

**Office of Rail Regulation**

**Further Assessment of Approaches to Improve Efficiency**

**Technical Appendix Number 11**

**Efficient European Re-railing Technique**

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## Executive Summary

This paper is one of a series commissioned by the Office of Rail Regulation in order to gain an improved understanding of the maintenance and renewal techniques used outside Great Britain. These reports have been produced as part of the PR08 process.

The CP4 settlement will require the industry to achieve further efficiency savings in the delivery of track renewal items. These targets could be achieved by using process flow and production line techniques to work:

- Smarter;
- Better;
- Faster; and
- Safer.

Re-railing is just one renewals activity within Network Rail's renewals portfolio. 222,323 track metres of rail was installed under the Category 2 works description "re-rail both rails" in 2006/07. This re-railing was delivered at a cost of £46.7m, equating to a unit rate of £210 per track metre.

This report expands on the initial report titled "High Output Stressing" (Technical Appendix Number 5 to RailKonsult's previous report to the ORR) and is based on best practice in Switzerland. It was developed through combining re-railing with high output heater stressing and mobile flash butt welding operations.

By adopting the methodology described in this report it would be possible to deliver re-railing activities (Category 2 works) at the equivalent price of £124 per track metre, giving a saving in the order of 40%. If this were applied to the 2006/2007 re-railing work bank, the annual saving would have been £19m.

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- SBB
- Sersa

### Disclaimer

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## **1.0 RE-RAILING TECHNIQUES**

### **1.1 Re-railing operations**

Re-railing of the railway infrastructure is undertaken either as single component renewal, (Category 2 works), or as part of a composite renewal such as re-rail, re-sleeper and reballast (Category 10 or 11 works). In 2006/2007 some 447 track kilometres of rail was renewed on the British network, 223 track kilometres of which was installed as Category 2 work, i.e. renew both rails.

The methodology adopted is generally the same across Britain with road rail excavators or jibbed rail mounted equipment operating with attachments for removing and replacing rails. There are mechanical machines available as individual machines or attachments to road rail excavators for undertaking unclipping and clipping up activities.

Stressing of newly installed continuous welded rails is a key element of the overall process. It is achieved by means of hydraulic tensors and is generally undertaken as a follow up activity, either in midweek or subsequent weekend possessions.

With the move towards the seven day railway and shorter track access regimes the industry needs to look at how the whole end to end process of re-railing is undertaken as well as the best types of bespoke plant available for delivering this type of work.

### **1.2 Extent of Methodology**

The approach described in this report is based on best practice in Switzerland, which was developed through combining re-railing with high output heater stressing and mobile flash butt welding operations.

### **1.3 Applicability**

The methods of re-railing discussed in this report are applicable to renewal activities rather than maintenance as they are undertaken when strings of continuous welded rail are installed rather than small sections of rail replacement such as defect removal.

Note that, whilst references are made to specific products and systems that are in use in particular countries, there may be other products available that provide a similar functionality. The report does not review all available alternatives, or consider their comparative merits. The case studies are included as being indicative of alternative approaches in asset management.

## **2.0 EUROPEAN APPROACH (SWITZERLAND)**

### **2.1 Method Deployed**

On average, 400 kilometres of rail is changed in Switzerland per annum. Of this total, 300 kilometres are changed in association with complete renewals and 100 kilometres are changed as the equivalent to Category 2 works in Britain.

As with other renewal items carried out in Switzerland, re-railing is undertaken predominantly in midweek possessions with single line working operations in place. However, some work is also done in short weekend possessions.

Following on from the success of combining heater stressing with mobile flash butt welding operations in Switzerland; SBB challenged the contractors who were carrying out this work to see if they could combine re-railing activities within the same possession to further improve efficiency by not having to return to site to stress the newly installed rails.

One Swiss contractor, Sersa, took up this challenge earlier this year and they have developed a successful production line process without the need to invest in expensive equipment to undertake the work.

The use of heater stressing combined with mobile flash butt welding enabled Sersa to achieve rates of 300 metres per hour. This included unclipping, stressing, welding and clipping up activities. Refer to Technical Appendix Number 5 to RailKonsult's previous report to the ORR, which details the high output stressing process. Therefore, combining re-railing with the stressing process was a sensible and natural progression to undertake.

The only extra element required to be introduced into the process was the exchanging of the old rails with the new. The rails still have to be unclipped, fastened down, thermally stressed and welded as previously was the case when only stressing operations were undertaken.

The thermal stressing provides a significant advantage over tensor stressing when it is undertaken in the same possession as the re-railing. This is due to the fact that stressing can commence once the first two strings of rail have been inserted and flash butt welded to the existing rail. Undertaking tensor stressing requires all the rail strings to be in place and all but the final 2 welds installed before stressing can commence.

The combined process that has been developed consists of the following activities:

- Cut rails into recoverable sections (18m);
- Unclip rails, with one man operated mechanical equipment;
- Remove old rails and replace with new using road rail machine;
- Mobile flash butt weld (108 metre strings);
- Heater stress with mechanised trolleys;
- Fasten down rails with one man operated mechanical equipment.

The following resources are required:

- 32 No staff on site, including protection staff;
- 8 No. Geismar wrenches (for removing and replacing the rail fastenings);
- 1 No. Road Rail Excavator;
- 1 No. Mobile flash butt welder;
- 2 No heater trolleys.

Having developed the process and undertaken a number of shifts with dedicated resources, the team are consistently achieving 750 track metres of re-railing completed in a single shift. This includes re-railing, stressing and welding. This work is undertaken in midweek possessions of between 6 and 8 hours and has a unit cost of around £124 per track metre (see section 4.2 for cost breakdown).

## **2.2 Management Approach**

Midweek possessions of between 6 and 8 hours are the norm in Switzerland so all types of work are undertaken in these short periods. They are generally in single line working conditions.

SBB are always looking to improve operations on its infrastructure in order to improve productivity, efficiency and safety. They work very closely with their contractors to develop new systems and encourage investment when required.

## **2.3 Technology Involved**

The technology deployed for this process is simple and readily available. One man operated machines are used for clipping and unclipping the rails, road rail machines are used for changing the rails, mobile flash butt welders for welding and motorised heater trolleys for undertaking thermal stressing. The use of dedicated manpower to undertake this type of work on a regular basis is one of the key factors in the success of the whole process.

### **3.0 CURRENT BRITISH APPROACH**

#### **3.1 Method deployed**

Category 2 re-railing work in Britain is commonly undertaken in relatively long weekend possessions although there are some areas where work is carried out in 6 hour midweek possessions. Productivity rates are linked to length of rail strings being installed.

The current methods of installation for Category 2 works vary depending on:

- Type of plant available;
- Length of the work; and
- Possession duration.

Removing and installing rails using rail thimble attachments on road rail vehicles or rail vehicles with jibs, such as a track layer is commonplace methodology. Other types of bespoke plant, such as purpose built rail threaders, have previously been the preferred method of installation. Today, there is also purpose built equipment such as the Track Rail Transposer. This has proved to be very successful for undertaking re-railing operations and scrap rail recovery.

Mobile flash butt welding is becoming more common place as more of this type of equipment becomes available in Britain and the process is fully supported by Network Rail Engineers, due to its superior weld quality and speed of operation.

Stressing of newly installed continuous welded rails tends to be undertaken as a secondary item, very often in midweek follow up possessions after a longer weekend possession has been utilised to install. Stressing of rail is undertaken using hydraulic stressing equipment to pull the rails to its stress-free state before being thermic welded.

The speed of this operation has been improved through developments in better roller techniques that allow rail movement. The new Vortok rollers are faster, safer and easier to install than traditional rollers. They also require less staff to undertake this part of the process

#### **3.2 Management Approach**

Re-railing tends to be planned in and undertaken at weekends due to the availability of long possessions. Stressing of rails is generally planned as a follow up activity in either follow up midweek possessions or subsequent weekend possessions. Where it is included within the core weekend possession, it is usually treated as a contingency item that can be deferred in the event of other activities being delayed.

Rerailing is not generally planned as an integrated activity or as a production line activity with dedicated teams.

#### **3.3 Technology Involved**

As with the Swiss method the technology is fairly simple and readily available such as road rail excavators or jibbed rail mounted equipment with attachments used for removing and replacing rails. There are mechanical machines available as individual machines or attachments to road rail excavators for undertaking unclipping and clipping up activities.

### **4.0 BENEFITS**

#### **4.1 Asset Management**

It is a known fact that better quality welds are produced by the mobile flash butt welding process. This approach reduces the potential number of broken welds in comparison with the thermic welding process. Flash butt welds are formed using the parent metal of the rail thus providing the advantage of being capable of inspection by current ultrasonic techniques.

The heater stressing system gives an even roll out of extension within the rails resulting in a better equalisation of stress when compared with the tensor technique where rails could be snagged on individual sleepers thus preventing equalisation of stress.

There will be a reduction in the imposition of protective speed restrictions during hot weather if the stressing operation is undertaken at the same time as the re-railing work.

## **4.2 Efficiency Savings**

It is not the intent of these papers to provide a detailed, bottom-up, financial analysis. The efficiency assessments are simple analyses that provide an indication of the financial advantages if best European practice was adopted in preference to current British practice.

The cost breakdown per track metre for delivery of rerailing using the Swiss method is as shown below:

Material costs	140 CHF
Contractor's direct costs	85 CHF
Transport, overheads and administration costs	<u>35 CHF</u>
Total cost per track metre	260 CHF

Using an exchange rate of 2.10 CHF to £1, this equates to approximately £124 per track metre of rail installed and stressed.

In 2006/2007, 223.3 track kilometres of rail was renewed on Network Rail's infrastructure as Category 2 type work. This rail was installed at a quoted cost of £46.7m, giving a unit rate of £210 per track metre. The Swiss methodology is effectively 41% cheaper. If this was applied to the 2006/07 Category 2 re-railing work-bank, it would have generated savings of £19m for the year.

## **4.3 Life Cycle Costs**

Facilitating full completion of re-railing works within a single operation will ensure that rail and fastening are not handled twice. This will minimise the risk of damage and extend the asset life, particular for components such as fastenings. There will also be reduced rail end damage if all the welding, including stressing welds, is completed in a single possession.

## **5.0 SAFETY ISSUES**

If the process described for re-railing and stressing were to be achieved on the same shift, it would result in fewer visits to site and less exposure of staff working on the infrastructure.

Introducing this process using single line working, as is undertaken in Switzerland, will be difficult due to the reduced gauge (narrower six-foot) on Britain's railway infrastructure.

### **5.1 Estimated Implementation Duration**

The process is not reliant on heavy investment or manufacture and delivery of specialist plant. However, implementation of the process requires the appropriate training of the dedicated teams. This is vital if the process is to be introduced successfully. As such, it is estimated that it would take between three and six months to implement.

### **5.2 Constraints and Dependencies**

Full approval of the plant and processes, such as thermal stressing, will be required. Currently, these activities have been piloted in Britain using approvals for the purpose of trials only.

The introduction of dedicated teams is reliant on there being a steady and sufficient work bank of re-railing work for continuation.

### **5.3 Investment Requirements**

There will be minimal investment requirements needed in order to introduce this re-railing system as it is more about process than equipment. There are mobile flash butt welders available as well as other plant items for undertaking the other activities such as clipping and unclipping rails and removing and installing rail.

As with the high output stressing, the primary investment required would be in the heater trolleys so that thermal stressing of rails could be undertaken.

### **6.0 RECOMMENDATIONS FOR FURTHER WORK**

The following items are suggested as potential areas for further study:

- Re-railing practices in other European countries

