

NOTICE BOARD

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NETWORK RAIL - SIGNAL ENGINEERING Track Circuit Bonding in S&C

Purpose

This Notice Board provides guidance in an alternative approach to the bonding of jointed d.c. track circuits in switches and crossings [S&C]: the principal benefit is to whole-life asset performance by the reduction in the potential for rail breaks from a decrease in the quantities of insulated rail joints [IRJs]. The effect of electrical interaction between adjacent track circuits is also reduced, obviating the need for feed-end relays in most circumstances. This is a second Notice Board on the theme of track circuit bonding. It is a Safe by Design initiative and has been endorsed by the relevant functional heads. This Notice Board forms its own briefing note.

Scope

This guidance applies to all track circuits on electrified and non-electrified lines and advises for the provision of insulated IRJs for S&C and the associated track circuit bonding to be undertaken in the style generally expected for electrified railways. The benefits which accrue are:

- a reduction in the risk associated with rail end breaks by the reduction in the number of insulated rail joints;
- S&C 'strengthening' from the improved positioning of insulated rail joints within and adjacent to S&C units;
- a reduction in track circuit bonding 'complexity' by removing the requirement for a continuous, series-bonded signalling rail;
- consistency of design approach whether electrified or not;
- a proven significant reduction in EMC-related influences such as track circuit residual voltage in most circumstances and the removal of the need to provide additional track circuit relays at first-design.

A non compliance is required to deploy these arrangements: an approved Tracker exists [12983] which covers multiple sites on the Western Route.

This Notice Board advises signalling project engineers and designers to discuss with RAM Signalling and RAM Track to decide when the approach described in this document is appropriate.

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Background (Track)

The failure of a broken rail end in S&C is a significantly more serious event than a clean break in plain line. Analysis over a four year period from 2009/10 to 2012/13 shows broken rail ends at joints in S&C accounting for 5% of all broken rails (34 out of 624). However over the four year period there were 104 'Track' 50+ incidents, of which 49 were broken rails and 23 (22%) were broken rail ends in S&C.

Note: the only joints in modern S&C are insulated joints, in older timbered designs of S&C installed in main lines 50% of the joints will be insulated rail joints.

It has been estimated that the changes proposed to IRJ provision may conservatively reduce their number in new S&C by 20% with a corresponding reduction in the numbers installed in the faster (straight) part of each unit.

S&C makes up approximately 2% of the total track mileage but broken rail ends in S&C generate 22% of the 50+ track hazards. Adoption of the proposal will over time reduce the number of IRJs in S&C with a corresponding reduction in the number of Track 50+ hazards of approximately 5% assuming all other factors remain constant.

Background (Track Circuits)

The reduction in quantity of IRJs in S&C impacts track circuit bonding designs. Track circuit bonding has traditionally maximised the amount of series connections so that any severance causes a revealed failure and appears as an occupied train detection section. Due to the failure modes exhibited by certain types of dc track circuit the NR Track Circuit Handbook was updated in 2000-2001 to describe the principal configurations which would protect against wrong side failure from disconnections and rail breakages in cabling and the rails which form any path where the bonding cannot be *in series* throughout. Such non-series bonding is predominant in at least one of the track circuit rails in most S&C units.

A main feature of bonding which minimises the risk of failing to detect trains but which has no benefit on detecting rail breaks is the concept of Yellow Bonding where multiple parallel reinforcement electrical paths are provided and inspection regimes have been adopted to minimise the risk from those paths becoming detached. The use of Yellow Bonding and the associated rules relating to track circuit polarity and its stagger within a single track and with adjacent tracks has performed to a level judged as ALARP and is well-established.

A reduction in the numbers of IRJs provided within S&C causes a reduction in the amount of rail sections and reduces the opportunity for connecting the remaining sections in series. Given that the track asset perspective is to reduce rail break opportunities by reducing IRJ quantities (and monitoring the remainder by alternative means) and to reduce reliance on the track circuit then the established practice of Yellow Bonding can equally be applied to those increased lengths of individual track circuits which would now be in parallel.

Standard bonding designs exist with IRJs positioned in either turnout or straight rail and thus they can be combined to provide a Yellow bonded arrangement for all the non-series bonded parts and IRJs can be provided only to prevent shorting between rails. In most cases it is possible to achieve a turnout rail position even in retro-fit situations.

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Three locations have been used to demonstrate the viability of the revised approach: at Taunton as part of the relaying of one end of a medium-sized country station with multiple platforms; at Penzance where residual voltage risk had been found to be high and in loops at Bristol Parkway. Taunton:

- IRJ count within and bounding the S&C reduced from 38 to 31 circa 20%;
- 7 track circuits: reduction in residual voltage in 5; no change in one and a tripling (from 3 to 9%!) on one.

Penzance provided an opportunity to arrange various arrangements of common rail bonding:

- various groups of S&C track circuits were re-configured from all-common-negative or all-common-positive to 'equal' quantities of negative and positive connections;
- 9 track circuits: 'pre' residual voltage ranging from 48% to 186% with 5 above 100%;
- post residual voltage ranging from 8% to 31% with an exception at 56% (later lowered);
- single ended track sections into platforms and sidings were added to common rail groups after being found to lower the residual voltages on themselves and the connected adjacent sections.



Documents

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