Economics of Rail Inspection

The goal for a more effective rail inspection strategy is a continual pursuit by all railroads. An earlier *Tracking R&D* article (see RT&S, July '85) previously addressed the effect on rail inspection frequency of the clustering tendency of rail fatigue defects. In addition, several major research activities are directed to the detection of rail defects and the optimization of inspection schedules for both heavy- and light-density rail lines.

One aspect of this that recently is being given close attention is the *Economics of Rail Inspection*. This involves an examination of the relative costs of various inspection strategies, together with the corresponding rail costs associated directly with these strategies. As referred to in one cost study,[1] the inspection strategies deal with a combination of methods (testing vehicle, hand probe, and visual); the relative amount of track covered using each technique; and the corresponding cycles per year for each method.

The comparisons employ a computer model that simulates the growth of fatigue defects in the rail. This helps determine the number of defects that would be found by the various approaches to rail inspection. By comparing the relative costs of the inspections themselves and the costs of the service failures (and derailments), the overall economics of the different rail inspection strategies are thereby obtained.

Each of the three inspection methods noted above has been given a level of effectiveness. It is based on the size of the defect in the railhead. The corresponding probability of derailment, in turn, is based on an earlier AAR study,[3] and is taken to be 0.1 percent. This translates into one defect in one thousand (combined service and detected defects) that will result in a derailment. The costs of the derailment, as well as the cost of the service failure, were likewise taken from the AAR study.

Significant results

The studies examined 13 inspection strategies or combinations of inspections, ranking them on the basis of relative costs. Among the strategies examined was one that reduced the amount of rail tested by hand probe and visual inspection to 50 percent of the trackage that contained 90 percent of the defects. (This is the clustering effect that was discussed in the earlier *Tracking R&D*.)

TABLE 1

RESULTS FOR MEDIUM DENSITY LINE

Inspection Cycles per Year			Calculated
Vehicle	Probe	Visual	Cost (in $1000)
0	0	12	2,655
12	0	0	2,241
0	12	0	2,175
10	2	0	2,146
10	0	2	2,121
8	4	0	2,052
8	0	4	2,001
6	6	0	1,960
4	8	0	1,884
6	0	6	1,883
2	10	0	1,868
2	0	10	1,815
4	0	8	1,788

Table 1 — Results for Medium Density Line

Table 1 presents the results of this investigation for a medium-density freight line carrying 25 MGT annually. It points out that significant savings can be obtained between the 'best' and 'worst' inspection strategies. Also, it appears that several strategies tended to provide near-optimum approaches to inspection, thus giving a railroad flexibility in scheduling inspection equipment throughout its system.

It must be noted that the calculations used average industry costs. The studies should thus be re-examined by individual railroads using their figures.

A related analysis,[2] dealt with the comparative economics surrounding inspection costs versus inspection frequencies on light (10-MGT/year), medium (20-MGT/year), and heavy (40-MGT/year) traffic on track with differing levels of cumulative tonnage. This analysis used the same model and cost assumptions as in the previous study.[1] Its results are presented in Table 2. The figures listed show that at increasing traffic and cumulative tonnage levels, it is, in fact, cost-effective to in-

TABLE 2
Comparison Of Inspection Costs

Cumulative Tonnage	Annual Tonnage	Cost per 1000 track miles (in $1000) 2 Inspections per Year	3 Inspections per Year
100 MGT	10 MGT/year	387	420
	20	663	651
	40	1,245	1,121
200 MGT	10	473	495
	20	841	802
	40	1,616	1,430

Table 2 — Comparison of Inspection Costs

crease the inspection frequency—in this case from 2 to 3 inspections per year.

Consequently, it was found that cost savings can be achieved by improving the inspection strategy so as to maximize the probability of finding a defect that will result in a derailment, but while keeping overall inspection costs at a reasonable level.

References:

1. Smith, R. A., "Comparative Cost of Alternate Inspection Strategies", Minutes of the Rail Integrity Meeting, AREA 1983 Regional Conference, Danvers, MA, October 1983.
2. Steel, R. K., "Rail Integrity: Recapitulation and Use of Concepts", Minutes of the Rail Integrity Meeting, AREA 1983 Regional Conference, Danvers, MA, October 1983.
3. Wells, T. R. and Gudiness, T. A., "Rail Performance Model: Technical Background and Preliminary Results", Association of American Railroads Report R-474, May 1981.