

Control Period 6 (CP6) Variable Usage Charge (VUC) guidance document – the calculation and approval of new rates

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Version 1



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1. Control Period 6 Variable Usage Charge guidance

1.1. What is the purpose of this document?

The purpose of this document is to set out the process for the calculation and approval of new Variable Usage Charge (VUC) rates in Control Period 6 (CP6). By new VUC rates we mean rates not on the CP6 Track Usage Price List published on 20 December 2018 and available on our website [here](#). This price list is shown in 2017/18 prices, however, updated versions of the price list reflecting the impact of inflation are also provided on our website [here](#).

This document also details the information required in to calculate new VUC rates and how to use the CP6 VUC calculator, a spreadsheet tool, available to interested stakeholders to calculate new VUC rates for CP6.

1.2. How is this document structured?

The remainder of this document is structured as follows:

- Who may find this document useful?
- What is the VUC?
- What is the background to this document?
- In what situations should a new VUC rate be calculated?
- When should an operator request a new VUC rate?
- What is the process for calculating and agreeing a new VUC rate?
- What will happen if a VUC rate is not agreed for a new vehicle type?
- What is the CP6 VUC calculator?
- How do I calculate a new passenger VUC rate?
- How do I calculate a new heritage operator VUC rate?
- How do I calculate a new freight VUC rate?
- Who should I speak to in Network Rail about this document?
- What about version control?
- Appendix 1 – New VUC rate letter template
- Appendix 2 – Version control

1.3. Who may find this document useful?

Anyone who is interested in the process regarding the calculation and approval of VUC rates for new or modified vehicles may find this document useful. Potential interested parties may include colleagues at train operating companies (passenger, freight, open access and heritage train operators), vehicle owners, vehicle manufacturers, the Office of Rail and Road (ORR) and Network Rail.

1.4. What is the VUC?

The VUC is one of a range of track access charges payable by train operators to Network Rail for use of its infrastructure. The purpose of the charge is to allow Network Rail to recover its efficient operating, maintenance and renewal costs that vary with traffic levels (e.g. track 'wear and tear' costs).

The charge is designed to be cost reflective and as a result ‘track friendly’ vehicles which cause less ‘wear and tear’ to the network are subject to lower VUC rates than vehicles which are more damaging. Theoretically, levying the charge should mean that, from a ‘wear and tear’ perspective, Network Rail is not disincentivised from accommodating additional traffic (i.e. it is recompensed for the ‘wear and tear’ resulting from more trains on the network).

1.5. What is the background to this document?

For CP5 Network Rail developed a guidance document setting out how to calculate new VUC rates. The CP5 guidance document was published on our website and iterated during the control period to provide further clarity in certain areas. This document updates the CP5 guidance document for CP6, following the 2018 Periodic Review (PR18).

1.6. In what situations should a new VUC rate be calculated?

A new VUC rate should be calculated in any of the following scenarios:

- Where a vehicle type due to begin operating on the network is not on the CP6 Track Usage Price List;
- Where a vehicle type already operating on the network is not on the CP6 Track Usage Price List; or
- Where a vehicle type has been modified following the publication of the CP6 Track Usage Price List on 20 December 2018 and as a result the vehicle characteristics (discussed in more detail, below) which determine the VUC rate have changed.

Except for the above instances, the Track Usage Price List published on 20 December 2018 will apply for the whole of CP6 and only be adjusted annually for inflation.

To reinforce the intention that the Track Usage Price List should not be re-opened during the control period, even if errors are subsequently identified, ORR changed the wording of the passenger track access contract in PR13. Specifically, ORR determined that the provision to change VUC rates in light of “*manifest errors*” should be removed from the contract. A similar provision did not exist in freight track access contracts.

1.7. When should an operator request a new VUC rate?

To help ensure that an appropriate VUC rate is available from the date that the relevant vehicle begins operating on the network, we suggest that as soon as the necessary vehicle characteristic information is available the operator initiates the process set out in Figure 1, below.

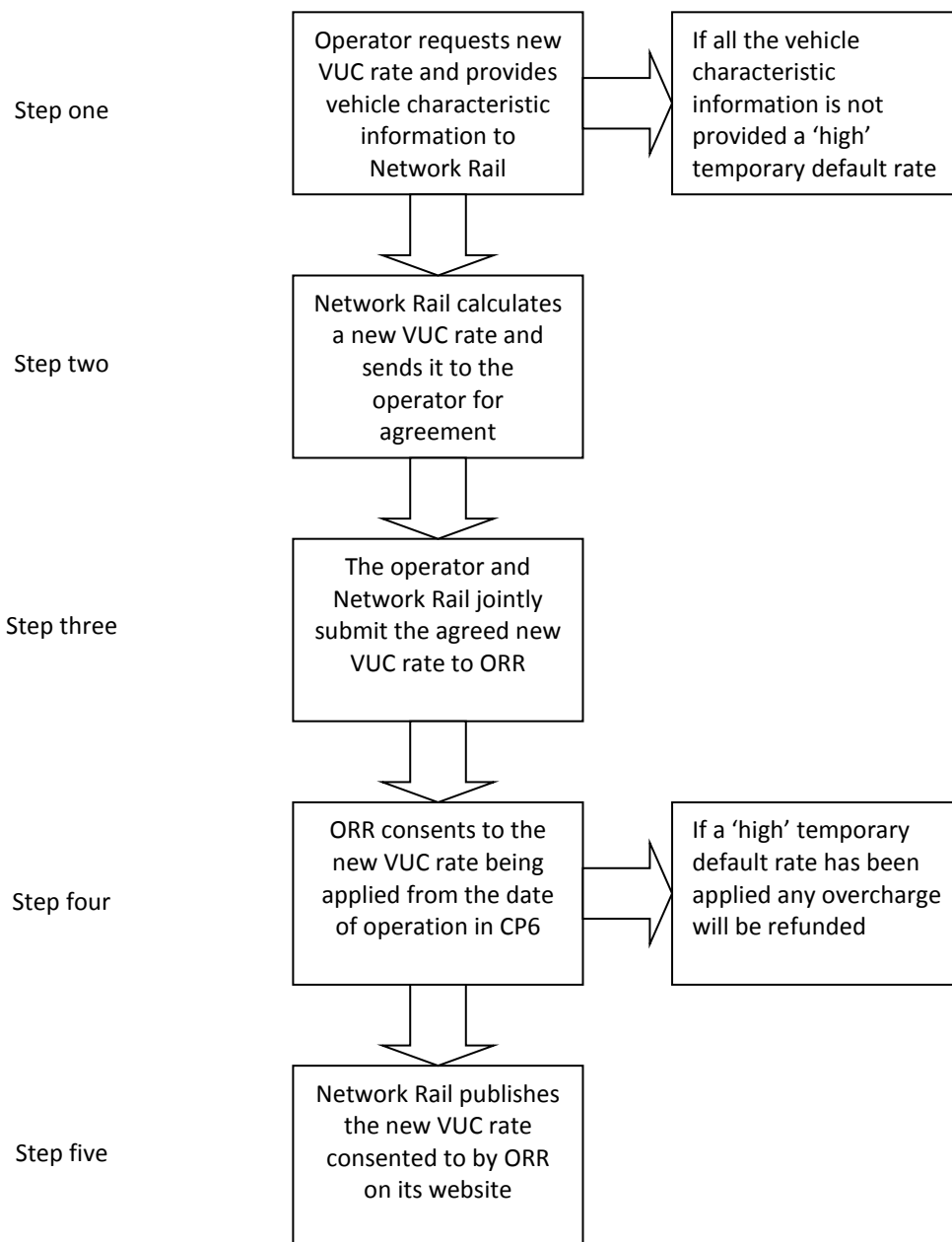
For new vehicles, most of the vehicle characteristic information necessary to calculate a new VUC rate is likely to form part of the overall suite of information prepared prior to obtaining a Statement of Compatibility (the document confirming that the vehicle is compatible with our infrastructure) from Network Rail. Therefore, we would encourage all parties involved in the vehicle compatibility process to be cognisant of the need to identify this information for charging purposes and, if possible, share it with the relevant train operator as early as possible. It is likely to be more efficient at this stage of the process to supply any information which, although not required to demonstrate compatibility with the infrastructure, is necessary to calculate the VUC rate. For example, information about the primary yaw

stiffness or the results of vehicle dynamics modelling necessary to determine the vehicle 'curving class' (discussed in more detail, below) and / or establish a freight vehicle's Ride Force Count (also discussed in more detail, below). Information in relation to the unsprung mass of a new vehicle may also be more easily obtained from the relevant party at this stage in the process.

1.8. What is the process for calculating and agreeing a new VUC rate?

The high-level process for calculating and agreeing new VUC rates is set out in Figure 1, below. As discussed in more detail in Section 1.9, below, if a new VUC has not been agreed by ORR prior to the vehicle operating on the network a 'high' temporary default rate will automatically apply. Once a new VUC rate has been determined by ORR, any difference between this rate and the 'high' temporary default rate will be refunded to the train operator.

Figure 1: High-level process for calculating and determining new VUC rates



Step one – requesting a new rate

- The *pro forma* setting out the vehicle characteristic information that the operator should provide to Network Rail to calculate a new VUC rate is available from Network Rail’s website [here](#). This information is also set out in Sections 1.11, 1.12 and 1.13 below for passenger, heritage and freight vehicles respectively.
- The completed vehicle characteristic information *pro forma* should be sent by the operator to the Network Rail customer team. The customer team will then forward this information to the Network Rail Track Access Billing team who will calculate the VUC rate.
- Requests for a new VUC rate and the provision of vehicle characteristic information should be made in writing (email is acceptable). Network Rail also has the option to propose a new VUC rate, if it considers this to be appropriate.
- As discussed in more detail in Section 1.9, below, if all the relevant vehicle characteristic information is not provided a ‘high’ temporary default rate will automatically apply.

Step two – calculating a new rate

- The operator may wish to use the CP6 VUC calculator to calculate the new VUC rate itself and provide this information to Network Rail, alongside the vehicle characteristic information. In this situation Network Rail would review the operator’s calculation to confirm that the correct rate has been calculated. The CP6 VUC calculator can be downloaded from our website [here](#), further guidance in relation to using the calculator is provided, below. This is a link to the ‘official’ version of the CP6 VUC calculator, which should always be used to calculate rates for submission to ORR. Rates should be submitted to ORR in 2017/18 prices. A version of the CP6 VUC calculator which allows VUC rates to be calculated in current prices is also available on our website, however, this is provided for information only.
- The new VUC rate calculated by the Network Rail Track Access Billing team will be sent to the operator by the relevant Network Rail customer team for agreement.

Step three – submitting a new rate to ORR

- If Network Rail and the operator agree the new VUC rate a joint submission should be made to ORR in writing requesting that it consents to this new rate. A template letter for this submission is provided in Appendix 1. The Network Rail customer team, with support from other Network Rail colleagues as appropriate, should work with the train operator to populate the template before submitting it to ORR.
- If Network Rail and the operator agree an appropriate VUC rate this will, generally, result in the VUC rate being consented to by ORR in a timelier manner than when both parties are unable to reach agreement. Therefore, it is in both parties’ interest to work collaboratively to agree a new VUC rate.

- If Network Rail and the operator cannot agree a new VUC rate either party has the option to refer the issue to ORR for determination. This referral to ORR must be made in writing at least 45 days after the new VUC rate was proposed by one of the parties.

Step four – ORR determination

- If the vehicle type has not yet began running on the network, it will pay the new VUC rate consented to by ORR from the date of operation in CP6 and no re-charge will be required.
- If the new VUC rate is consented to by ORR after the new vehicle type begins operating on the network a re-charge will be required. The reason for this is that, as discussed in more detail in Section 1.9, below, prior to the determination of a new VUC rate the vehicle type will automatically be subject to the relevant temporary default rate. Because this default rate is set at the highest relevant rate on the price list it is likely that the operator will be due a refund equal to the difference between the agreed VUC rate and the default rate. Network Rail will issue an adjusting invoice or credit note in relation to any money due / owed within 28 days of ORR consenting to the new VUC rate.
- Where a new VUC rate has been calculated to reflect a vehicle modification, the operator should provide its Network Rail customer team with a schedule setting out the date it expects each vehicle be modified. This should allow the new VUC rate to be applied to individual vehicles as they are modified. If it becomes apparent that the modification date of a vehicle will vary from that set out in the schedule provided to Network Rail, it is the operator's responsibility to inform Network Rail so that this can be appropriately reflected in charges.
- If ORR does not initially consent to the VUC submitted by Network Rail and the operator, it may be necessary to provide additional supporting information and / or make a new joint submission, as required by ORR.

Step five – publication of the new rate

- Following ORR consenting to a new VUC rate, within 28 days, Network Rail will publish on its website¹ details of the new VUC rate alongside other new CP6 rates. Network Rail's Regulatory Economics team will be responsible for the publication of this information.

1.9. What will happen if a VUC rate is not agreed for a new vehicle type?

If in CP6 a vehicle type operates on the network without a new VUC rate consented to by ORR it will be charged the relevant VUC default rate, set out on the Track Usage Price List and shown, below.

¹ Available at: [here](#)

Passenger Variable Usage Charge default rates

Vehicle Type	Pence per vehicle mile (2019/20 prices)
Locomotive	100.51
Multiple unit (motor)	45.35
Multiple unit (trailer)	21.16
Coach	17.46

Freight Variable Usage Charge default rates

Vehicle Type	£/kGTM (2019/20 prices)
Locomotive	8.0724
Wagon (laden)	5.4730
Wagon (tare)	2.8227

These rates will be charged, uplifted annually for inflation (CPI), until such a time that a bespoke CP6 VUC rate is consented to by ORR. The CP6 VUC default rates are set at the highest rate on the CP6 Track Usage Price List for each type of vehicle and thus provide a strong incentive to operators to provide the information necessary to calculate the correct VUC rate. However, once a bespoke VUC rate is agreed all journeys charged at the default rate will be refunded and recharged at the newly agreed CP6 rate (i.e. the net impact will be that all journeys will be charged at the cost reflective bespoke VUC rate rather than the higher default rate).

1.10. What is the CP6 VUC calculator?

To calculate VUC rates for vehicle types not initially on the CP6 price list we have developed a CP6 VUC calculator - a spreadsheet tool which, when input with the relevant vehicle characteristic information, will calculate a new VUC rate using the same engineering methodology that underpins the published price list. This rate can then be submitted to ORR for approval before being applied in CP6.

The calculator has been provided to interested stakeholders and can also be downloaded from our website [here](#). This is a link to the 'official' version of the CP6 VUC calculator which should always be used to calculate rates for submission to ORR in 2017/18 prices. A version of the CP6 VUC calculator which allows VUC rates to be calculated in current prices is also available on our website, however, this is provided for information only.

1.11. How do I calculate a new passenger VUC rate?

Figure 2 shows the input screen used for calculating new passenger VUC rates.

Figure 2: VUC calculator passenger input screen

Existing vehicle

New vehicle name Price base

Vehicle type Passenger Freight

Locomotive/coach/MU Locomotive Coach or multiple unit

Vehicle type Motor Trailer

Descriptor

Vehicle weight (tonnes) Total number of seats

(For passenger vehicles, weight should be the vehicle tare weight)

Number of axles

Unsprung mass (kg/axle)

Vehicle maximum speed (mph)

User calculated operating speed?

Use route-based maximum speed?

Curving class

User-defined TGamma table

Heritage operators

Heritage operator rate?

Calculate VUC rate Close this window Further information

As shown in Figure 2, above, to calculate a new passenger VUC rate it is necessary to populate certain vehicle characteristic input fields. These fields allow an assessment of the vehicle type’s ‘track friendliness’ to be made and a cost reflective VUC rate to be calculated. Below, further explanation and guidance is provided in relation to each of the vehicle characteristic input fields that need to be populated. As noted, above, the Network Rail Track Access Billing Team will perform this calculation prior to submission to ORR for approval. However, the operator may also wish to calculate the new VUC rate itself and provide this information to Network Rail alongside the relevant vehicle characteristic information (the passenger vehicle characteristic *pro forma* can be downloaded from our website [here](#)).

- **Vehicle type:** Prior to calculating a passenger VUC rate you should ensure that the passenger option is selected so that the appropriate input fields are displayed.
- **Existing vehicle:** If you wish to calculate a VUC rate for a vehicle type included on the CP6 VUC price list it is possible to automatically populate all of the input fields by selecting the existing vehicle type from this drop-down list. To determine the VUC for an existing vehicle which has been modified it is possible to select the existing vehicle from this list and then update the appropriate parameters that have changed because of the modification. For the avoidance of doubt, the only parameters that should be changed are those that have changed directly because of the modification. For example, if due to the modification the vehicle weight has changed then this is the only parameter that should be changed in the calculator, above. Please note that if an existing passenger coach or multiple unit is selected the “Total number of seats” field will display a zero value. However, this is not because the vehicle is assumed to have zero seats, rather the weight associated with passenger loading (which is derived from the number of seats that the vehicle has) has been included in the “Vehicle weight” value for the vehicles on the published CP6 price list.

- **New vehicle name:** If a vehicle type is not selected from the existing vehicle drop down box, the name of the vehicle should be input into this field so that it is clear to which vehicle type the new rate would apply. Generally, passenger vehicles use the following naming convention:
 - **Locomotive:** XX/X (e.g. 43/0);
 - **Multiple Unit Motor:** XXX/M (e.g. 139/M)
 - **Multiple Unit Trailer :** XXX/T (e.g. 315/T)
 - **Coach:** X (e.g. 1 for a Mk1 coach)
- **Price base:** This drop-down box should be used to select an appropriate price base. VUC rates increase annually for inflation and this functionality allows you to see the applicable VUC rate in either the current or previous years. Rates submitted to ORR for approval should always be calculated in 2017/18 prices using the 'official' version of the CP6 VUC calculator, published in April 2019, and available [here](#). A version of the CP6 VUC calculator which allows VUC rates to be calculated in current prices is also available on our website, however, this is provided for information only.
- **Motor / trailer:** The appropriate option should be selected confirming for multiple units whether the vehicle is a motor or trailer vehicle. This selection does not impact the level of the VUC rate but clarifies whether the proposed rate will apply to the motor or trailer vehicle. For CP6 we have also introduced the option of having more than one VUC rate for multiple unit motor/trailer vehicles within a vehicle class. For example, instead of having a single average rate for all CI 390 motor vehicles (a '390/M' rate), the operator may choose to have separate rates for the different variants of motor vehicle (e.g. a '390/M DMS' rate and a '390/M MS' rate), which should result in the same overall charge as the average motor rate. We introduced this option for CP6 because we observed in CP5 that there is increasing variation between individual vehicles within a multiple unit (e.g. with more units having distributed traction) and that it is becoming increasingly common for multiple units to run in different vehicle formations (e.g. as 5-car or 8-car unit variants). These emerging trends make it increasingly challenging to calculate an appropriate single, weighted average, VUC rate for motor or trailer vehicles. The option for having more than one VUC rate for each motor or trailer vehicle in a multiple unit is only available for vehicles which are not already on the original CP6 Track Usage Price List – it is not possible to re-open CP6 VUC rates which have already been determined. If stakeholders wish to take advantage of this option they can use the descriptor drop-down box to select the relevant motor or trailer descriptor, if available. The drop-down list includes a range of commonly used motor/trailer descriptors; however, the list is not meant to be exhaustive. If the descriptor that you would like to use is not available, you can manually enter a descriptor in the vehicle name field.
- **Locomotive / coach or multiple unit:** The appropriate option should be selected confirming whether the vehicle is a locomotive, coach or multiple unit. All other things being equal, coaches and multiple units pay lower VUC rates than locomotives, reflecting the lower traction forces that each wheel imposes on the track.
- **Number of axles:** The number of axles that the vehicle has should be entered. Together with the vehicle weight this value is used to calculate the average axle load of the vehicle.

- **Vehicle weight:** The weight of the vehicle in tonnes should be entered. This should be the tare weight of the vehicle in serviceable condition (i.e. the weight of the vehicle with no passengers). Where multiple variants of a vehicle type exist (and will be subject to the same new VUC rate) a weighted average of the vehicle weight should be calculated based on a typical train set formation. As noted, above, if an existing passenger coach or multiple unit is selected, this value will include passenger loading and the “Total number of seats” field will display a zero value.
- **Total number of seats:** The total number of passenger seats in the vehicle should be entered here. Where multiple variants of a vehicle type exist, and will be subject to the same new VUC rate, a weighted average of the number of seats should be calculated based on a typical train set formation (fractions of a seat are permissible).

For multiple units and coaches the VUC is calculated for the weight of the vehicle with 50% of seats full (assuming 75kg per passenger). The calculator will therefore take the total number of seats entered, multiply it by 75kg and multiply by 50%, before adding it to the tare weight to determine the total vehicle weight for the VUC calculation. Hence, the number of seats entered should be the total for the vehicle.

As noted, above, if an existing passenger coach or multiple unit is selected this field will display a zero value. However, this is not because the vehicle is assumed to have zero seats, rather the weight associated with passenger loading is included in the “Vehicle weight” value.

- **Unsprung mass:** The unsprung mass per axle should be entered into this field in kilograms. The unsprung mass is determined as the mass of equipment which is not separated from the track by the primary suspension and a proportion of any mass that is partially separated from the track by the primary suspension (e.g. bogie trailing arms and traction linkages). Therefore, the unsprung mass comprises the masses of the wheelset, axle boxes, brake gear, any axle-mounted gearbox or final drive, and any other equipment which may be mounted on the wheelset or axleboxes. If the unsprung mass is not the same for every axle then it is permissible to take an average for that vehicle. For determining the unsprung mass of the wheelset it is acceptable to calculate its mass with the wheel diameter halfway between the new and fully worn diameters.
- **Maximum speed:** The maximum speed of the vehicle type should be entered in miles per hour. If the ‘user calculated’ operating speed field (see, below) is left blank, this maximum speed value will be converted into an ‘operating’ speed to be used for charging purposes using the standard formula². The operating speed of a vehicle is a representative ‘average’ speed at which the vehicle type typically travels on the network and is used for charging purposes. The majority of vehicle operating speeds are calculated formulaically based on the vehicle’s maximum speed. The maximum speed entered should be the lowest of:
 - the maximum speed specified when the vehicle type was built, if this continues to be a physical constraint which the vehicle type cannot exceed;
 - or

² Operating Speed = 0.021.Max. Speed^{1.71} (e.g. 55mph = 0.021*100mph^{1.71})

- the maximum speed specified by the operator, assuming this is a physical constraint which the vehicle type cannot exceed.

For the avoidance of doubt, by physical constraint we mean a vehicle-based constraint which limits the maximum speed of the vehicle, irrespective of where it operates on the GB rail network.

- **Route-based maximum speed:** For CP6 we have introduced the option of basing the maximum speed of the passenger vehicle on the maximum line speed of the routes over which it operates, rather than the maximum speed that the vehicle is capable of. Where different passenger operators operate the same vehicle class on different routes and are limited to different maximum line speeds, we have introduced the option of having two (or more) separate VUC rates for the relevant vehicle class. Operators may wish to take advantage of this option if the maximum speed of the vehicle class that they operate exceeds the maximum line speed over the routes that the operator runs. To enter a route-based maximum speed the user should tick the route-based maximum speed box and enter the relevant line speed value - the maximum line speed across all the routes over which it operates. If a route-based maximum speed is entered in this field this value will be used to calculate the vehicle operating speed using the standard formula, instead of the maximum speed described, above. This option is only available for new vehicles which are not on the original CP6 Track Usage Price List – it is not possible to re-open CP6 VUC rates which have already been determined (even if there are changes to line speeds during the control period). To make this proposal workable we will need to apply the following charging principles:
 - Each operator is only allowed one VUC rate per vehicle class because our billing system is not sophisticated enough to apply different rates when the same vehicle runs on different parts of the network.
 - Where vehicles are loaned between train operators the obligation is on operators to inform us, otherwise the ‘parent’ rate would continue to apply. This is because our billing system attaches rates to vehicles, not operators.
 - If vehicles were to be redeployed or cascaded to a different part of the network, with a different maximum line speed, again the onus is on operators to inform us otherwise the ‘parent’ rate would continue to apply.
 - Where an operator has requested a lower VUC rate which reflects the maximum line speed on the relevant route, and that line speed is subsequently increased, it would be necessary to calculate an updated VUC rate for that vehicle class. This new rate would apply from the date that the line speed was increased.
- **User calculated operating speed:** If an operator considers that the standard formula³ used to estimate a vehicle’s operating speed, based on either its maximum speed or the route-based line speed, gives rise to a result that is not a reasonable estimate of the vehicle’s true operating speed it has the option to calculate an

³ Operating Speed = 0.021.Max. Speed^{1.71} (e.g. 55mph = 0.021*100mph^{1.71})

operating speed based on the published timetable. If an operating speed based on the timetable is entered into the user calculated operating speed field, this value will be used in the VUC calculation rather than the operating speed derived from the vehicle's maximum speed or the route-based maximum speed.

When calculating an operating speed based on the timetable, the operator should take a weighted average of the relevant journeys and exclude stopping time at stations. If an operator wishes to use an operating speed based on its analysis of the timetable it should provide enough supporting information to Network Rail / ORR to demonstrate that this speed is appropriate.


- **Curving class:** The specified 'curving class' is a way of categorising vehicles according to the rail surface damage (wear and rolling contact fatigue) that they generate. Operators have the option to calculate a bespoke curving class (see 'user defined TGamma', below). However, they also have the option to select the most appropriate generic curving class from the existing list in the calculator. If a generic curving class is selected from the list in the calculator it is not necessary to complete the user defined TGamma fields. The generic passenger curving classes in the calculator typically use the following naming convention "Coach_XX_YY", where "XX" is the primary yaw stiffness (in MNm/rad) and "YY" is the weight in tonnes. To determine the nearest curving class for a vehicle both the primary yaw stiffness and vehicle weight should be rounded up.
- **User defined TGamma table:** As noted, above, rather than specify one of the existing generic curving classes included in the calculator the operator has the option to manually input bespoke TGamma values determined from vehicle dynamics modelling of the vehicle over a specified range of curves. To do this the user defined TGamma box should be selected and TGamma values for each axle and curve radii entered. If an operator chooses to use this, it is not necessary to select one of the generic curving classes from the list provided in the calculator. Carrying out vehicle dynamics modelling to generate a bespoke curving class, rather than selecting a generic curving class, will result in a more cost-reflective VUC rate but will mean that further analysis must be carried out. A guidance note can be downloaded from our website [here](#) setting out the process for conducting the vehicle dynamics modelling. Network Rail would also be happy to assist with this modelling if the operator considers that this would be helpful.

Once the relevant vehicle characteristic information set out, above, has been entered the user should click the "**Calculate VUC rate**" button and a new passenger VUC rate will be calculated and displayed as shown in Figure 3, below.

For the avoidance of doubt, where a vehicle has been modified a new vehicle sub-class should be created, rather than a revised calculation of the original rate based on the new weighted average vehicle characteristics across the relevant fleet.

Figure 3: VUC calculator passenger output screen

CP6 VUC Calculator: **Passenger vehicles**
V7e: March 2019



Vehicle data	
Vehicle name/class	360/M
Vehicle type	Coach or Multiple Unit
Number of axles	4
Speed (max, mph)	100
Route speed (max, mph)	
Speed (operating, mph)	55.24 (Calculated)
Tare weight (t)	47.1875 Seats 0
Operating weight (t)	47.1875
Unsprung mass (kg)	1870
Curving class	Coach_24_50
Ct factor	0.89

Calculate another vehicle VUC rate

Calculated VUC		
2019/20 prices		
VUC	14.37	3.0447
	p/vm	£/kGTM
VUC Breakdown		
<i>Track</i>	7.92	1.6776
<i>Structures</i>	1.29	0.2720
<i>Signals (variable)</i>	0.21	0.0454
<i>Signals (fixed)</i>	0.23	0.0490
<i>Surface damage</i>	4.73	1.0008

As shown in Figure 3 above, the output sheet from the VUC calculator sets out:

- The calculated VUC rate is expressed in both pence per vehicle mile (p/vm) and £ per 1,000 gross tonne mile (£/kGTM). When submitting new passenger VUC rates to ORR for approval, it is the rate calculated in p/vm that should be submitted. This reflects how rates are shown in the passenger section of the Track Usage Price List. The equivalent rate shown in £/kGTM is not relevant to passenger operators, it is only applicable to freight operators who run passenger vehicles (e.g. for testing purposes). The VUC rates shown in both p/vm and £/kGTM are broken down by asset type for information only. This shows what proportion of each VUC rate aims to recover track ‘wear costs’ versus signalling ‘wear and tear’ costs, for example.
- the vehicle characteristic information underpinning the VUC rate.

A copy of this output screen should be annexed to the Network Rail / operator joint submission to ORR (template letter provided in Appendix 1) requesting the determination of a new VUC rate. It is possible to convert the output sheet to PDF, alternatively, a ‘screen grab’ of the output screen could be taken.

1.12. How do I calculate a new heritage operator VUC rate?

For CP6 we added new functionality into the VUC calculator so that it can calculate VUC rates for heritage train operators. By heritage train operators we mean North Yorkshire

Moors Railway (NYMR) and the West Coast Railway Jacobite (Jacobite) services. Both operators are subject to bespoke VUC rates set out in their respective sections of the CP6 Track Usage Price List. If during CP6 one of these operators starts operating a different type of rolling stock for which there is not already a rate on the relevant part of the Track Usage Price List, the operator could choose to use the VUC calculator to generate a new VUC rate.

The process for calculating a new heritage operator VUC rate is the same as that described for passenger operators, above. However, once the relevant vehicle data has been populated, the user should tick the heritage operator box shown in Figure 4, below, and then select whether the rate will be applicable to NYMR or Jacobite services.

Figure 4: VUC calculator heritage passenger input sheet

Existing vehicle

New vehicle name Price base

Vehicle type Passenger Freight

Locomotive/coach/MU Locomotive Coach or multiple unit

Vehicle type Motor Trailer

Descriptor

Vehicle weight (tonnes) Total number of seats
(For passenger vehicles, weight should be the vehicle tare weight)

Number of axles

Unsprung mass (kg/axle)

Vehicle maximum speed (mph)

Curving class

User calculated operating speed?

Use route-based maximum speed?

User-defined TGamma table

Heritage operators Heritage operator rate? NYMR Jacobite

Calculate VUC rate Close this window Further information

The output sheet for heritage operators is shown in Figure 5, below. The main difference between this sheet and the passenger output sheet is that, for heritage operators, different rates are calculated for each year of CP6 (for passenger operators the same rate is applicable in all years). This reflects ORR's PR18 determination to phase-in the increase in VUC rates over CP6 for heritage operators.

Figure 5: VUC calculator heritage passenger Output sheet

Vehicle data	
Vehicle name/class	4 (Trailer)
Vehicle type	Coach or Multiple Unit
Number of axles	4
Speed (max, mph)	125
Route speed (max, mph)	
Speed (operating, mph)	80.90 (Calculated)
Tare weight (t)	42.35 Seats 0
Operating weight (t)	42.35
Unsprung mass (kg)	1860
Curving class	Coach_60_50
Ct factor	0.89

Calculate another vehicle VUC rate

Calculated VUC					
2019/20 prices					
VUC	2019/20	2020/21	2021/22	2022/23	2023/24
p/vm	13.66	13.66	14.06	14.45	14.83
VUC Breakdown					
<i>Track</i>	6.73	6.73	6.89	7.06	7.23
<i>Structures</i>	1.00	1.00	1.06	1.11	1.16
<i>Signals (variable)</i>	0.27	0.27	0.26	0.25	0.25
<i>Signals (fixed)</i>	0.31	0.31	0.30	0.29	0.28
<i>Surface damage</i>	5.35	5.35	5.53	5.72	5.91

1.13. How do I calculate a new freight VUC rate?

Figures 6 and 7, below, show the input and output screens used when calculating new freight VUC rates.

Figure 6: VUC calculator freight input screen

The screenshot shows the VUC calculator freight input screen. It features several input fields and dropdown menus. The 'Existing vehicle' and 'New vehicle name' fields both contain 'FIAB (L)'. The 'Price base' is set to '2019/20'. Under 'Vehicle type', 'Freight' is selected. The 'Vehicle weight (tonnes)' is 45.6. The 'Number of axles' is 8, and the 'Unsprung mass (kg/axle)' is 1292. The 'Curving class' dropdown is set to 'Y25_loaded'. The 'Load condition' is 'Laden'. The 'Suspension band' dropdown is set to 'Y25-1'. The 'Freight commodities' section has 'Other' checked. The Network Rail logo is in the top right corner. At the bottom, there are three buttons: 'Calculate VUC rate', 'Close this window', and 'Further information'.

As shown in Figure 6, above, to calculate a new freight VUC rate it is necessary to input certain pieces of vehicle characteristic information. This allows an assessment of the vehicles' 'track friendliness' to be made and a cost reflective VUC rate to be calculated.

Further explanation and guidance is provided, below, in relation to each input field. As noted above, the Network Rail Track Access Billing Team will perform this calculation prior to submission to ORR. However, the operator may also wish to calculate the new VUC rate itself and provide this information to Network Rail alongside the relevant vehicle characteristic information (the freight vehicle characteristic *pro forma* can be downloaded from our website [here](#)).

- **Vehicle type:** Prior to calculating a freight VUC rate you should ensure that the freight option is selected so that the appropriate input fields are displayed.
- **Existing vehicle:** If you wish to calculate a VUC rate for a vehicle type included on the CP6 VUC price list it is possible to automatically populate all of the input fields by selecting an existing vehicle type from this drop-down list. To determine the VUC for an existing vehicle which has been modified it is possible to select the existing vehicle from this list and then change the appropriate parameters. For the avoidance of doubt, the only parameters that should be changed are those that have changed directly because of the modification. For example, if due to the modification the vehicle weight has changed then this is the only parameter that should be changed in the calculator, above.
- **New vehicle name:** The name of the vehicle should be entered so that it is clear to which vehicle type the new rate would apply. Generally, freight vehicles use the following naming convention:
 - **Locomotive:** XX/X (e.g. 66/0);

- **Wagon (laden):** XXXX (L) (e.g. FRAA (L))
 - **Tare Wagon (tare):** XXXX (T) (e.g. FRAA (T))
 - **Coach:** X (e.g. 1 for a Mk1 coach)
- **Price base:** This drop-down box should be used to select an appropriate price base. VUC rates increase annually for inflation and this functionality allows you to see the applicable VUC rate in either the current or previous years. Rates submitted to ORR for approval should always be calculated in 2017/18 prices using the 'official' version of the CP6 VUC calculator, published in April 2019, and available [here](#). A version of the CP6 VUC calculator which allows VUC rates to be calculated in current prices is also available on our website, however, this is provided for information only.
 - **Locomotive/wagon:** This option should be selected to confirm whether the vehicle is a locomotive or a wagon. If the locomotive option is selected the load condition and suspension band boxes will disappear and be automatically populated by the model (a locomotive will always operate in a tare condition and attract a locomotive suspension band).
 - **Load condition:** This option should be selected to confirm whether the rate being calculated will apply when the wagon is tare or laden. If both a tare and laden rate is required, the calculation process should be performed twice with appropriate input data. As noted, above, this box will disappear if the locomotive option is selected.
 - **Number of axles:** The number of axles that the vehicle has should be input. Together with the vehicle weight this value is used to calculate the average axle load of the vehicle.
 - **Vehicle weight:** The operating weight of the vehicle, in tonnes, should be entered. The operating weight is the weight at which the vehicle will typically operate and thus could be less than the gross laden weight of a wagon. For laden wagons, if more than one commodity type is selected, an average operating weight across the different commodities should be entered. Alternatively, the user may wish to calculate VUC rates for different commodity types separately and enter an appropriate operating weight each time. We consider that the latter approach is more appropriate where the laden weight is likely to vary materially across commodities.
 - **Unsprung mass:** The unsprung mass per axle should be entered in kilograms. The unsprung mass is determined as the mass of equipment which is not separated from the track by the primary suspension and a proportion of any mass that is partially separated from the track by the primary suspension (e.g. bogie trailing arms and traction linkages). Therefore, the unsprung mass comprises the masses of the wheelset, axleboxes, brake gear, and any other equipment which may be mounted on the wheelset or axleboxes. If the unsprung mass is not the same for every axle then it is permissible to take an average for that vehicle. For determining the unsprung mass of the wheelset it is acceptable to calculate its mass with the wheel diameter halfway between the new and fully worn diameters.
 - **Curving class:** The specified 'curving class' is a way of categorising vehicles according to the rail surface damage (wear and rolling contact fatigue) that they generate. Operators have the option to calculate a bespoke curving class (see 'User defined

TGamma table', below). However, there is also the option to select the most appropriate generic curving class from the existing list in the calculator. If a generic curving class is selected from the list in the calculator it is not necessary to complete the 'user defined TGamma' fields. The generic freight curving classes in the calculator are based on the vehicle's suspension type (e.g. "Y25_loaded" or "Y25_empty").

- User defined TGamma table:** As noted, above, rather than specify one of the existing generic curving classes included in the calculator the operator has the option to manually input bespoke TGamma values determined from vehicle dynamics modelling. To do this the 'user defined TGamma' tick-box should be selected and TGamma values for each axle and curve radii entered. If an operator chooses to do this it is not necessary to select one of the generic curving classes from the list provided in the calculator. Carrying out vehicle dynamics modelling to generate a bespoke curving class, rather than selecting a generic curving class, will result in a more cost reflective VUC rate but will mean further analysis has to be carried out. A guidance note can be downloaded from our website [here](#) setting out the process for conducting the relevant vehicle dynamics modelling. Network Rail would also be happy to assist with this modelling if the operator considers that this would be useful.
- Suspension band:** The suspension band reflects the suspension/bogie type of the wagon. Wagons with 'track friendly' suspensions/bogies will pay a lower VUC than wagons with suspensions/bogies that impose higher forces on the track, all other things being equal. Only freight wagons registered in the Rolling Stock Library (RSL) prior to 1 April 2014, and not on the CP6 price list, have the option to select one of the existing suspension bands in the VUC calculator. For all other wagons this part of the VUC calculation has been replaced by the Ride Force Count (RFC) methodology, described, below.

Suspension band	Vehicle type
0	All locomotives
1	4-wheel wagon with pedestal type suspension
2	4-wheel wagon having leaf springs, friction damped
3	Bogie wagon with three-piece bogie
4	Bogie wagon with enhanced three-piece bogie e.g. "swing motion", and parabolic 4-wheel wagon
5	Basic bogie wagon with primary springs, e.g. Y25
6	Bogie wagon with enhanced primary springs – low track force bogies, TF25, "axle motion" (like HV primary sprung bogies)
7	Bogie wagon with enhanced primary springs and steering

As noted, above, this box will disappear if the locomotive option is selected.

- Ride Force Count (RFC) value:** The RFC is a metric developed in CP4 to provide a quantitative assessment of the 'track friendliness' of a wagon's suspension/bogie type, following vehicle dynamics modelling. The methodology for estimating a freight wagon's RFC value is set out in a user guide available from our website [here](#).

The *RFCpro* software is required in order to calculate the RFC value from the results of vehicle dynamics modelling, and can also be downloaded from our website [here](#).

- **Freight commodity:** The user should select from the list of commodities in the calculator the ones for which it requires a VUC rate and for which the vehicle parameters that have been entered are applicable. There is an option to select all commodities which, for example, may be appropriate when calculating a new VUC for a commonly used freight locomotive. However, if a vehicle can carry a range of commodities, and the laden weight of the vehicle varies materially for different commodities, then a separate calculation for each vehicle weight and pertinent commodity should be performed to calculate an appropriate VUC rate for each commodity.

Once the relevant vehicle characteristic information set out, above, has been entered the user should click the “**Calculate VUC rate**” button and a new freight VUC rate will be calculated and displayed as shown in Figure 7, below.

As determined by ORR during CP5, if a freight operator runs a train designed for passenger use (e.g. for testing purposes) the VUC rate should be calculated using the passenger charging methodology, rather than the freight charging methodology. This means calculating the rate using the passenger part of the VUC calculator as described in section 1.11, above. However, in this situation, the rate submitted to ORR for approval should be the rate expressed in £/kGTM on the passenger output sheet (not the rate expressed in p/vm which is normally used for passenger operators). The rate expressed in £/kGTM is equivalent to the rate expressed in p/vm and consistent with how VUC rates are shown in the freight section of the Track Usage Price List.


For the avoidance of doubt, where a vehicle has been modified a new vehicle sub-class should be created, rather than a revised calculation of the original rate based on the new weighted average vehicle characteristics across the relevant fleet.

Figure 7: VUC calculator freight output screen

CP6 VUC Calculator: Freight vehicles
V7e: March 2019

Vehicle data	
Vehicle name/class	FIAB (L)
Load condition	Laden
Number of axles	8
Weight (t)	45.6
Unsprung mass (kg)	1292
Curving class	Y25_loaded
Suspension band	Y25-1
RFC value?	N
Suspension factor	0.938
Ct factor (structures)	1

Calculated VUC					
All values in £/kGTM	2019/20 prices				
Existing CP5 rate?	2019/20	2020/21	2021/22	2022/23	2023/24
Other Y	1.1097	1.1097	1.1097	1.1097	1.1097



Calculate another vehicle VUC rate

As shown in Figure 7, above, the output sheet from the VUC calculator sets out:

- The calculated VUC rates for each year of CP6; and
- the vehicle characteristic information underpinning the VUC rates.

The “Existing CP5 rate?” flag on the output screen (see in Figure 7, above, next to the commodity type) indicates whether a VUC rate existed in CP5 for this vehicle/commodity combination. Where a “Y” is displayed in this field it indicates that a CP5 rate did exist for this vehicle/commodity combination and, therefore, the vehicle characteristics underpinning the rate that has been calculated are the same as those underpinning the rate on the published price list. Therefore, one would expect the rate that has been calculated to be consistent with that set out on the published price list. If an “N” is displayed in this field it indicates that a VUC rate did not exist for this vehicle/commodity combination in CP5.

A copy of this output screen should be annexed to the Network Rail / operator joint submission to ORR (template letter provided in Appendix 1) requesting a new VUC rate is approved. It is possible to convert the output sheet to PDF in the workbook. Alternatively, a ‘screen grab’ of the output screen could be taken.

1.14. Who should I speak to in Network Rail about this document?

We would be happy to discuss any aspect of this document or the process more generally in relation to the calculation and determination of new VUC rates. Depending on the nature of your query you should contact one of the, below, Network Rail colleagues in the first instance.

Person	Area	Contact Details
Reece Kershaw-Whittle Area Support Analyst	Billing and rate calculation issues	Reece.Kershaw-Whittle@networkrail.co.uk 0161 880 3887
Mark Burstow, Principal Vehicle Track Dynamics Engineer	Engineering and technical issues	Mark.Burstow@networkrail.co.uk 01908 782906
Ben Worley, Regulatory Economics Manager	Policy and periodic review issues	Ben.Worley@networkrail.co.uk 033 085 43971

1.15. What about version control?

The date this document was published and its version number are shown on the cover page. This document is intended to be a 'living' document and updated from time to time so that it includes additional guidance, where appropriate, based on the industry's experience of the VUC rate calculation and approval process in CP6. Appendix 2 details the iterations made to this document.

Appendix 1 – New VUC rate letter template

[Insert Network Rail name]
[Insert job title]
Network Rail
[Insert first line of address]
[Insert second line of address]

[Insert ORR representative name]
[Insert job title]
The Office of Rail and Road
One Kemble Street
London, WC2B 4AN

[Insert operator representative name]
[Insert job title]
[Insert train operator name]
[Insert first line of address]
[Insert second line of address]

[Insert date]

Dear *[Insert name of the appropriate member of the ORR Track Access team, consistent with the address line, above]*

Proposal to supplement the CP6 Track Usage Price List

The purpose of this letter is to propose a supplement to the Control Period 6 (CP6) Track Usage Price List, consistent with Schedule 7 of *[insert train operator name]* Track Access Contract. In particular, a new Variable Usage Charge (VUC) rate for the *[insert vehicle name]* vehicle type operated by *[insert train operator name]*.

This supplement to the Track Usage Price list has been agreed between Network Rail and *[insert train operator name]*. It is required because *[Insert relevant background information e.g. whether the new rate is required due to the introduction of a new vehicle type, the modification of an existing vehicle type and when the new vehicle type is due to begin operating on the network]*

The new VUC rate proposed in this letter was calculated using the agreed CP6 VUC calculator developed by Network Rail in 2017/18 prices. The output sheet from the calculator, which sets out the proposed new rate and input information, is appended to this letter.

If you have any queries in relation to the calculation of the proposed new VUC rate, or the content of this letter more generally, we would, of course, be happy to discuss this with you in more detail.

Yours sincerely

[Insert Network Rail name]
Network Rail

[Insert operator representative name]
[Insert name of train operator]

[Attach output sheet(s) in 2017/18 prices from the CP6 VUC calculator setting out the proposed new rate(s) and input data]

Appendix 2 – Version control

Version number	Description of change	Date	Author
1	Original CP6 version created.	23 April 2019	Ben Worley (Regulatory Economics Manager, Network Rail)