dovetail GAMES

Class 419 MLV

Whilst we do our utmost to reproduce sounds that are accurate and true-to-life, sometimes these sounds may not completely tally with the user's expectation. Due to the nature of the simulation, it is often not possible to reproduce a completely accurate soundscape for a variety of reasons such as limitations with our current technology and occasional inability to gain meaningful access to the locomotives being created. You should therefore regard the audio reproduction for our locomotives as authentic interpretations rather than perfect recreations.

1 Background

1.1 Class 419 MLV

The British Rail Class 419 Motor Luggage Vans (or MLV) were battery electric multiple unit cars built from 1951-61 by BR at Eastleigh Works.

Ten of these units were built for the boat trains from London Victoria to Dover and Folkestone. Units were originally numbered in the range 68001-68010, but were classified Class 419 under the TOPS system and were then renumbered 419001-419010, the numbers actually carried on the units in service reduced to 9001-9010, omitting the first two digits.

The units were also fitted with batteries to allow them to operate over the short-distance of non-electrified line at the quayside. The batteries allowed the units to be used at low-speed for 20–30 minutes, and could be recharged when the unit was taking power from 750 V DC third-rail.

They were withdrawn from traffic in 1991/92, with the closure of Dover Western Docks railway station and the end of the boat train services.

1.2 Class 419 Design & Specification

Builder	British Railways – Eastleigh Works
Locomotive Weight	45 long tons
Vehicle Length	65ft 6in (21.65m)
Vehicle Width	9ft (2.74m)
Top Speed	90 MPH (145km/h)
Brake Types	Air (Electro-Pneumatic/Auto) & Vacuum
Power Output	2 x 250 hp (190 kW) traction motors

2 Rolling Stock - Locomotives

2.1 Class 419 MLV in Network SouthEast livery.

2.2 Class 419 MLV in Jaffa Cake livery.

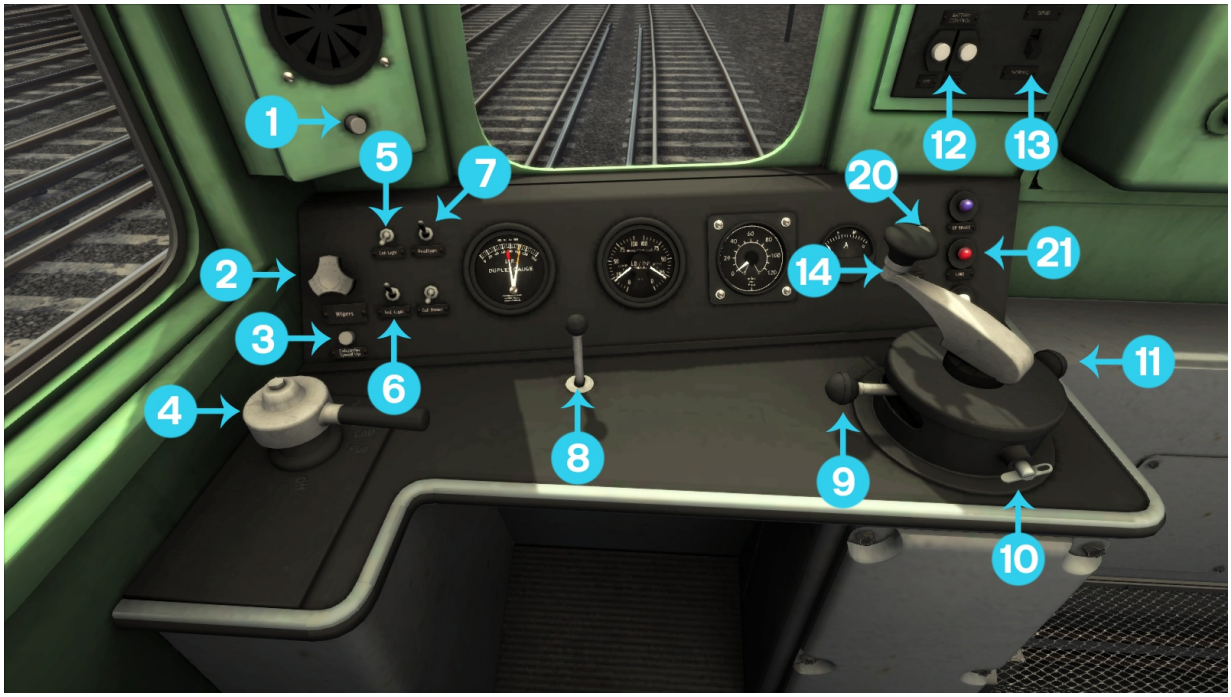
3 Rolling Stock – Coaches & Wagons

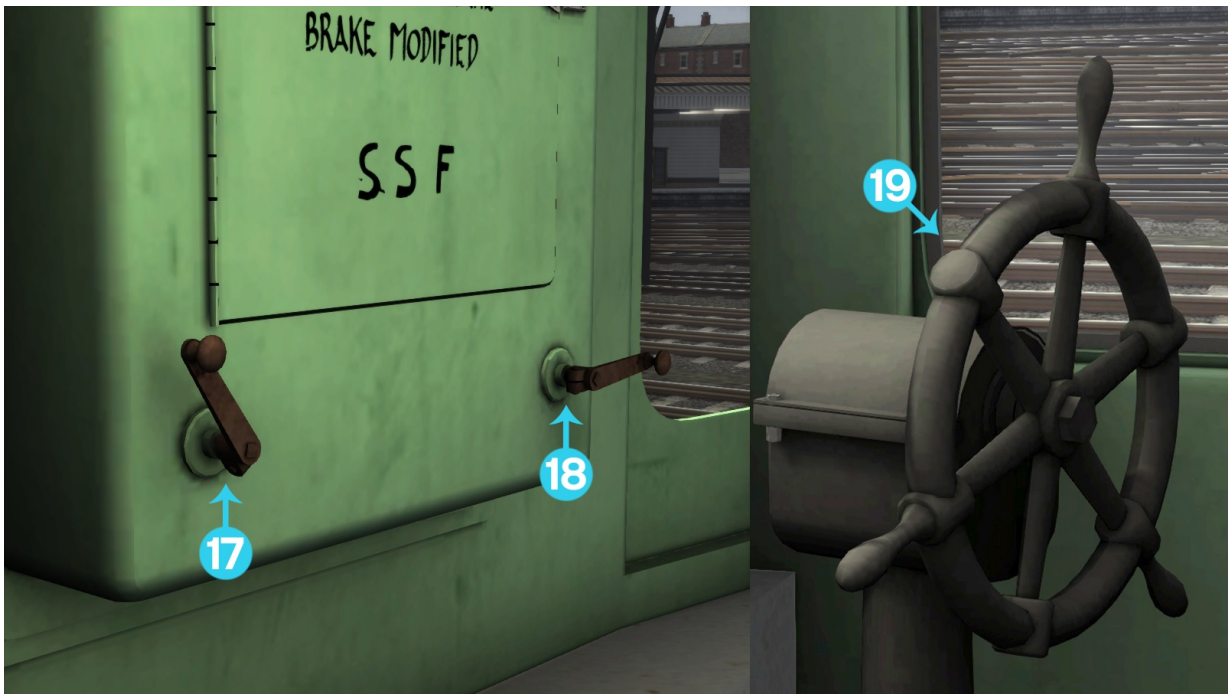
3.1 Mk1 General Utility Van (GUV) in BR Blue livery

3.2 TTA Wagon (water only)

4 Driving the Class 419

4.1 Cab Controls & Keyboard Controls





1	AWS acknowledge (Q)
2	Wiper (V)
3	Exhauster Speed up (O)
4	Train Brake (; / ')
5	Cab Light (L)
6	Instrument Lights (I)
7	Headlight (H / Shift+H)
8	Horn Lever – Low Tone (Space), High Tone (B)
9	Reverser (W / S)
10	Master Key (mouse control only)
11	Master Switch (X)
12	Battery Power On/Off (P)
13	Series Switch (Y)
14	Power Handle (A / D)
15	Guards Buzzer (C)
16	Sun Visor (U)
17	Destination Blind 1 (Ctrl+6)
18	Destination Blind 2 (Ctrl+5)
19	Handbrake (/)
20	Overload Reset (R)
21	Indicator Lights (EP Brake, Line, Motor Generator)
22	Brake Lap ( ]) (keyboard control only)
23	Brake Release ([ ) (keyboard control only)
24	Brake Service (Enter) (keyboard control only)
25	Brake Emergency (Backspace) (keyboard control only)
26	Brake Lap ( ]) (keyboard control only)
27	Deadman's Handle (Ctrl+D / Ctrl+Shift+D) (Advanced Mode only, keyboard control only)
28	Advanced/Simple Mode (Ctrl+B)
29	Notch Up Power Controller (Ctrl+A)
30	Brake Mode Up (Ctrl+8)
31	Brake Mode Down (Ctrl+7)
32	Efficiency Reporting System (Ctrl+4)
33	Only pick up mail bags at next station (Ctrl+9)
34	Reduce number of mail bags picked up (Ctrl+0)
35	Unload all mail bags at next station (Delete)
36	Pick up all mail bags at next station (Home)

4.2 Master Switch

This switch controls the supply of air to the brake valve and activates the desk allowing the power controller and reverser to be used. It must first be unlocked with the master key then pushed forward ("**X**" key or Sander key on the HUD). Doing so will sound an AWS self-test which you will need to acknowledge. Once the master switch is open, you will be able to move the reverser and release the automatic air brake.

4.3 Reverser

The reverser selects the desired direction of travel. On the Class 419 it is interlocked with the master switch and the power controller handle. If power controller is not shut, the reverser handle will be locked in either the forward or back position. In addition, the master switch will also lock the reverser in neutral if the switch is closed, while the reverser will lock the master switch if it not in the neutral position.

4.4 Power Controller Handle

The Power controller handle on the MLV is quite a complex device. The unit is fitted with an air-oil camshaft controller as fitted to most southern region EMUs built from 1956 onwards. This will be discussed in a later part of this section.

4.4.1 Deadman's Handle

The Class 419 is fitted with a Deadman's handle. Originally the Deadman's system was only active if the reverser was moved to the forward or reverse position. However, this meant the driver could select neutral and coast with Deadman's system disabled! In the mid 1980s BR rectified this by fitting a speed sensor which detected if the unit was above 6mph and so kept the Deadman's system active above this speed. The SSF label on the destination blind case indicates the unit is speed sensor fitted. Upon releasing the Deadman's handle (which was spring loaded) an emergency application of the automatic air brake would ensue.

In Train Simulator this system is replicated. By default the Deadman's handle is controlled by the reverser position. As such moving the reverser forward or back will depress the Deadman's handle. However, consequently, if you move the reverser from the direction of travel while moving faster than 6mph, the Deadman's handle will release and as a result an emergency application of the air brake will ensue.

If desired, switching to advanced mode with "**Ctrl+B**" the Deadman's system is not automatic, as such it must be depressed with "**Ctrl+D**" and released with "**Ctrl+Shift+D**".

4.4.2 Camshaft Controller

The unit is fitted with a camshaft controller. By moving the power controller towards the fully open position ("**A**" key to notch up and "**D**" key to notch down), this selects the desired target for the camshaft controller. However, reducing the power handle will not reduce the target for camshaft controller and it will continue to notch up to the furthest position. For example, if the handle is moved to the weak field position then back to series, the system will continue to notch up to weak field.

The controller has 5 main positions. Off, Shunt, Series, Parallel and Weak field. In the shunt position all the resistances are in the system and so the unit will run at a low speed between 5-10mph depending upon the load and voltage. In Series voltage to the motors is split so the

motors run at half power. In parallel the full voltage is applied to both motors and so the motors run at full power. In weak field, the field coil is weakened increasing the current allowing the unit to reach a higher speed.

There are additional resistance notches between Shunt and Series, and Series and weak field. There are 7 series resistances notches with gradually reducing resistances and 4 parallel resistance notches in a similar arrangement. Notching up is done automatically by a system known as a current limiting relay, when the current drops below a specified value (720/900 amps in series, 720 amps in parallel and 1180 amps to enter weak field) the system will notch up one notch. Notching up takes just over 1 second to occur. As such while at speed (greater than 43mph) it will take about 18 seconds to reach weak field from the off position. The transition from series to parallel takes place around 18mph, the transition from parallel to weak field takes place around 43mph.

It should be noted the current limiting relay can be halted by returning the power handle to the shunt position, this will arrest the notching up process until the handle is moved back to either series or weak field. Returning the handle straight to off will reduce drop the camshaft back to the first notch.

While the system is not replicated on the MLV, you should not run in resistance notches (including shunt) for more than about 4 minutes to prevent overheating and their resultant failure. Ordinarily you would have to shut off and wait about 15-20 minutes afterwards for the resistances to cool down before reselecting power. If you suspect that you will be unable to reach full parallel in a reasonable time you should use the series switch which will prevent the camshaft from notching up above full series (unless the camshaft is already above full series whereby it will halt its progression, if this happens shut off and reapply power). This will likely be needed in poor adhesion conditions where you will struggle to gain speed quickly enough.
The unit has two acceleration rates in series. Moving the handle to either series or parallel will use the lower acceleration rate (720 amps notch up current), while moving the handle straight to weak field will use the higher acceleration rate (900 amp notching up current). The low acceleration rate can come in useful in low adhesion conditions or if you don't need to accelerate quickly.

If the adhesion is so bad that even the low acceleration rate is causing wheel to slip you may need to use the shunt position to hold a notch, or use manual notching. On the MLV this is done by rapidly moving the handle from Shunt to Series and back. This notches the system up one notch. As this is difficult to do quickly and accurately enough with keyboard or mouse, a key combination has been set up to manually notch up. This can be done by holding the "**Ctrl+A**" key combination. Be careful doing this as you can notch up quicker than intended and thereby cause an overload (trip is at 1500 amps).

Under battery power, the current limiting relay will notch up rapidly due to the lower voltage and resultant lower current. This causes an unusual drop in power when transitioning into parallel due to the way the resistors are set up causing you to transition into parallel too early. As such you will likely experience a jolt as the power drops and then a surge as the system continues to rapidly notch up towards full parallel. This behaviour is however to be expected. You may wish to use the series only switch to avoid it.

4.4.3 Overloads

While this is quite tricky to do with the MLV, it is possible if for example the unit notches up too early due to wheel slip and the unit suddenly regains traction, or if running on battery power and then switching back to 3rd rail power underway. If this occurs, return the power handle to off and depress the overload reset but ("**R**" key).

4.4.4 Safety systems

There are additional safety systems regarding the camshaft controller. Firstly, a no volts relay is fitted which will automatically run down the camshaft if no voltage is being delivered to the motor. The Overload reset is an additional system which will run down the camshaft if activated. Finally, a traction interlock is fitted if the train pipe is pressure drops below 45psi then power will be cut, and will no reengage until pressure has risen above 56psi.

4.4.5 Wheel slip

The MLV is fitted with an advanced adhesion model. There is no wheel slip detection or control systems and such you must be able to recognise wheel slip and act accordingly. The most common way is observing the speedo, if it is seen to rise suddenly and rapidly or indicate above the speed you are travelling you can be sure it is slipping. If wheel slip is detected shut off power and return the handle to the shunt position until the wheels regain traction. You may be unable to avoid wheel slip totally, and may have to live with a small amount of slip. The use of the shunt position and manual notching may be required and this is described in the camshaft control section.

4.5 Braking Systems

By far one of the most complex parts of the MLV is its braking system. The unit itself is fitted with 4 types of brakes. These are Electro-Pneumatic Brakes (EP), Westinghouse automatic air brake (auto air), Vacuum and the units hand brake.

4.5.1 EP Brakes

The first and primary brake is the EP Brake. This is a quick acting brake which actuates instantly along the entire length of the train. It operates by allowing air to flow from the main reservoir pipe into the brake cylinders. It is graduable in both application and release and allows an infinite variation of brake cylinder pressure between about 6psi and 52psi. The brake is however not fail safe and can fail. If the EP brake fails the EP indicator light will go out, and there will be no contactor sounds from the brake handle or response either.

4.5.2 Auto Air Brake

Because EP brake is not failsafe, the unit is fitting with an automatic air brake as a backup braking system. However, on the MLV you will find it also will need to be used if operating with air braked stock or vacuum braked stock. The system is slower to respond than the EP Brake and does not actuate instantly along the entire train length, as such you will should familiarise yourself with the brakes slow response. The unit is fitted with triple valves which means the brake is **not** graduable in release, an increase in brake pipe pressure will cause the brake to release completely, in addition the auxiliary reservoir will need to be recharged once released which can take some time so be very careful on approach to terminus station, be prepared to use the emergency position if need be.

4.5.3 Vacuum Brakes

The MLV is unusually for a EMU also fitted with vacuum brakes, all MLVs were fitted with through pipes and proportional valves, however there is some debate as to which were fitted with vacuum exhausters (9001/2 were definitely fitted). However, for gameplay reasons all MLVs in the pack have working vacuum exhausters. The switch to activate the exhauster is not modelled and so the exhauster will only function when a vacuum brake mode is selected. The vacuum brake is also applied by a proportional valve outside the cab, which applies the vacuum brake in proportion to the automatic air brake. The EP brake will have **no** influence over the vacuum brake. The exhauster can be sped up with the Exhauster speed up button or by pressing the "O" key.

4.5.4 Hand Brake

The unit is also fitted with a hand brake for parking purposes. This is applied with the "**/**" Key.

4.6 Brake Valve

The unit is fitted with the typical EP/Auto air brake valve. There are five brake positions on the controller. The details are as follows:

Position I: *Release and Running Position* (EP and Automatic Air Brake).
Both EP and automatic air brakes are released. Brake pipe and equalising reservoir are maintained at working pressure (70psi).

Position II: *Full Service* (EP)
The EP brake is applied to give maximum brake-cylinder pressure. Between positions I and II the self-lapping mechanism controls the air pressure in the brake cylinder in proportion to the angular movement of the brake controller handle.

Position III: *Lap* (Automatic Air)
All ports in the brake controller are closed, and with the automatic brake application the be brake valve may be returned to this position when the desired brake pressure has been obtained. Additional this position will hold any application of the EP brake at the pressure it was last at.

Position IV: *Service* Application (Automatic Air)
Operates the automatic air brake only.

Position V: *Emergency Brake Application* (EP and Automatic Air)
Both EP and automatic air brake are applied together to the full extent. The EP brake will also be applied more rapidly than in the normal full service position.

Be very careful when using the brake controller, accidentally overshooting the EP full service position can hold an application at a lower than desired pressure instead of full service. This however can be very useful when using the automatic air brake only (such as when using vacuum hauled stock) as if you quickly enough the handle can be brought to the lap position without the EP brake having time to apply.

On the MLV the brake handle can be applied the normal way with the "**;**" to move the handle towards release, and the "**'**" key to move towards emergency. However, there are some additional controls added to make your life easier. The "**[**" key will quickly move the brake handle to the release position (much quicker than the normal key), the "**]**" key will move the handle quickly to the Lap position and the "Backspace" key will quickly move the handle to emergency. The "**Enter**" key will move the handle to the automatic air service position

quickly. However if both the "**Enter**" and "**]**" key are depressed at the same time the handle is moved to an intermediate application position between the two allowing a more steady rate of application. This can allow some fine applications of the automatic air brake by holding the "**]**" key and tapping "**enter**" to make fine applications of the auto air brake.

4.7 Brake Modes

To allow realistic brake performance and compatibility with various multiple units the MLV has a variety of generic brake modes which automatically set brake characteristics and also setup the efficiency reporting system. The brake modes can be decreased with "**Ctrl 7**" and increased with "**Ctrl 8**". The brake modes are as follows:

Brake Mode 0: *MLV + SR EMU fitted with EP/Auto brakes and cast-iron tread brakes:*
Use this brake mode if operating with a generic EMU fitted with cast iron tread brake behaviour, currently only the MLV is so fitted with this brake behaviour.

Brake Mode 1: *MLV + rolling stock fitted with single pipe automatic air brake and distributor valves:*
Use this brake mode if operating rolling stock which use the single pipe automatic air brake only, and are fitted with distributors, for example the TTA wagon.

Brake Mode 2: *2 X MLV + Coaching stock fitted with dual pipe air brakes.:*
Use this brake mode if operating with 2 MLV's heading coaching stock operating with dual pipe automatic air brakes (such as a rail tour).

Brake Mode 3: *2 X MLV + Vacuum fitted coaching stock:*
Use this brake mode if operating with 2 MLV's heading coaching stock operating with Vacuum brake (such as the Vulcan Van Train Rail tour).

Brake Mode 4: *MLV + Vacuum fitted coaching stock:*
Use this brake mode if operating with a single MLV's heading coaching stock operating with Vacuum brake (such as the GUVs included with the pack).

Brake Mode 5: *MLV + 4-EPB:*
Use this brake mode if operating with the DTG 4-EPB as currently sold.

Brake Mode 6: *MLV + 2-EPB:*
Use this brake mode if operating with the DTG 2-EPB as currently sold in the BR blue pack.

Brake Mode 7: *MLV + 4-CIG or 4-BIG or 4-VEP.:*
Use this brake mode if operating with the DTG 4-CIG or 4-BIG or 4-VEP as currently sold in their respective packs.

Brake Mode 8: *MLV + 8-CIG or 8-BIG or 8-VEP.:*
Use this brake mode if operating with the DTG 8-CIG or 8-BIG or 8-VEP or some combination as currently sold in their respective packs.

Brake Mode 9: *MLV + 12-CIG or 12-BIG or 12-VEP.:*
Use this brake mode if operating with the DTG 12-CIG or 12-BIG or 12-VEP or some combination as currently sold in their respective packs.

Brake Mode 10: *MLV + 2-HAL.:*
Use this brake mode if operating with a 2-HAL or other older 4 coach Southern EMU fitted with single pipe automatic air brake.

Brake Mode 11: *MLV + 4-SUB:*
Use this brake mode if operating with a 4-SUB or other older 4 coach Southern EMU fitted with single pipe automatic air brake.

Brake Mode 12: *Custom Brake mode:*
Use this if you desire to make your own setup using the supplied controllers and scenario scripting.

4.8 Battery Control

To allow the MLV to operate over unelectrified lines, the unit is fitted with a series of Lead acid batteries. There are 100 230 Amp-hour cells, each with a nominal voltage of 2V giving a total of 200V. However actual voltage output of a lead acid battery varies between about 2.15V when fully charged down to 1.8V when practically discharged so voltage will vary between about 215V and 180V depending on the state of charge. When voltage drops below 1.8V the batteries will however be permanently damaged.

The state of charge is indicated by the charge meter in the cab. Entering the red is not healthy for the battery so try to avoid it, and above all costs avoid going down to the far left of the red section as this will completely discharge the batteries damaging them and very likely leading you to get stuck without any charge.

After repeated use the maximum charge the batteries can hold will decrease, by default this is set to 90% of their original maximum. However, this can be decreased further by use of scenario scripting.

Depending upon the use of the batteries and their charge state they can last upwards of 30 minutes of start stop running, however there is no hard and set on how long the batteries will last and it will very much depend upon the initial charge state, degradation of the cells and usage.

The batteries are charged from a motor generator feeding the cells at about 200V. Charging from completely discharged to about 70-80% charged can take 4-5 hours, however to reach 98% full charged the batteries will need to charge for upwards of 20 hours.

To activate the batteries the Battery on button needs to be depressed (alternatively the "P" key). This will deactivate the motor generator which will stop the batteries charging. To switch back to 3rd rail power the "P" key again can be pressed or the battery off button depressed and charging will resume.

4.9 Line Voltage

On the southern region, the line voltage is nominally stated to be 750V, however this isn't entirely true and it can vary between 580V and 830V. For timing and motor design purpose's the voltage is taken to be 90% of the maximum at 675V. This is the default voltage for the MLV, however this can be adjusted using scenario scripting by adjusting the "Line Voltage" controller. In addition, this can be set to 0 for non-electrified track. The unit will react accordingly, increasing, or decreasing performance depending on supplied voltage.

4.10 Parcel System

The MLV is fitted with a unique parcels system. At each station, a select amount of mail bags will be unload or loaded. This is randomized after each station. In addition, the randomization can be varied by using a few additional controls. By pressing the "**Ctrl+9**" key, succeeding stations will only pickup mail bags not drop off. "**Ctrl+0**" will reduce the maximum number of parcels at each station to be loaded and unloaded from around 35 to around 8.

The "**Delete"** key will override the above and cause the next station stop to unload all mail bags from the MLV. The "**Home**" key will do the opposite and cause the next station to apply a full load of mail bags.

4.11 Guard System

The MLV is fitted with a guard system, this system is active when the doors of the MLV are open. It provides some measure of protection against accidentally moving with the doors open but does not guarantee a scenario will not fail if you do so. Upon detecting movement, the guard will make an emergency application of the automatic air brake for 15 seconds. However, the air brake may not be quickly enough to stop the scenario failing so do try to avoid it. In addition, since parcel stops can take longer than the typical station stops the doors may remain open after those on the train have shut. The guard will remain active until all doors on the MLV are fully shut. Once done he will give two rings on the bell at which point you may proceed (do not mistake the bell on another EMU for your guard's bell!).

4.12 Efficiency reporting system

The MLV is fitted with an efficiency reporting system which will report various statistics on your current session such as energy consumption, approximate CO_2 production (based on power stations producing CO_2 and respective losses), unit efficiency (useful work over the total energy consumed), average speed and distance travelled. This can be called up at any time with the "**Ctrl+4**" key.

4.13 Automatic Warning System (AWS)

The MLV is fitted with a typical AWS system. The system is self-tested once the master switch is opened. On a clear indication a bell will ring and the Sunflower display will change to black if it isn't already. Upon a caution or danger aspect a horn will sound which will need to be cancelled within 2.7 seconds or an emergency application will ensure. The alarm is cancelled as usual with the "**Q**" key. After the alarm is cancelled the sunflower display will turn to the yellow and black aspect.

On the MLV however if you fail to cancel an application in time, the AWS will cause a brake demand which will last 60 seconds after the alarm has been canceled and you will unable to release the brakes or apply power.

4.14 Indicator Lights

There are 3 indicator lights in the MLV cab. The first is the EP indicator light which will be lit if the EP brake is functional. The Next down is the Line light which will indicate if there is a traction voltage available (either by battery or line voltage). The one below is the Motor generator light which will be lit if the motor generator is operable and supply voltage to the controls and charging the batteries.

5 Scenarios

5.1 [MLV] Part 1: Brighton to London Bridge Parcels

Take a parcels train from Brighton between South Croydon and London Bridge station. Beware of signals as the lines are busy today!

Duration: 30 minutes
Difficulty: Medium

5.2 [MLV] Part 2: Stopper to London Bridge

Take a MLV leading a 4-VEP from Crystal Palace to London Bridge station.

Duration: 30 minutes
Difficulty: Medium

5.3 [MLV] Part 3: Parcels to Brighton

Take charge of a MLV and take two GUVs bound for Brighton from London Bridge to East Croydon stopping at every station. Be careful as the rails are very slippy today!

Duration: 50 minutes
Difficulty: Hard

6 Acknowledgements

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Beta Testing Team
Edward Fisk – Class 419 setup, audio & scenarios