London Underground
Point and switch system development

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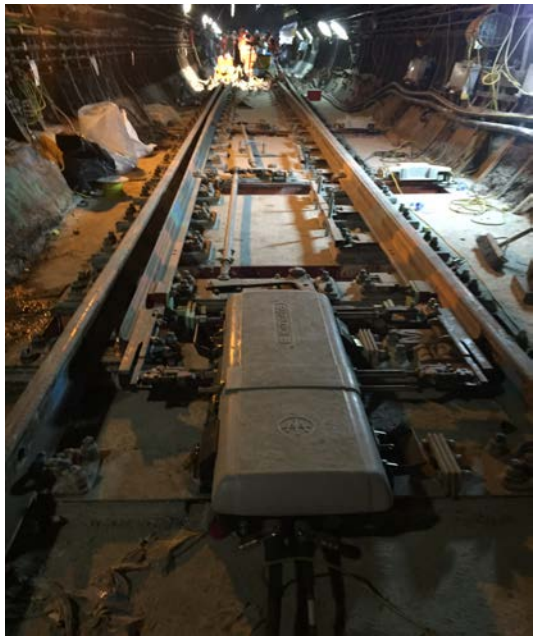
London Underground point system development Finding the 21st century

- As recent as 2007, we were still renewing standard switches with pneumatic point machines as we didn‘t have any recognised approved electric alternatives.
- Reliability data and MTBF rates were largely unknown and un-recorded.
- Standard configurations which could optimise switch performance didn’t exist.
- During PPP, JNP continued to innovate and progressed the Surelock development work with Siemens.
- Significant derailments on NR and LU drove positive system design development.
- Reliability target set by Mayor of 5yrs MTBF.

London Underground point system development
What are we doing?!

- In 10years, London Underground has developed various switch designs, improved the mechanical supplementary drive and introduced the supplementary detector, BR998 from NR.
- Continual development with Siemens have provided us with an approved electric point machine, the Surelock.
- Surelock is currently our preferred point machine, with 240 now installed on our network, including 3 in training centres.



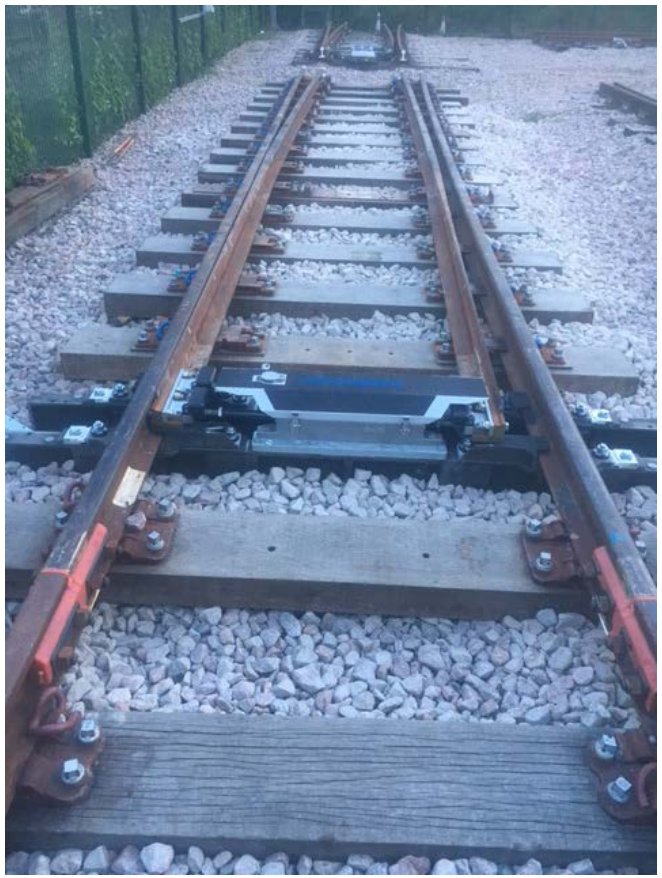
Electric point machine development

- London Underground need to comply to Utilities Contracts Regulations 2006 and demonstrate value for money through competitive tendering for all procurement, where practicable.
- Our sole existing electric point machine supplier, Siemens, have not gone through competitive procurement or cost & performance benchmarking exercise as it's a product of PPP.
- In 2012, we started preparing a Technical Requirements Statement for the next electric point machine, taking into consideration Industry, LU and European Standards.
- Following a PQQ, a tender was issued in 2015 to 2 suppliers. The responses clearly demonstrated a more reliable, cost effective and maintainable point machine was available through Europe. The machine was already in use on other railways.
- In 2016, a contract was awarded to Voestalpine for the design, development and supply (subject to successful assurance) for the Unistar HR EM (Heavy Rail Electric Mechanical).

Unistar HR EM – challenging the LU P&C system

The new point machine offered by VAE allows for the following improvements;

- Stretcherless point system.
- 160mm toe opening.
- Electric mechanical AC brushless motor with 2 second throw time offering improved obstruction detection.
- On bearer, fully tampable.
- Trailable.
- Additional actuation to manage compliant flangeways on long switches.
- MTTR – 30mins.
- 10yrs MTBF – Aim to exceed!
- 26 week maintenance interventions (lubrication only)/ 52 week gauge checks. No further maintenance required.
- Minimal fault finding.



Installation at Arnos Grove JNP point care depot

Unistar HR EM – Stretcher bar requirements past and present

Where?	Standard number	Clause	Requirement
CURRENT **LU**	S1195 Issue: A6 Issue date: 01/02/13 Title: Signalling – Functional Requirements	3.6.3.4 3.6.3.4.1	Stretcher bars and supplementary drives Points shall have at least two stretcher bars (except for wide-to-gauge points).
CURRENT **Railway Group**	GC/RT5021 Issue: 5 Issue date: December 2011 Title: Track System Requirements	4.4.2 4.4.2.1	Stretcher bars on switches and switch diamonds Sufficient stretcher bars of the required length shall be provided to ensure that the design flangeway is always achieved on the open side when a switch rail is correctly fitting to its adjacent stock rail or wing rail on the closed side. A lock stretcher bar, where provided, is not a stretcher bar for the purpose of this requirement.
WITHDRAWN **Railway Group**	GI/RT7004 Issue: 1 Issue date: December 2000 Title: Requirements for the Design, Operation and Maintenance of Points	Page 12 of 23	On passenger lines, not less than two stretcher bars, excluding the lock stretcher bar, shall be used to connect together the switch rails of a set of switches or switch diamonds. Stretcher bars shall be insulated where appropriate to meet signalling requirements.
WITHDRAWN **HSE books HMRI**	Railway Safety Principals and Guidance Part 2 Section A Guidance on the Infrastructure	Section 22	Switches and crossings. Factors to consider about switches and crossings - All moving parts should be positively located and should be locked in the correct position during the passage of trains in the facing direction At least two stretcher bars and a stock rail gauge tie should be provided for switches

The Requirements for stretcher bars has been consistent within Industry Standards and Guidance Notes over the years. However, the requirement for stretcher bars reflects UK custom and practice in delivering the functional requirement to manage gauge and flangeways.

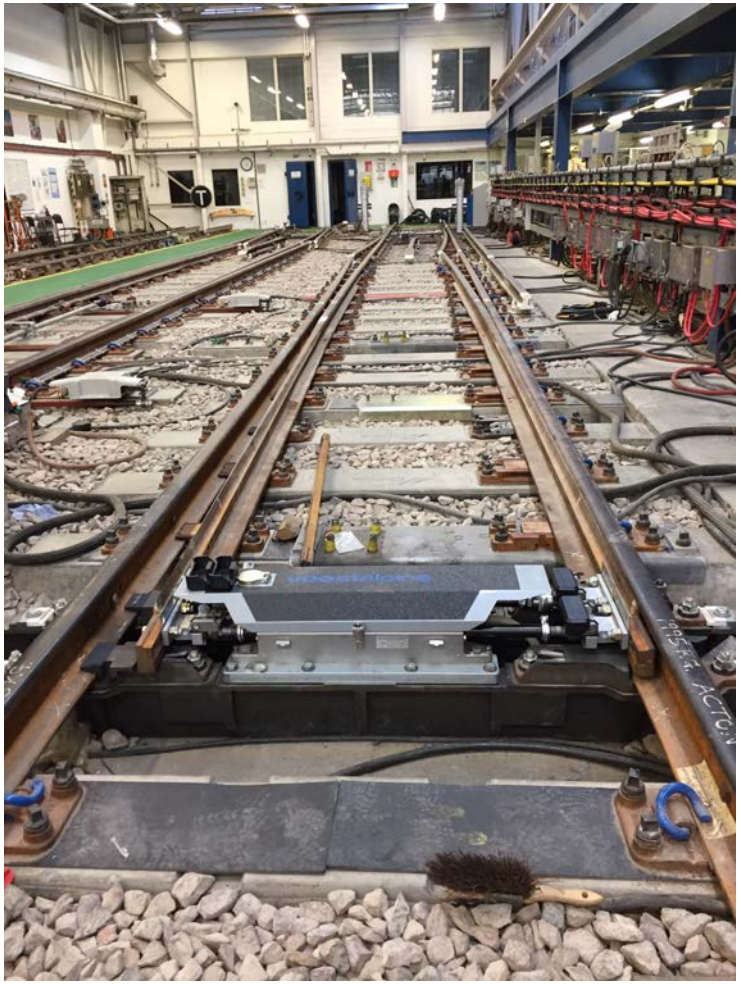
Unistar HR EM – A future without stretcher bars

Stretcher bars remain a requirement through LU Standard, S1195. The need has been removed from ORR Requirements.

The stretcher bar is utilised by LU to primarily manage gauge of the switch rails and switch to stock rail fit, including flangeways.

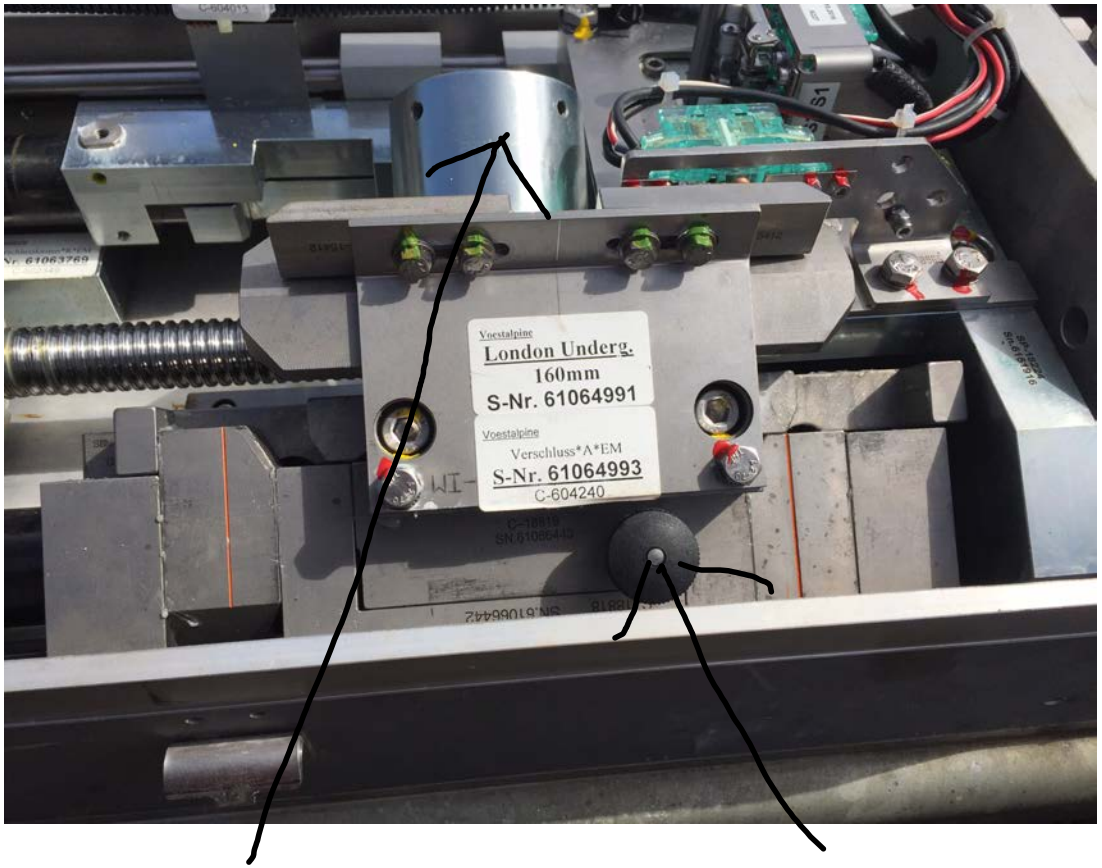
Without a stretcher bar, do we need to manage residual flangeways? How much residual flangeway can we accept?

The removal of stretcher bars allows LU to fully use the Unistar point machine to its full un-compromised capability, provides a point machine for a 21st century railway and removes known hazards within the point system.



On bearer Unistar point machine at LU Acton Signals Training Centre

Unistar HR EM – trailability



Spring Pack

Drop Bolt

In the event of a run through, the spring pack allows the lock blades (primary lock) to separate.

Release of the primary lock allows both switch rails to open, allowing passage of train with no damage to the point machine or the switches.

A bolt drops into the gap presented by the separate lock blades, replicating an obstruction to the point machine detection.

The run through is then detected by the signalling system and revealed.

Unistar HR EM – Next Steps

Voestalpine are completing assurance documents to demonstrate the Unistar point machine can meet our Requirements; formal LU reviews have commenced.

We will demonstrate through safety justification the removal of stretcher bars from a points system is safe for LU.

Frequency converter shown here outside of hollow steel bearer – will be placed within allowing a fully tampable switch

Unistar HR EM – training

The Unistar HR EM is now installed at two locations in London, Acton Signals Training Centre and Arnos Grove point care depot.

The installation of the Unistar at Acton was used to evaluate training needs, review the installation and maintenance manuals and identify what is different? Where do we now need to focus our efforts for introducing the machine and new concepts?

The machine is now visible and available for all to see… we await feedback and comments with great anticipation!

Unistar HR EM – Next Steps

- The first operational installation is planned for South Harrow, Piccadilly Line in May 2018.
- First installations are planned for short switches where no supplementary drives are required.
- First sites will be managed as trials, where operational and maintenance data will be collated to support full safety case.
- Next development stages will include applications for depots (where trailability function can be fully realised and benefit gained), deep tube sites and longer switches.
- Longer switches will be managed by installing additional Unistar machines through switch length.
- The Frequency Converter will allow detailed condition monitoring and motor settings adjustments.

Surelock – Next steps

- Siemens have responded to our appetite to continued development and improvements.
- The next steps for Surelock allow us to move to double drive and linear back drive, making further performance improvements.

- This set up also allows us to remove stretcher bars where the Surelock and linear back drive perform the same function

London Underground – Next Steps

- Update to Standards to reflect what we're doing and open up the requirements for further development, including challenging the requirement for 6weekly FPL test.
- Move the design and supply of whole P&C system to suppliers, including performance and reliability targets to be achieved.
- 'Fit and Forget' – smarter utilisation of remote monitoring.
- Support a 24hr railway with expansion of Night Tube.
- Support the culture change required to gain full maintenance benefit of these new points systems.
- Keep challenging what we've always done!