OPERATIONAL TESTING OF INTELLIGENT RAIL LUBRICATION SYSTEM

Final Report
Transit IDEA Project 24

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I INTRODUCTION

Project Transit 24 is very important for commuter rail, transit and high speed rail, in improving both the performance and safety. It is really disappointing that the project (Transit 24) funding is stopped after completion of Stage 1. Considerable initial effort has gone in completion of this important first stage. Interactions and agreements of work and designs suitable to Metra and Amtrak, actual designs and construction of the first system was undertaken and completed. Formation of the project review committee consisting of Metra, Amtrak and TRB engineers was another significant task that was accomplished. At this juncture the project funding is canceled/terminated. It is very disappointing that so much effort is to no avail.

The work on Stage I of this project has been completed. It includes the following activities:

Field Survey on Lubrication Needs.

Meetings with METRA to determine their needs.

Discussions with AMTRAK for their participation in the project including high speed rail.

Project Committee.

Design upgrade of SENTRAEN 2000^{TM} for AMTRAK and METRA use and optimization of features.

Fabrication of SENTRAEN 2000^{TM} T, ITS-controlled lubrication delivery system.

These are discussed individually below:

II FIELD SURVEY ON LUBRICATION NEEDS

Nine different systems including AMTRAK were contacted to determine their current practices/use of rail wheel lubrication. These were:

AMTRAK

Greater Cleveland Regional Transit Authority

Maryland Department of transportation , Mass Transit Administration (MTA)

Massachusetts Bay Transportation Authority (MBTA)

Metro-Dade County Transportation Administration

New Jersey transit Corporation

Niagara Frontier Transportation Authority

South Eastern Pennsylvania Transportation Authority (SEPTA)

Washington Metropolitan Area Transit Authority

Amtrak operates over the tracks of other carriers, except in the North East corridor. Way side grease applicators are used on curves of the freight railroad tracks. Amtrak trains get the benefit of these wayside lubricators. They do not use any onboard lubricators, including on the North East Corridor.

Out of all the systems contacted, two do not use any form of rail lubrication, three use wayside lubricators and several are using or trying out the use of stick lubricators mounted on trucks. No system to date are using an intelligent, computer controlled lubrication system.

Details of the survey of the various systems are given in Appendix I.

III MEETING WITH METRA TO DETERMINE THEIR NEEDS

A meeting was held to discuss the above project and to determine what will be suitable for METRA for the adaptation of SENTRAEN 2000™ to a METRA train.

Present: **Tranergy**

Sud Kumar, Principal Investigator

METRA

Bill Tupper - Department Head, Engineering

Bill Archer - Director, Engineering Department

Rich Soukup - Chief Mechanical Officer.

After some discussion, it was resolved that the SENTRAEN 2000T™ unit adapted to commuter passenger system should have the following characteristics:

Computer control of lubrication should:

Apply lube to the rail gage side

Apply lube on the high rail on curves

Increase the application rate as speed increases

Be able to compute flow for an average number of cars

Control lube flow rate such that it is not affected much by lube temperature

Increase the rate of lubrication for sharper curves

Apply lubricant from the nozzles of both the short and the long hoods of the locomotive to permit locomotive wheel flange lubrication when it is moving in either direction.

Apply a water based environmentally safe clean lubricant which has no solids such as graphite or Molybdenum Disulphide.

Discussions were also held about the specific parameters to be measured for the determination of benefits. These are:

Friction coefficient on the high rail gage side

This will be measured with a tribometer on the rail gage side...

before the lube train,

after the lube train,

after the 2nd train,

after the 3rd train, -- and so on --

until the friction coefficient on the rail gage side nearly equals the value of friction for the dry rail.

Electrical energy used by the locomotive for operation with and without the lube system for the same train. The locomotive will be wired for measurement of volts and amps being used for a certain trip. Data files will be saved to determine the KWHrs used.

Wear particles will be collected by a specially designed magnetic device mounted on the rail both for dry rail conditions and for a limited number of trains after the lube train has passed. A comparison of the weights of these wear particles will give us a comparison of rail wheel wear for trains running with and without lube.

Wheel profiles of the locomotive wheel will be taken at a three month interval for operation with and without lube to compare the effect of lube on wheel wear/profile degradation.

IV DISCUSSIONS WITH AMTRAK FOR THEIR PARTICIPATION IN THE PROJECT INCLUDING HIGH SPEED RAIL

Discussions were held with:

Mr. Terrence Brunner

Assistant Chief Mechanical Officer

Locomotive/Mechanical Services - NEC

AMTRAK,

Philadelphia, PA 19104

Mr. Brunner is familiar with the testing and progress of SENTRAEN 2000™, the Intelligent Rail Lubrication System of Tranergy developed for freight railroad through a Locomotive Maintenance Officers Association (LMOA) Committee on advancements. The LMOA reviewed the progress of this system for a year at the end of which a paper was presented at a 1996 LMOA annual meeting. Mr.

Brunner participated in that review. Mr. Brunner is very interested in the system because of the high wear that develops in Amtrak locomotive wheels used in the North east Corridor. He would like to see the SENTRAEN 2000T developed and tested so that Amtrak can take advantage of it. He recommended participation of Mr. Ron Cless, General Manager Locomotives Amtrak Chicago, in the project via membership in the panel. Mr. Brunner wants to follow the project progress through the reports and attend the meetings when he can.

V PROJECT COMMITTEE

After discussions with Metra and Amtrak the following project committee was formed:

1. Dr. Selwyn Berg, Technical Project Advisor from IDEA Program
2. Rich Soukup, Chief Mechanical Officer of Metra
3. James Stinson, Director Mechanical, Milwaukee Line, Metra
4. Bill Tupper, Director of Engineering Department, Metra
5. Von Schuster, Asst Chief Engineer, Milwaukee Line, Metra
6. Ron Cless, General Mnager Locomotives, Amtrak - Chicago
7. Terrence Brunner, Asst Chief Mechanical Officer Amtrak - Philadelphia

Amtrak will normally be represented by Mr. Ron Cless in project meetings. Mr. Brunner would like to receive reports of the project and will attend when he cad.

VI DESIGN UPGRADE OF SENTRAEN 2000^{TM} FOR METRA & AMTRAK

The SENTRAEN 2000^{TM} system developed for the freight railroads needs adaptation for passenger service. The requirements for passenger service were determined and are given in Section III. To satisfy these requirements not only the hydraulic hardware needed to be changed, the controlling computer also needed to be changed.

The computer used in the freight application SENTRAEN 2000^{TM} is a Motorola CPU #332 which has 32 bit logic. It was needed because of extra complexity required for switching in handling direction of travel issues. The computer is designed to handle lubrication from either the short or the long hood end of the locomotive automatically in the train consist. The electronics circuitry needed is therefore considerably increased and so is the expense.

For Metra/Amtrak application use of a single ended unit will be satisfactory. It can also be simpler and less expensive. A computer design based on a Motorola CPU processor #68HC11, which is

an eight bit processor, was designed and developed. Figure 1 shows the block diagram of the computer for this project. A description of the new single ended Tranergy controller is given below.

VII FABRICATION OF SENTRAEN 2000T, ITS-CONTROLLED LUBRICATION DELIVERY SYSTEM

The SENTRAEN 2000T unit suitable for Metra/Amtrak trains designed above has been built. Photographs of some of the key components of the system are shown in Figures 2, 3 and 4. Figure 2 shows the Motorola HC11 chip based new computer/controller for the unit. Figure 3 shows the communication keypad for the computer and Figure 4 shows the hydraulic controller box. Software for the lube application has also been written.

VIII IMPORTANCE OF THIS RESEARCH FOR HIGH SPEED RAIL

The system developed in this research project has important implications in the improvement of performance and safety of high speed rail in the following areas:

1) Reduction of wheel flange and rail gage side wear.
2) Reduction of energy consumption by reducing the train resistance.
3) Enabling higher speeds by increasing the threshold speed of hunting of trains at higher speeds.
4) Improvement of safety by reducing the lateral creep forces produced on wheels and simultaneously increasing the hunting speed as in 3) above.

Hunting of trains is a major limiting factor in restricting achievement of higher speeds. The theoretical basis for this is given in the appendix II titled “Excessive Lateral Creep Force also Produces Early Hunting:.