

Case Study

June 24 - August 6, 2014

Union Pacific River Sub Trial

The standard running conditions for this sub division are speeds of 50 miles per hour on tangent track and

down to 35 miles per hour going through the curves. Under normal running conditions there are three

trackside applicators - located at MP 177.30, MP 177.75 and MP 184.2. The longer coal trains have on-board spray applicators and these trains make up about 25% of all traffic going through this division. (When we started our trial we were not aware that the on-board applicators were applying TOR.) The objective of the trial was to see if TOR Armor could carry down the track for a distance of 4 miles and reduce lateral forces. Lateral forces of all trains were taken twice daily, however, for this report we only recorded the force readings of trains with over 500 axles (coal trains). Typical forces were recorded as follows for the initial dry conditions:

North rail just located west of the Lateral force site

Lateral Force Readings (Dry)

Date	# of Axles	Average Lateral Force Dry	
		High Rail	Low Rail
6/25/14	566	10.40	11.88
	618	10.14	10.96
6/26/14	590	9.75	10.94
	618	9.18	9.67
6/29/14	618	9.02	11.40
	562	8.02	8.23

The test site was reconfigured as follows: The force site was at MP 176.9 and one applicator was used and set

up at MP 180.9. The applicator with TOR Armor was set into operation during the day on July 7, 2014. The

application rate was 0.15 seconds per six axles and forces were taken and recorded as follows:

Lateral Force Readings (with TOR Armor applied)

Date	# of Axles	Average Lateral Force 3 % 0 \$ « « .) +	
		High Rail	Low Rail
7/8/14	660	4.84	4.76
	602	5.45	6.44
7/11/14	673	2.65	2.46
	558	6.06	5.85

On average, there was a reduction in lateral forces of 50%. Forces started going up shortly after this date because one of the bars had worked its way loose and was only partially applying product. At this stage we also discovered that the longer coal trains still had the on-board spray applicators working. The bar was tightened and the on-board applicators were turned off for this

section of the sub, and now we had a situation where the only product being applied was the TOR Armor™

The above figures represented TOR Armor being carried down over a four mile stretch and bringing the forces of the longer coal trains down by 50% and more. The TOR Armor applicator was turned off on August 4, 2014 at 11:00am. After turning off

the applicator, forces of all trains were carefully watched and recorded in order to determine the retention of the product on the rail head. After 4,500 axles had passed over the test site without TOR Armor being applied, the forces of the longer coal trains started going back up to the dry state force levels. By the end of the day on August 5, 2014 forces were as follows:

Date	# of Axles	Average Lateral Force Dry	
		High Rail	Low Rail
8/5/14	614	9.16	9.53
	558	10.17	10.70

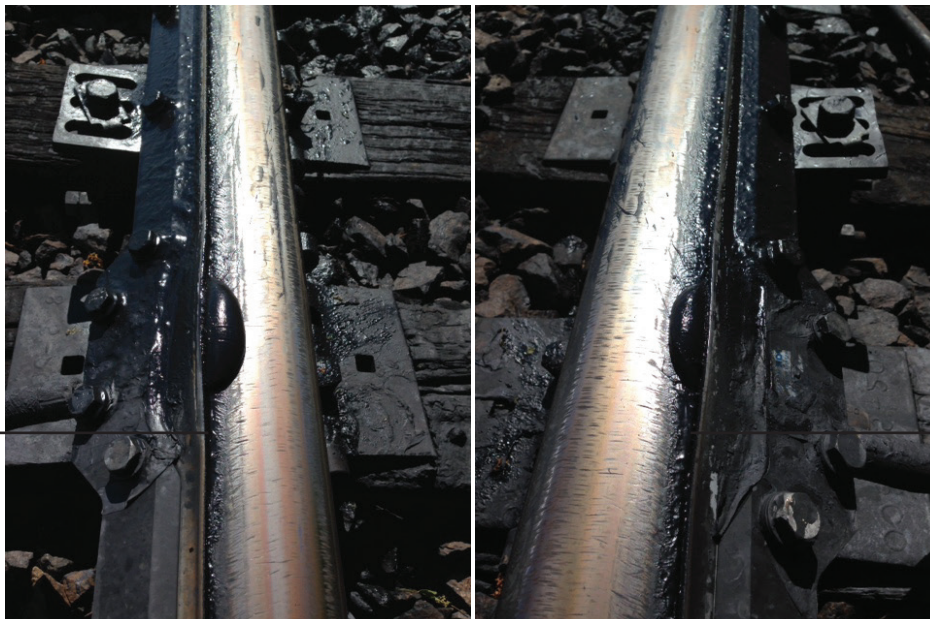
The above readings were taken on the longer coal trains. However, force

readings for the period from June 24 to August 6, 2014 that include the pre and

post-trial dry stages were taken on all trains and showed the following results:

Percent Reduction of All Trains	
High Rail	Low Rail
32.66	36.88

Overall, the above documented reduction in lateral forces proved to be a highly successful trial.



TOR Armor on applicator bar at south rail.

TOR Armor on applicator bar at the north rail.