Train Workbank

Purpose

This document describes the process of Train Workbank generation in RailBI.

Audience

Users and ISD Staff

Data & data lifecycle

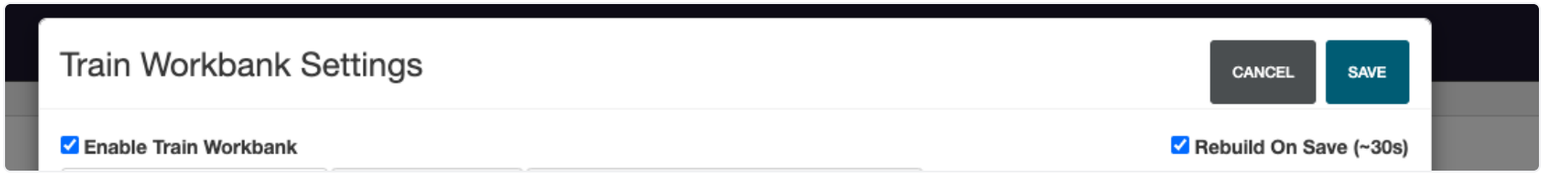
1. Data preparation
    a. Execution of import "train_mapping_prepare_rdg_data"
        i. This script takes batch and scheme_to_batch tabs from NR train workbank - usually titled "Passenger TF model CP7 v1.1"

2. Train Assets import
    a. Execution of import "trains"
        i. This script takes output from preparation script and manual exclusions defined in "data_import/trains/train_toc_class_to_remove.py"
            1. This script updates train assets with related data, including train track map and train scheme maps. It also creates a new train version for every train.
                a. train, train_class/subclass, fic families, train_families
                b. assets asset positions
                c. train_versions, train_version_classes
                d. asset technology installations
                    i. installation_date → is the introduction date from train workbank

        ii. This script updates the global "train workbank settings" - set of date overrides, batch inclusions and default national deployment strategies

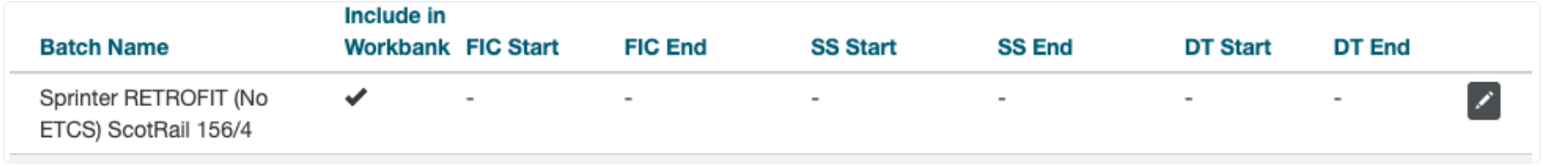
Train Workbank Configuration

1. Train Workbank (TW) configuration can be updated via Option Settings → Advanced. There are 3 areas were settings can be updated - all within the advanced tab within settings.
    a. Train Workbank
        i. Enable Train Workbank toggle



1. toggling ON this setting and saving will import the latest default settings from the system into this option and allow for viewing the "trains calendar"
2. toggling OFF this setting will disable train workbankk generation for this option

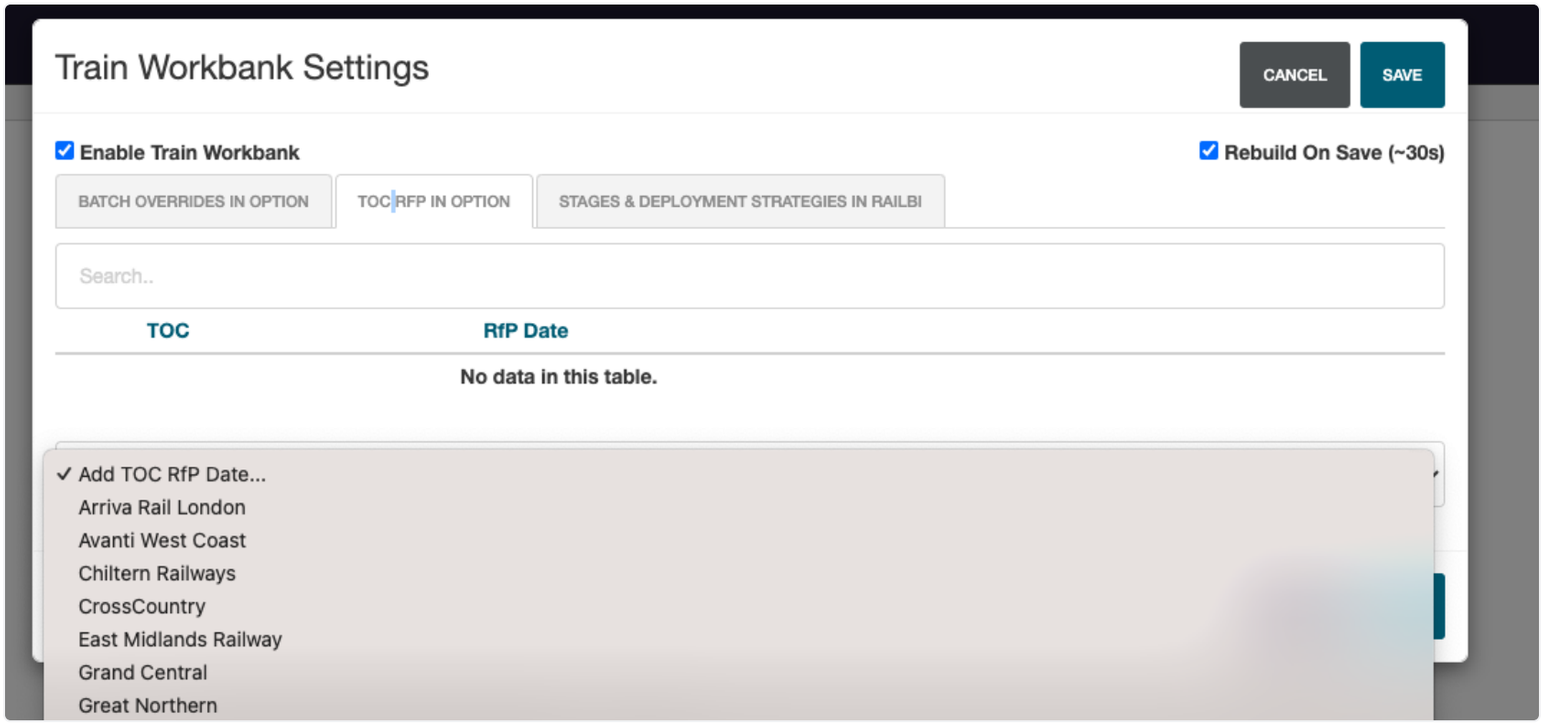
i. Batch Overrides in Option



Batch Name	Include in Workbank	FIC Start	FIC End	SS Start	SS End	DT Start	DT End	
Sprinter RETROFIT (No ETCS) ScotRail 156/4	✔	-	-	-	-	-	-	

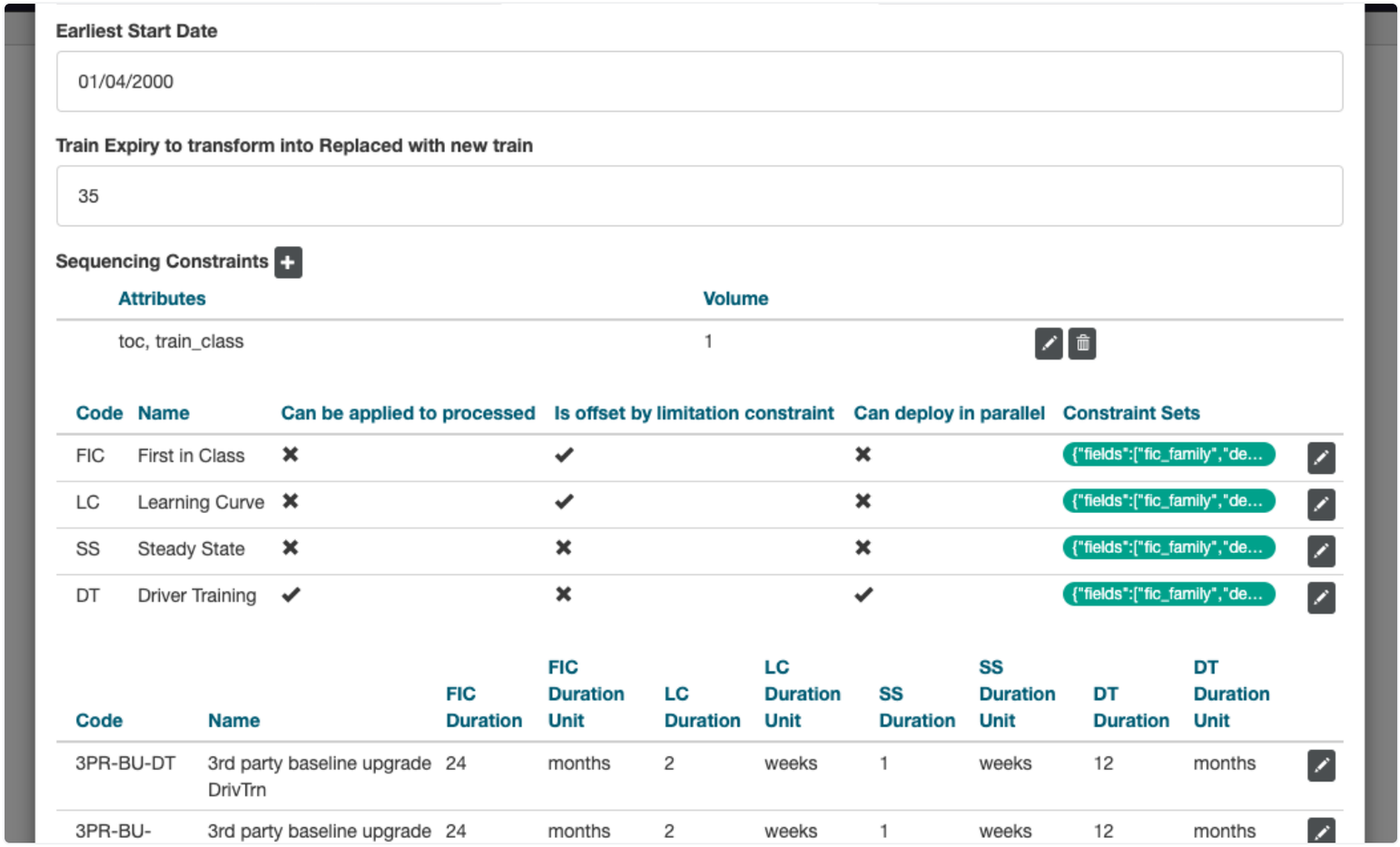
1. Through this interface the date overrides can be updated and batches can be included and excluded from the train workbank generation

i. TOC RFP date in Option



1. Date that will defines the earliest possible date that any deployment can be made for the specified TOC

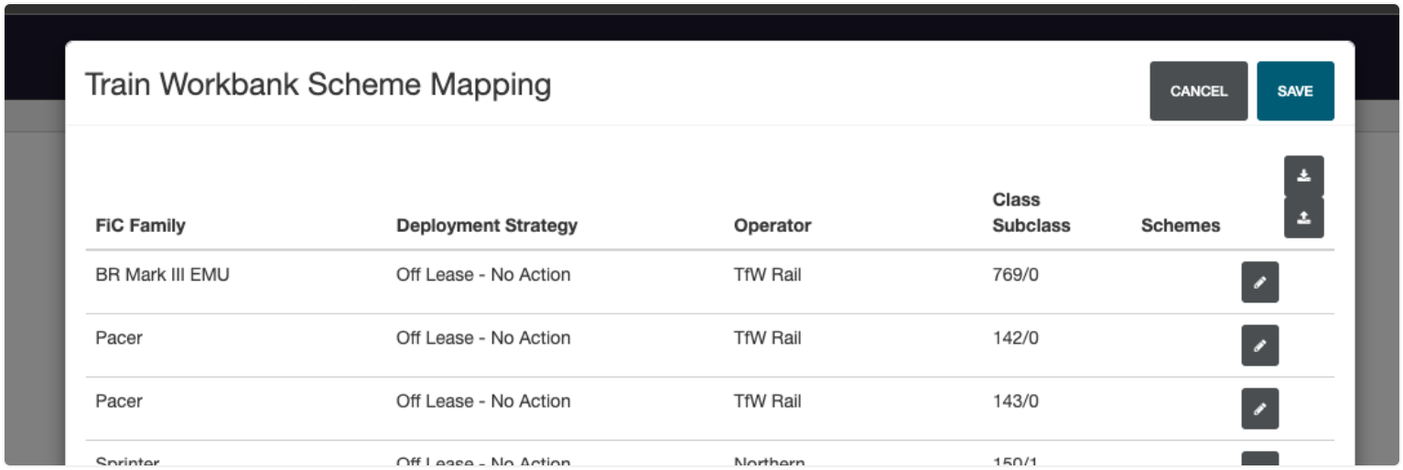
i. Stage & Deployment strategies in RailBI - GLOBAL CONFIGURATION APPLICABLE TO ALL OPTIONS



1. Earliest FIC date possible
2. Change deployment strategy to Replaced With New Train after X years
3. Sequencing Constraint - restriction on how many trains can be deployed at the same time - default is one train per TOC per class
4. Stages
    a. Code, Name - describe the stages
    b. Can be applied to processed - Usually train is considered processed one any stage has been applied. At that point no other stage should be applied to that train. UNLESS this setting is toggled on on the stage meaning the stage like DT can be applied on the train that already had a stage assigned
    c. Is offset by limitation constraint - This setting needs to be updated in tandem with limitation constraint definition. It's implied by the fact that stages have the limit defined
    d. can deploy in parallel - marks stage as an exception from sequencing constraint
    e. Constraint Sets aka limitation constraint define how many trains sharing defined attributes need to be deployed to satisfy the stage

1. Deployment Strategies
    a. Code, Name - describe the deployment strategy
    b. FIC/LC/SS/DT duration and unit - define durations of stages for that deployment strategy

a. Batch to Scheme Mapping

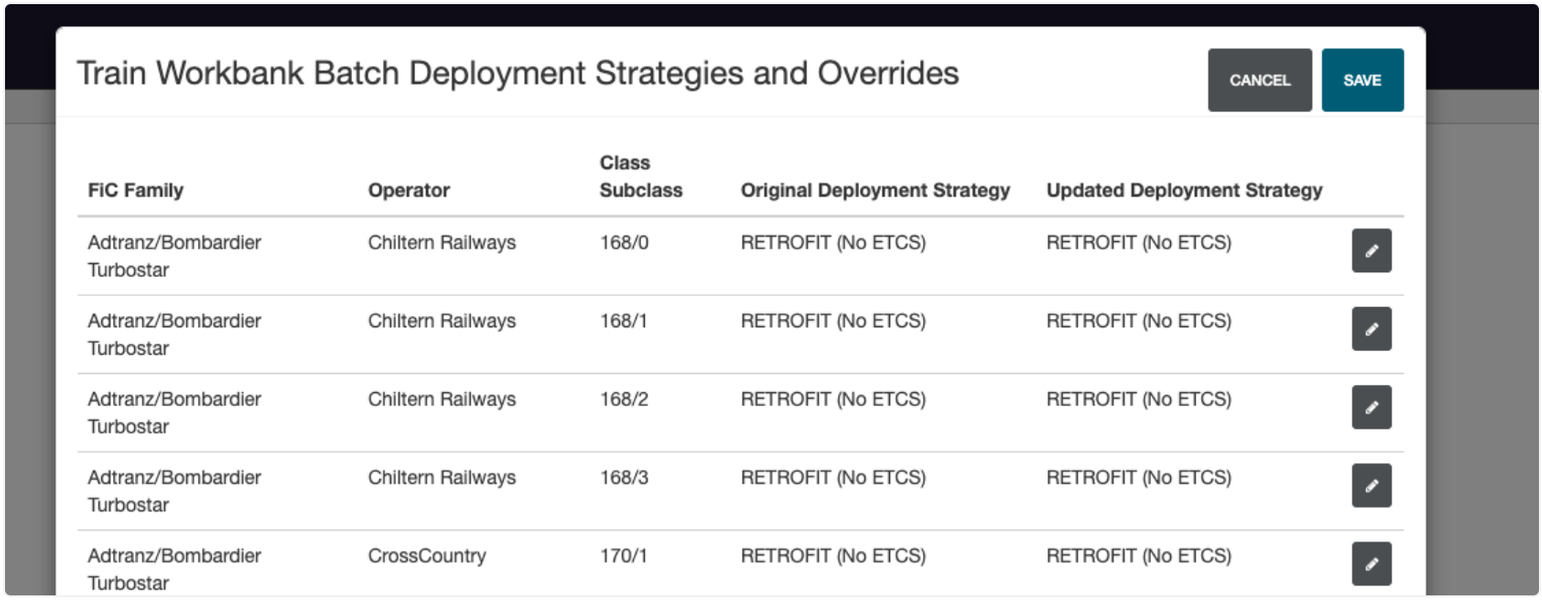


i. Lists interlockings assigned to the batch by default

ii. Allows for changing interlocking assignment per batch

iii. Any changes to this will require full option rebuild as ETCS projects need to be adjusted to include/exclude changes

a. Batch Deployment Strategy Overrides



i. Allows for viewing and changing deployment strategy assigned to the batch

Train Workbank Generation

1. Input configuration is getting pre-loaded and stored by batch using original national deployment strategy. Using here there original deployment strategy because deployment strategy can be overridden by a user or system if ETCS date is greater by X (usually 35) years
2. Algorithm then loops over the stages starting with FIC, followed by LC, SS and DT. We are processing them in that order because it made easier to manage dependencies between stages with constraints getting more granular FIC/LC being restricted by both sequencing and limitation constraint
3. As the algorithm loops over the stages it aim to complete each stage by ETCS date

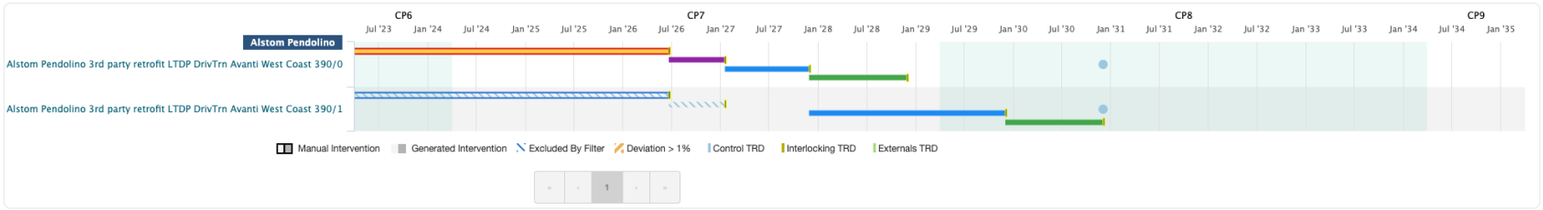
4. If the stage contains limitation constraint the algorithm will prioritise which batch should be taken first based on wether the batch contains override, ETCS target date and number of trains in the batch
5. Then algorithm moves to sequencing stage - meaning figures out the order of deployment for batches that are sharing all or some of: target date, limitation constraint, sequencing constraint. This is where if some batches contain date override, RailBI will attempt to position generated deployments around the deployments with overriden dates to deploy as efficiently as possible in time for ETCS date if possible
6. Once the deployment is positioned, algorithm aims to offset (or "push back") the previous stages earlier to make room for the deployment.
    a. If earlier stages have been hard set by override, then the offset is not possible and "bounce back" gets applied that then positions the new deployment as soon as possible after the hard-set earlier date, likely now breaching the target ETCS date
        i. If both early and new deployment have date overrides RailBI chooses to trust user input more than constraints and allows for deplyoments to break the constraint
7. Finally the deployments are "saved" and algorithm moves onto another stage

Train Workbank Advanced Override Cases

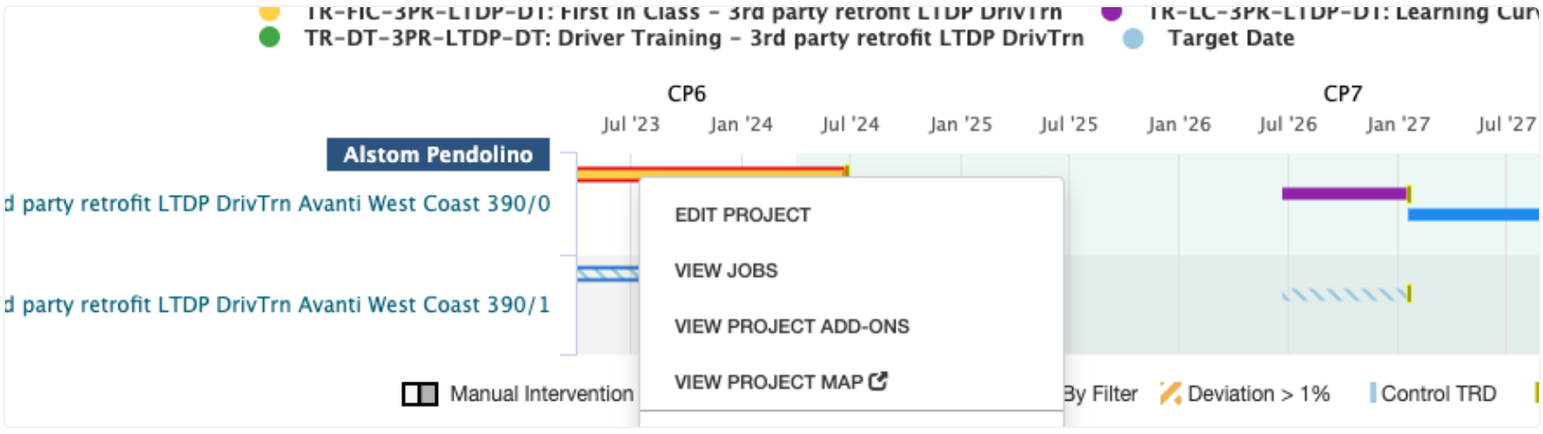
Below we will describe the behaviours where multiple date overrides get applied. Behaviour differs if the override is applied on the single batch within constraints vs multiple batches with the same constraint

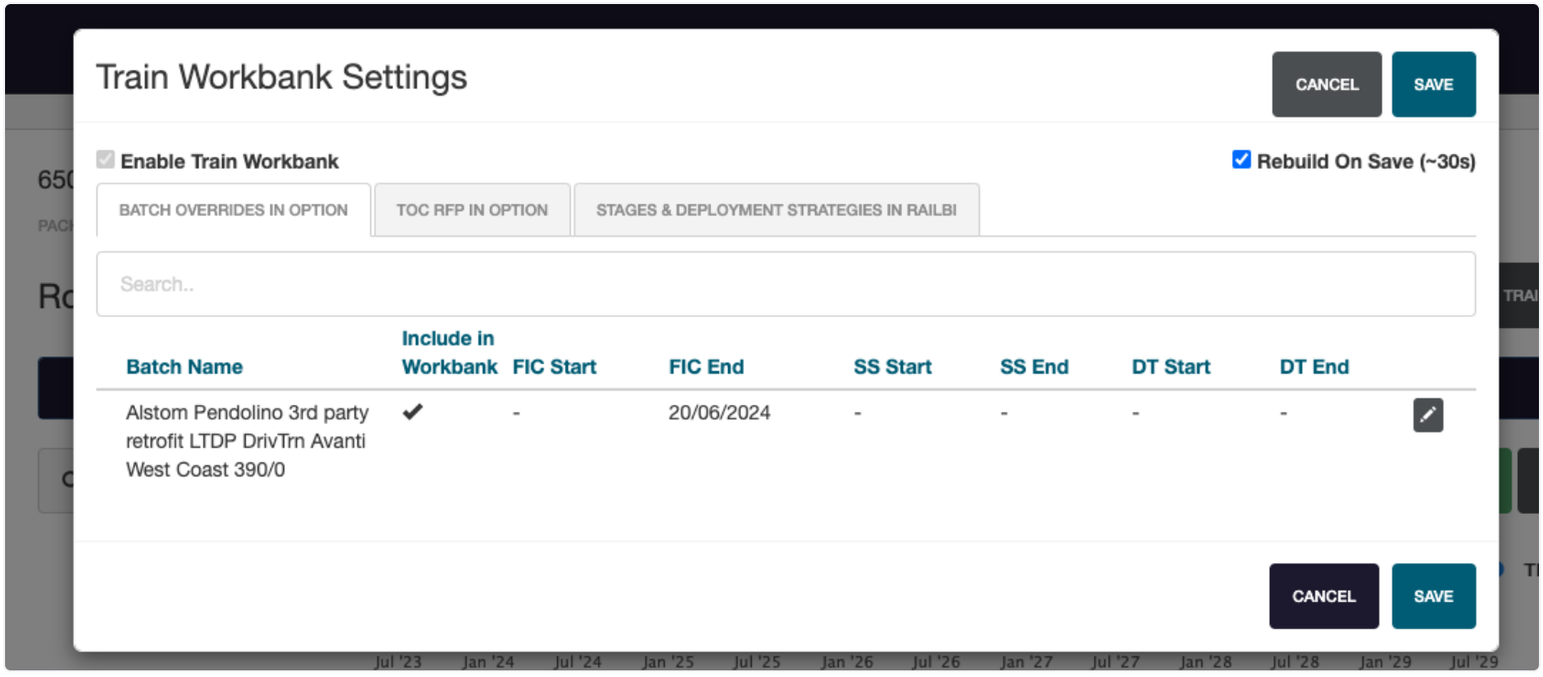
Simple - two subclasses sharing the same constraints - Pendolino (FIC family)

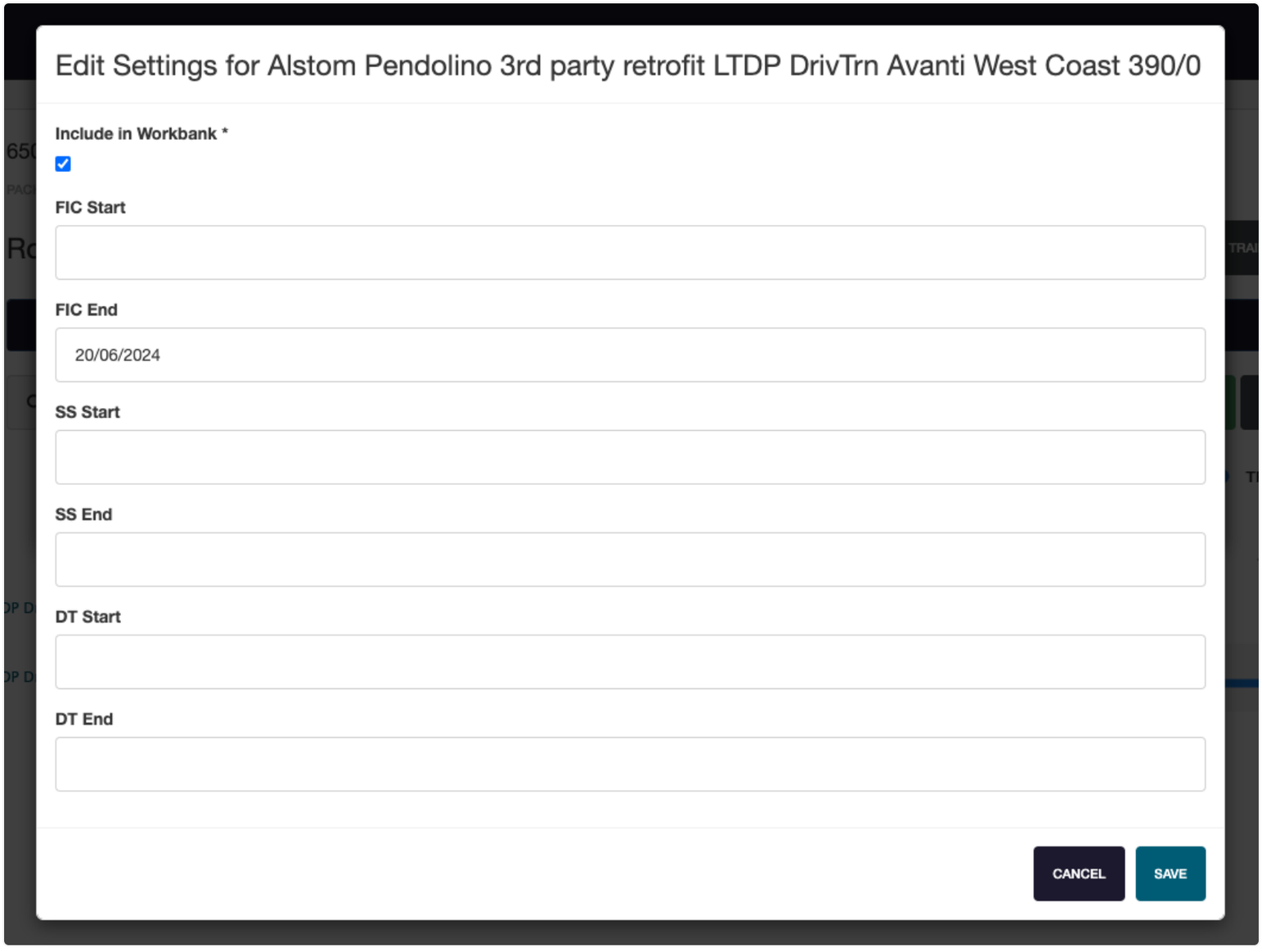
Below shows the deployments without any overrides applied



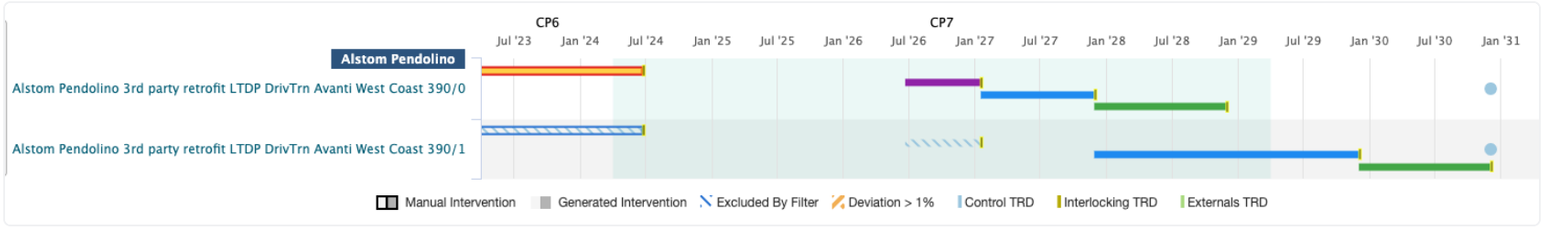
Deployments can be edited by clicking on the calendar deployment and selecting "edit project". That opens a pre-filtered modal allowing to edit FIC/SS/DT dates







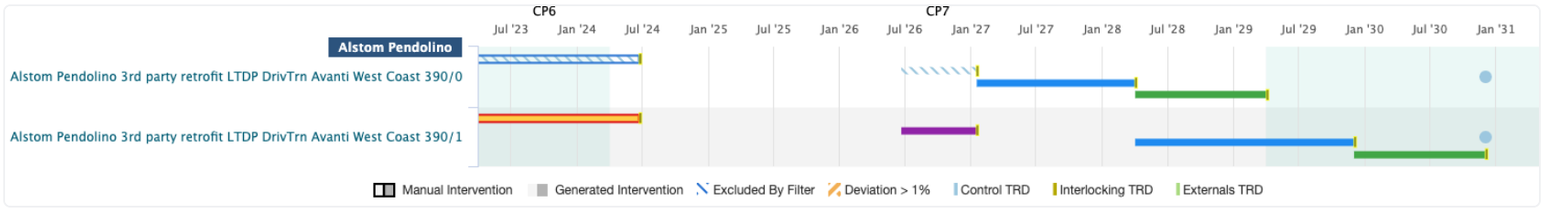
FIC start/end earlier than default - set on the batch with FIC



a. FIC stage performed at the overridden dates, remaining stages as late as possible in time for ETCS

b. FIC highlighted in red with warning - manual override

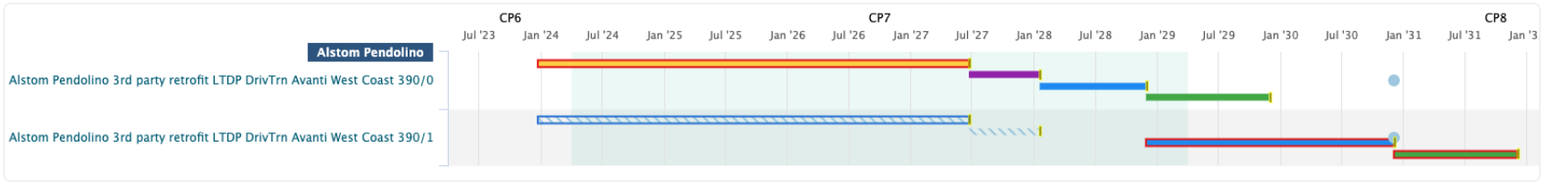
FIC start/end earlier than default - set on the batch without FIC



a. FIC stage performed on the batch that the override is set on

b. FIC highlighted in red with warning - manual override

FIC start/end set later than default - set on batch with FIC



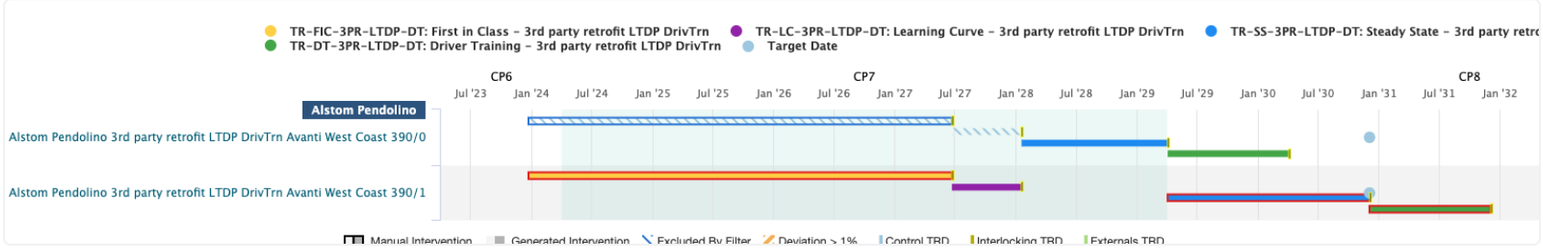
a. FIC positioned to match FIC date, all remaining stages pushed back to match constraints.

b. Warning on FIC - starting in the past, date overridden

c. Warning on SS - breach of ETCS date

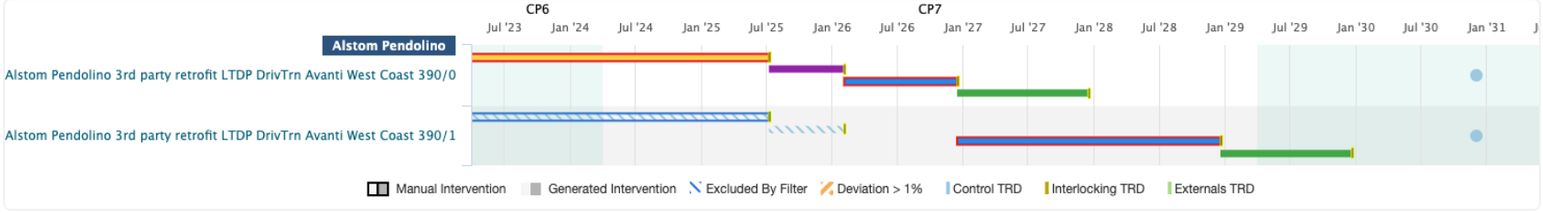
d. Warning on DT - breach of ETCS date

FIC start/end set later than default - set on batch without FIC



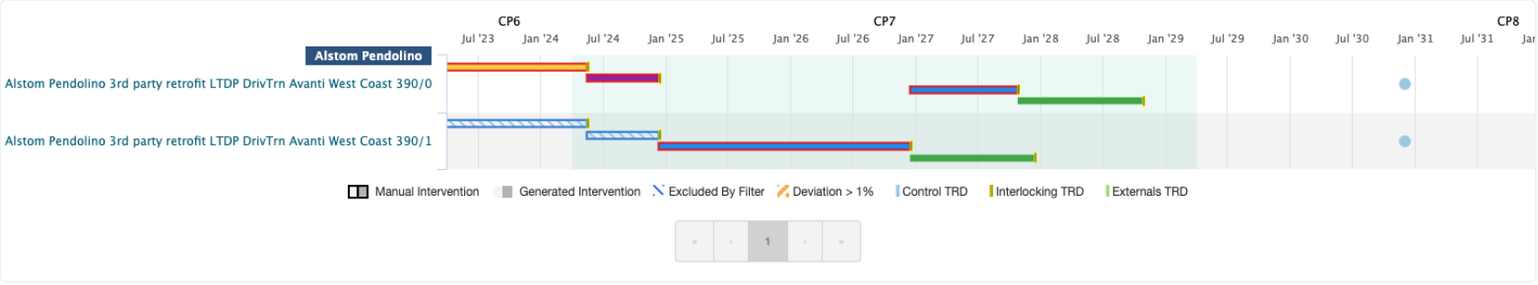
e. same as above but FIC on the opposite subclass

SS start/end earlier than default on earlier SS - set on batch with FIC



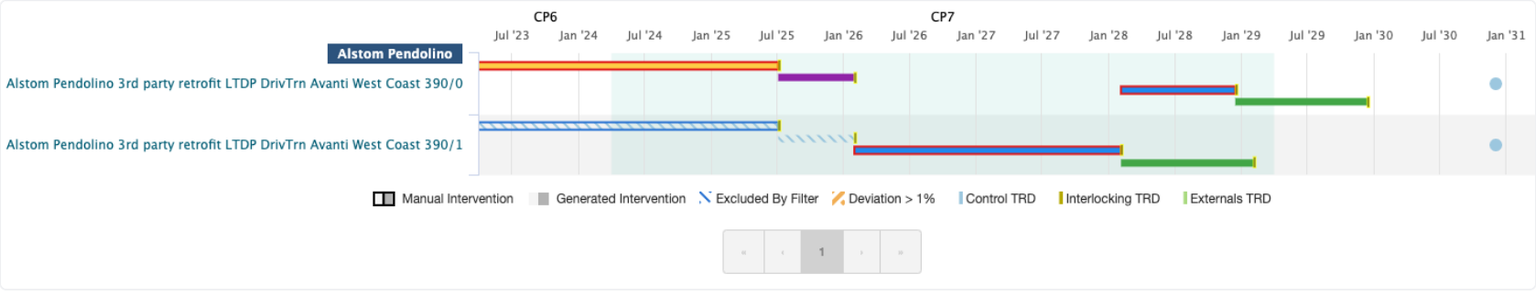
f. SS with override is aligned to the SS start date override, FIC and LC are pushed earlier to satsify constraint, remaining SS and DT are fit in time for ETCS

SS start/end earlier than default on earlier SS - set on batch without FIC



g. SS with override aligned with the date same as above, remainins overrides as soon as possible after

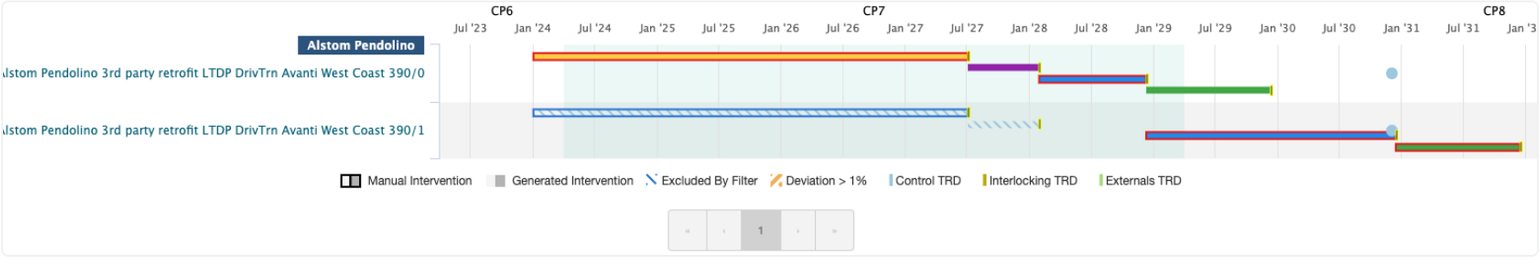
SS start/end later than default - set on batch with FIC



h. earlier SS is aligned to overridden date

i. later SS is chosen to be generated before the earlier SS to satisfy the ETCS date

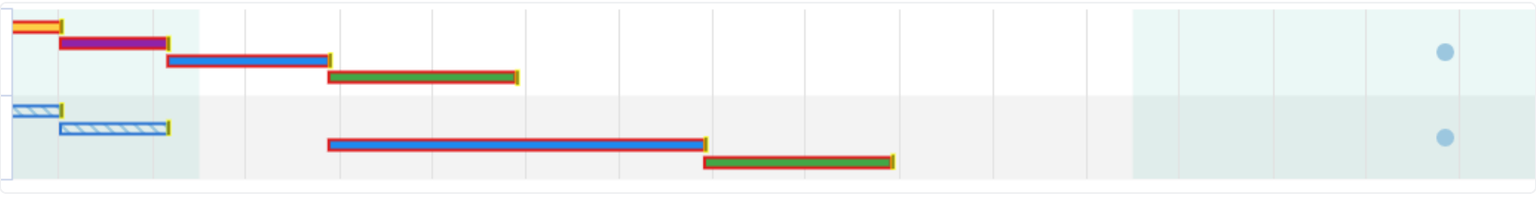
SS start/end later than default - set on batch without FIC



j. later SS set to match the overriden date

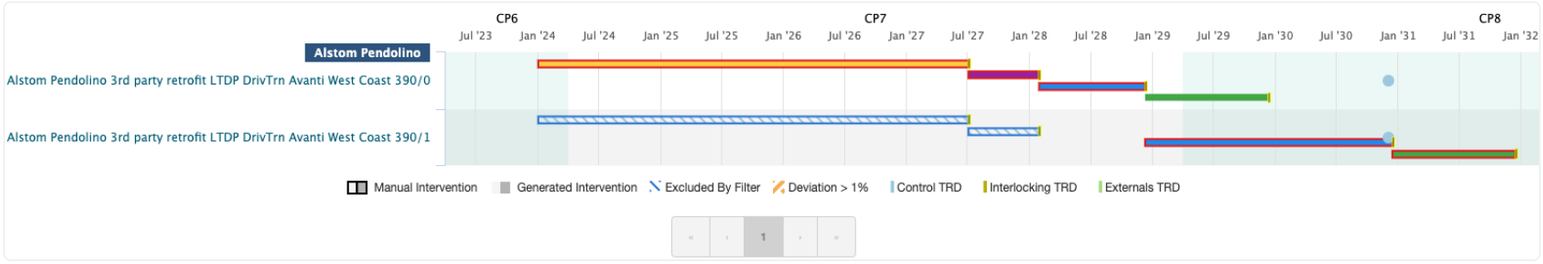
k. remaining deployments adjusted to match, but impossible to satisfy the ETCS date

DT start/end earlier than default - set on batch without FIC



l. DT with override set to match the date overrides, remaining deployments as soon as possible before that

DT start/end later than default - set on batch without FIC



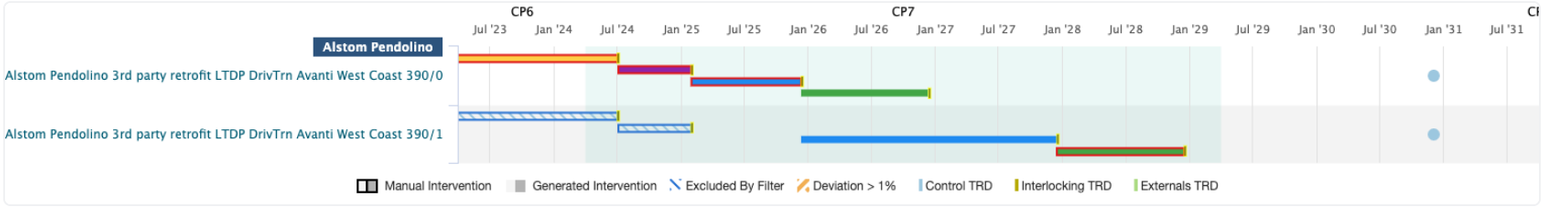
m. DT aligned to overridden date

n. remaining deployments moved to match

Simple - multiple overrides

Move FIC earlier, but align the rest of the deployment straight after FIC

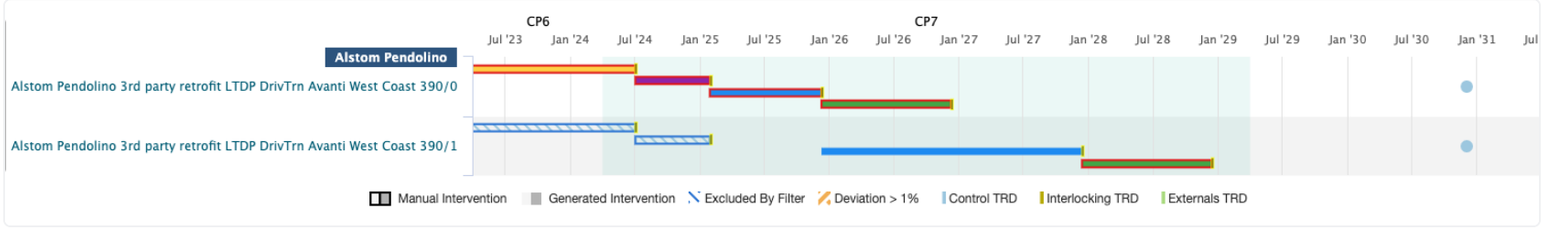
1. FIC end override + DT end override



1. FIC adjusted to hard set date
2. DT end override aligned and deployments scheduled as soon as possible before DT

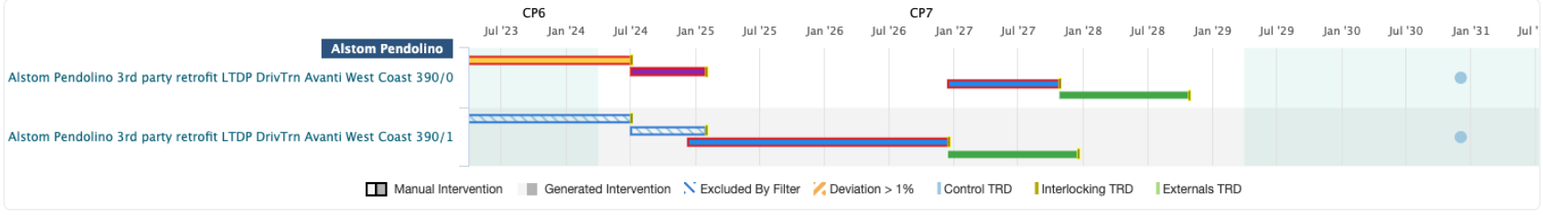
Move FIC earlier, but provide a DT override breaking override aiming to complete deployments earlier

1. Fic end override + DT end override too ealry to fit all deployments



1. FIC set to match the user override
2. DT not aligned with forced dates due to constraints

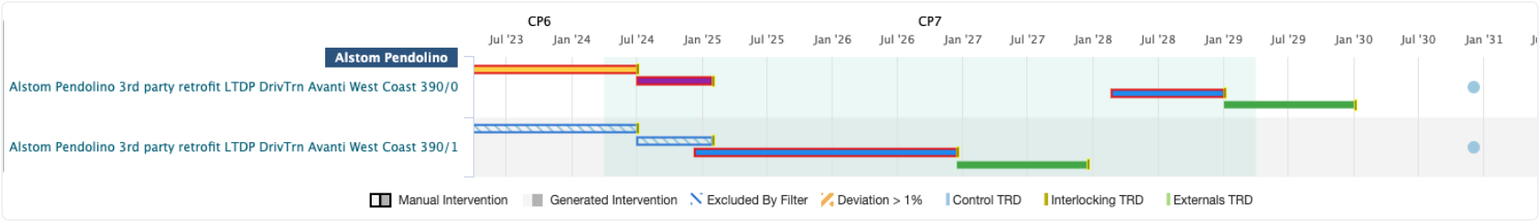
Move FIC earlier, but provide a SS override breaking override aiming to complete deployments earlier



1. FIC aligned with the override date
2. SS aligned with override date

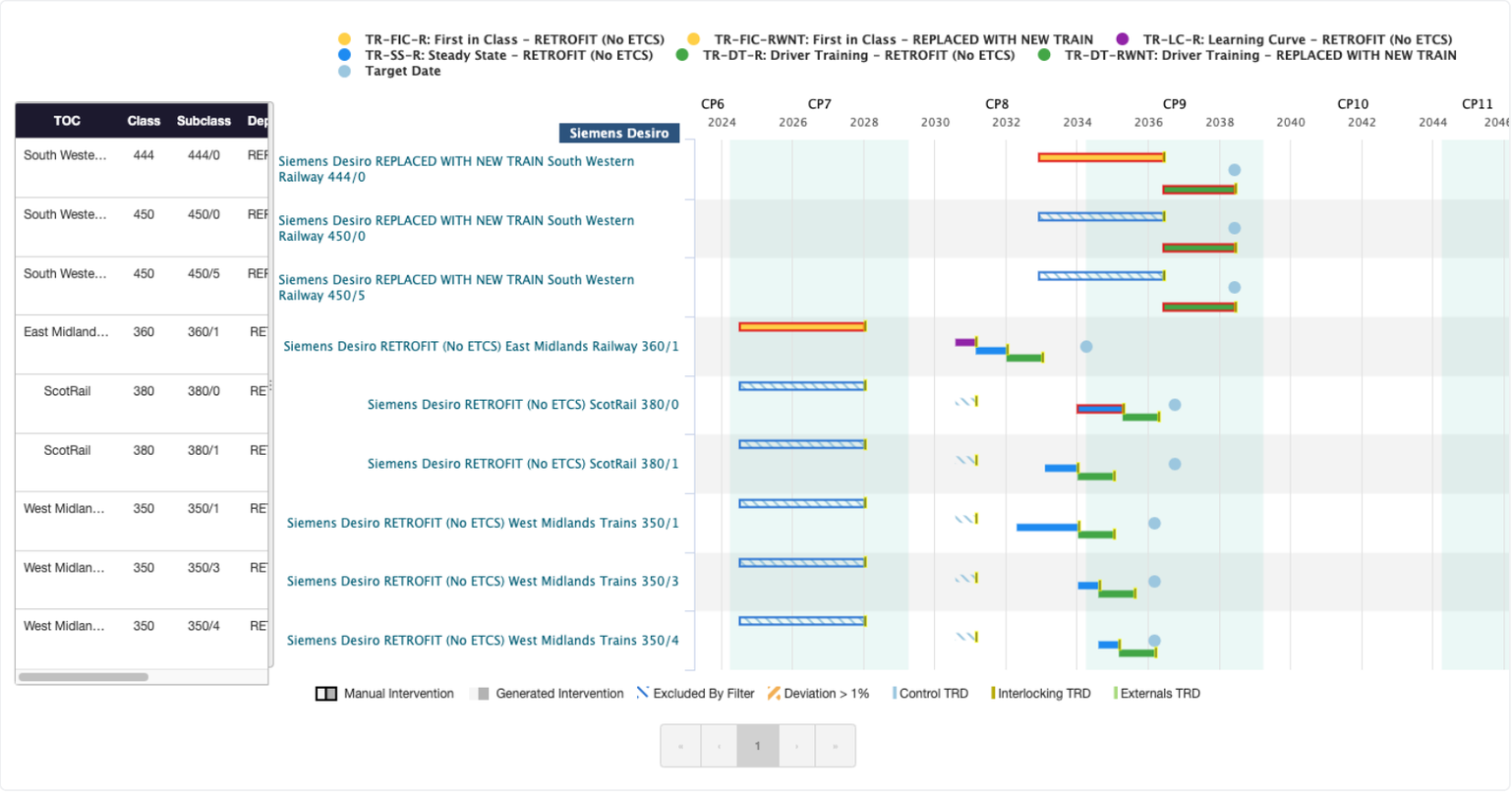
3. Constraints broken as SS overlaps with LC

Move FIC earlier, but provide a SS override breaking override aiming to complete deployments earlier; also set override on another SS



1. Result same as above apart from second SS aligning to the new override date

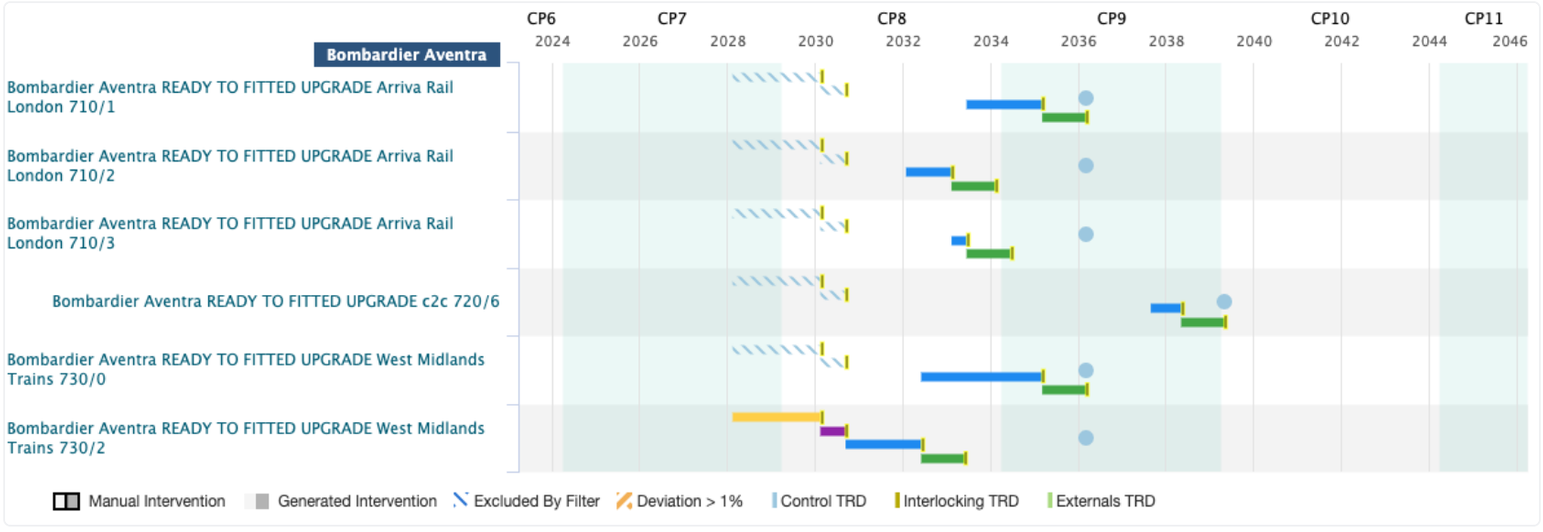
Complex - various subclasses sharing some constraints - Siemens Desiro (FIC family)



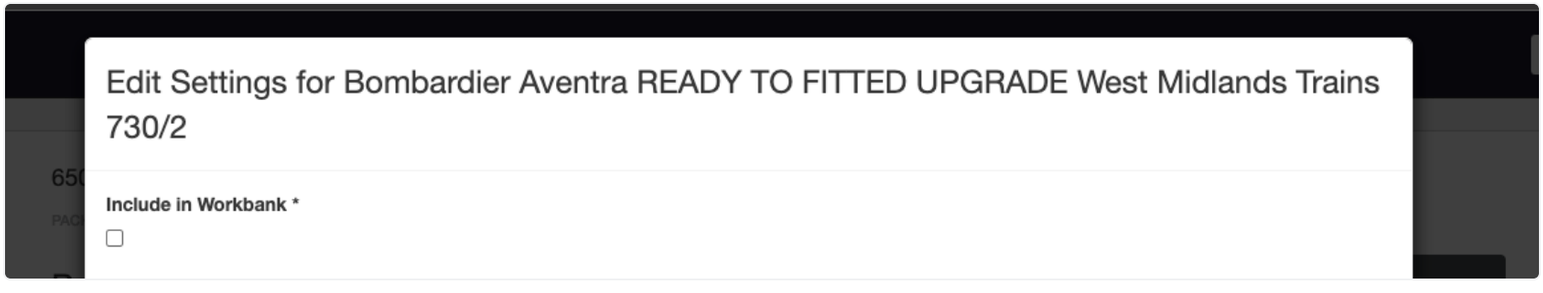
1. FIC override + 360/1 SS override + 180/1 SS override
2. deployments with overrides align to overriden dates
3. remaining deployments scheduled in time for ETCS

Constraints editing funcitonality

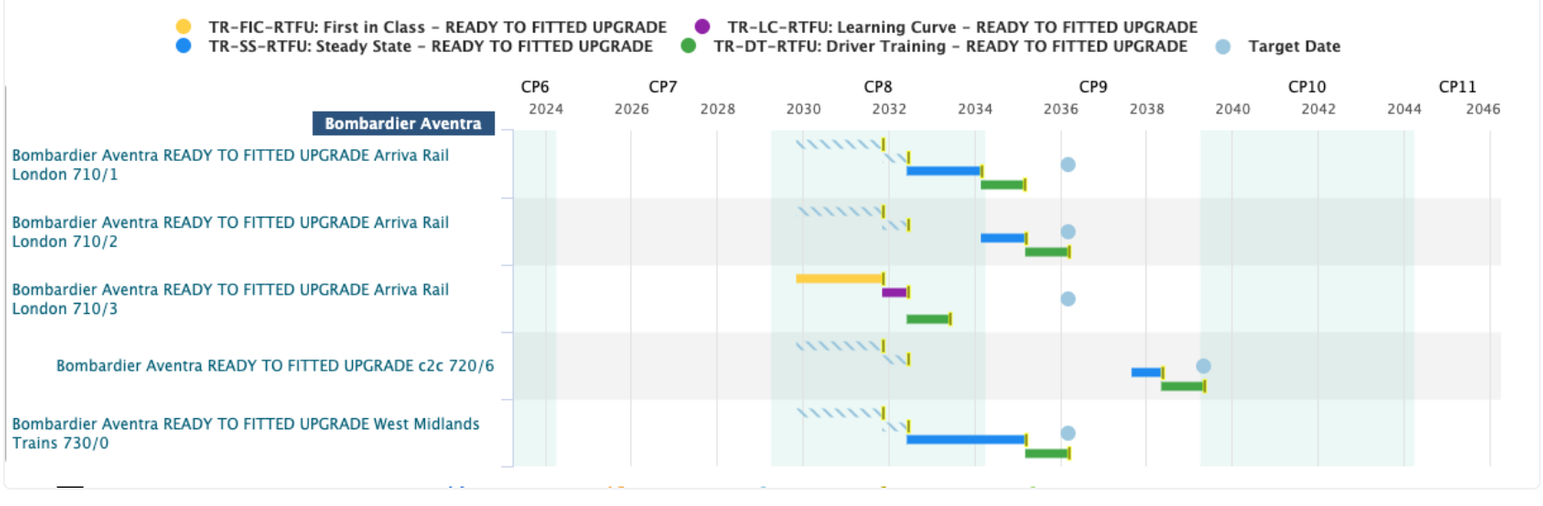
We will be using Aventra FIC family for experimentation. Without constraint changes it looks like this:



Batch exclusion

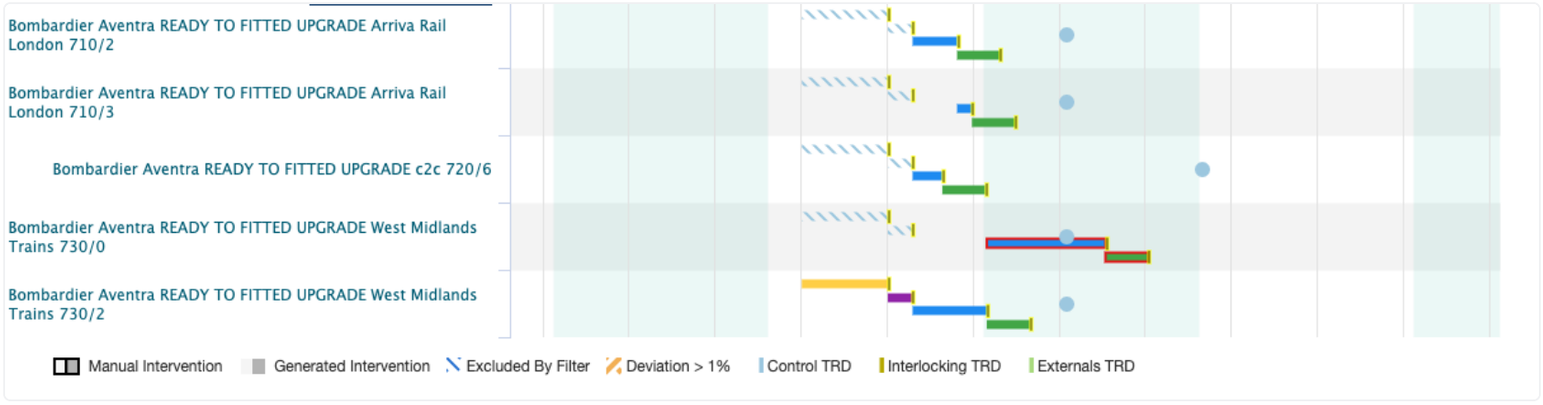


o. removing 730/2 (bottom line) removes the batch from the deployment chain



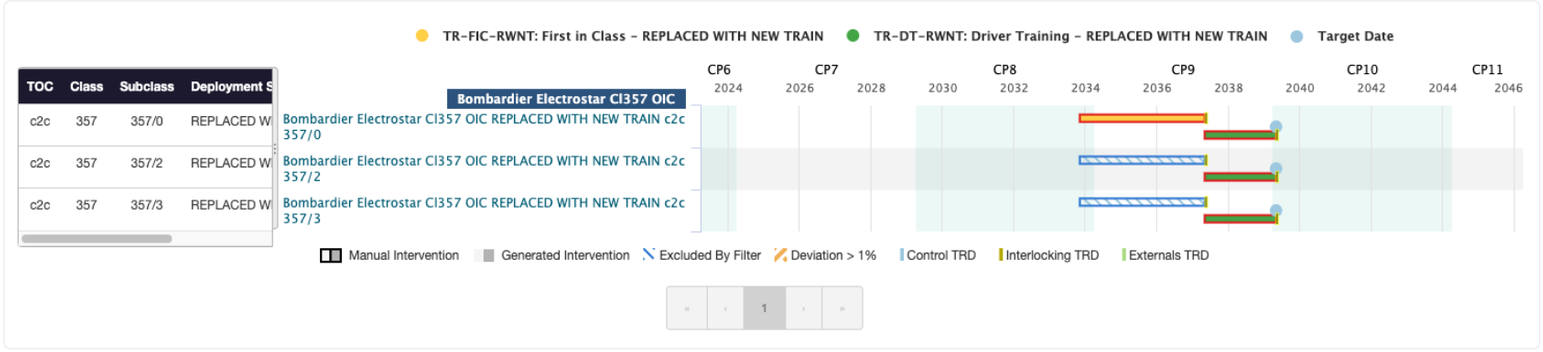
TOC RfP date

This configuration sets the date when contract for TOC commences - setting the earliest possible FIC date for the TOC

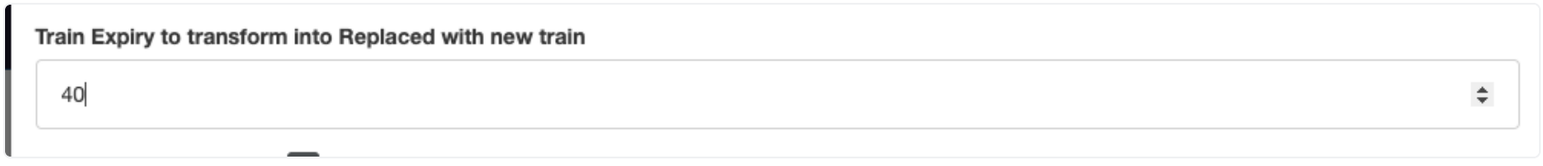


1. Setting 1/1/2030 for west midlands railway
2. Remaining interventions pushed forward

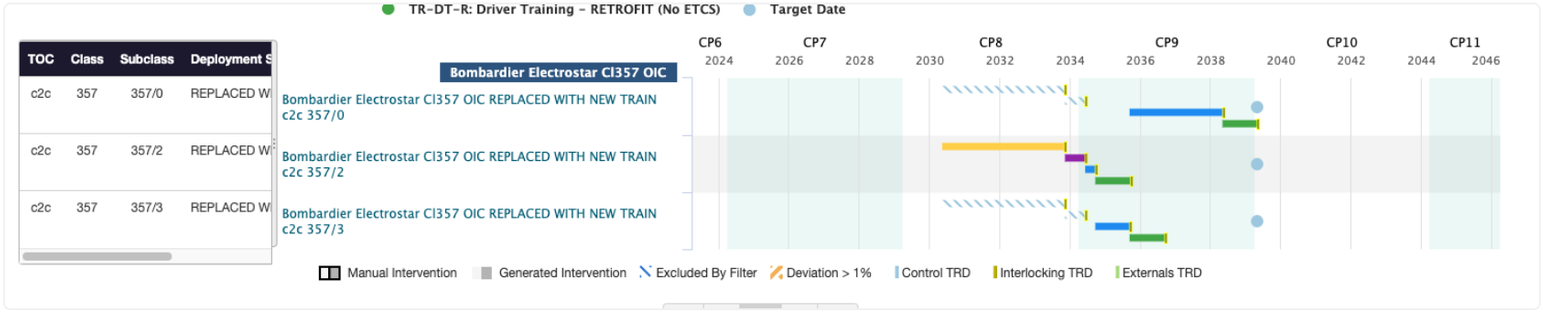
35 year old trains to be changed to "replace with new train" (Bombardier Electrostar Cl357 OIC fic family)



Trains are 38 years old at the ETCS date. We will attempt to change the rule to 40 years

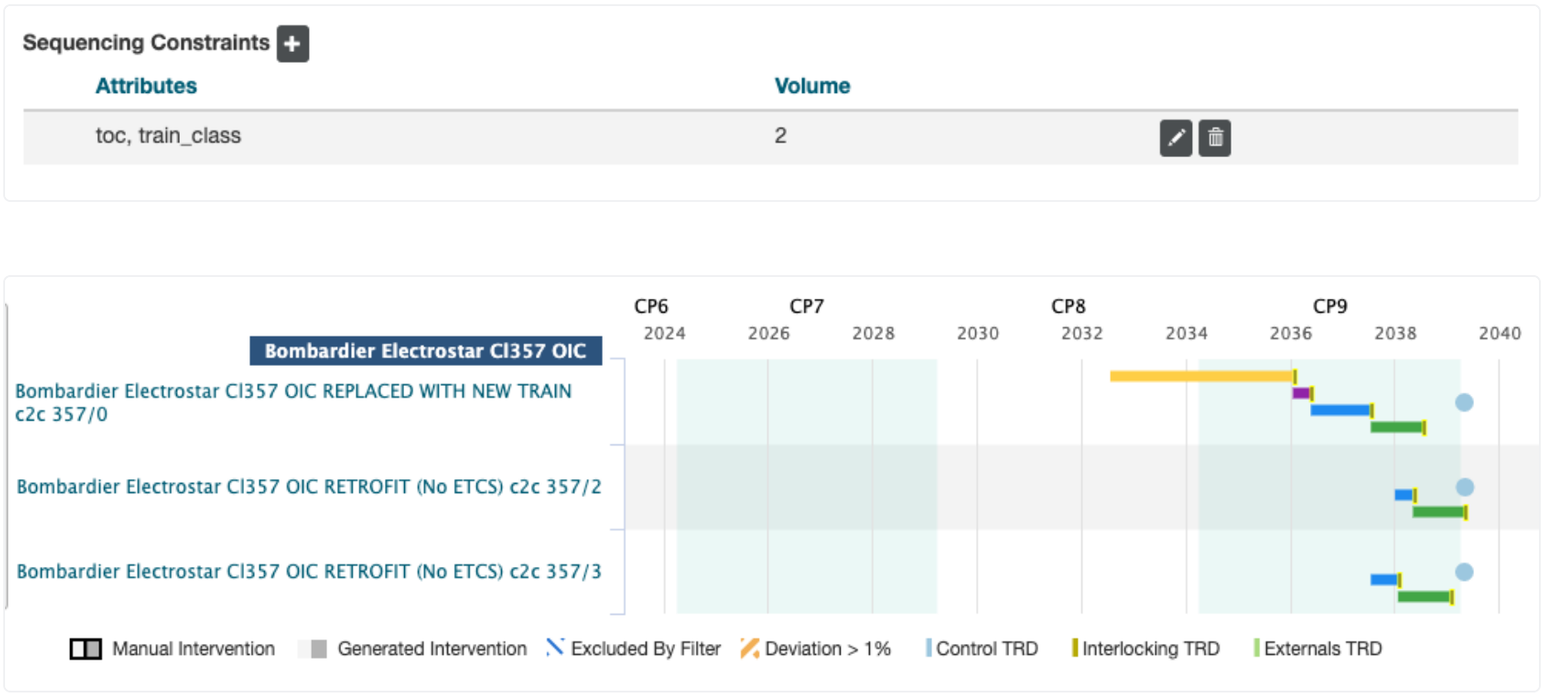


Effect - Train are keeping their original deployment



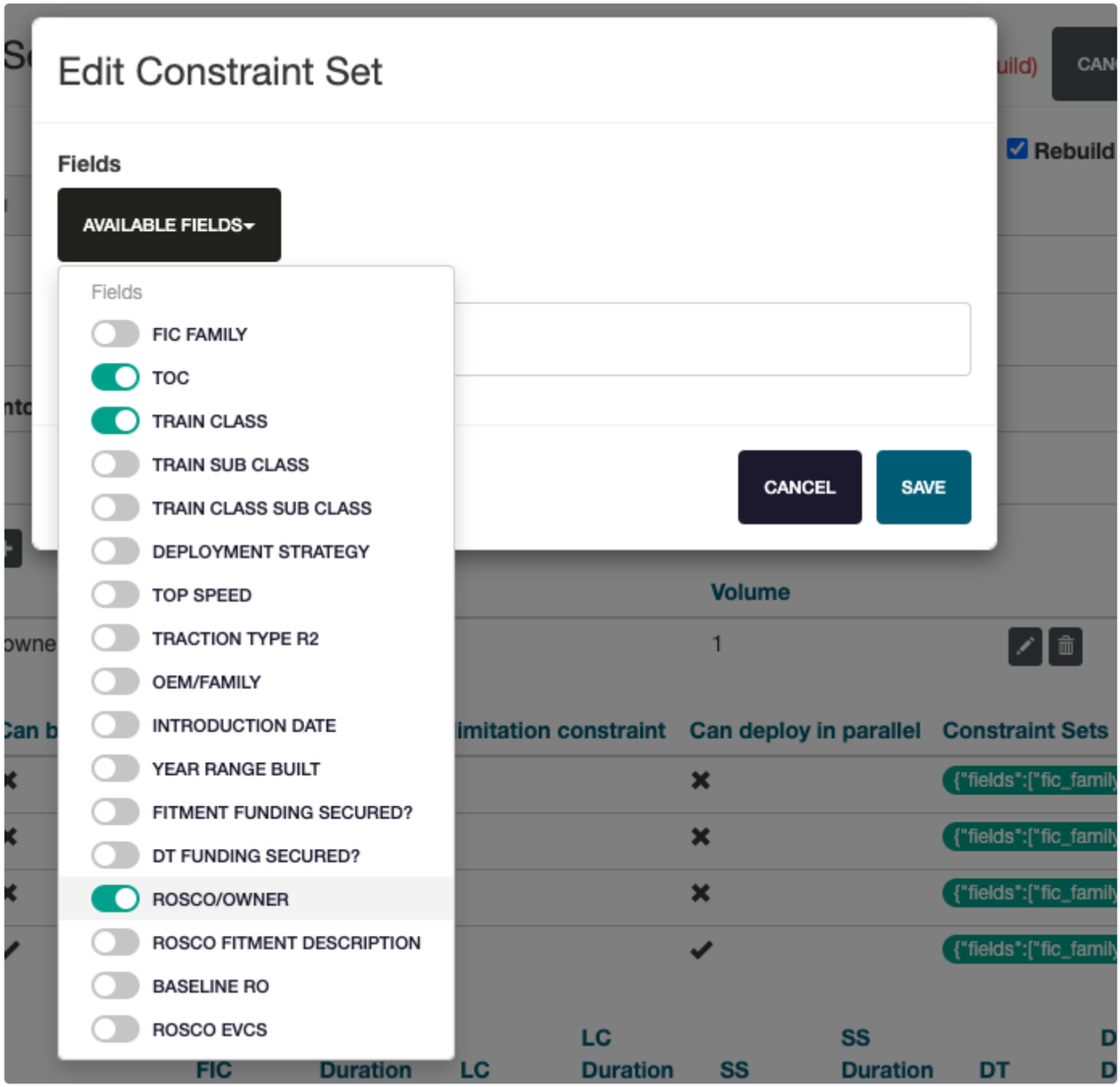
Sequencing Constraint override - volume

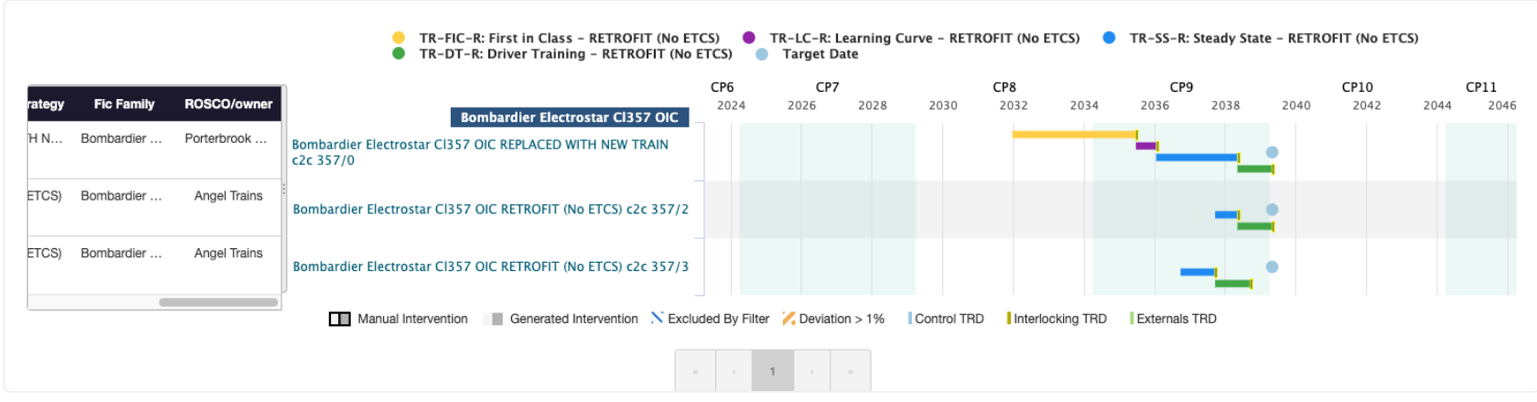
By default only one train per toc per class can be installed at the same time. By changing volume to 2 we can allow for two trains to be deployed at the same time for TOC and CLASS



1. LC and SS halved in duration, DT is unaffected due to parallel characteristic. FIC is unaffected due to having one train.

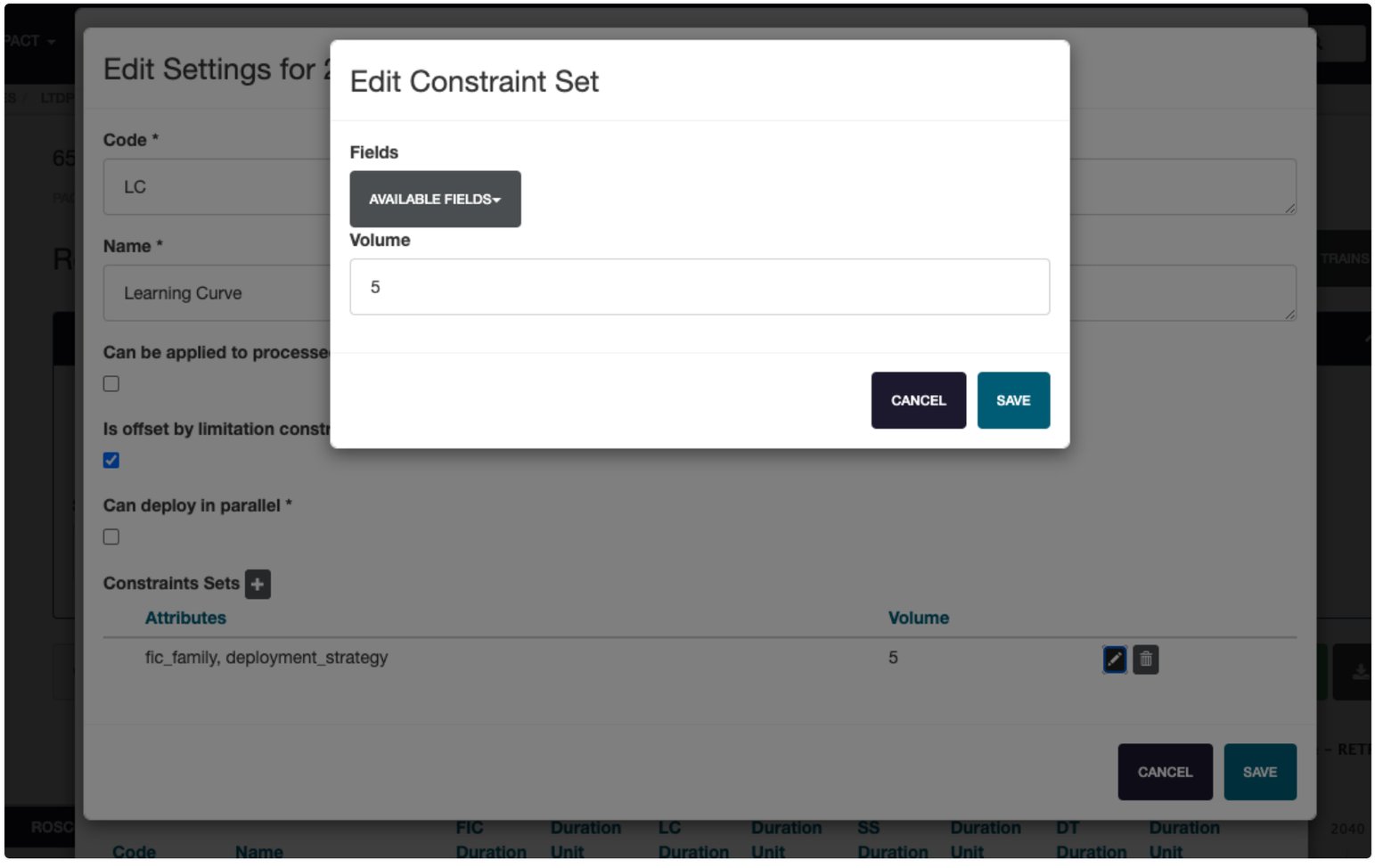
Sequencing Constraint override - attributes



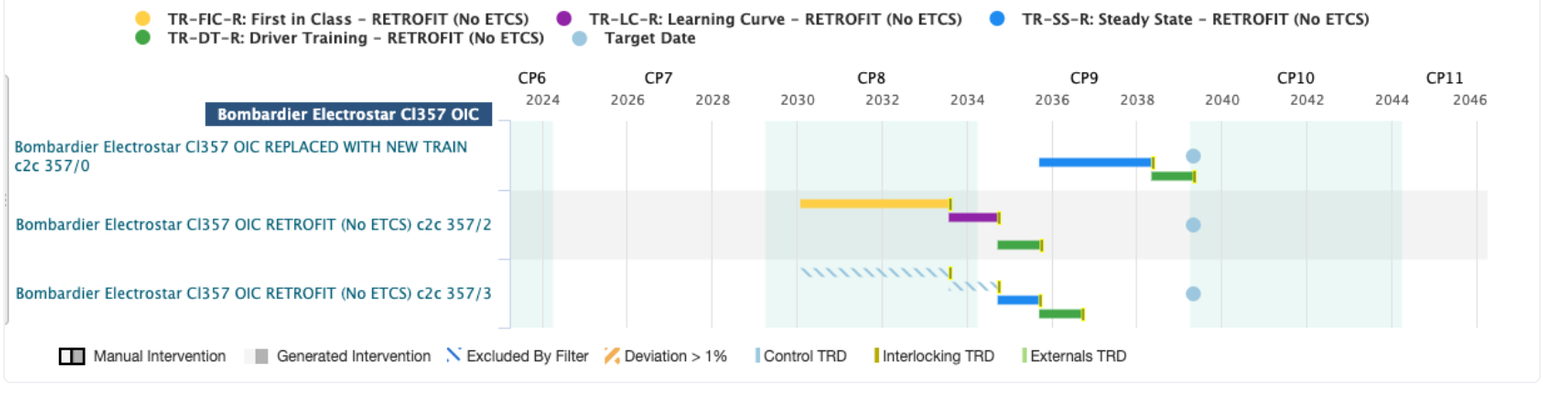


1. Adding ROSCO as and extra constraint to make the constraint - only one train can be deployed per TOC, Train CLASS, ROSCO combination allows for subclass 0 to be done in paralllel with subclasses 2 and 3 because of different ROSCO on subclass 0

Limitation Constraint override - volume



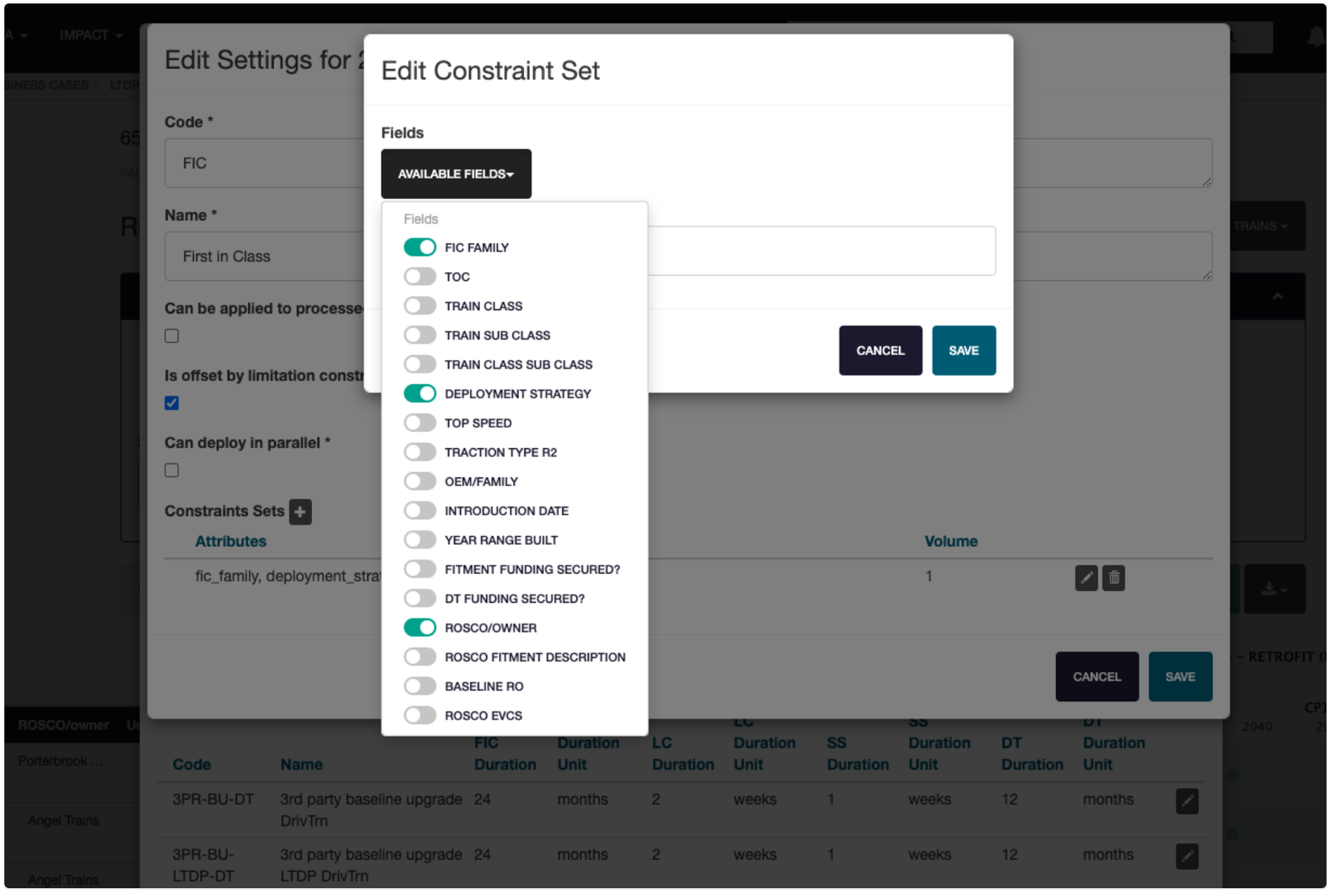
1. Within Edit stage we are going to edit the constraints of LC stage
2. We will change the volume to 10 to enforce 10 trains to go through the LC stage

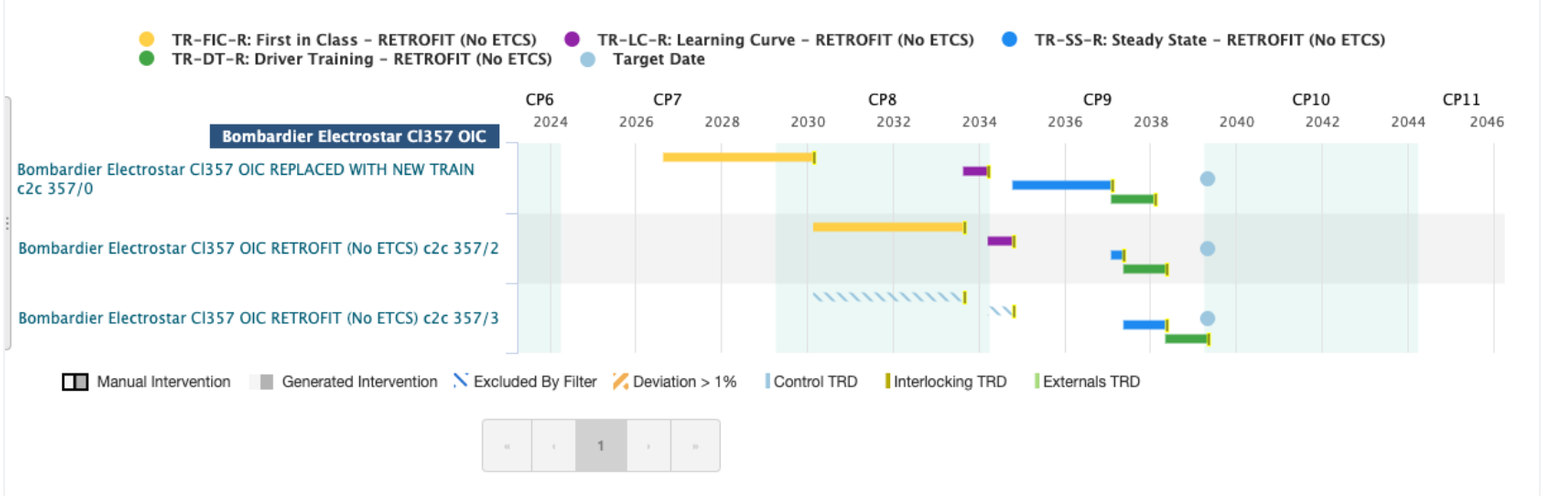


1. 10 trains in LC. Making it total of 11 trains with FIC - hence no SS on class 357/2

Limitation Constraint override - attributes

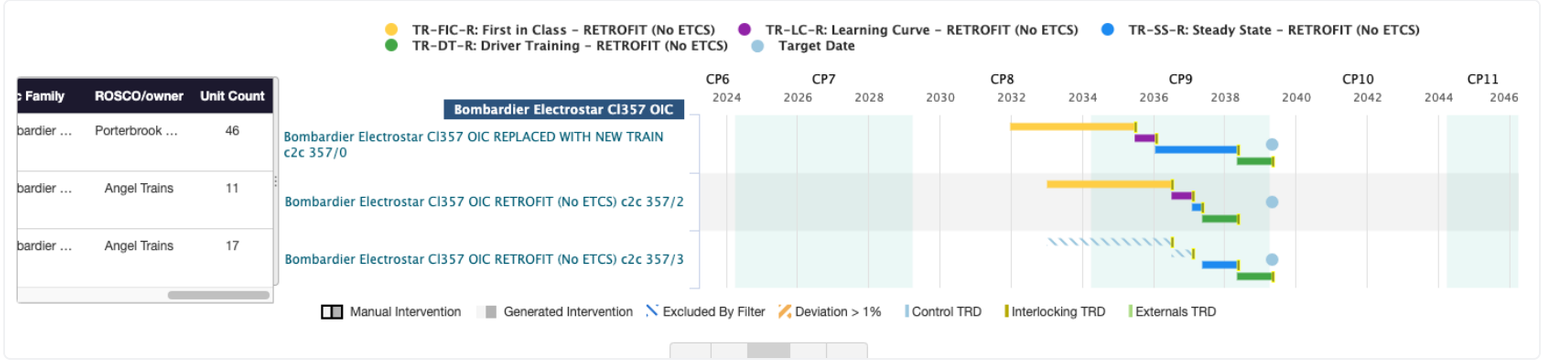
NOTE: limitation constraint attributes have to be updated to match on all stages, otherwise RailBI will raise an error





1. Added ROSCO as an extra limitation constraint on top of deployment strategy and FIC family. Enforcing extra FIC for each ROSCO
2. Notice that FICs and LCs are not deployed in parallel due to the sequencing constraint being TOC/Class, not TOC/Class ROSCO

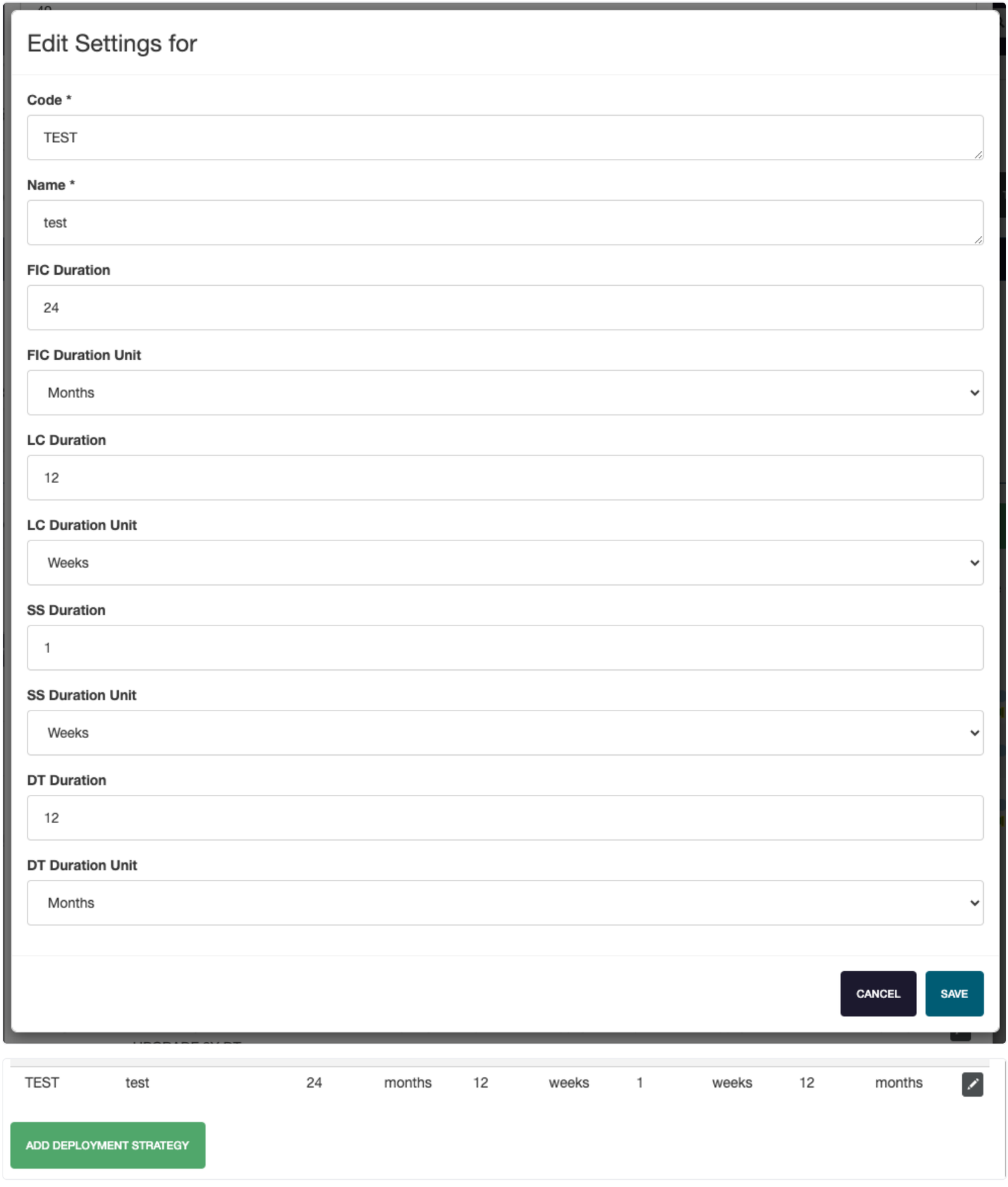
Adding ROSCO to sequencing constraint as above allows for parallel deployment of FICs and LCs



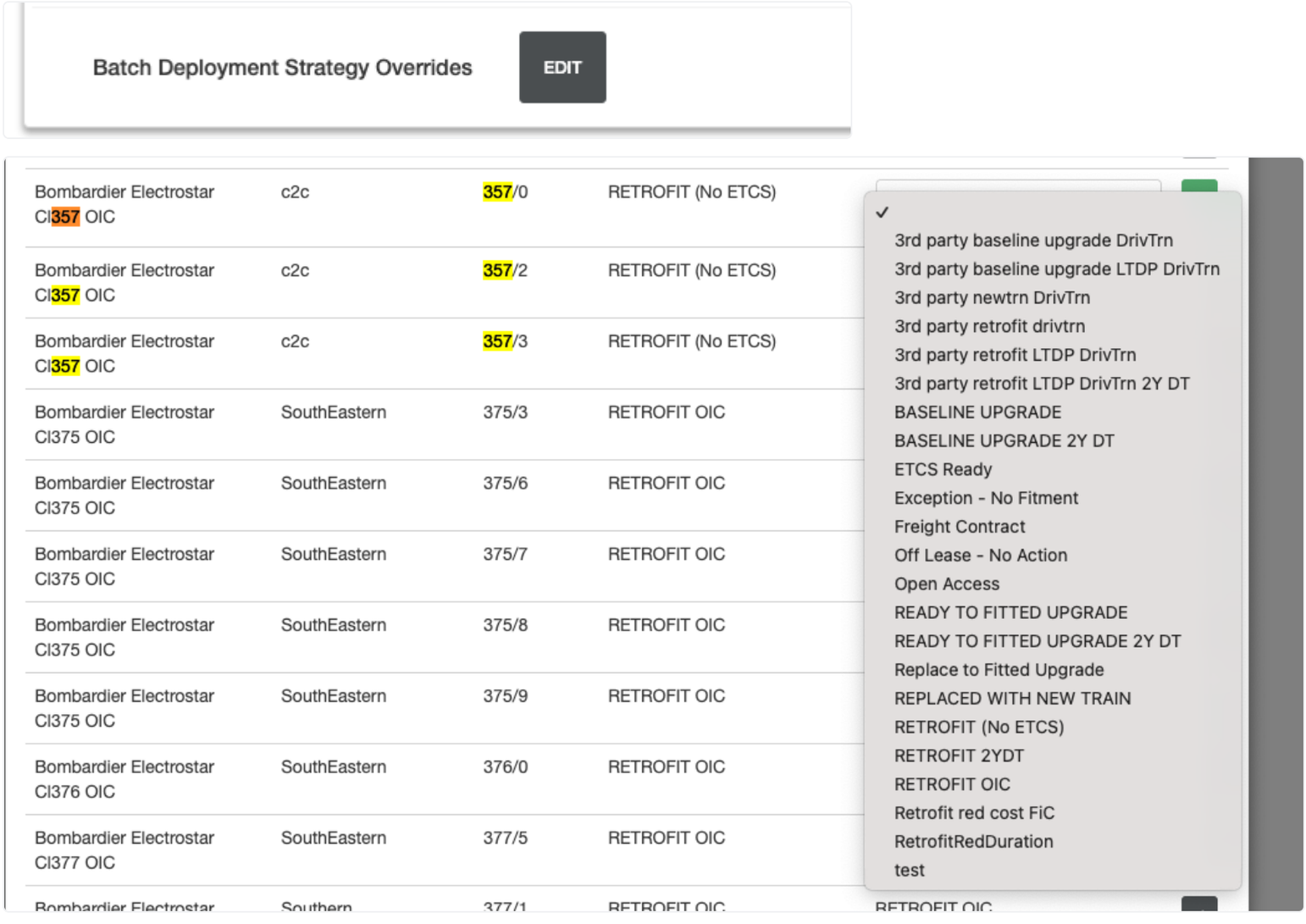
New Deployment Strategy and Deployment Strategy Override

R	RETROFIT (No ETCS)	42	months	6	weeks	3	weeks	12	months	
R-2YDT	RETROFIT 2YDT	42	months	6	weeks	3	weeks	24	months	
R-OIC	RETROFIT OIC	18	months	6	weeks	2	weeks	12	months	
R-RedCostFIC	Retrofit red cost FiC	42	months	6	weeks	3	weeks	12	months	
R-RedDur	RetrofitRedDuration	42	months	6	weeks	2	weeks	12	months	
RTFU	READY TO FITTED UPGRADE	24	months	6	weeks	3	weeks	12	months	
RTFU-2YDT	READY TO FITTED UPGRADE 2Y DT	24	months	6	weeks	3	weeks	24	months	
RWNT	REPLACED WITH NEW TRAIN	42	months	-	-	-	-	24	months	

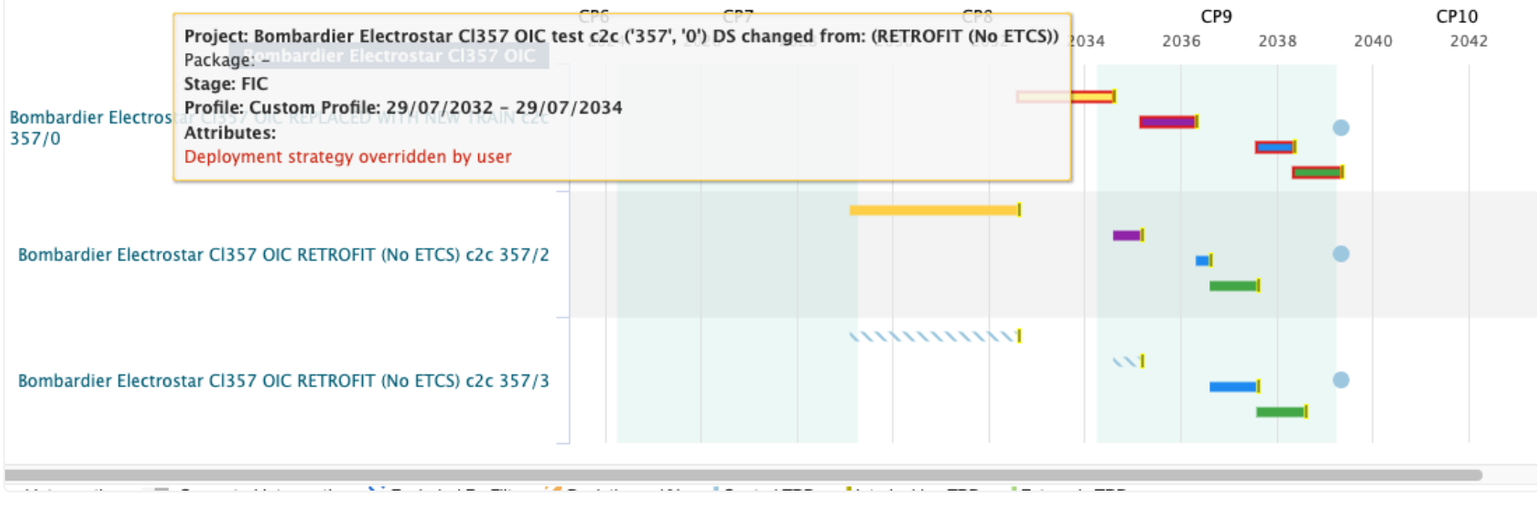
ADD DEPLOYMENT STRATEGY



To Override the deployment strategy use needs to go to advanced settings within the option:



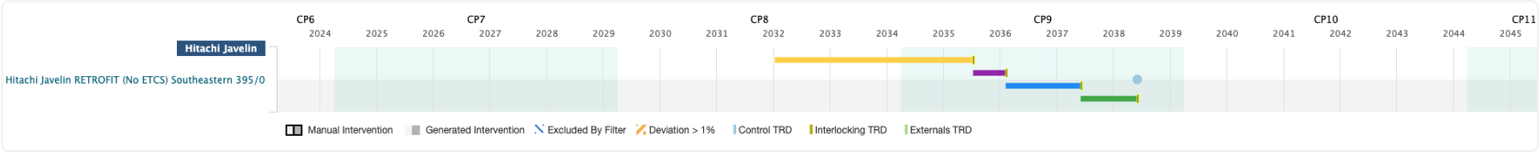
Selecting new deployment strategy for 357/0 subclass.



1. FIC per deployment strategy. Deployments follow the sequencing constraint restriction
2. RailBI highlights that the deployment strategy was overridden

Train-Track mapping adjustment

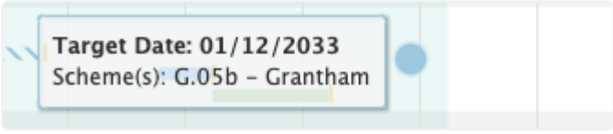
To demonstrate the impact we will be using Hitachi Javelin class 395. Without any changes the deployment looks like this:



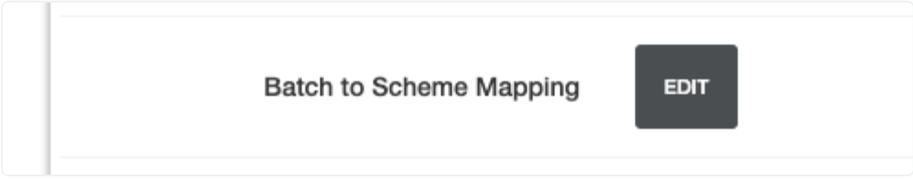
With target date coming from Scheme A.04 on 1/6/2038.

(Note: this is not a realistic scenario)

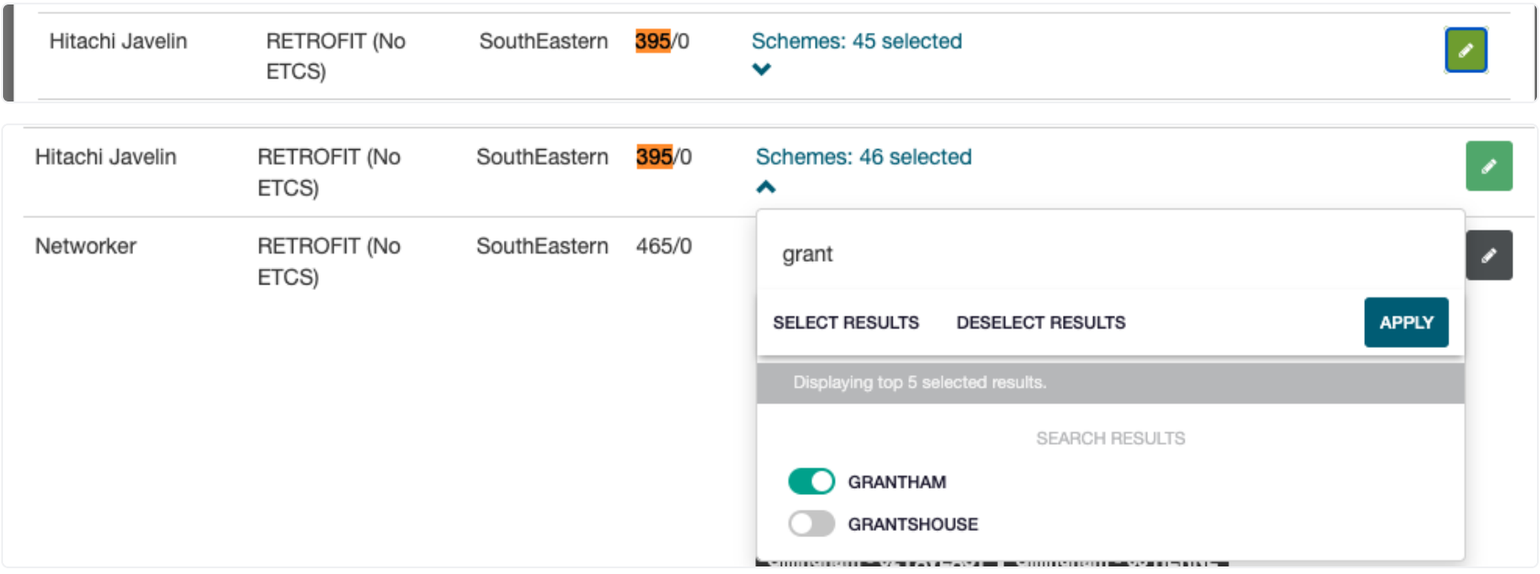
1. We will add one of the intelockings of the G.05b - Grantham scheme that is dated for 1/12/2033 to the batch to sccheme map of class 395



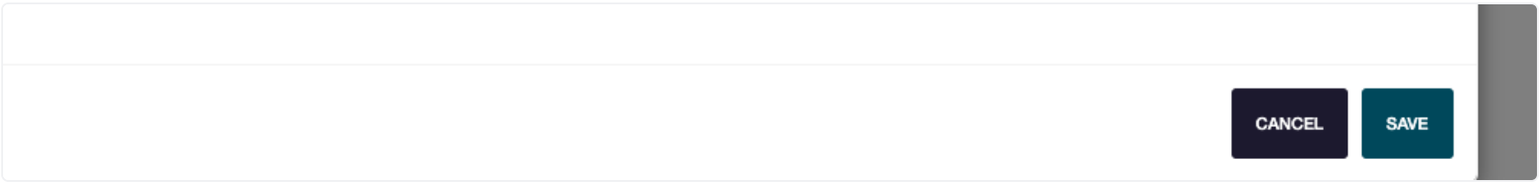
2. Mapping of train batches to interlockings can be adjusted via advanced setting.



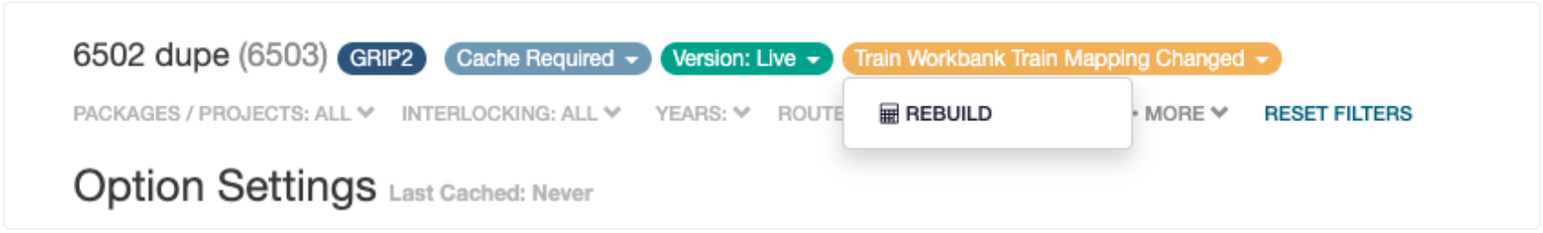
3. We will search (via ctrl+F) for 395



3. Then we need to press save



4. Change of batch to Scheme requires the rebuild of the ETCS Level 2 projects so we need to trigger the option rebuild (20 min)



4. Upon rebuild the 395 batch is picking up the date from the G.05b date as expected