regard to uncertainties surrounding work sites.

The accuracy of the train path layout should be adapted to the accuracy of the traffic and the range of actual trains compared to a typical convoy.

The theoretical timetables, except in special cases (suburban system with high time precision, etc.), are not expected to have an accuracy greater than half a minute.

In addition, there are no different timetable variants in response to timetable requests differing from each other by less than 3 minutes, nor will subsequent requests for adjustments or discrepancies of less than 3 minutes be accepted. Only exceptionally are specific timetables created to allow for temporary work or speed restrictions, when they are shorter than 3 minutes.

2. REFERENTIAL BASES

2.1 Layout parameters in relation to the infrastructure

A fixed selection of line parameters is used as the basis for the calculation of routes:

- the profile in length, if necessary corrected curves;
- the speed limit, as defined by the Technical Information;
- the performance code resulting from the electrical power available for traction and the level of electromagnetic disturbances allowed;
- the specificity to be taken into account for the connections of self-propelled trains in the station during the journey.

This computing infrastructure can be communicated to applicants.

2.2 Layout parameters in relation to convoys

Two lists of curves can be used to create the layouts:

- generic motor-driven (force x speed) curves over a staggered range of performances covering the field of the various traction units likely to run on the network;
- curves (resistant force x speed) representative of the different typologies of convoys for trains towed by a locomotive.

The list of these motor-driven and resistant curves constitutes the range of layout conditions that can be requested by an applicant of train paths, possibly associated with a towed tonnage.

The calculation of the basic operating time of the route of each train path is performed using the motor-driven curve or the triplet (motor-driven curve, resistant curve, tonnage). The applicant must enter the reference rolling stock selected for its train path order.

It is the responsibility of the applicants to only select trains, for a given train path, capable of keeping to the timetable of the allocated train path at any point in time, without risk of coupling failure or deterioration of the track by skating.

2.3 Layout standards

The layout standards are established by SNCF Réseau in view of the policy defined in Article 1.

Their publication does not preclude carrying out a specific calculation if a particular situation justifies it.

The following minimum separation standards are applicable if no different local restrictions are defined.

The minimum interval between intersecting routes is 1 minute.

On lines operated under the single-track scheme:

- in the case of crossing **with** stop: at least 1 minute must separate the two departures;
- in the case of crossing **without** stop: arrival of the 1st train at least 5 minutes before the other train passes without stopping, departure at least 1 minute after it has passed.

Beyond (or exceptionally below) these limits, the minimum separation intervals between train paths are described section of line by section of line, and if necessary station by station, by the following standards:

- timetable standards on national lines;
- timetable standards on regional lines;
- timetable standards in the station, or for stations where they exist, in the specific document “Standards for the use of the infrastructure - Operating compendium of station ....”;
- timetable standards for sections equipped with IPCS with particular timetable conditions.

These standards are available on the SNCF Réseau website http://www.sncf-reseau.fr/fr/les-documents-techniques-et-referentiels .

The values are updated taking into account the results of feedback, changes in the infrastructure, the environment and, in general, anything that affects the calculated values.

Calculations leading to their determination incorporate, for lateral signalling, beyond the required technical time, a minimum margin of free track for the constraining signal (χ of 35 seconds, in general)

The calculated values are rounded with a consistent accuracy according to the reliability of trains running in the area (usually 30 seconds or a minute).

The standard determines - by the definition of the timetable standards - the level of the reliability requirements of a zone; it cannot in any case diverge from the practices noted in the annual graph, except between the publication of a modification, and the actual publication of the annual timetable following the date of this publication.

Additional occupancy rate rules, measured over a sliding hour, can be defined in addition to these unit values to facilitate the application of the robustness rule of the graph defined in Article 7.3 (maximum timetable number of train paths or passages at a given critical point)

A) Spacing between train paths going in the same direction

It is defined systematically for routes in the normal direction. It is also defined for the opposite direction when it is used for routes in the annual timetable, it being noted that there are no restrictions in principle on the use of normalisation or IPCS for the routes.

A table of the type below describes the spacing standards to be respected:

Train path speed	Course	Line 1	Line 2
≥140	A / B	min. time	min. time
120			
100			
...			

The spacing standards to be respected between divergent or convergent routes are covered by a similar table if the minimum values are different from the above values.

In accordance with what is indicated above (see beginning of 2.3), the scheduler may need to adapt the minimum times specified in these standards in BAPR (limited permissive automatic block) and BM (manual block) to take account of the effective length of the cantons, provided that this adaptation is justified by a calculation.

B) Minimum intervals between incompatible routes in opposite directions

The PRs correspond to staking points included in the timetable documents.

A standard interval, applicable to the pairs of trains having the same configuration, is determined to reference the timetables used at junctions and at the station entrance.

This interval is determined at the PR, under whose right of which timetable conflicts are processed, or the GOVs are laid out.

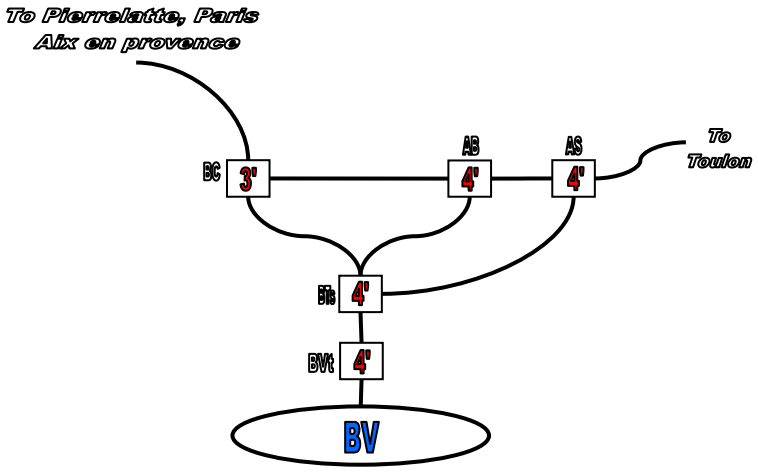
If no PR identifies this PC, it is necessary to define the area with a timetable incompatibility. It begins at the protective square and ends at the point of release allowing the formation of an incompatible route. If there is no PR in the IS, the PC is defined by a PK (see station diagram).

For two successive trains T1 and T2 succeeding in this order in secant route:

- if the staking point is in the conflict zone, the interval to be calculated is the sum of the following three elementary times:
  - the time **t1**, necessary for T1 to release, from the PR defining the zone of conflict, the point of release allowing the formation of the route for T2;
  - the time **te**, to establish a route for T2 (10 to 25 seconds);
  - the time **t2**, required for the train T2 to travel from the constraining signal plus the free track margin time (χ) to the staking point.
- if the entered staking point is out of sync with the conflict zone (passenger building for example), this interval is the time noted above:
  - reduced by the time required for T1 and T2 to travel between the conflict point and the staking point, if the latter point is downstream for T1;
  - or reduced by the time required for T1 and T2 to travel between the staking point and the conflict point, if the latter point is downstream for T1.

For stations, the calculated minimum intervals are described:

- either in a diagram modelling the station with its predefined zones or staking points



- or in a table of the type below:

STATION / PR	1st train / Special features	Minimum value	2nd train
X1			
X2			
X3			
...			
Xn			

This information can be found in the "Infrastructure Standards - XXX Station Operating Compendium" document if it exists, otherwise in the "Scheduled route standards in the station" document.

C) Special technical or timetable conditions that only apply locally

There are various line requirements, for example:

- maximum number of train paths per hour in one direction and at a given point;
- rate to be taken into account in case of LTV;
- standard travel time between A and B: x min;
- capped speed limit of 200 km/h for travel between 23:00 and 6:00.

CASE OF PASSENGER TERMINALS (STATIONS)

The document: “Infrastructure Standards - XXX Station Operating Compendium”, for stations which possess one, available on doc.explore, describes, in particular:

- the railway complex (work sites, wharf tracks, routes);
- how the operating pipes work;
- the rules for using the work sites;
- the authorised and recommended routes for technical manoeuvres;

- the minimum, robust and maximum operating times defined by SNCF Réseau for back-hauls, coupling/uncoupling, flow speeds, etc. The operator may send the desired operating times in a separate document.

The transport plan proposed by the applicant must take account of the operating guidelines described in this document where available. In the event of non-compliance with these operating guidelines, SNCF Réseau may propose remedies or reject non-compliant requests.

Should there be no “Infrastructure Standards - XXX Station Operating Compendium” document, if the stabling times are greater than 20 minutes and unless there is a framework agreement specifying another value, they are likely to be rejected by SNCF Réseau when the request affects the operating robustness of the site or requires the refusal of another train path.

3. TRAVEL TIME OF A TRAIN PATH

The travel time of a train path is the sum of basic time blocks:

- basic operating time,
- running time margin,
- works time supplement (possibly),
- stabling time requested,
- additional time required for the graph (traffic stops, stabling extensions, and domestications).

3.1. Basic operating time

Basic operating time represents the most difficult operating time normally achievable. It is the result of the computation of the convoy (motor characteristics and running resistances) requested by the applicant on the computing infrastructure.

The management of possible equivalences is the exclusive responsibility of the applicant.

Basic operating time is based on:

- the traction unit,
- the towed mass,
- the type of material towed,
- characteristics of the line travelled on (profile, speed limits, electrical equipment, traction restrictions, etc.),
- the time required for starting and braking during normal stops.

3.2. Running time margin

The running time margin is supplemental time consisting of:

- **A-Margin** (for operational hazards), designed to cope with the inaccuracy of speed measurement, to compensate for authorised overloads and the consequences of incidents such as closed signals, occasional overshooting of normal stabling time, speed limitation for accidental cause, etc.
- **T-Margin**, intended to compensate for lost time resulting from temporary speed restrictions for works (scheduled or unannounced), occasional use of the IPCS for maintenance, or speed limits related to the infrastructure (when not included in the basic operation time).

3.3. Supplemental minutes

If, when applying the train path timetable principles, the T-margin does not compensate for the expected time losses, SNCF Réseau may allocate a works time supplement (also called V-margin). This V-margin may be applied to:

- the entire duration of the service (annual supplemental minutes, which can be included as soon as the systematic timetable is constructed),

- and/or a part of the services (temporary supplemental minutes).

These supplemental minutes are the subject of a "table of supplemental minutes", a summary drawn up before the construction period of the annual timetable, and then kept up to date.

3.4. Stabling time

The stabling times are requested by the applicant (commercial stops and service stops) and allocated by SNCF Réseau taking into account operating constraints.

3.5. Other supplemental (works) time

SNCF Réseau may include other supplemental time due to constraints caused by the mere assembly of the graph: stops [C], lengthening of stops, additional holding time(s) due to the insertion of the train path into the traffic (domestication), deviated route to ensure the proper functioning of track circuits.

4. SPLITTING UP THE NETWORK INTO LTV SEGMENTS

The construction of a timetable leads to the distinction on the main axes of the network of certain points where it seems strategically important that train paths stick to their timetable, so as not to disturb the other train paths and the connections, and thus the construction of the overall system. These points are important geographical nodes, or stations emitting high traffic.

The grid of the structuring axes between these strategic points defines the segments, called LTV segments, on which the T-margin is affected.

SNCF Réseau establishes and updates, for each annual timetable:

- a table listing the LTV segments (and associated T-Margin values),
- a map of LTV segments, showing the associated T-margins.

5. VALUES OF THE RUNNING TIME MARGIN

5.1. Value of the running time margin on LC/HSL

The normal running time margin is 4.5 min/100 km on conventional lines, and 5% of the basic operating time on HSL tracks, except in special cases described in the line reference document.

The running time margin is made up of:

- On the conventional line (LC), the rates are:
    - A-Margin: 2 min /100 km,
    - T-Margin: 2.5 min /100 km.
- On HSL, the running time margin is basically allocated to A-Margin. However:
    - In the case of works allowing a speed limit greater than or equal to 220 km/h: SNCF Réseau reserves the right to use half of the margin of the segment to compensate for the loss of works time, without exceeding 1 minute 30.
    - In the case of works allowing a speed limit less than 220 km/h:
        - If the works period is greater than or equal to 26 weeks: an additional timetable adapted to the works is normally produced,
        - If the works period is between 1 week and 26 weeks (cumulative): search for industrialised variants, applicable as far as possible to several work periods,
        - If the works period is less than 1 week: SNCF Réseau reserves the right to reuse an existing variant, in consultation with the applicants concerned.

5.2. Exceptional margin case of ≤ 3 min/100 km

For certain train paths, on an exceptional basis and at the express request of the applicant, and after SNCF Réseau's agreement, the conventional line margin may exceptionally be reduced to a rate of less than or equal to 3 min/100 km.

The distribution of A and T margins is then as follows:

- For margin rates equal to 3 min/100 km: A-Margin = 0.5 min/100 km, and T-Margin = 2.5 min /100 km,
- For margin rates strictly less than 3 min/100 km, the A-margin and T-margin distribution is discussed with the applicant.

When an applicant wants a change in the margin rate, the request must be made:

- during the “timetable” expression of needs application (EdB) (during the year Y-3, Y being the year of service) for a train path included in the timetable,
- during the EdB 24h application (during the Y-2 year) for a train path not included in the timetable (occasional need for 24 hours).

In addition, special margins are also applied on the Ile de France network.

6. DISTRIBUTION OF THE RUNNING TIME MARGIN

The running time margin is distributed with the aim of favouring the best running time and the best overall respect of the timetables. Part of the margin may for this purpose be concentrated at the approach to certain individual points of the train journey.

On a high speed line, the distribution of the running time margin between two staking points is therefore allowed to be an average value of 5%.

On conventional lines, the margin distribution is described in the following points.

6.1. Distribution of the margin outside of works periods

Distribution of the margin
A larger portion of the T-Margin may be positioned at the end of the LTV segment to absorb the impact of unannounced work.

The A-margin is distributed to absorb potential traffic difficulties as the nodes approach.

In addition, in the context of short segments (generally less than about 150 km), part of the A-margin may be transferred from one segment to the neighbouring segment to better absorb the traffic constraints in the important nodes.

In all cases, the rate of total running time margin will be between 3 min and 7 min /100 km on a conventional line, without the flow of the line section being degraded.

6.2. Distribution of the margin during works periods

Distribution within an LTV segment
In the case of known work on an LTV segment, the margin may be allocated to the work zones, if the deviation from the nominal route (excluding work) is greater than 2 minutes (this 2-minute threshold may be reduced in dense zones or at points of convergence of the structuring network).

A journey will then see its total margin rate reduced to 2 min/100 km before or after the work area in order to concentrate the maximum of the T-margin to this one area.

V-Margin will be added when construction time losses exceed the T-Margin.

Use of the T-margin of an adjacent LTV segment
In the case of work on a given LTV segment, resulting in loss of time greater than the T-margin of the segment, part of the T-margin of an adjacent LTV segment may be used. This provision does not apply to either sides of complex nodes.

6.3. Route with varying timetables for technical reasons

As an exception to the general principles set out in the preceding paragraph, in order to limit the creation of variants for technical reasons, no variant will be created if the difference between the total travel times is less than or equal to three minutes. In this case, the timetable is constructed:

- on the basis of the worst performing variant, for the calendar variants on a given train path,
- on the basis of the material of the train, for the train paths in the timetable (in the case of a less performing material on a train path of the timetable, a variant will have to be created).

These principles may also be applied for deviations longer than three minutes, unless the applicant has specifically requested the creation of a timetable variant.

7. 7. LAYOUT OF THE GRAPH

7.1. Compatibility between train paths

The train paths are laid out in such a way that 2 on-time trains running on the "standard" infrastructure do not interfere with each other.

The routes are therefore designed with open signals, except in cases (crossing, station where trains enter with a closed exit signal, dead end station, scheduled reception on occupied track, etc.) where it is necessary to set up these routes with closed signals.

Travel times are then calculated to take this situation into account.

The minimum time differences to be respected are those defined in the timetable standards mentioned in point 2.3 above.

This standard infrastructure is:

- either the actual infrastructure, including planned tracks for use in the stations;
- either a reduced fixed configuration of this infrastructure, described in the line standard, or in the instruction annexed to the PGF of the line section concerned (for example by setting up all 2-way trains on a single track, using IPCS, during a specific time period).

7.2. Line/station interactions

The GOVs are set up in parallel and coherently.

The compatibility of track occupations does not, however, give rise to a check of the sets of lanes globally allocated to an applicant for a fixed period.

7.3. Limitations relating to filling

There is no general objective to manage the line-by-line fill rate because the network effect is essential.

The basic graphic layouts (train paths with a frequency greater than once a week) are considered robust provided that an isolated disturbance of 10 minutes on a train is absorbed within one hour after it occurs.