TITLE OF THE PROJECT: Rail Grinding Best Practices and Condition Monitoring Acceptance System

Type XXXXXX - Contract number R3.109

Project website http://www.railcrc.net.au

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ERRAC evaluation XXXXXXXXXXXXXXXXXXX

Keywords
Rail grinding, curve lubrication

Summary
Development of good practice for combined below rail and above rail decision model for reducing cost, risks and enhancing rail-wheel life based on:
1. Rail grinding
2. Wheel-rail condition monitoring.

Background
facilitate an increase in the non-urban passenger rail task of 27.6 per cent or 0.6 billion passenger-kilometres to 2.8 billion passenger-kilometres in 2014/15. Cargo carried by Australian rail freight services has grown by 42.7 million tonnes or 6.9 per cent to 664.1 million tonnes in 2004/05 largely due to increased demand for coal and ores and recovery in the grain sector (resulting in an 11.8 per cent increase in grain tonnes). The annual net tonne-kilometre task has grown by 15.4 billion tonne-kilometres or 9.0 per cent to 185.6 billion tonne-kilometres in 2004/05. The growth in the national rail freight task was not only influenced by an increase in throughput but also by a 2.0 per cent increase in average distance travelled. Expected industry growth is projected to increase the annual rail freight task by 98.2 billion tonne-kilometres, or 52.9 per cent, to 283.8 billion tonne-kilometres in 2014/15. (Australian rail transport facts, Apelbaum, 2007) This is possible by advances in rail design, increased speed of the carriers, longer trains and heavier axle loads. Ironically the benefits come with a cost due to increase in risk of wear and fatigue leading to early replacements, rail breaks and derailments.

Rolling contact fatigue (RCF) alone costs European railways around € 300 million (AUD$ 485 million) per year and these defects account for about 15% of the total cost of maintenance. The total costs of all defects are about € 2 billion (AUD$ 3.23 billion) per year (Cannon et al., 2003). In recent years, railroads have been purchasing over 500,000 tons of rails per year at an estimated total cost of US $1.25 billion for replacement of worn out and degraded rails. In 2000, the Hatfield accident in UK was caused due to rolling contact fatigue. It killed 4 people and injured 34 people and has lead to the cost of £ 733 million (AUD$ 1.73 billion) for repairs and compensation payments. In 1977, the Granville train disaster in Australia killed 83 people and injured 213 people. Number of derailments in Australia in 2006 was 118 and that in 2007 was 65 for the first half of the year (Australian Transport Statistics 2007) A significant number is due to wear, RCF(Rolling contact fatigue) and maintenance related problems. Number of deaths in 2006 was 40 along with 125 serious injuries. Same figures for 2007 were 26 for deaths and 95 for serious injuries for a period of first six months. In such a backdrop it becomes imperative that corrective and preventive measures are needed to overcome rail wear and fatigue to prevent early replacements, derailments and rail disasters, Chattopadhyay et. al. [2003].

Rail grinding and lubrication helps in controlling surface fatigue defects, wear and noise if applied properly. It is expected to maintain optimal rail and wheel profile, eliminate corrugations and head-checks, maintain surface topographies Dong et. al [1994], reduce operating and maintenance cost, wheel/rail performance and reduce risks of derailments.

After the unfortunate Hatfield accident, considerable amount of research work was commissioned in the UK by the then Railtrack and the RSSB to understand the causes of RCF (Rolling contact fatigue) and wear. The fundamentals of the RCF (Rolling contact fatigue) and wear were developed by research group led by Ajay Kapoor and the application of this science into technology was completed by the then AEA Technology Rail (the old British Rail, Derby where Clayton and Canon worked).

There is a large integrated project INNOTRACK, funded to the tune of Euro 20M by the EU. This work is focussed on reducing Life Cycle Costs and is driven by the railway industry.

This project is expected to develop the best practices in rail grinding combining rails and wheels in decision model to avoid or retard rail wheel wear and fatigue under varying operating conditions. A condition monitoring system would be developed to assess the remaining life and suggest proactive measures to avoid interruptions to service, early replacements, derailments and rail disasters.
Objectives

The objective of this research is to enhance rail and wheel life and thereby increase the capacity, efficiency and safety for bulk freight and passenger traffic. It is also expected to reduce maintenance costs and operational risks by improving track reliability, availability, throughput, productivity and safety. It is expected to reduce wear, RCF (Rolling Contact Fatigue), early replacements of rail and wheels, unplanned downtimes and derailments.

Some of the factors to be considered are:
- Axle load,
- Curve radius,
- Speed,
- Material,
- Rail size,
- Rail type,
- Profiles,
- Surface roughness,
- Grinding facet,
- Rail waviness,
- Wheel flats,
- Wheel hollowing,
- Irregularities of wheels and rail,
- Cant balance,
- Lubrication,
- Moisture, and
- Temperature

Specific objective of this research is to develop best practice model for optimal grinding decisions based on effect of various factors on rail wheel wear and fatigue of right and left rails and wheels for:

1. Developing Guideline for
   a. Rail grinding condition monitoring
   b. Wheel condition monitoring
   c. Rail-Wheel interaction monitoring

2. Develop Combined below rail and above rail decision model for enhancing rail-wheel life. (Rail and Wheel Life and wear simulation software)

3. Compile data from industry partners combined with published and available data from overseas.
   a. Profiles
   b. Wheel-rail life
   c. Operating and maintenance condition

4. Integration simulation software into participant’s infrastructure and rolling stock asset management systems.

Description of work
LCC (Life Cycle Costing) model will be developed and analysed for cost and risks. Vehicle simulation VAMPIRE and FEA (Finite Element Analysis) would be used for the technical assessment of various parameters related to wear, fatigue and curving performance:

- Curve radius
- Wheel and rail material
- Profiles
- Cant deficiency
- Wheel set yaw stiffness
- Bogie wheelbase
- Axle load
- Speed
- Coefficient of friction between wheel and rail
- Lubrication
- Moisture
- Temperature and
- Grinding parameters

**Results**

<<NOT RECOMMENDED TO INCLUDE IN THIS SHEET, UNLESS RESULTS HAVE BEEN PUBLISHED BY THE CRC>>

**Additional information**

Duration: 1/9/08 – 31/8/11