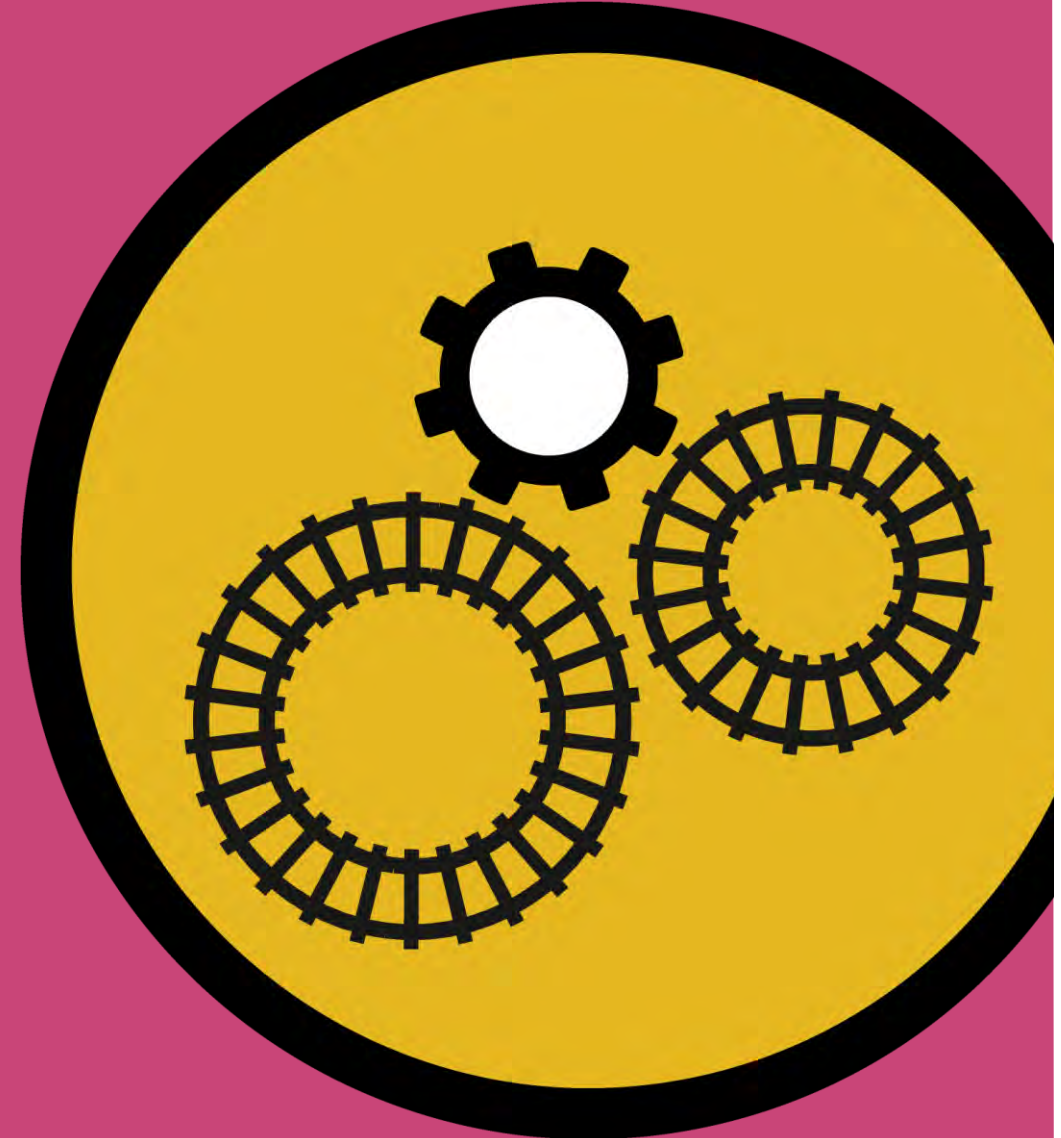


Technology Development Team

The Principles of Point Operating Equipment and
the High Performance Switch System (HPSS)

Presentation to PWI: 24th February 2021



Network
Services



Technical Services

Presentation Team



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Overview of Presentation

1. Technology Development Team: what do we do?
2. Point Operating Equipment (POE): why do we have it and what does it do?
3. POE / Track / Track Support: design considerations & interfaces
4. Types of POE in use in Network Rail
5. Why is POE so critical and what happens if it goes wrong?
6. Development of HPSS: a brief history
7. New developments: HPSS Mk2 and beyond.....

Questions & Answers

Technology Development Team: What do we do?

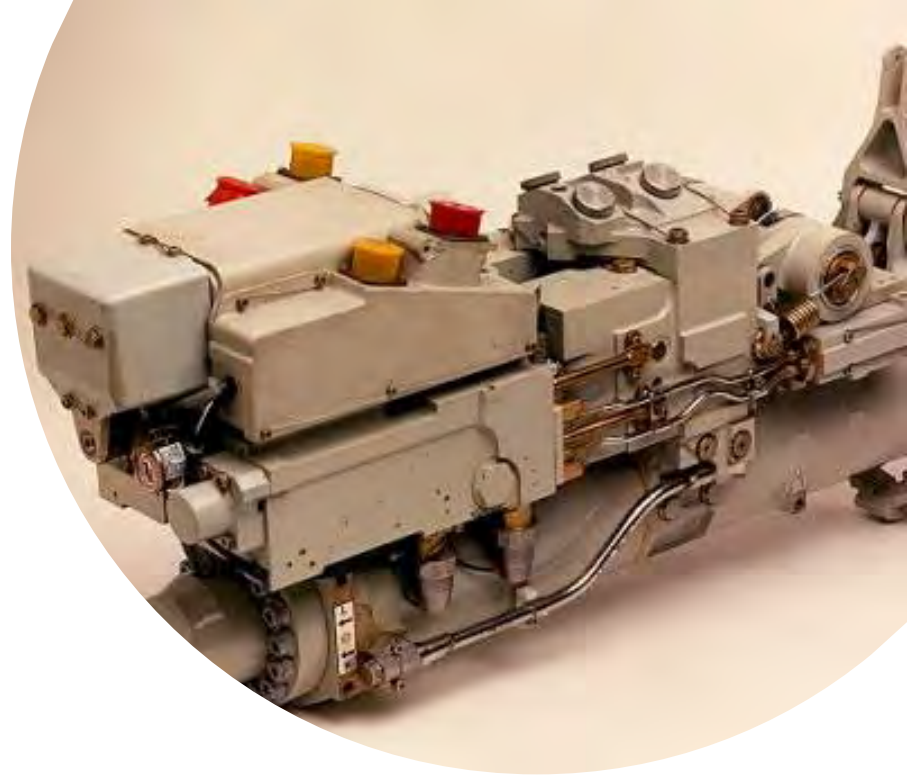
Technology Development Team (TDT) - What do we do?



- Based in Weston-super-Mare, the team are responsible for the design & development of point operating equipment, most notably the High Performance Switch System (HPSS)
- We procure all parts, assemble & test the HPSS point operating system
- We provide spares, tooling and user guides / training materials etc.
- We provide customer / technical support (office and field based)

Technology Development Team - History

- Originally part of Fairey Hydraulics Ltd (FHL), suppliers of aerospace flight control systems (acquired by United Technologies Corporation in 2002)
- Diversified into industrial sector in early 1990s, leading to creation of Industrial Actuation Division (IAD)
- IAD acquired by Network Rail (National Supply Chain) in 2012, now part of Route Services
- IAD transferred into STE in December 2018, renamed Technology Development Team (located in the Technology Development Centre)
- Transferred into Technical Services as part of the Putting Passengers First reorganisation in 2020



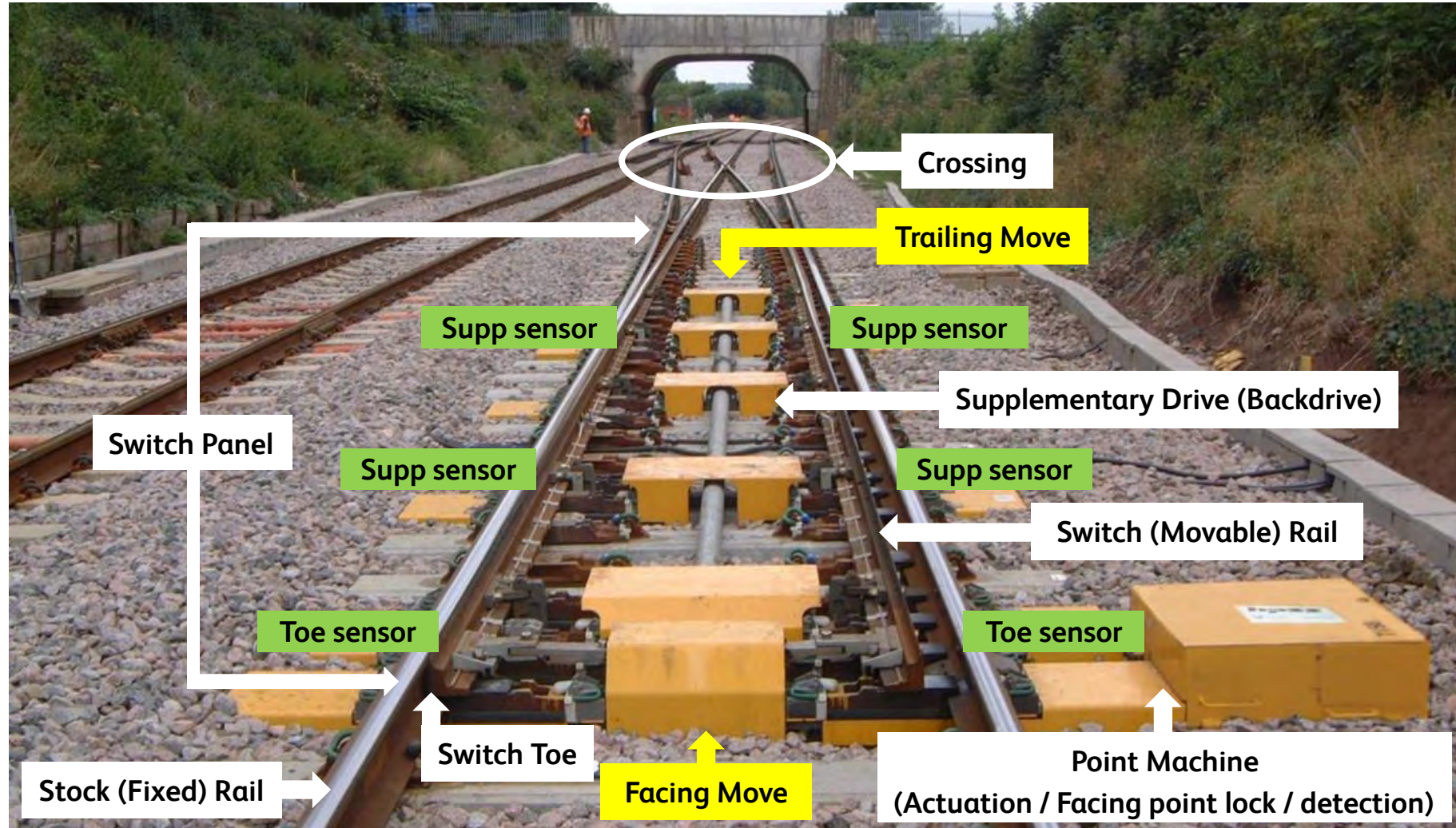
Point Operating Equipment: Why do we have it and what does it do?

Why do we have Point Operating Equipment?

Purpose of POE:

- POE forms part of a Switch & Crossing (S&C) system
- Switches and crossings steer trains safely from one track to another.
- POE carries out the Actuation, Locking and Detection (ALD) of the switch rails (relative to the stock rails)
- POE typically consists of:
 - Point machine to move and lock the switch rails at the toe (facing point lock) and provide rail position / lock detection
 - Supplementary drive to transfer drive forces along the length of the switch and to lock it in position
 - Supplementary detection to detect any obstructions between stock and switch rail (tight gauge)

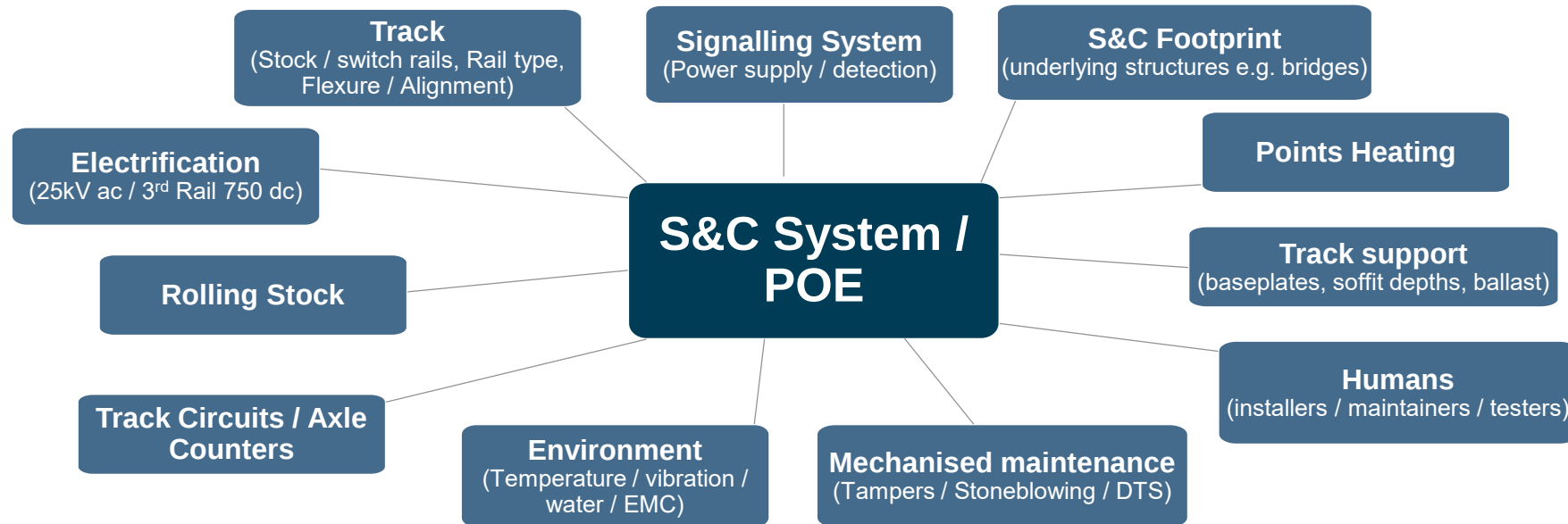
Switch & Crossing / Point Operating Equipment layout



POE / Track / Track Support: Design considerations & interfaces

Point Operating Equipment: Key interfaces

POE design needs to consider the following key interfaces:



Key interactions / issues:

- Voiding (accommodate up to 7mm)
- Switch Rail creep (mechanical set-up / thermal effects)
- Variation in gauge
- Change in philosophy – dropping detection (safest option) vs running in degraded mode (keep trains running)

Types of Point Operating Equipment in the Network Rail infrastructure

Types of POE in Network Rail's infrastructure

Total POE asset count: 20,140

comprising:

• Clamplock	7,581
• HW	7,047
• Mechanical	2,033
• Other	1,555
• M63	750
• HPSS	593
• Hy-Drive	390
• Electrical	191

Point machines:

- Mechanical (hand / ground frame)
- Electro-mechanical (e.g. HW, M63, HPSS)
- Electro-hydraulic (e.g. Clamplock, Hy-Drive)
- Train Operated (hydraulic)
- Pneumatic

Supplementary drives (backdrives):

- Mechanical (bell cranks/rodding in 6 foot or 4 foot)
- Mechanical (torsion backdrive)
- Hydraulic

Types of POE in Network Rail's infrastructure

- HW (Alstom)
- Electro-mechanical
- 7,000 in service
- Introduced in 1950s
- Clamplock (British Rail)
- Electro-hydraulic
- 7,500 in service
- Introduced in 1970s
- M63 (Westinghouse)
- Electro-mechanical
- 750 in service
- Introduced in 1963



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Types of POE in Network Rail's infrastructure

- Hy-Drive (SPX/Alstom)
- Electro-mechanical
- 400 in service
- Introduced in 2007
- HPSS (Network Rail: TDT)
- Electro-mechanical
- 630 in service (NR & HS1)
- Introduced in 2000



POE: Asset utilisation

- Utilisation of the assets is increasing, with higher speeds and tonnages
- In 1950 POE design life was for 100,000 operations, now they are routinely doing 350,000
- The switch block from a “GRS mod 5” point machine (designed in the 1920s), is still part of the current HW design
- Time available to maintain and inspect is minimal, therefore fit and forget low maintenance is the objective for all new POE

**Why is POE so critical and
what happens if it goes wrong?**

What happens when POE goes wrong?

- If any POE fails to fully actuate, lock or detect, the signalling system 'fails safe' (right side failure), leading to....



- Signal to Red = Train delays
 - Passenger dissatisfaction
 - Maintenance staff on track (safety)
- S&C / POE is more complex than plain line and requires detailed attention in order to reduce risk of derailment / points failure.

What happens when POE has a 'Wrong Side Failure'?

Potters Bar, May 10th 2002

- Seven people were killed in the accident at Potters Bar, which was caused by a set of points moving under a train
- The bolts holding the stretcher bar in place had worked loose and the rails moved under the force of the train
- Poor maintenance established as a factor. Following this accident, a decision was taken by Network Rail the following year to bring all track maintenance in-house

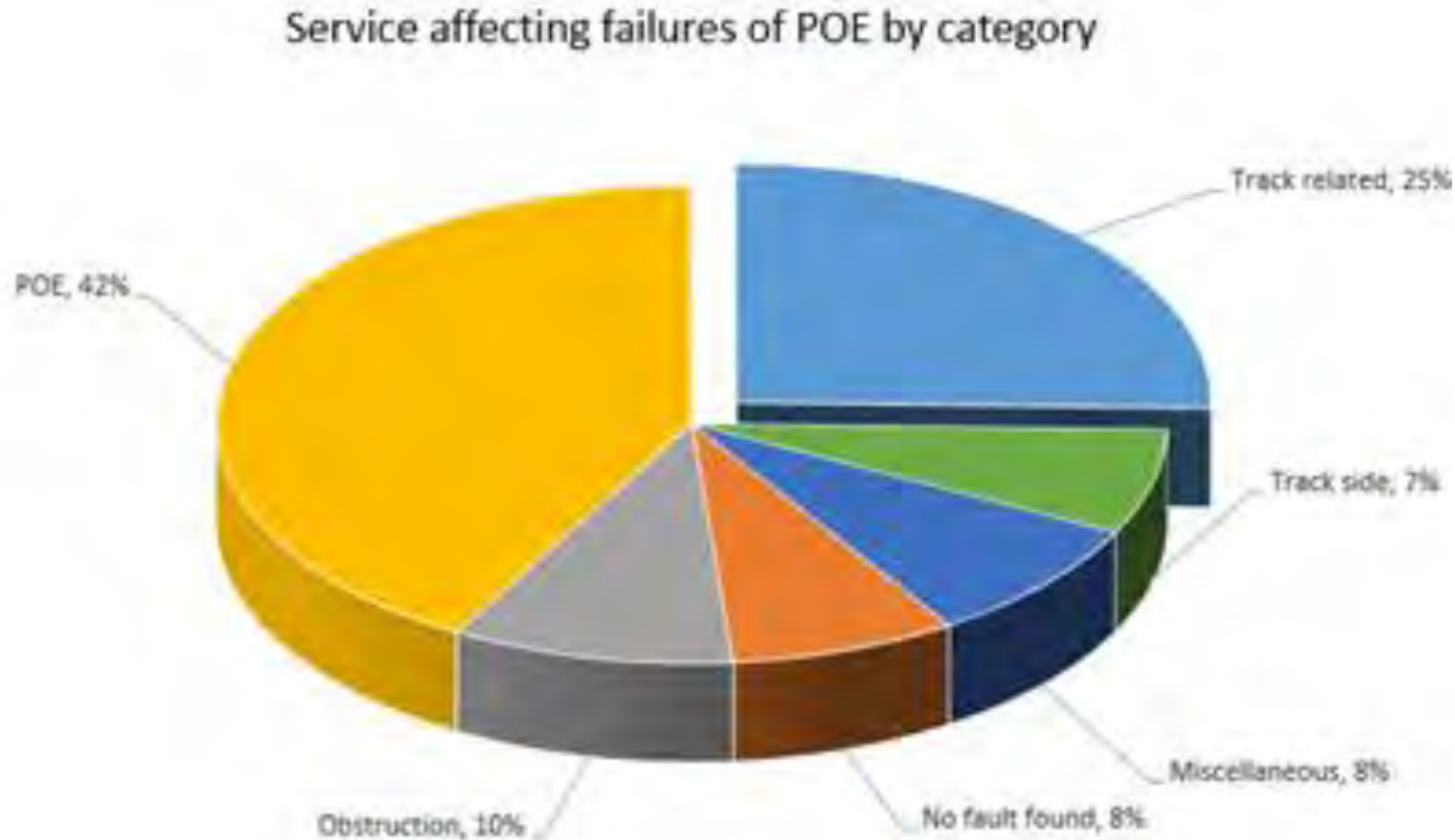


Grayrigg, February 23rd 2007

- One person were killed and 30 seriously injured, in the accident which was caused by a poorly maintained set of points
- Cause of the accident: poorly maintained stretcher bars (disconnected or missing); 3 bars, one not in position, second had nuts and bolts missing, two were fractured



Typical POE Service Affecting Failures



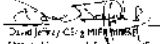
- ‘POE’ includes items specific to POE like pumps, rams, motors, gearboxes, levers etc.
- ‘Track side’ is: relays, power supplies, cables
- Vibration is the enemy of POE and therefore good track support is essential

Development of HPSS: a brief history

HPSS Development

- Commenced in June 1994, 4 year product development to trial
- Prototype trial: 1998 to 2000 (Tamworth, trailing points)
- Facing point trial: 2000 to 2001 (Nunhead Junction 989 & 990pts)
- Full Product Acceptance obtained in 2001

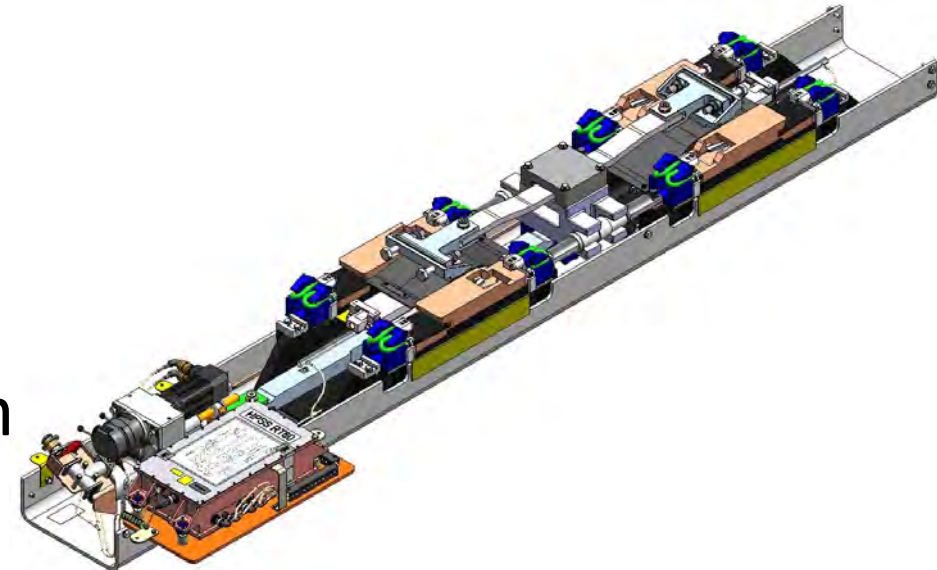


RAILTRACK Certificate of Acceptance		
Certificate No:	PA05/079	Issue 1 Date 23 Jan 2001
Effective Date:	29 January 2001	Page 1 of 1
Product:	High Performance Switch Actuation System (Configuration page 2)	
Manufacturer:	Industrial Automation Division, Cloverham Limited 63/64 Casselle Road, Wotton-Super-Mare BS24 9LS	
General Conditions: The product identified above is accepted for use on Railtrack infrastructure within the scope of authority defined below. Acceptance of any change to the product is liable to a demonstration that the change from the original has been assessed and is negligible. Continuous change to product configuration shall be notified to Railtrack Acceptance Services. Any deficiency affecting the product shall be resolved in writing to Railtrack Acceptance Services.		
Scope of Authority: The High Performance Switch Actuation System is accepted for installation and use on Railtrack infrastructure in Trailing and Spring Point applications (not for speed up to 90 MPH or 75 mph in the direction of travel) as detailed in the certificate.		
Specific Conditions: See page 2 and onwards of this certificate for the specific conditions, restrictions and constraints of acceptance.		
Signature:  David Jeffrey CEng MEng FIMM Deputy Technical Infrastructure System Review Panel		

Issued by: Railtrack Acceptance Services, 100, 101, 102, 103, 104, 105, 106, 107, 108, 109, 110, 111, 112, 113, 114, 115, 116, 117, 118, 119, 120, 121, 122, 123, 124, 125, 126, 127, 128, 129, 130, 131, 132, 133, 134, 135, 136, 137, 138, 139, 140, 141, 142, 143, 144, 145, 146, 147, 148, 149, 150, 151, 152, 153, 154, 155, 156, 157, 158, 159, 160, 161, 162, 163, 164, 165, 166, 167, 168, 169, 170, 171, 172, 173, 174, 175, 176, 177, 178, 179, 180, 181, 182, 183, 184, 185, 186, 187, 188, 189, 190, 191, 192, 193, 194, 195, 196, 197, 198, 199, 200, 201, 202, 203, 204, 205, 206, 207, 208, 209, 210, 211, 212, 213, 214, 215, 216, 217, 218, 219, 220, 221, 222, 223, 224, 225, 226, 227, 228, 229, 230, 231, 232, 233, 234, 235, 236, 237, 238, 239, 240, 241, 242, 243, 244, 245, 246, 247, 248, 249, 250, 251, 252, 253, 254, 255, 256, 257, 258, 259, 260, 261, 262, 263, 264, 265, 266, 267, 268, 269, 270, 271, 272, 273, 274, 275, 276, 277, 278, 279, 280, 281, 282, 283, 284, 285, 286, 287, 288, 289, 290, 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High Performance Switch System (HPSS)

- System designed for 25 year life, only requiring annual inspection resulting in competitive 'whole life cost'
- Designed for use in high speed, high tonnage lines (CEN56 & CEN60 rail)
- Fully tampable design, drives to stall, with no residual gap at stock rail
- Electronic control system, integrated with NR Intelligent Infrastructure system, key parameters monitored in 'real time'
- Use of linear sensor technology to detect both open and closed switch rails at all times



HPSS: Product Range

HPSS (High Performance Switch System)



Ancillary Products:



Power Pack



Drive Unit



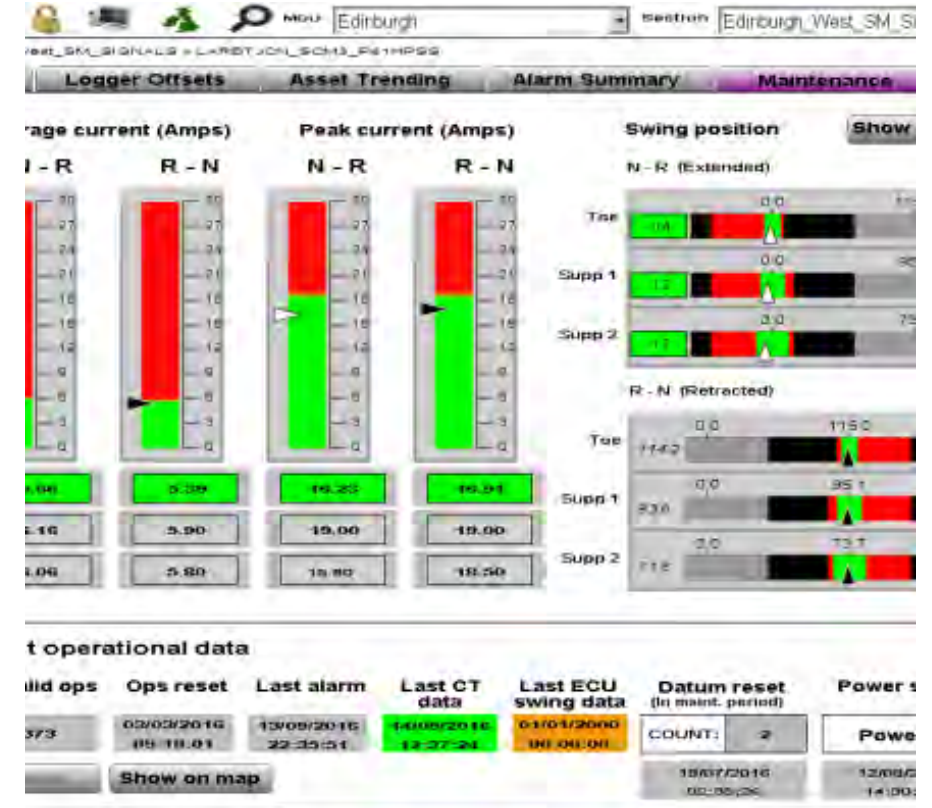
HPSS Handset



Remote Condition Monitoring (RCM)

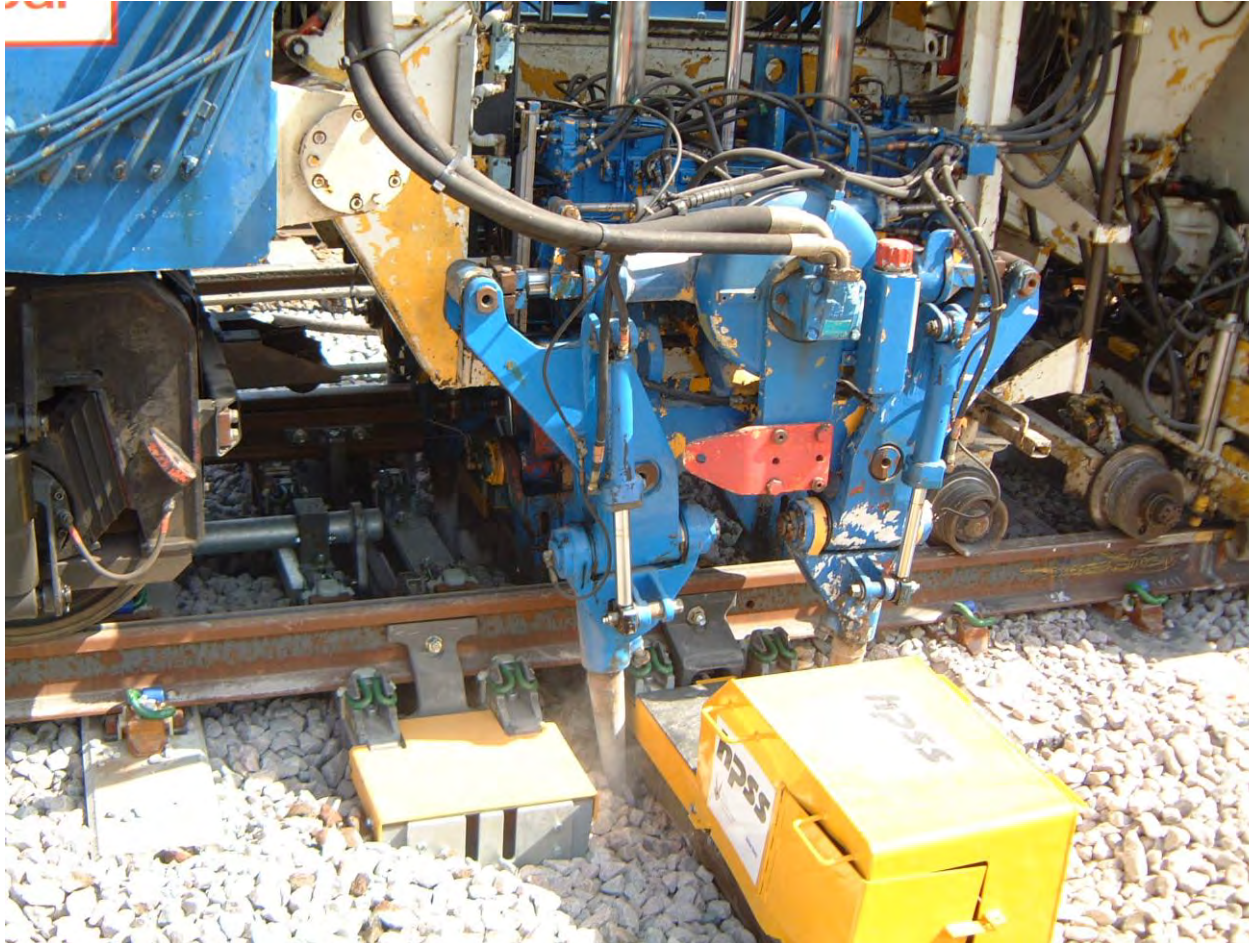
Currently approved for the following switch sizes:
RT60 'C' to 'SG' & CEN56/NR56 'BV' to 'SGV'

Remote Condition Monitoring 'Predict & Prevent'



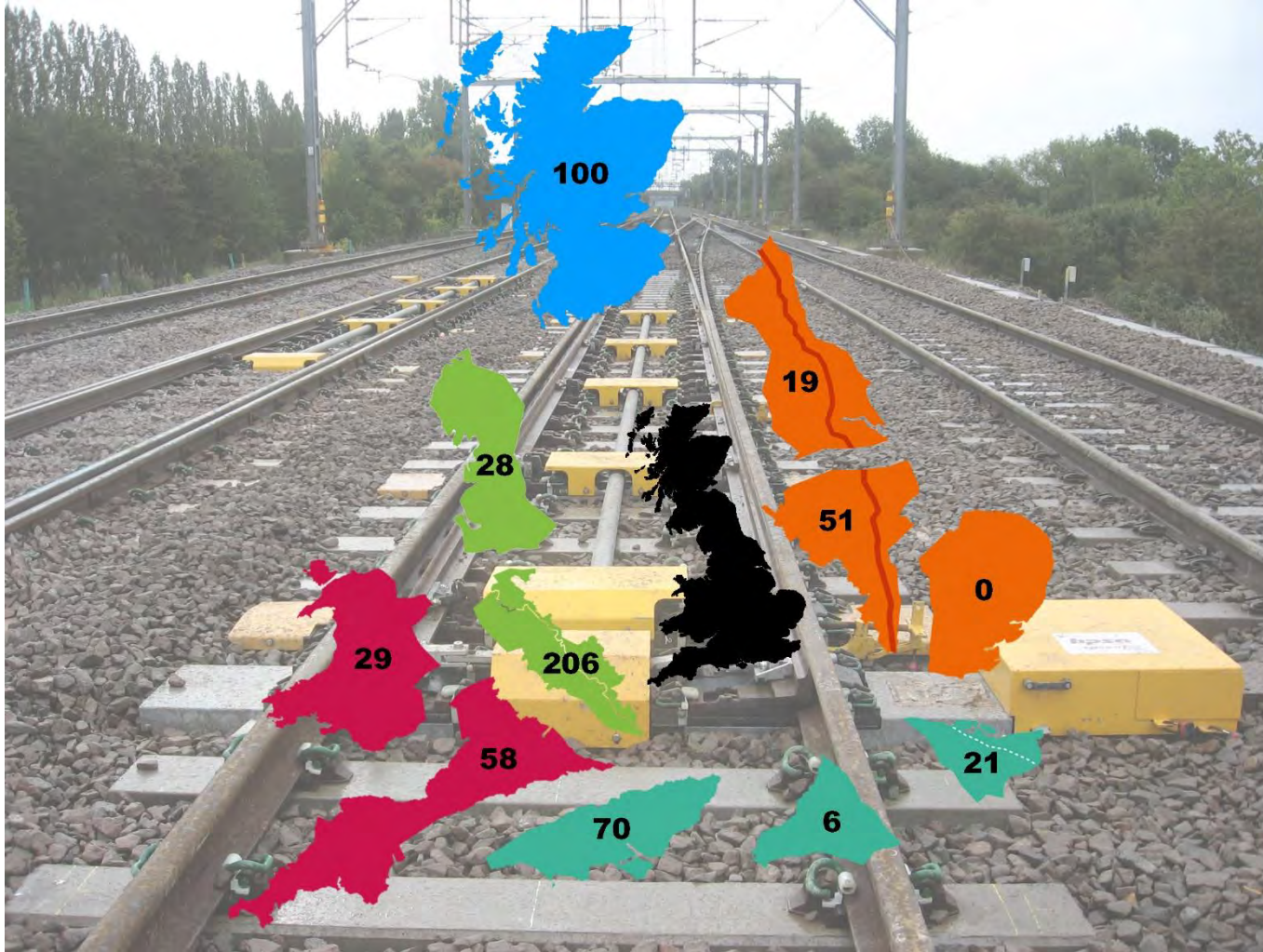
- Integrated with NR Intelligent Infrastructure 'RADAR' system
- Monitoring of key HPSS parameters / trend analysis

HPSS: Track maintenance (tamping)



- HPSS can be machine tamped through the entire switch panel

HPSS: Population by Region / Route



- Population: 630
comprising NR Regions:
- Eastern: 70
 - North West & Central: 235
 - Scotland: 100
 - Southern: 97
 - Wales & Western: 87
- plus:
- HS1 (St Pancras): 41

New developments: HPSS Mk2 and beyond....

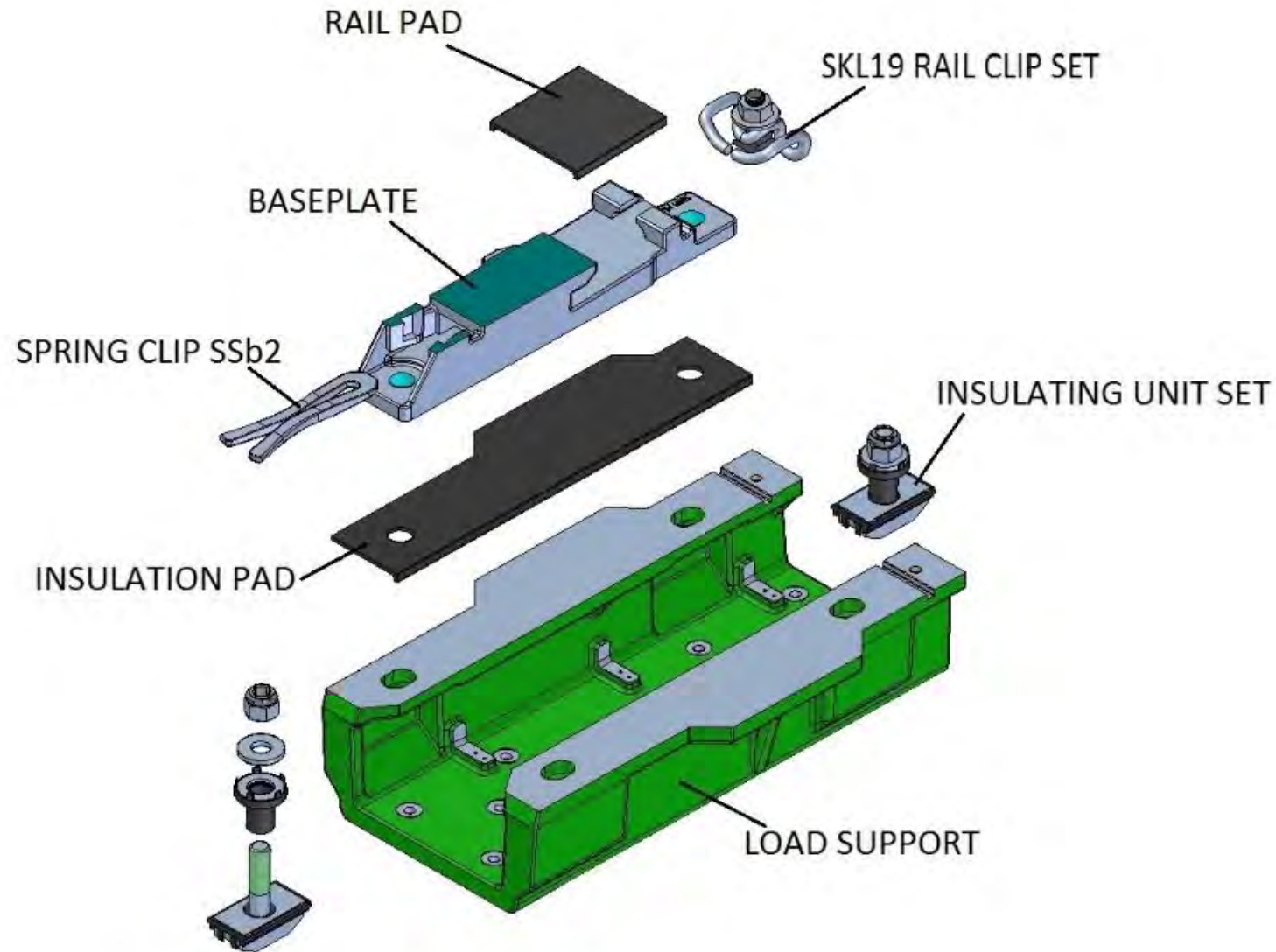
HPSS Mk2: currently in development



Key changes:

- Use of NR standard Schvihag baseplates
- Improved maintainability (e.g. quick remove / replace lids & covers)
- Introduction of 'Fault Tolerant' detection
- Under Bearer Pads (as required)

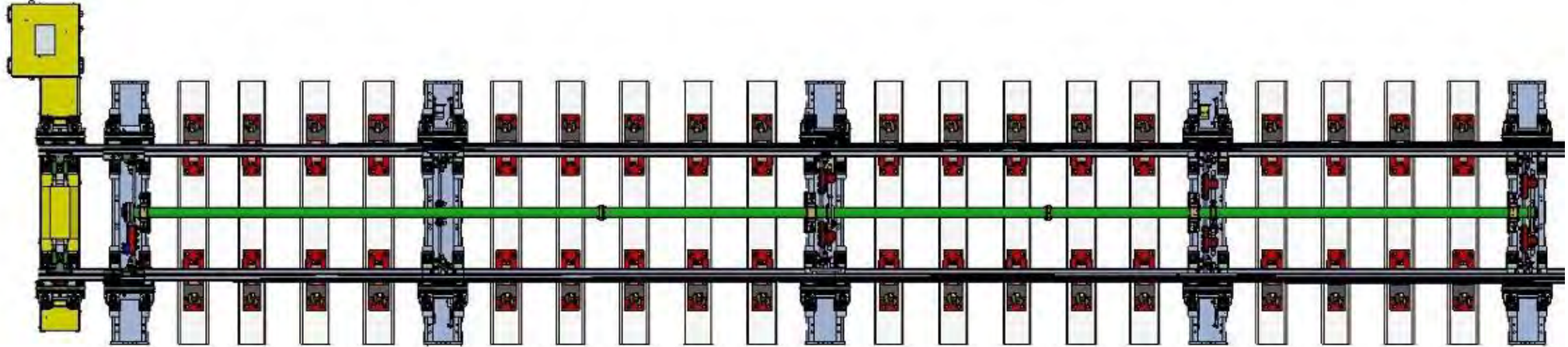
HPSS Mk2: Track support / Schwiuhag baseplates



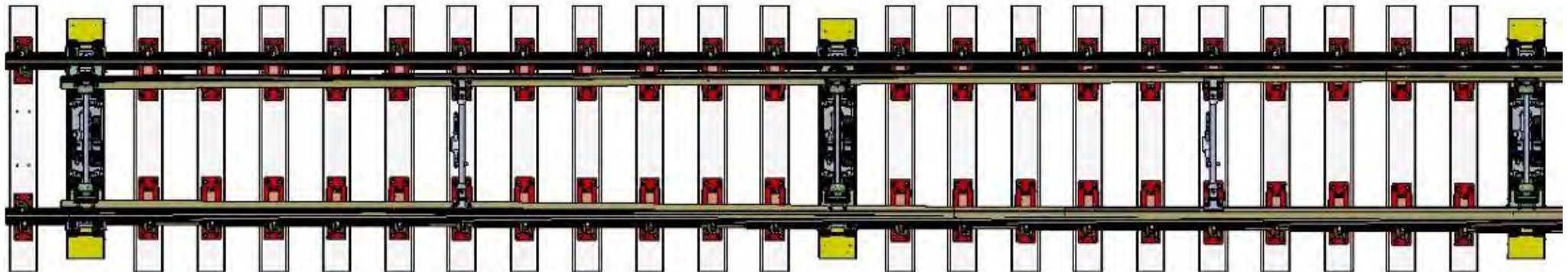
HPSS Mk2: Fault Tolerant Detection

- Existing POE (including HPSS): single component failures/faults can result in downtime & train delays
- Fault Tolerant design incorporates 2 pairs of Toe sensors
- Enhanced logic tolerates certain detection failure modes and maintains system Insafe 'degraded mode'
- Fault Tolerant ECU coupled with RCM provides enhanced points monitoring to predict & prevent service affecting failures
- Enables systematic fault-finding, to reduce 'no cause found' and repeat failures (and fewer staff on track)

Future HPSS design option: Multiple machines



Existing HPSS switch layout

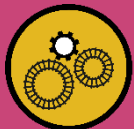


Multiple HPSS switch layout

Thank you



Network
Services



Technical Services

Questions & Answers