

PICCADILLY INTERIM CONTROL UPGRADE (PICU)

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**A report of the LURS meeting at All Souls Club House
on Tuesday 10 September 2019**

Upgrade of the Piccadilly Line has been cancelled four times since 1999, so after the last cancellation, part of the SSR Bombardier contract, PICU was approved in-house with a 4.5 to 1 business case and a cost just over £48 million. It was fully commissioned on Tuesday 3 September 2019. New trains are now ordered for 2026, but no funding is available for new signalling and control room, now expected in the early 2030s.

The interim control upgrade aims were to:

- Replace life expired Piccadilly line signalling system from the frame up.
- Move the Piccadilly line 'lock, stock and barrel' out of Earls Court Control Room.
- Introduce a new, smarter, simpler end-user specified graphical user interface.
- Bring back long-line public address capability.
- Update the fan and ventilation control system.
- Modernise the traction earth detection interface.
- Provide a smart solution for closed-circuit TV selection.
- Provide back-up/alternative control options, if possible.
- Move to a two-tier command and control.

BEFORE – EARL'S COURT

The Earl's Court Control Room provided signalling for both the Piccadilly and District lines until 3 September and remains for the District Line until completion of the 4LM upgrade. The Piccadilly Line has moved to the new South Kensington control centre. The old premises were dated, having very limited natural light, life expired equipment, and asbestos problems in the roof, ceiling, walls and floor. It had been heavily modified over the years, with the route buttons originally hidden in drawers for expected rare use, and similarly the signal post telephones situated under the diagram, a walk away from each desk. The Line Controller was later added on a raised dais at the rear of the room. The programme machine desks were life expired, and signal button wiring was degraded beyond repair such that there was a need to run a point-to-point wire when any button cable failed.

The old system had five layers. Most striking when entering were two track diagrams covering the walls around half the room. The top one showed junction and programme machine modes, whilst the one beneath showed signals and train positions. Between the two diagrams was a panel for warning lights and a warning bell. On the signallers' desks were a panel of manual route control buttons above a panel of programme machine and train describer buttons. The signallers kept paper box sheets and consulted paper timetables to keep track of the service. There was a high proportion of known but unfixable faults, and therefore each desk operated differently, and it took six months to train to work there.

The PEECS diagram was the Piccadilly East End Control System in the Earl's Court Control Room. It was installed to replace the infamous 'Metal Mickey' system, the next generation of signalling control, but was only intended to last ten years in the mid-1990s. Only one of two graphics processors remained functioning, with no spares available and severe ghosting on the screen. It looked smarter than the fixed line diagram but was no different in terms of useful information. The actual controls were situated in Earl's Court room 39, a former broom cupboard. PEECS had the single highest failure rate of any signalling system on LU and was not supportable after 2018. Replacement was more critical than that of older systems in the room, even before the new Control Room was ready, so Cockfosters to King's Cross was brought over to PICU in 2016 in room 33 for two years until decisions were made upon whether to go to the new Hammersmith 4LM control room. Once the new strategy was agreed, it was only 18 months to move to the new setup using only engineering hours except for one Night Tube closure to transfer the final six areas. After moving the east end signalling and controllers to South Kensington, the line to Rayners Lane transferred four months later, and finally Northfields to Heathrow transferred on 3 September. District Line trains within these areas are also controlled, including to Ealing Broadway and in/out of Ealing Common Depot. Earl's Court station and the Circle Line signalling should transfer to the new Hammersmith control centre in the coming year, leaving the Parsons Green sidings desk to work alone at Earl's Court Control Room for another two years under Thales plans!

AFTER – SOUTH KENSINGTON

This features solid state computerised signalling control with no keyboard, using two design criteria:

1. Real time and immediate input confirmation, from site not the centre.
2. Only one way (the easy way) to edit the railway. With high end-user input in development, the PICU Training Manual is only around 60 pages long.

There are no audible alerts or warnings, to keep the workplace calm at times of stress, unlike at the Earl's Court centre. Point status, reverse or normal, was not available before but is indicated through a graphic change. CCTV controls and phone directory are all available on screen. Simply adding to a departure time will hold a train at a controlled signal without needing to take control of that area. It is possible to reform a train to a new number and destination immediately, or at some future time. Run Data will display the history of a train through the day.

The PICU equivalent of the former track diagram display mentioned previously, each signal operator has three screens to show the whole line plus an additional single screen to select, display and operate route signally buttons. Train numbers, junction information and trip details are now shown for each train. Approaching train destinations now determine junction behaviour. There is no need to micro-manage junctions as before, so managing the railway is now possible on a broader scale. With a reduction of 14 staff members, assessments have shown an average 70% decrease in workload over the old systems at time of normal timetabled operation and, if rolling stock were available, up to a potential of 3 trains per hour could operate due to service recovery improvements.

A mouse mat provides a reminder of common displays for train edits with the black mouse, and a similar mat relates to the red mouse for direct signal control, which replicates the former signal control buttons. A full operating simulator is also provided which supports both PICU and legacy site training needs. There is also a portable simulator which can be taken to site and plugged into any computer workstation.

A new Customer Information Messaging (CIM) system was also developed for the new control room. The CIM system gives the Line Information Specialist (LIS) the capability to send out text and audio messages to any Piccadilly-served platform and booking hall. In order to reduce noise levels in the control room, the new CIM is provided with a directional speaker, so that only the LIS can hear the message that is being checked before dispatch to stations. This system is also future proofed for the new train fleet.

In the new control room at the Griffin Rooms, there are ten desks, off-the-shelf design, so in total they cost less than just one desk at the Highgate and Hammersmith control centres. There are four signallers, two controllers, the line information specialist, a technical officer, train doctor, and the Service Manager. All have the three display screens plus one other screen to select either signal control or train service data lists (dependent upon grade and role), whilst controllers have another three above for over-view, with display on each selected and configured by the individual user. Every user has a CCTV view screen. Signallers have since been provided with a fourth screen. Internal dividing walls are all glass panels. The carpet features the largest ever roundel, in Piccadilly Line blue.

The building is fully Disability Discrimination Act compliant, including kitchen, lift, shower room, toilets and lockers, a first for LU control rooms. There is a four-hour uninterruptible power supply (UPS) for everything. The building is bomb-blast proof to withstand a 150kg charge, one-hour fire compliant, with ninety minutes down the fire escape. It has two air-conditioning circuits in case of failure, with forced fresh air, and two lighting circuits. It is a new building within a listed building, being opened as the Officers Dining Club in 1918, an opening photo showing Lord Ashfield. Historic photos have been displayed around the building. The building is designed for a 20-year life, whilst the system has a 40-year life. New signalling implementation may be 15 years away when funding becomes available.

The Control Room 'proper' is named after a former Piccadilly Line Service Manager Steve Crawshaw who sadly passed away from Cancer in 2013.

FORMER HARDWARE

A view of superseded equipment at Earl's Court showed HP 1000 mini-computers from the 1970s, as still used on the Bakerloo Line, and more recent programmable logic controllers (PLCs), all in danger from the leaking roof. A bank of carefully aimed free-standing Argos fans cooled the relays to keep the Piccadilly Line running.

NEW HARDWARE

Each of the 18 on-site Interlocking Machine Rooms (IMR) have only one small identical cabinet with four sections: power, communications, PLC and input/output. This links directly to the air-powered signal lever frame's inputs and outputs, no matter the style or voltage, and even to relay interlocking drives.

The communications network is a closed dual-redundant set of digital subscriber line (DSL) rings in both the east and westbound tunnels. Redundant equipment remains on site, as removal would have doubled costs!

The IMR equipment communicates with only four cabinets in the new control centre. The off-the-shelf modular hardware has no moving parts and requires no air conditioning. There is a built-in maintainer's terminal although everything can be monitored or re-set remotely, except for a full system reboot which has been used once. Provision is made for future connection to 4LM and DTUP signalling.

Train Managers and key stations also have PICU screens, so all view the same information. The four train crew centres have three-screen displays, although they only needed two, as they can act as stand-by signalling control locations in the event of a major incident in the Control Centre.

The evening ended with the usual question and answer session, responses to which have been incorporated into the appropriate parts of this report, and the speaker was congratulated on his excellent presentation.

John Hawkins