TRAINSAFE
SAFE INFRASTRUCTURE WORKSHOP

DEMONSTRATION OF THE RESEARCH CLUSTER MECHANISM FOR “TRACK WELDING”

STAGE 1

ISSUE HIGHLIGHTED IN THE STATE OF THE ART REPORT

This resulted in the topic of ‘Track Welding’ forming part of the agenda for the ‘Safe Infrastructure’ workshop.

The following is the relevant extract from the State of the Art Report

Track joints

Railway track can either be mechanically fastened (i.e. bolted) or continuously welded. Most modern high speed / heavily used lines are continuously welded, but mechanically fastened track still continues to have a significant share (e.g. approximately 30% in the UK).

Mechanically fastened track generally consists of two rails on softwood, hardwood, or to lesser extent concrete, sleepers. Adjacent sections of rail are bolted together using either standard fishplates, which are typically 18-20 inches long depending upon the type of rail (Figure 10a), or insulated block joints (IBJs) that are used to ensure correct operation of the track circuitry system.

Continuously welded rails are most usually laid on either steel or pre-stressed concrete sleepers and fixed with clip fastenings (Figure 10b). The second most commonly used fixing technology for continuously welded rails are "AS1" track plates that clamp the rail in place (Figure 10c). Continuously welded rails offer several advantagesover traditional mechanically fastened track. These include higher travelling comfort and a reduction in the levels of noise generated. Continuously welded track also has lower maintenance costs, and is considered an essential technology for high speed lines.

Figure 4.10 – Common methods of joining and fixing track: (a) mechanically fastened, (b) continuously welded and fixed with clip fastenings, and (c) continuously welded and fixed with AS1 track plates.

In normal operation, the stress state in continuously welded track will vary with the ambient temperature due to thermal expansion and contraction. Low temperatures tend to induce tensile stresses, whereas high temperatures can induce compressive stresses. The latter, if excessive, could result in the buckling of the rail. To prevent this occurrence, continuously welded rails are installed with a pre-tension. This has the effect of providing a neutral stress state at a higher temperature than ambient. Ongoing studies are investigating the effect of this pre-tensioning on crack growth within continuously welded rails.

Geometric defects in railway joints can occur when the rail parent material wears at a different rate to the welded joint. Imperfections generate dynamic forces in the track when impacted by a wheelset and contribute to a proportion of rail breaks occurring near to the ends of rails. This area could benefit from further research in welding techniques, metallurgy and the maintenance regimes of welds.

STAGE 2
DISCUSSION PRESENTATION FROM A TRACK WELDING EXPERT

A brief five minute presentation to introduce the topic to the workshop delegates. This defined the topic scope and highlighted the key specific issues to be addressed.

STAGE 3

RESULTS OF FACILITATED DISCUSSION AT THE SAFE INFRASTRUCTURE WORKSHOP

The output from a two hour session, which was then presented to the other workshop delegates for comment.

TRACK WELDING

Safe Infrastructure Workshop
29th – 30th October 2003
Leamington Spa, UK

1. What are the critical passive safety issues relating to the topic?

- **Weld Repairs (Plain Line and S&C)**
  - Standards required (Europe-wide) for process, inspection, training
  - Weld repair process introduces own defects
- Joint alignment (dynamic forces and consequences)
- ALT Welds
  - Acceptance criteria uniform irrespective of duty
  - 100% inspection regime required? Inspect at site before welds enter service. Resource and technology issue
  - Data from existing inspection regimes not fed back into weld quality and acceptance criteria
  - Only a significant problem in the UK?
- FBW
  - 100% inspection regime required? Inspect at site before welds enter service. Resource and technology issue
- 'Legacy' - latent problems with failure rates of 10-15year+ old welds in weld population. Effect of change in track duty on failure rate of existing weld population
- 'Safe Life' decisions - modelling

2. What are the issues relating to standards?

- Prescriptive standards working? e.g. SNCF less regulation but fewer problems?
- Performance related standards vs. uniform acceptance criteria
- Performance 'guarantees'?
- Weld Repairs
  - No standards (only 'local' acceptance criteria)

3. What are the overall recommendations (solutions) for addressing the critical passive safety issues identified in slide 1?

- Diagnosis of weld quality issues (supplier-network owner co-ordination) e.g. central SNCF system for investigation of all weld failures.
- Analysis of surviving welds
- Develop standards for weld repairs
- Accelerated development of inspection technology esp. existing tools (UST, EC, Acoustic, Radiography)
- Develop tools to improve product quality – alignment, temperature control, weld metallurgy, grinding kit, stress relieving (US)

4. What are the business benefits of the proposed recommendations?

- Reduce risk of rail failure (and consequential effects)
- Improve perception of railway industry (growth)
  - Environmental benefits (corrugation – noise)
- Reduce £3M costs removing and replacing 'defective' ALT welds
- Welding productivity – through process development

5. What are the priorities for future research activity?

- Understand critical weld defects re: immediate 'post processing failures' and in welds surviving many years.
- Critical weld defect sizes and locations - modelling
- Welding and Inspection technologies
- Joint misalignment measurement and correction equipment
- Standards development (incl. Benchmarking against international practice)