RailKonsult

Office of Rail Regulation

Review of European Renewal and Maintenance Methodologies
Technical Appendix Number 2

Reuse of Serviceable Track and Signalling Components

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Executive Summary

This report focuses on the reuse of serviceable track and signalling components, primarily in Switzerland and the Netherlands. It deals with the following assets:

- Plain line rails plus S&C ironwork;
- Sleepers and bearers;
- Ballast;
- Point motors and signal heads; plus
- Miscellaneous components such as base plates and AWS magnets.

The Swiss rail authorities have a well-established recycling management regime. This is built around a central depot that receives both track and signalling components replaced as part of their on-going renewals programme. These components are assessed, refurbished and then allocated to subsequent maintenance or renewal jobs.

As an indication of the quantum of recycling achieved, approximately one third of the plain line rail removed from track is reused in Switzerland.

In the Netherlands, a higher proportion of sites are ballast cleaned in comparison to the level of ballast cleaning undertaken in Britain. This results in reduced demand for new stone as well as reduced transportation of spent and new ballast around the country.

The benefits identified through the use of such approaches include:

- Reduction in investment in new components;
- Reduction in problems associated with long-lead times for specific components;
- Improved “carbon footprint” for the rail industry;
- Reduction in disposal costs; and
- Reduction in exposure to increased cost of raw materials such as steel.

Employing a proactive recycling strategy has been demonstrated to produce cost efficiencies. For example, it is possible to make savings of the order of 37% on the procurement of new rail and refurbished Swiss point motors can be up to 75% cheaper than the cost of buying a new point motor.

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1.0 RECYCLING OF SERVICEABLE COMPONENTS

1.1 Reuse of Serviceable Track and Signalling Components

Environmental and sustainability factors are important elements that need to be considered by all parties. Both public and private sector clients increasingly require recycled content in construction projects. Prices for raw materials and components are likely to increase substantially due to world demand. Therefore, the optimisation of recycling or refurbishment of components and material should be considered whenever reasonably practicable and safe to do so.

The reuse of serviceable track and signalling components is not common practice in the British rail industry today. Opportunities are available to refurbish railway infrastructure components, where practicable, to deliver efficiency gains and introduce a more sustainable approach.

Cascading of track components such as rail and sleepers to lower category routes, when they had been replaced but not life expired, was once seen as the norm prior to privatisation. However, today this is very rarely undertaken and in most cases it is not practiced at all. Most of the material taken out of the track when a renewal or enhancement takes place is simply taken away as scrap.

Although Network Rail recycles most of the ballast that is removed from the track, the recycled ballast is primarily used in other industries such as highway construction. Very little is returned and used in the rail industry. The industry could benefit enormously if more recycling of ballast were to take place on site. This would provide cost savings not only on material, but also on haulage, as less engineering trains will be required.

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 available alternatives, or their comparative merits. The case studies are included as being indicative of alternative approaches in asset management.

1.2 Extent of Methodology

In most areas of Europe, and in particular in Switzerland, old components are returned to a depot where they can be sorted, refurbished where possible and then re-used on the railway infrastructure as required. This report will concentrate on the Swiss experience as a case study.

1.3 Applicability

This subject can be classed as affecting both renewal and maintenance work categories. Cascading serviceable components into lower category lines would save material costs on renewal items. Refurbishment of components could also be used to enhance maintenance supplies and reduce costs of new and expensive components.

2.0 EUROPEAN APPROACH

2.1 Method Deployed

It is common practice in Switzerland to recover old components that have been taken out of the track, particularly on switch and crossing renewals, and return them to a depot for sorting. In Switzerland, this takes place at a single depot in Hargendorf. Here, items such as point motors, signal posts, signal heads, switch and crossing ironwork, base plates and plain line rails are all refurbished for reuse on the infrastructure.

Hargendorf is also the depot that builds up new switch and crossing layouts for the whole of Switzerland’s switch and crossing renewal program. This depot provides SBB with staff that have the competency and expertise to assess track components for recycling, both on site and within the depot.

Tilting wagons are used to deliver the new switch and crossing panels for the Swiss “Just in Time” delivery method of switch and crossing renewals. These same wagons are used to return complete panels of old track back to the same depot for dismantling and inspection. Thus they get full utilisation out of one set of wagons and do not incur additional train costs or the need for additional possessions. Once back at the depot, the track panels are broken down and all the materials are sorted into either scrap or components that can be refurbished.

2.1.1 Point Machine

Nearly all point machines brought back into the depot are refurbished. This is facilitated by the fact that all the point machines are of a standard configuration, apart from on the new high-speed route between Berne and Zurich (NBS Mattstetten – Rothvist). Although this refurbishment operation was initially carried out by the original manufacturers (Seimens), SBB now undertake this practice in-house.

The old point motors go through a rigorous cleaning process. They then undergo a complete refurbishment of the internal working mechanisms and are repainted. Where parts are not reusable, they are either manufactured at the depot or, if that is not possible, they are bought in from the original manufacturer. Currently, 90% of the parts are found to be re-useable.

The process follows a production line technique, consisting of the following elements:

- The machine is dismantled;
- Heavily contaminated parts of the machine are dismantled
- The complete machine is submerged in a degreasing unit;
- Each individual component is inspected and either cleaned for re-use or scrapped;
- Contacts are re-galvanised where applicable;
- Cases and components are repainted;
- Complete unit is reassembled; and is then
- Tested and certified ready for re-use.

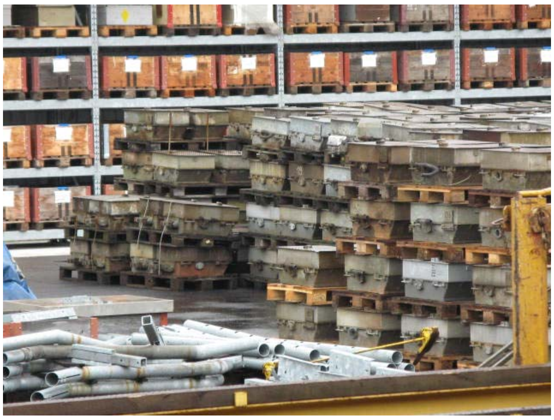
If new parts are required they are replaced. Standardisation of the point motor mechanism has simplified this process. The point motor boxes are then repainted before the internal mechanisms are reassembled. To ensure quality, the complete system is tested and certified as meeting the required standard.

Old point motors waiting to be cleaned and stripped down

Parts re-painted

Re-assembly and testing

Certificate of conformance



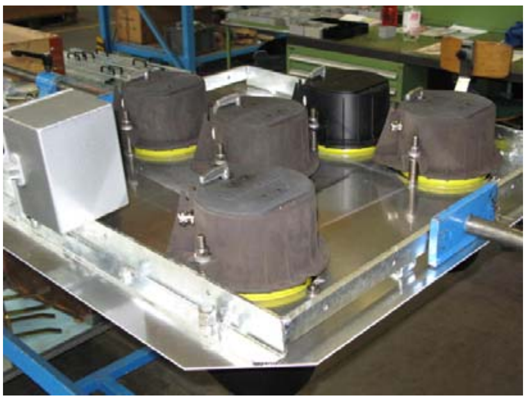
Stockpile of old motors awaiting refurbishment

The units are then used either on the new switch and crossing layouts that are built up at the depot, or are sent out as individual maintenance replacement units on receipt of orders from local engineers. The cost of a new point motor is 10,000 Swiss francs, whereas the cost of a refurbished unit is only 1,500 Swiss francs. In 2007, 630 point motors were refurbished and reused on the infrastructure. These are not restricted to lower category routes. There are currently 700 point motors at the depot ready for refurbishment.

2.1.2 Signals Heads

As with the point motors, there is a similar programme of refurbishment of old signal heads. They go through a rigorous inspection and refurbishment process, which includes laser realignment of the light mechanism. The completed units are then mounted into new cases made at the depot and, where required, are mounted onto new signal posts and dispatched as required for new installation. A total of 180 were refurbished and reused in 2007.

Refurbished signal heads



Refurbished heads mounted on new casing

2.1.3 Plain Line Rails

Before plain line rails are removed from the track, they are inspected on site by a competent member of staff from the Hargendorf depot and marked up as either scrap or suitable for reuse. This is dependant on criteria such as wear, defects and location of use. It is important that this process is undertaken on site and not at the depot as the inspector will have the advantage of knowing the exact location the rail was in service, which will assist in the decision whether to re-use or scrap. The old rails on site are normally removed in longer lengths (108m) or sometimes cut into lengths of 18 metres. Both rail lengths are loaded onto stumec type wagons before being returned to the depot.

The reusable rails then go through a mechanised production line process of refurbishment, which consists of the following elements:

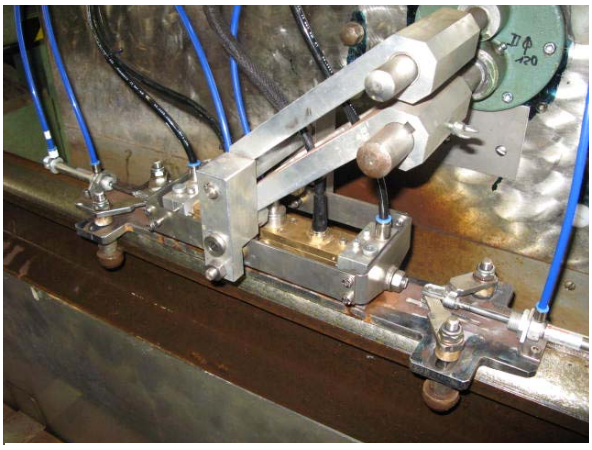
- Vertical realignment using rollers;
- Lateral realignment using rollers and press;
- Head re-profile by a planning process;
- Ultrasonic testing (using 0°, 2 x 38° and 2 x 70° probes) to ensure that the rail is defect free; and
- Removal of any existing welds or bolt holes.

These rails are then flash butt welded together to produce rail strings between 36 metres and 108 metres in length, before being distributed and reused in lower category lines or sidings. Approximately ⅓ of all rail removed from the track is refurbished and cascaded down to lower category lines. The cost saving on buying new rail is approximately 70%. In 2007 65 kilometres of rail was refurbished and cascaded down to lower category lines, with rail as old as 1957 successfully completing the refurbishing process.

Old rails stacked waiting refurbishment

Roller press for straightening the rails

Rail profiling through planning



Ultrasonic inspection

The practice of cascading rails is also common practice in the Netherlands where 70% of all rail removed from the main lines is cascaded down to lower category routes, or busy harbour areas such as Amsterdam and Rotterdam.

2.1.4 Switch and Crossing Ironwork

The main difference between the plain line rails and switch and crossing ironwork recycling method is that the inspection of the switch rails is undertaken at the depot and not on site. Once again, the ironwork will go through a rigorous inspection process before being either scrapped or refurbished and then cascaded to lower category lines for re-use as individual components such as crossings or ½ sets of switches.

It is very rare for complete switch and crossing units (i.e. with bearers) to be cascaded to lower category lines. However, if the unit has not been in service very long and is replaced as a consequence of enhancement work, it will be inspected and refurbished where necessary before being cascaded as a complete unit.

2.1.5 Sleepers / Bearers

In Switzerland, steel sleepers are the only type of sleepers or bearers considered for reuse on the infrastructure. However, all sleepers and bearers are recycled in some way. Timber sleepers and bearers are sent to Sweden to be used as heating fuel, whilst concrete bearers are returned to the original manufacturer where they are crushed and used as aggregate for use in the highway industry.

It was noted that in the Netherlands, 40% of all concrete sleepers removed from the track are cascaded down to lower category lines for reuse on the infrastructure.

2.1.6 Other Signalling Items

Suitable serviceable items such as base plates and hand points handles are re-used where applicable. AWS magnets are also returned to the depot for refurbishment before being reinstated on the infrastructure when required.

The Swiss have recently started undertaking refurbishment of signal relays as they are now reaching an age where this is required. This is an operation that is well established in Britain. Whilst signalling enhancement schemes are taking place, there is still a heavy demand on the older systems.

2.1.7 Ballast

In Switzerland, in addition to normal plain line ballast cleaning, recycling of ballast on switch and crossing renewals work is also undertaken. This work is done by means of a purpose built machine called a Weiger which excavates and screens the ballast on site in order to make use of existing good material and reduce the amount of new ballast needed. The proportion of reballasting of switch and crossings using this system is between 7 and 10%.

In the Netherlands, 90% of renewal sites are ballast cleaned, rather then traxcavated. This is in order to maximise the useful life of the ballast. Recently, a high power screening machine was used together with a Rapid Ballast Excavating machine to undertake reballasting and renewal of 26 kilometres of track through Zoetermeer near Amsterdam. This method saved 80% on new ballast costs. These savings were achieved through the need for less new ballast required, reduced wagon capacity and reduced costs of removal and disposal of the spent ballast.

The formation rehabilitation trains used across Europe has the facility to recycle ballast by not just sieving, but also washing and grinding the stone to return it to its original state (see separate report).

Shoulder cleaning is a practice used in Europe. Purpose built machines are used to remove the ballast shoulder, sieve the material and return the good ballast onto the track shoulder. This system not only recycles the old ballast, but improves track drainage by means of removing the small degraded fines that prevent water from escaping, thus extending the life of the asset.

2.2 Management Approach

In Switzerland the management philosophy is to re-cycle everything where possible and to undertake this at a centralised depot. This makes use of resources that are already available for undertaking build-up work for new infrastructure and ensures that consistent quality control is achieved.

Dedicated teams are used in the various parts of the depot to undertake the required element of either refurbishment or build up of new infrastructure. The number of staff working at the depot is 120 split as follows:

- 38% in the signalling refurbishment department;
- 20% in the rail refurbishment section; and
- 42% in the switch and crossing build up area.

When the demand for new switch and crossings is low, staff are used to dismantle the old switch and crossing panels, thus accommodating the peaks and troughs in resource requirements.

Whilst not touched on in detail in this report, there is also a management process used in the Netherlands by ProRail whereby as much serviceable material as possible is cascaded and reused in the main harbour areas, such as Amsterdam and Rotterdam.

2.3 Technology Involved

Production line processes using purpose built plant and machines facilitates efficient working methods to be undertaken in the depot at Hargendorf.

Specialist plant, such as the power screener and the formation train, allow for effective recycling of ballast at locations across Europe.

3.0 CURRENT BRITISH APPROACH

3.1 Construction Methodology

Not all components removed in Britain are scrapped. Practices such as refurbishment of crossing by means of weld repair on crossing noses are undertaken off-track in order to create strategic spares at certain locations. It should be noted that crossing noses are also weld repaired in-track as a maintenance activity.

From a signalling point of view, some equipment such as HW63 point machines are recovered and refurbished and held on stock for replacement as and when necessary. As already noted, relays are recovered and refurbished as they are now classed as strategic spares.

In general, the British philosophy has been to dispose of removed components, with refurbish and reuse the exception. However, there has been an increase in the latter approach during the last Control Period.

3.2 Management Approach

Before the adoption of the loose sleeper renewal process in the 1980's, British Rail ran central material depots that provided support to the prefabricated renewal technique then used within plain line track renewals. These depots also sorted returned material into scrap and serviceable materials. The serviceable material recovered was reused throughout the network. However, after the widespread adoption of loose sleeper renewal as the preferred process, these depots were closed and the reuse of serviceable materials significantly reduced as a consequence.

Today, even though Network Rail has a centralised organisation in the form of the National Delivery Service to manage its track materials, the British rail industry does not have a cohesive management system in place for controlling any form of widespread reuse of serviceable materials that could benefit the industry.

For example, engineers do not routinely inspect track renewal items prior to renewal in order to determine whether there are any serviceable or recyclable materials available. This results in the approach used on many renewal sites (particularly on switch and crossing renewal sites) to cut everything into small sections for ease of loading and removal from site. This restricts the possibility of the potential re-use of various components and the majority, if not all, of the old material ends up as scrap.

Whilst Network Rail has a policy to recycle old material wherever possible, this does not take the form of reusing or refurbishing items for returning to the railway. For example, in 2005 Network Rail recycled 91% of old ballast that was removed from the railway infrastructure. However, the majority of this was sold to other industries for recycling and not returned to the railway. Hence, no haulage savings were achieved.

3.3 Technology Involved

There are a number of ballast cleaning systems in use on the British network for recycling of ballast. These range from modern high output machines through to smaller items of plant that can undertake similar types of work over shorter lengths.

4.0 BENEFITS

4.1 Asset Management

Proactive adoption of a refurbishment and recycling policy provides better use of none life-expired materials and components. This increases the availability of spares and assists in managing the problem of long lead times when ordering new components.

Recycling of components also demonstrates sustainability and shows “green credentials” for the railway industry by reducing the need to buy new every time, thus saving natural resources.

4.2 Efficiency Savings

This section is not intended to provide a rigorous business case assessment. For example, capital investment requirements are excluded and no discounted cashflows have been considered. It is, however, included to provide an indicative view of the potential operational opportunity available if similar approaches were adopted in Britain.

4.2.1 Rail

Cascading or refurbishing of components reduces the cost of having to purchase new components. This is particularly the case currently with respect to items such as rail, as the cost of steel is continuously rising.

It is estimated that a net saving per tonne of rail of 37% (£220 per tonne) can be achieved on the basis of the following:

- Cost of new rail at £600 per tonne;
- Cost of recycling rail at £180 per tonne (based on the Swiss experience of the process costing 30% of the cost of new rail); and
- Recoverable cost from selling scrap rail at £200 per tonne.

The prices quoted are based on industry experience during early 2008.

Refurbished rail could be cascaded down, as per European best practice, onto renewal sites on lower category lines. As the predominant specification for renewals on lower category lines is steel sleeper relay, it is considered that cascaded rail could be used instead of new rail on this type of work.

Based on the historical average length of steel sleeper relay undertaken annually over the past 5 years of 240 kilometres, a potential saving on new rail of £5.8 million per annum could be achieved.

Further savings could be realised if refurbished rail was used on lower category lines during maintenance where short sections of rail are used for defect removal.

4.2.2 Ballast

Recycling of ballast on site will reduce the amount of new ballast needed, thereby reducing the overall cost of the renewal. It will also reduce the number of wagons and trains required to deliver the new material, which will provide further efficiency savings. Costs will be further reduced when reusing or refurbishing takes place as disposal costs are eliminated.

Historically under British Rail, the percentage of reballasting sites that were ballast cleaned rather than traxcavated was in the region of 85%. This practice has reduced to some 36% today thus reducing the amount of site recycling of ballast that could take place. The reduction in unit costs from Category 11 to Category 10 (renewal by traxcavation and renewal by ballast cleaning) indicates an opportunity to achieve a 44% reduction in costs. This is based on figures from the ICM model (2006 costs).

Additionally, adopting practices such as the power screener methodology used recently in the Netherlands would further extend the ability to recycle ballast on site to include traxcavation sites. Potential savings through recycling ballast on traxcavation sites have not been assessed.

4.2.3 Signalling Equipment

As already indicated, the Swiss have achieved savings of 75% through the use of refurbished point motors.

4.3 Life Cycle Costs

The life cycle benefit is that the life of the component or material is extended through refurbishing or recycling. Currently, when removing materials from site, they are ultimately seen as life expired. If they are refurbished back to a quality that is acceptable for re-instatement in the infrastructure then they are lasting longer, deferring the need and cost of buying new.

5.0 SAFETY ISSUES

The most important safety issue with regards to refurbishing or recycling materials is the quality control element that ensures that the material or component being reused or cascaded is fit for purpose and contains no inherent defects.

As seen from the Swiss example, the inclusion of a standard testing, quality and certification regime in the process can provide adequate controls with respect to the risks of reliability or failure.

The quality of recycled ballast is controlled through the use of fixed sized screening mechanisms. These ensure that the ballast returned to the track is of sufficient size and quality to provide assurance that the extended life is sustainable, including the subsequent track quality of the infrastructure it supports.

6.0 IMPLEMENTATION INTO GREAT BRITAIN

6.1 Estimated Implementation Duration

The underlying processes already exist within Great Britain and are currently practiced on a small scale by companies that specialise in the recovery and refurbishment of components. As such, the move to widespread adoption of this approach could commence straight away.

When setting up new facilities for Network Rail's manufacture and delivery of modular switch and crossings, consideration could be given to the possibility of replicating the process of reuse of materials similar to that carried out at the Hargendorf depot in Switzerland.

Introduction of the new medium and high output ballast cleaning machines into the British rail industry has seen a gradual return to ballast cleaning as a process. However, mechanised ballast cleaning remains at a low level of activity and full excavation has taken over as the primary method of reballasting. Unfortunately this has resulted in the selling on or even scrapping of ballast cleaning machines due to the lack of workload.

As a consequence, the number of skilled operators that were deployed on this type of equipment has also diminished. Therefore, widespread implementation of this type of equipment more would require investment and training of new operators.

6.2 Constraints and Dependencies

The use of serviceable materials and components may initially be restricted to lower category lines due to the perceived risks of using recycled materials on prime routes. Lower category routes tend to take a lower priority in renewals programs and hence the implementation of a recycling regime may not be seen as a priority to the industry.

It is certainly evident from the Swiss example that standardisation of components would make recycling and reuse of components far easier than is currently possibly in the British rail industry. However, Network Rail is already making significant progress in standardisation of the components being used.

6.3 Investment Requirements

Setting up a centralised depot to manage and refurbish serviceable material will undoubtedly incur a significant level of investment through land procurement, unless existing facilities can be modified. However, as already stated, consideration could be given to the possibility of combining this operation with the proposed new modular switch and crossing depot(s) which would reduce the need to invest in a separate purpose built depot.

It is noted that Network Rail have announced proposals to expand the depot at Whitemoor Yard in March to accommodate a world class recycling facility that would make better use of ballast and concrete sleepers.

As noted previously, investment would also be required in new plant and operator training, before a return to more ballast cleaning were to be realised.

7.0 RECOMMENDATIONS FOR FURTHER WORK

It is recommended that further detailed research be undertaken into the strategies adopted by other European countries on re-use of serviceable materials and components. This report has primarily focused on the Swiss approach.

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