TECHNOLOGY DIGEST

Timely Technology Transfer

"ECP BRAKE FINANCIAL ANALYSIS WORKBOOK, VERSION 1.0"

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Summary

The Association of American Railroads' Railway Technology Department under the direction of the Electronically Controlled Pneumatic (ECP) Brake Technical Advisory Group has completed the initial version of the *Financial Analysis Workbook*, a computer based program/spreadsheet.

The ECP Brake *Financial Analysis Workbook* was developed to enable individual railroads and private car owners to determine the economic viability of implementing ECP brakes on all or a part of their freight car fleets. It identifies costs and potential benefits likely to result when using ECP brake systems and alternative onboard health monitoring features on freight cars in dedicated and general service.

Several preliminary assessments have been conducted with the workbook using the best available annualized industry data and a range of reasonable estimates for installed cost of ECP brake systems. These assessments suggest substantial benefits for using ECP brake-equipped trains in nearly all categories examined, especially for maintenance costs, cost of delays, and accident costs. The results, not unexpectedly, were greatest for high-mileage, high-utilization freight cars.

ECP brakes control application and release of brakes using electronically activated valves which replace current pneumatic control valves. ECP brake systems provide faster application and release of brakes on all cars simultaneously, as well as graduated release, thereby eliminating the need for stretch braking. Slack action is greatly reduced, which reduces draft system failures, and lading damage. Currently, several prototype ECP brake-equipped trains are operating on Class 1 railroads to assess some specific applications.

Suggested Distribution:

- ❑ Equipment/Rolling Stock
- ❑ Equipment Maintenance
- ❑ R&D
- ❑ Operating/Mechanical-Car

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INTRODUCTION/CONCLUSIONS

Working with an industry group, the Association of American Railroads' (AAR) Railway Technology (RT) Department developed performance requirements designed to ensure future interoperability of Electronically Controlled Pneumatic (ECP) brake systems supplied by different manufacturers within a common communications protocol. ECP brakes control application and release of brakes using electronically activated valves which replace current pneumatic control valves. ECP brake systems provide faster application and release of brakes on all cars simultaneously, as well as graduated release, thereby eliminating the need for stretch braking. Slack action is greatly reduced, which reduces draft system failures, accidents and lading damage. Improved stopping ability can permit higher train operating speeds and improve line capacity. ECP brakes are also significantly easier to use than conventional air brakes.

Under the direction of the ECP Brake Technical Advisory Group, RT has completed the initial version of a *Financial Analysis Workbook*, a computer based program/spreadsheet. This workbook was developed to enable individual railroads and private car owners to determine the economic viability of implementing ECP brakes on their freight car fleets. It identifies costs and potential benefits likely to result when using ECP brake systems and alternative onboard health monitoring features on freight cars in dedicated and general service.

Several preliminary assessments have been conducted with the workbook using the best available annualized industry data and a range of reasonable estimates for installed cost of ECP brake systems. These assessments suggest substantial benefits for using ECP brake-equipped trains in nearly all categories examined, especially for maintenance costs, cost of delays, and cost of accidents. Results were greatest for high-mileage, high-utilization freight cars.

GENERAL DESCRIPTION OF THE WORKBOOK

To financially justify large, costly projects, a thorough and systematic analysis of the projected costs and benefits expected to accrue during the economic life of the project is needed. In the ECP Brake Program, the *Financial Analysis Workbook* is a tool for such analysis. The workbook includes analysis spreadsheets for major costs and benefits. Many railroad, car owner, supplier and AAR individuals were queried to obtain the most comprehensive possible listing of potential costs and benefits. Cost and benefit factors were identified and refined, and the best available data was collected and analyzed for each cost and benefit. A strong effort has been made to ensure that assumptions and methods used in the workbook are highly visible and accessible. For example, default values are used in some spreadsheets to estimate the effect workbook users thought ECP brakes could have in producing a benefit. Thus, anyone using the workbook can adjust the values to their own estimates.

The initial workbook used annualized industry-wide data and produced results on a "per-car-year" basis. Data used in the workbook was obtained from several sources: AAR and FRA data for the industry, data from railroads, and some "common knowledge" estimates. However, the open methodology facilitates its use by individual railroads and car owners, using their own data to evaluate their own situations.

COST FACTORS

No published costs were available for large scale application of ECP brake systems to the freight car fleet. Because no cost estimates were available for use in the workbook, a range of cost estimates was used as a temporary placeholder. Once the competitive market place and expected economies of scale during manufacturing establish actual costs to realistically assess offsetting benefits, the place-

holder can be removed. Three cost factors were used in this analysis.

- Costs of ECP brake system, complete with necessary onboard brake system controllers, diagnostics, and valves; onboard electrical and communications subsystems, installed and functional.
- Residual value of pneumatic valves removed from cars retrofitted with ECP brake systems. These valves could presumably be sold to other users. When ECP brake systems are installed on newly built cars, there will be no residual value.
- Costs of ECP brake system, complete with necessary brake system controllers, diagnostics, and valves; onboard electrical and communications subsystems, installed and functional; onboard health monitoring sensors and/or processors, using onboard electrical and communication interfaces.

BENEFIT FACTORS

A number of potential benefits were identified and refined by the Economics Working Group. Candidate benefits were intended to be as comprehensive as possible of all value which might accrue, yet not overlap with other benefits. The following *potential benefits* have evolved from this process.

- Savings in maintenance costs for wheels (e.g., thermal cracked), brakes, equipment, track, and other collateral damage reduced using ECP brake-equipped trains and operating procedures.
- Savings in maintenance costs (bearings, equipment, track, roadbed, and collateral damage) reduced or eliminated using one or more onboard health monitoring sensor and processing subsystems. Widespread use of onboard health monitoring also may reduce the need for wayside detectors.
- Savings achieved by eliminating or reducing delays from terminal air brake tests, yard air brake bleeding; unscheduled mechanical delay incidents, such as undesired emergencies, broken knuckles, accident cleanup time, shipment penalties, etc., avoided using ECP brake equipped trains and onboard health monitoring.
- Savings in operating costs (e.g., fuel, broken knuckles, freight loss and damage).
- Savings related to reduced training and periodic refresher training requirements for crews using ECP brake-equipped trains.
- Savings in systems and purchases that are no longer needed with ECP brake equipped trains (e.g., pneumatic air brake valves).
- Increases in revenues contributing to overhead and profit, resulting from greater capacity of existing lines, structures, and facilities due to increased speed, predictability, or availability in operations using ECP brake-equipped trains.
- Savings related to delayed and/or reduced investment(s) resulting from reduced delays, greater trip reliability, and increased capacity of lines and yards.
- Savings in cost of accidents (equipment, track, roadbed, lading, and collateral damage) prevented or avoided through the use of ECP brake equipped trains.
- Savings in costs of accidents (equipment, track, roadbed, lading, and collateral damage) prevented or avoided using onboard health monitoring.
- Savings achieved by minimizing the costs of damage from otherwise unavoidable accidents through the use of onboard health monitoring to detect derailments and incipient accidents.

Most of these benefits have been addressed in the workbook, although not necessarily in a one-to-one correspondence. Some benefits were combined in single spreadsheets. Other benefits considered railroad or car owner-specific were omitted for later consideration by workbook users in two spreadsheet "blanks" included in the workbook.

WORKBOOK USES

The initial workbook, which serves as a starting point for other assessments, is a base case study for high utilization cars running in solid/unit trains. Using the workbook, case studies can be formulated to evaluate freight car implementation strategies, as well as onboard health monitoring alternatives. Case studies can be prepared by railroads and car owners to assess specific approaches. To create specific case studies for individual railroads or private car owners, the workbook can be copied to provide working frameworks for entering individualized data and for evaluating situations of interest.

The cost-benefit analysis workbook consists of a summary results spreadsheet and 11 supporting spreadsheets. The results page summarizes economic results from each spreadsheet. Summary results include: Net Present Value, Internal Rate of Return (the cost of capital that would result in a zero net present value) graphs, a graph of Investment Recovery as a Function of Time, and a graph of Yearly Discounted Cash Flows. In addition, two spreadsheet pages are included to facilitate analyzing additional or unique benefits by workbook users.

The currently available spreadsheet pages are as follows:

- Results summary and graphs

  Calculations merged from individual spreadsheet pages
- ECP Cost — Costs associated with application of ECP Brakes Delays — Delay Reduction Savings
- Increased_Speed — Savings resulting from the ability to run trains faster
- Accident — Accident Cost Savings
- Maintenance — Car Maintenance Cost Savings
- Loss_Dam — Loss and Damage Savings

  EOTS — End of Train Device Savings
- InitTerm — Savings from Reductions in Time to Perform Initial Terminal Tests
- IntermedTerm — Savings from Reductions in Time to Perform Intermediate Brake Tests
- Hump Yard — Savings from Reductions in Time to Bleed Freight Car Brakes prior to classification in Hump Yards or Flat Yards

WORKBOOK AVAILABILITY

The ECP Brake *Financial Analysis Workbook* is available in Microsoft Excel format. The workbook and hard copy documentation are **available to member railroads at no charge** by contacting either Tom Guins at AAR, 50 F Street, N.W., Washington, D.C. 20001 (202) 639-2259 or John Peters at AAR, TTC, P. O. Box 11130, Pueblo, CO 81001 (719) 584-0692.

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