226622

ENTERED
Office of Proceedings

MAR 16 2010

Part of
Public Record

BEFORE THE
SURFACE TRANSPORTATION BOARD

STB Finance Docket No. 35305

ARKANSAS ELECTRIC
COOPERATIVE CORPORATION – PETITION
FOR DECLARATORY ORDER

OPENING EVIDENCE AND ARGUMENT OF UNION PACIFIC RAILROAD COMPANY

PUBLIC VERSION – CONFIDENTIAL AND HIGHLY CONFIDENTIAL INFORMATION HAS BEEN REDACTED

J. Michael Hemmer
Louise Anne Rinn
Union Pacific Railroad Company
1400 Douglas, STOP 1580
Omaha, Nebraska 68179
Telephone: 402.544.3309

Joe Rebein
Laurie A Novion
Corey Schaecher
SHOOK, HARDY & BACON L.L.P.
2555 Grand Blvd.
Kansas City, Missouri 64108-2613
Telephone: 816.474.6550

Dated: March 16, 2010

Attorneys for Union Pacific Railroad Company

Filing contains color.

TABLE OF CONTENTS

ATTACHMENTS

Counsel Exhibit No. 1:	BNSF Railway Company's Responses and Objections to the First Set of Interrogatories and Requests for Production of Documents of Western Coal Traffic League, Concerned Captive Coal Shippers, Entergy Arkansas, Inc., Entergy Gulf States Louisiana, LLC, and Entergy Services, Inc., Interrogatory No. 2
Counsel Exhibit No. 2:	Union Pacific Railroad Company's Objections and Responses to Western Coal Traffic League, Concerned Shippers and Entergy's First Set of Interrogatories and Requests for Production of Documents, Interrogatory No. 2
Counsel Exhibit No. 3:	General Order No. 19 (Orin Subdivision Timetable Amendments)
Counsel Exhibit No. 4:	Joint Line Agreement

VERIFIED STATEMENT OF DAVID CONNELL

Exhibit DC-1:	Dr. Erol Tutumluer's March 15, 2009 article Laboratory Characterization of Fouled Railroad Ballast Behavior
Exhibit DC-2:	UP/BNSF Orin Subdivision Dustfall Collector Network Sample Data, Nov. 2009
Exhibit DC-3:	BNSF/UP Coal Load Groomed Profile Field Testing, Sept–Dec 2005
Exhibit DC-4:	Joint Initiative Mitigation of Track Ballast Fouling, April 19, 2006
Exhibit DC-5:	BNSF/UP Chemical Dust Suppression Agents Field Testing, 9/05-8/06
Exhibit DC-6:	Ecofab Presentation, 2007
Exhibit DC-7:	Coleman Aerospace Report and Email, 2008
Exhibit DC-8:	Shannon & Wilson's Union Pacific Railroad Ballast Study: North Platte Division, dated July 30, 2008
Exhibit DC-9:	UPRR's SPRB Coal Route: Capacity Improvements 2000-2009 Trackage
Exhibit DC-10:	Shannon & Wilson's Union Pacific Railroad Ballast Study: North Platte Division, dated January 2010

BEFORE THE
SURFACE TRANSPORTATION BOARD

STB Finance Docket No. 35305

ARKANSAS ELECTRIC
COOPERATIVE CORPORATION – PETITION
FOR DECLARATORY ORDER

OPENING EVIDENCE AND ARGUMENT OF UNION PACIFIC RAILROAD COMPANY

Arkansas Electric Cooperative Corporation ("AECC") alleges that BNSF Railway Company's ("BNSF's") Tariff 6041-B Items 100 and 101, with respect to its coal dust emission standard, represent an unreasonable rule or practice and an illegal refusal to provide service. In its December 1, 2009 Order, the Board instituted a declaratory order proceeding and invited interested parties to participate.

That Order identified three issues to be addressed: (1) whether BNSF's tariff provisions constitute an unreasonable rule or practice; (2) whether BNSF may establish rules designed to prevent coal dust emissions from coal trains operating over its lines; and (3) whether BNSF actions to enforce compliance with those tariff provisions would violate BNSF's common carrier obligation. *Arkansas Elec. Coop. Corp.—Petition for Declaratory Order*, STB Docket No. 35305 (STB Decision served Dec. 1, 2009) at 1. Union Pacific Railroad Company ("Union Pacific") believes that BNSF, or any railroad, can and should establish rules that promote safe, reliable and efficient transportation over its lines. Union Pacific also believes that the BNSF rules in question are reasonable because reducing coal dust emissions would promote safety, reliability and efficiency.

Although Union Pacific submits that the BNSF tariff rules in question do not apply to Union Pacific contract or common carrier customers and that BNSF has indicated no intention of refusing to allow Union Pacific trains to run over the Joint Line if they do not comply with the coal dust rules, Union Pacific reserves the right to challenge any such BNSF attempts to enforce its rules by stopping Union Pacific trains. Finally, Union Pacific is concerned that if the Board restricts BNSF's ability to adopt such rules, its own efforts to develop measures to prevent coal dust emissions on its lines in conjunction with Union Pacific customers will be impeded.

INTRODUCTION

Union Pacific is a co-owner of the Joint Line, transporter of Southern Powder River Basin ("SPRB") coal on the Joint Line for AECC and other customers, and operator of its own rail lines that transport SPRB coal.

Union Pacific and BNSF each own 50% of the Joint Line, a 102-mile stretch of railroad used to serve numerous coal mines and transport coal from Wyoming's SPRB. (Glass VS at 2; Connell VS at 3.) Under the ICC-approved Joint Line Agreement entered into by BNSF's and Union Pacific's predecessors, BNSF is the operating railroad but both railroads operate trains on the Joint Line. (Connell VS at 3-4.) Each railroad pays 50% of capacity projects on the Joint Line. Additionally, each railroad pays its share of maintenance and operating costs in proportion to each railroad's usage. (*Id.*)

Union Pacific transports coal from the SPRB for customers over the Joint Line and its own lines to destinations in 23 states across the western two-thirds of the United States. (Glass VS at 2.) Union Pacific's Joint Line-originating coal network runs from Shawnee Junction in eastern Wyoming to Fremont, Nebraska (spanning approximately

533 route miles), and south on its Kansas Subdivision to Menoken Junction, just west of Topeka, Kansas (amounting to approximately 612 route miles). (Glass VS at 3.) Union Pacific's track miles from Shawnee Junction to Fremont and Gibbon Junction to Menoken Junction total nearly 1,600. (Glass VS at 3; Connell VS at 17-18.)

Our submission will discuss the accumulation of coal dust on railroad right-of-way, describe coal dust's harm to track infrastructure and how it disrupts traffic flow, and survey methods to reduce coal dust emissions from rail cars. We also explain how we reached the conclusion that preventing the accumulation of coal dust is superior to continuous efforts to remove it. Based on the review of an independent engineering expert, BNSF's Items 100 and 101 tariff rules appear to address a legitimate concern as well as rest on significant underlying data and research. On their face, the BNSF rules do not impose unreasonable or disproportionate consequences for failure to comply. Next we explain that AECC's concern that BNSF might refuse service is unwarranted because coal shipped by rail to AECC's plants moves under long-term contracts with Union Pacific, and BNSF tariff rules do not apply to movements on Union Pacific. Finally, we address how a Board finding that the BNSF rules constitute an unreasonable practice would interfere with Union Pacific's ability to develop and implement coal dust prevention measures with its customers.

These opening arguments are supported by the accompanying verified statements of David Connell, Vice President-Engineering of Union Pacific ("Connell VS"), Douglas Glass, Vice President and General Manager-Energy of Union Pacific ("Glass VS") and independent expert witness Gregory Muleski, Ph.D of Midwest Research Institute ("Muleski VS").

Mr. Connell discusses Union Pacific's coal history in the Southern Powder River Basin, the composition of the lines Union Pacific uses to move coal, the 2005 Joint Line derailments, and the railroads' response to those derailments. He then addresses Union Pacific's research of various methods of reducing coal dust loss during transport, and the implications of coal dust removal based on the scope and rate of coal dust accumulation.

Mr. Glass explains Union Pacific's coal transportation system and Union Pacific's customer relationship with AECC. He also explains Union Pacific's concerns regarding coal dust, the importance of adopting reasonable rules that insure customers assume responsibility for their lading, that AECC's concern that its trains would be stopped is misplaced, and the pronounced and detrimental impact a Board decision finding the BNSF tariff rules unreasonable would have on Union Pacific's collaborative efforts with its customers.

Finally, Dr. Muleski summarizes his findings about the coal dust monitoring along the Joint Line and concludes based on his extensive experience that rail cars filled with coal are susceptible to erosion which results in coal dust being emitted into the airflow above the cars, that the fixed TSM location at MP 90.7 and the IDV.2 value appear to be a reasonable method to characterize airborne dust from a passing car, and that several viable and proven methods exist to mitigate fugitive coal dust.

ARGUMENT

I. Coal Dust Rules Promote Safe, Reliable and Efficient Rail Transportation

The accumulation of coal dust creates significant safety concerns regarding the stability of the track, harm to track infrastructure, and the possibility of derailments to the detriment of service to rail customers. Coal dust rules that prevent such accumulation promote safe, reliable and efficient rail transportation.

A. SPRB Coal Cars Emit Excessive Coal Dust that Threatens Track Integrity

AECC suggests that BNSF has not provided facts showing that "coal or coal dust emitted from coal cars during transit can have adverse effects on rail roadbeds, and thus overall rail operations." (AECC Pet. at 3.) AECC even goes as far to question "if there even is" a coal dust problem. (AECC Pet. at 6.) But as explained below, the overwhelming factual information and observation of railroad inspectors, maintenance personnel and scientific researchers demonstrate otherwise. (Connell VS at 9, 12-14; Muleski VS at 2-3.) The fact that coal dust is dispersed by coal trains, accumulates on railroad right-of-way, and has a harmful impact on ballast and track is well-documented by scientific and engineering studies. (Connell VS at 13-17, Ex. DC-1.)

After the two Joint Line derailments in May 2005 and the accompanying unparalleled damage and widespread instability throughout the Joint Line, Union Pacific undertook to learn how these events occurred and so that it could prevent a recurrence, has developed an understanding of how serious a threat coal dust is to rail ballast integrity.[1] (Connell VS at 5, 9-17.) "[T]he root cause of the instability of the ballast was excessive coal dust that had become unstable when mixed with the substantial

---

1 Prior to those derailments, BNSF found coal dust accumulating primarily near switches and bridges during the 2002 to 2003 time period, and increased levels of coal on the Joint Line right-of-way resulted in spontaneous fires. (Connell VS at 6.) Both railroads approved additional maintenance in those areas of concern. (*Id.*). As a result of those efforts, key indicators suggested the track was in a stable and safe condition by late 2004 and during the first quarter of 2005. (*Id.*) These indicators included a joint inspection in October 2004, a decrease in slow orders, good geometry car readings and improved volume. (*Id.*)

precipitation that had occurred on the Joint Line" that spring. (Connell VS at 9.) Extraordinary track restoration over an extended period of time was necessary to fix track stability. (Connell VS at 10-11.) The combination of ballast instability and extraordinary track maintenance resulted in slow orders and disrupted coal transportation service. (Connell VS at 10.)

Falling or blowing coal from the top of open cars as a result of wind erosion is the primary source of coal loss, although coal loss also occurs due to improper car sealing or defective bottom dump cars. (Muleski VS at 2, 4.) Coal dust fouls the ballast and is harmful because the coal dust foulants "reduce the shear strength and thus load-bearing capacity of the ballast." (Connell VS at 13.) As a result, the ballast may not be able to perform its function of distributing the load to the sub-ballast between cross ties, rails or ties may become unstable, and the possibility of derailments increases. (Connell VS at 12-13.) Research by Professor Tutumluer at the University of Illinois demonstrated "a relationship between ballast shear strength, coal dust contamination, and moisture content." (Connell VS at 13-14.)

Those 2005 events led to coal dust investigations and studies by BNSF, Union Pacific, shippers and producers to better understand the impact of coal dust on the ballast and to evaluate ways to reduce coal dust deposition on the rail right-of-way. (Connell VS at 12-16.) For example, Dr. Erol Tutumluer conducted the first detailed examination of the mechanical properties of coal dust. He concluded that the coal dust significantly compromises the shear strength of railroad ballast and that it is an unusually dangerous fouling agent, particularly if it accumulates in dry conditions and is later saturated by heavy precipitation. (Connell VS at 13-14, Ex. DC-1.) Additionally, Union Pacific, in cooperation with shippers and customers, has explored methods to prevent coal dust deposits. (Glass VS at 9-11.) The National Coal Transportation Association ("NCTA") formed three committees to study how repairs or improvements to cars, load profiling, and the application of surface sprays could reduce the loss of coal dust during coal rail transport.

The characteristics that make coal dust an unusually dangerous fouling agent are multiplied by its ability to permeate ballast and leave no outward sign at numerous locations that it has attained unacceptable levels. That allows it to accumulate without being revealed by ordinary inspection techniques until after the coal dust is wet and the damage has begun. (Connell VS at 14.)

Based on its increased understanding of the danger of accumulating coal dust to track stability and integrity, Union Pacific retained the engineering firm Shannon & Wilson, Inc. to determine coal dust levels on Union Pacific's principal main lines used to transport SPRB coal by taking core samples. (Connell VS at 16.) Shannon & Wilson found that coal dust comprises as much as 20% of the fines volume on Union Pacific's own line nearly 600 miles beyond the Joint Line. (Connell VS at 17.) Substantial volumes were found at many locations that on the surface appeared clean. This is consistent with Dr. Muleski's views that "one could expect coal dust to be lost throughout the trip." (Muleski VS at 3.)

B. Coal Dust Prevention Is Superior to Removal

AECC apparently recognizes the likelihood that the Board will conclude that coal dust impacts track stability and safety because it alternatively argues that normal maintenance can adequately address any coal dust concerns. (AECC Pet. at 3.) But coal dust continues to accumulate on coal routes despite ongoing and extensive efforts by BNSF and Union Pacific to remove it through undercutting and other maintenance activities. Track maintenance and undercutting alone cannot solve coal dust problems, and the best solution is for shippers to keep their coal in their railcars in the first place. (Connell VS at 18-19.)

As a result of the 2005 derailments, significant undercutting, shoulder ballast cleaning, tie repairs, and switch replacement and cleaning to restore the Joint Line that year and continued into 2006. Since that time, Union Pacific has expanded those efforts to areas on its own coal rail corridor, and some of those same areas on the Joint Line required cleaning again due to the rapid new accumulation of coal dust. (Connell VS at 11.)

Despite coal dust mitigation efforts, coal dust continues to accumulate at disturbing rates of deposition on the Joint Line as well as Union Pacific's main line as far as 600 miles beyond the Joint Line, a finding recently confirmed by Shannon & Wilson. (Connell VS at 17; Glass VS at 6.) Simpson Weather studied the rate of coal dust deposition on the Joint Line and methods to contain the dust. It similarly concluded that unless further mitigation measures are employed, coal dust will continue to accumulate on the Joint Line at very high rates. (Connell VS at 14.)

The increasing amount of coal dust deposition over time on its own line has required Union Pacific to undercut more frequently. (Connell VS at 11; Glass VS at 4-5.) Where before, Union Pacific expected the need to undercut main line track every eight to twenty years, it now anticipates that the same track may need to be undercut as often as every six years (and three years on switches). (Connell VS at 17.)

Undercutting hundreds of miles of Union Pacific rail corridor annually is not feasible, sustainable or acceptable, due to the significant disruption of transportation service it poses and the railroad's inability to remove all coal dust. (Connell VS at 18.) Increased undercutting and maintenance, particularly at the rates necessary to keep up with the increased accumulation rate, disrupt traffic flow and may slow down service to customers because maintenance crews are on the track more often, reducing track capacity and delaying trains. (Glass VS at 5; *see also* Connell VS at 17-18.) Based on a 6-year average undercutting cycle of Union Pacific's Joint Line-originating coal network (totaling 1590 track miles), Union Pacific would need to undercut an average of 265 miles per year on this corridor. Given average production rates for undercutting and a working season limited to approximately seven months, Union Pacific would have to deploy at least one undercutting gang nearly continuously and a second much of the time to achieve the necessary average of 1.24 miles every day of the working season. (Connell VS at 17-18.) Due to machinery and gang down-time, and necessary movement from one job site to another, it is unlikely that Union Pacific could sustain this amount of annual undercutting perpetually. (*Id.*)

Adding to the complexity of the problem, coal dust is not always visually apparent. (Connell VS at 14; Glass VS at 6.) Ballast that looks clean based on a visual inspection may have coal below the surface. (Connell VS at 14.) Finally, undercutting and ballast cleaning cannot remove all of the deposited coal dust fines that are in the ballast, and the presence of coal dust even in small amounts increases the likelihood of track-related problems and derailments. (Connell VS at 18; Glass VS at 4, 6.)

The pernicious characteristics of coal dust on the track bed and the increasing evidence of deposition beyond the Joint Line demonstrate that preventing coal dust emissions before they accumulate on the right-of-way is both necessary and appropriate. As Mr. Glass explains, the best solution is for shippers to keep their lading (in this case, coal) and the dust particles from it in the railcars and off of the right-of-way." (Glass VS at 5.)

C. Railroads Can and Should Adopt Common Sense Rules that Promote Safe, Reliable and Efficient Rail Transportation

Railroads are responsible for safely transporting freight over their lines. But railroads must depend on shippers to load freight so that it can be moved safely and remain in the cars tendered for shipment. In connection with that responsibility and in recognition that rail transportation relies on shipper, railroad and receiver cooperation, railroads have authority to adopt rules or practices related to the rail transportation they provide, including rules to promote safe and efficient operations. 49 U.S. C. § 10702(2).[2] As shown above, coal dust emissions affect both track safety and service to customers, and track maintenance efforts do not sufficiently address the problem. Thus, reasonable rules dealing with coal dust emissions from open top coal railcars promote safe, reliable, and efficient rail transportation.

In light of the track instability problems caused by coal dust, it is sensible for a railroad to adopt reasonable rules to increase the probability that customers' coal stays in the open top cars and off the railroad right-of-way. Generally, shippers are responsible for loading their freight into cars so that it remains in the car and does not fall on the

2 AECC implicitly concedes the existence of such authority to adopt rules because it has not challenged the load profiling requirements under Items 100 and 101.

track, which creates safety risks to other trains, the railroad's track, and the right-of-way. (Glass VS at 5-6.) Similar to customer rules for other products transported by railroads, coal owners should bear responsibility for keeping their lading in the railcar after it is loaded at the mine. (Glass VS at 6.)

On Union Pacific lines, we have similar rules directed towards commodities that present particular risks if they are deposited on the track during transit. And railroad loading rules addressing coal dust emissions from unit coal train open top cars would be similar to Union Pacific's tarpaulin requirement for scrap metal or iron moving in open gondolas and netting requirement for woodchips: in both examples, loading rules require customers to take precautions to keep their lading in the railcar due to safety and track concerns. (Glass VS at 6-7.) Likewise, Union Pacific's rules concerning the transportation of soda ash in covered hoppers with the bottom gates secured help prevent leakage of that caustic substance onto Union Pacific's track. (Glass VS at 6.)

Thus, similar to rules governing other products moved by railroads, railroads should be permitted to adopt reasonable unit coal train open top car rules that address safety problems associated with shippers' coal leaving open top coal railcars and being deposited on railroad right-of-way.

II. BNSF's Tariff Rules for Inhibiting Coal Dust Are Reasonable

Railroad rules designed to reduce or prevent coal dust emissions from railcars operating on their lines directly address a known safety concern—accumulation of coal dust on the right-of-way—and assist railroads in performing their obligation to provide safe, reliable and efficient rail transportation. BNSF's Items 100 and 101 are not an unreasonable approach to dealing with track problems associated with the accumulation of coal dust.

A. Because Railroads Cannot Prevent Emissions by Unilateral Action, Shippers Must Change Loading Practices

Coal dust prevention cannot be achieved without securing shippers' coal in the railcars. Dr. Muleski explains that coal-loaded open-top railcars are "susceptible to wind erosion resulting in coal dust becoming incorporated into the airflow above the car," where larger coal dust particles are deposited on or near the track bed, and smaller coal dust particles become suspended in the air. (Muleski VS at 2, 5, 7.) But unilateral mitigation by a railroad cannot solve coal dust problems or prevent the causes of coal dust emissions for the following reasons: (1) shippers own the coal; (2) shippers own virtually all of the railcars used to transport SPRB coal over rail lines; (3) shippers' suppliers load the coal into the railcars; and (4) the coal is loaded before the railcars are released to the railroad for transport. (Glass VS at 9.)

Due to these circumstances, neither BNSF nor Union Pacific can take unilateral actions to keep shippers' coal (and associated coal dust) from leaving the railcars, such as by installing covers on railcars, repairing railcar holes and seams, or changing coal loading practices. Therefore, shippers must change their loading practices and/or implement railcar modifications in order to prevent coal dust emissions. Otherwise, coal dust will continue to accumulate on the Joint Line and on Union Pacific's own lines used to transport SPRB coal.

B. Coal Dust Prevention Methods Exist, More Are Being Developed, and BNSF's Tariff Rules Do Not Require any Particular Approach.

BNSF's coal dust tariff rules are performance-based instead of conduct-based, which provides flexibility and discretion to shippers. The Integrated Dust Value (IDV.2) performance standard does not require shippers to use any particular type of technology or method of reducing coal dust emissions, giving shippers various options.

Effective and viable options for preventing coal dust exist. Various methods exist to reduce coal dust emissions and accumulation of coal dust on railroad right-of-way, and others are being developed. (*Cf.* AECC Pet. at 5.) Examples of preventative methods include:

- uniformly shaping loaded coal cars in a bread-loaf shape, which Simpson Weather concludes makes them less likely to dust during rail transport;[3]
- repairing railcars to close holes and seams throughout which coal may fall, as suggested by NCTA committee studies; and
- spraying surfactant on the surface of the coal, which Simpson Weather concludes makes it "less susceptible to blowing off during transportation."

(*see generally* Connell VS at 15-16; Glass VS at 9; Muleski VS at 3, 8, 9.) In addition, efforts are underway to develop compression (using pressure or vibration or both) or car covers as additional alternatives. (Glass VS at 9-10; *see also* Muleski VS at 3, 8.)[4] A manufacturer plans to introduce a mechanical system that can compact coal in coal cars,

---

3 Coal dust emissions are "accentuated if the coal surface is higher than the car sidewalls," and the surface profile of the coal load also can affect the level of emissions. (Muleski VS at 2, 5-6.)

4 "Compaction reduces the surface area available for erosion and smoothes the service to reduce shearing from the air." (Muleski VS at 8.)

and Union Pacific hopes to field test the system with one or more of our customers. (Glass VS at 10; *see also* Connell VS at 16.) Additionally, Union Pacific currently is evaluating covers as an alternative method of coal dust prevention and is working with manufacturers and interested parties on design and testing. (Glass VS at 10; *see also* Connell VS at 16.)[5]

Simpson Weather and the NCTA committee studies all conclude that these methods, alone or in combination, can effectively reduce coal dust emissions and the resulting accumulation on the track bed. (Connell VS at 14-16.) BNSF's tariff rules reasonably leave the decision of which preventative method, or combination of measures to use, in the hands of shippers, based on their individual needs and what is best-suited to their unique company circumstances.

C. There Is Ample Evidence to Support the Reasonableness of the IDV.2 Standard

Consistent with the goal of safe and efficient rail transportation, BNSF Items 100 and 101 explain that the purpose of the Integrated Dust Value (IDV.2) emission standard[6] is "to enhance retention of coal in rail cars." (BNSF 6041-B, Items 100-101, Ex. A to AECC Pet.) And the IDV.2 standard adopted by BNSF is not an arbitrary standard, despite AECC's suggestions otherwise. (AECC Pet. at 1, 4, 6.) Instead, ample evidence supports the reasonableness of BNSF's IDV.2 standard.

---

5 Dr. Muleski concludes that "[c]overing the coal very effectively prevents wind erosion by isolating the coal surface from the wind." (Muleski VS at 8.)

6 BNSF's tariff rule, Item 100 (which applies to the Joint Line), states that trains shall not emit more than an IDV.2 of 300 units. An IDV.2 unit is "a measure of the volume of coal dust coming off of the coal train over its entire length." (Ex. A to AECC Pet.)

Scientific researchers agree that coal dust has a harmful impact on track ballast. And coal dust continues to accumulate on coal routes, despite railroads' ongoing efforts to remove coal dust by undercutting and other maintenance activities. (Connell VS at 16-17; *see generally* Muleski VS at 3-6.) In light of these facts, BNSF's coal dust emission standard is not an unreasonable approach to addressing coal dust problems. (*See generally* Muleski VS at 6-9.)

AECC opines that the provisions of Items 100 and 101 are without justification, but it fails to acknowledge the underlying coal dust problems or to fairly evaluate the process BNSF undertook in the development of the IDV.2 standard. First, BNSF studied the coal dust situation, collected dusting event data on the Joint Line, and analyzed the accumulated data before developing a performance standard, all reasonable steps.

Second, BNSF's testing process and development of an Integrated Dust Value approach are not unreasonable. "The general description of how the IDV.2 value is calculated appears to be a reasonable method to characterize airborne dust from a single train passage." (Muleski VS at 9.) For example, the location of the Track Side Monitor equipment at milepost 90.7 on the Joint Line was based on the balancing of various factors, including access to utility services, ease of maintenance, interference with railroad operations, security, and ambient conditions, and is reasonable for the testing performed. (Muleski VS at 6-7.) Similarly, it is reasonable to conclude that an "event with a higher IDV value corresponds to more mass being deposited on the right-of-way," assuming wind conditions are similar, "[b]ecause (a) airborne dust at the sampling location is due to erosion of the coal surface and (b) large (saltating) particles are necessary for erosion." (Muleski VS at 8, 9.)

D. **It Is Premature for the Board to Find BNSF Rules Unreasonable Because There Are No Negative Consequences to Weigh Against the Benefits**

It would be premature for the Board to decide that the BNSF rules are unreasonable and invalidate them at this time. The rules do not establish any negative consequences for shippers whose trains do not comply, so shippers cannot be injured by the rules as they exist. Items 100 and 101 do not contain any enforcement provisions, and BNSF has not announced any plans to enforce the coal dust emission standards in those tariff rules. (BNSF's Obj. & Resp. to WCTL's et al.'s 1st Set of Interr. & Req. for Prod. of Docs., Interr. No. 2 [Counsel's Ex. 1].)

In particular, AECC's concern that BNSF will refuse to move trains that do not comply with the standards is misplaced and unwarranted in Union Pacific's view. For reasons stated below in Part III, these rules do not apply to AECC. Moreover, stopping Union Pacific trains because their emissions exceeded the IDV.2 would be ineffective. A Union Pacific train must already be released from the mine and moved as much as 75 miles and at least 28 over the Joint Line before it can pass the monitor at mile post 90.7, the device that measures the emission. (*See generally* Glass VS at 8 and n.1; *see generally* Connell VS at 3, illustration.) By the time the data on the train is captured and analyzed, the train will have likely covered the remaining 27 miles to the end of the Joint Line. *Id.* So if this is a Union Pacific train, it will have passed Shawnee Junction at MP 117.1 and be on Union Pacific line by the time BNSF would have reason to stop the train. *Id.*

If and when the BNSF adopts definite enforcement mechanisms, the Board can then assess whether the benefits of the rules outweigh the drawbacks based on facts and not speculation. Until then, hypothetical penalties cannot be fairly weighed against the probable benefits of the BNSF rules.

Allowing the BNSF rules to remain in effect at this time will deliver benefits. The accumulation of coal dust unquestionably causes serious problems. Methods to control coal dust exist; others are being developed. The existence of the BNSF rules and the necessity to continue monitoring and measuring will add to the data and information available on the absolute and relative efficacy of those methods.

III. AECC's Concern that BNSF Would Stop Movement of Trains Is Misplaced and Unwarranted

AECC, without any factual basis, asserts that "BNSF threatens to refuse to allow trains handling the shipper's cars to operate over . . . [the Joint Line] or otherwise penalize the shippers," presumably concerned that its own coal shipments will be impacted. (AECC Pet. at 1, 6.) But any fears weighing on AECC's shoulders are misplaced and the result of misconceptions about the nature and scope of the provisions in BNSF's Item 100 in Tariff 6041-B.[7]

A. BNSF Tariff Rules Do Not Apply to AECC Coal that Moves Under Union Pacific Contracts

AECC is not a customer of BNSF, a point immediately acknowledged by BNSF. (BNSF Reply to AECC Pet. at 3, 7.) Therefore BNSF's tariff rules do not apply to AECC shipments. Instead, AECC is Union Pacific's customer: AECC owns an interest in three coal-fired power plants, all of which are subject to long-term contracts with Union Pacific under 49 U.S.C. § 10709. (Glass VS at 3-4.)

[7] Item 101 applies to the BNSF Black Hills subdivision. Union Pacific has no ownership interest in or trackage rights over those tracks and Union Pacific trains do not operate over that line. Accordingly, only Item 100 which applies to the Joint Line could conceivably be relevant to Union Pacific's trains carrying AECC coal.

BNSF's tariff rules do not bind Union Pacific customers any more than Union Pacific tariff rules can bind another railroad's customers. While railroads providing transportation are to establish reasonable rules and practices on matters related to the transportation that the railroad provides, those rules are for transportation that the railroad establishing the rules provides. 49 U.S.C. § 10702(2). Moreover, transportation under § 10709 contracts is not subject to the Interstate Commerce Commission Termination Act ("ICCTA"), including § 10702. *See* 49 U.S.C. § 10709(c)(1).

B. BNSF Has Not Stated It Will Stop Union Pacific Trains From Operating

Union Pacific has received no information that BNSF intends to enforce the provisions of traveling on the Joint Line by refusing to allow Union Pacific trains to move. (Glass VS at 7; UP's Obj. & Resp. to WCTL's et al.'s 1st Set of Interr. & Req. for Prod. of Docs., Interr. No. 2 [Counsel's Ex. 2].) Nor do the tariff rules contain any enforcement provisions. BNSF's discovery responses likewise state that it is not formally considering any penalties or consequences for failing to comply with Items 100 and 101 and that no decisions have been made regarding such penalties or consequences. (BNSF's Obj. & Resp. to WCTL's et al.'s 1st Set of Interr. & Req. for Prod. of Docs., Interr. No. 2. [Counsel's Ex. 1].)

While BNSF operating rules for the Joint Line can govern Union Pacific, its coal-dust related operating rules are not at issue in this proceeding.[8] Nevertheless, BNSF's coal dust operating rule, General Order No. 19 (Orin Subdivision Timetable Amendments) poses no threat to AECC or other Union Pacific customers because it

[8] AECC specifically cited two BNSF tariff rules. Its petition was silent on BNSF operating rules.

contains no provision authorizing BNSF to stop or refuse to allow a non-complying train to move over the Joint Line. (General Order No. 19 [Counsel's Ex. 3].) Nor has BNSF notified Union Pacific that it would do so. (Glass VS at 8.)[9] Moreover, for the reasons explained in II.D., it would be counterproductive for BNSF to stop Union Pacific trains just as they were leaving the Joint Line.[10]

Thus, BNSF's rules addressing coal dust, whether found in BNSF Tariff 6041 or in BNSF's operating rules, should not impact Union Pacific's movement of coal for AECC or other Union Pacific customers.

C. If BNSF Were to Stop Union Pacific Trains in the Future, Union Pacific Would Seek Immediate Relief

BNSF's authority to issue and apply operating rules to the detriment of Union Pacific and its customers is limited. The Joint Line Agreement requires that BNSF control the Joint Line, and that its direction shall be without discrimination. (Joint Line Agreement, Section 2.1. [Counsel's Ex. 4].) BNSF operating rules must be reasonable, just and fair, and trains of both owners given equal dispatch. (*Id.*, Section 2.7.) Accordingly, BNSF cannot interfere with Union Pacific trains operating over the Joint Line because they are emitting too much coal dust unless it does so for its own trains as well.

---

9 *See also* UP's Obj. & Resp. to WCTL's et al.'s 1st Set of Interr. & Req. for Prod. of Docs., Interr. No. 2 [Counsel's Ex. 2]. Similarly, based on BNSF answers in discovery, BNSF has formed no intention to do so. (BNSF's Obj. & Resp. to WCTL's et al.'s 1st Set of Interr. & Req. for Prod. of Docs., Interr. No. 2. [Counsel's Ex. 1].)

10 All of the Joint Line mines are located on the northern half of the Joint Line, but the monitoring station that would measure the emissions on loaded Union Pacific trains is located near the southern end where all Union Pacific trainloads exit the Joint Line.

Should BNSF modify its operating rules in the future to provide that it can stop trains or otherwise begin to interfere with their operations solely because they are emitting too much coal dust, and then apply the rule in a manner that interferes with Union Pacific's contractual or common carrier obligations to its customers, Union Pacific will seek immediate relief, challenging the rules and their application. (Glass VS at 8.) But this is hypothetical and speculative, and should not be addressed now in the absence of actual facts that allow a judgment of whether the BNSF actions are reasonable.

IV. A Board Finding the BNSF Rules Unreasonable Would Interfere with Union Pacific's Ability to Develop Coal Dust Emission Prevention Measures in Conjunction with its Customers

By ruling now that BNSF's tariff rules are unreasonable or by narrowly defining what constitutes a reasonable rule, the Board's decision would chill Union Pacific's ongoing efforts to collaborate with its customers on the reduction of coal dust deposits. (Glass VS at 9-13.) As a result, the Board's decision would interfere with Union Pacific's ability to provide safe, reliable and efficient rail transportation to our customers by inhibiting cooperation from customers and by limiting our responses to coal dust to those that are within the sole control of a railroad.

Union Pacific has a demonstrated history of collaboration with our customers in developing and implementing technology and methods that improve service and operations. (Glass VS at 11-12.) Successes include the deployment of distributed power, adoption of higher capacity cars, shifting to longer trains, and improved mechanical inspections and repairs that dramatically reduced equipment-caused derailments. (Glass VS at 11-12.) None of these could be achieved by Union Pacific or the customer acting alone. Each effort has delivered benefits in safety or reliability or both. All required communication and sharing of information over time to accomplish.

The example of the reduction in equipment-caused derailments illustrates this process well. In response to a number of broken wheel and axle derailments involving heavy-haul cars, Union Pacific conducted a comprehensive mechanical evaluation. Based on this research, we adopted a number of improvements on our own coal cars that were in heavy-haul coal service. To further reduce equipment-caused derailments, in April 2005 we reached out to customers asking that they voluntarily follow the same inspection and repair standards that we were using for our cars. In late 2006, we incorporated those standards as recommendations in our Wyoming rules circular. At the beginning of 2008 we adopted these standards as requirements in the rules circular. The number of derailments caused by equipment failure declined from 17 during 2002 to only six in 2008. (Glass VS at 12.) We shared information about why the changes were necessary and the resulting reduction in derailments. We also provided time to become familiar with and to understand the new standards. (*See generally* Glass VS at 12.)

Union Pacific is following the same process on coal dust. Unlike the program for the prevention of mechanically-related derailments, however, where we had access to all of the information we needed on the causes of derailments, we require the active assistance of our customers to collect and refine data and to develop alternative technologies to control coal dust. We have two projects underway that will share data and information on coal dust prevention with our customers. One will share the coal dust emissions data collected at the Track Station Monitors located on the Joint Line and on Union Pacific's South Morrill subdivision. The other will share visual images of actual load profiles of customers' loaded cars on the Joint Line. Both sets of data will be available to Union Pacific customers and their mines via a secured website. The information will allow the shippers, mines and Union Pacific to observe the amount of dust emitted from the trains as well as the consistency of loading profiles. (Glass VS at 10-11.) The ability to collect this data will enhance our ability to measure the effectiveness of prevention methods for individual trains and trends over time. In order to test other methods for limiting coal dust emissions, such as compression, we will require active cooperation of some mines and customers to test the technique because the cars, the coal and the loading facilities belong to them, not Union Pacific.

A Board decision rejecting or curtailing aspects of BNSF's coal dust tariff rules will discourage customer participation in coal dust discussions and demonstrations with Union Pacific and halt our progress toward reaching informal agreements with customers concerning the reduction of their coal dust emissions. (Glass VS at 13.)

CONCLUSION

Accumulating coal dust on railroad ballast and other areas of the right-of-way is a significant and ongoing concern impacting the safe and efficient transportation of SPRB on the Joint Line and Union Pacific's coal routes on its own rail line. In furtherance of railroads' obligation to provide safe and efficient coal transport over their rail lines, the Board should permit railroads to adopt reasonable rules to prevent coal dust emissions from open top coal cars and the subsequent accumulation of coal dust on rail lines. A Board decision that concludes BNSF's Item 100 and 101 are unreasonable or that narrowly and prematurely defines the scope of reasonable enforcement provisions will both discourage communications between railroads and coal customers and chill Union Pacific's efforts to work with its customers on developing coal dust solutions.

Dated: March 16, 2010

Respectfully submitted,

By: /s/ Joe Rebein

Joe Rebein
Laurie A. Novion
Corey Schaecher

SHOOK, HARDY & BACON L.L.P.
2555 Grand Blvd.
Kansas City, Missouri 64108-2613
Telephone: 816.474.6550

J. Michael Hemmer
Louise Anne Rinn
Union Pacific Railroad Company
1400 Douglas, STOP 1580
Omaha, Nebraska 68179
Telephone: 402.544.3309

Attorneys for Union Pacific Railroad Company

COUNSEL'S EXHIBIT 1

BEFORE THE
SURFACE TRANSPORTATION BOARD

STB Finance Docket No. 35305

PETITION OF ARKANSAS ELECTRIC
COOPERATIVE FOR A DECLARATORY ORDER

BNSF RAILWAY COMPANY'S RESPONSES AND OBJECTIONS TO THE FIRST SET OF INTERROGATORIES AND REQUESTS FOR PRODUCTION OF DOCUMENTS OF WESTERN COAL TRAFFIC LEAGUE, CONCERNED CAPTIVE COAL SHIPPERS, ENTERGY ARKANSAS, INC., ENTERGY GULF STATES LOUISIANA, LLC, AND ENTERGY SERVICES, INC.

BNSF Railway Company ("BNSF"), pursuant to 49 C.F.R. §§ 1114.26 and 1114.30, hereby responds and objects to the First Set of Interrogatories and Requests for Production of Documents served by Western Coal Traffic League, Concerned Captive Coal Shippers, Entergy Arkansas, Inc., Entergy Gulf States Louisiana, LLC, and Entergy Services, Inc. (collectively "WCTL") on December 18, 2009 ("WCTL's First Set of Discovery Requests").

GENERAL OBJECTIONS AND

OBJECTIONS TO DEFINITIONS AND INSTRUCTIONS

The following general objections and objections to definitions and instructions are made with respect to WCTL's First Set of Discovery Requests.

1. BNSF objects to WCTL's First Set of Discovery Requests to the extent they seek documents that contain confidential and proprietary information relating to

relating to coal dust emissions: Cordilleran Environmental Consultants, General Electric Railcar Services Corporation (along with Operations Management International, Inc.), Six-Sigma Qualtec, Smarter Solutions, Inc., and Zeta-Tech Associates, Inc.

Interrogatory Number 2:

Please identify any penalties or consequences that BNSF has considered, discussed, or otherwise reviewed, relating to any trains operating on the Joint Line or Black Hills Sub-Division, including UP trains that are operated on the Joint Line, that fail to comply with Items 100 and 101 of BNSF's Price List 6041-B.

BNSF Response: BNSF objects to Interrogatory Number 2 to the extent it seeks information relating to compliance with Items 100 and 101 of BNSF's Price List 6041-B that is protected from disclosure by the attorney-client privilege, the work product doctrine, or any other privilege. Subject to and without waiving its specific and general objections, BNSF states that no formal non-privileged consideration has been given to specific penalties or consequences relating to trains that fail to comply with Items 100 and 101 of BNSF's Price List 6041-B, no decisions have been made regarding such penalties or consequences, and no actions have been taken to enforce compliance with Items 100 and 101 of BNSF's Price List 6041-B.

Interrogatory Number 3:

Identify any Federal or State agencies, departments or governmental authority that raised concerns relating to the release of coal dust from railcars and/or the accumulation of coal dust on the Joint Line. For each such agency please identify:

a. The agency, department or governmental authority involved;

b. The nature of the concerns raised;

c. Any regulatory steps that may have been contemplated to minimize the release and/or accumulation of coal dust, including any proceedings or investigations that may have been instituted; and

d. Any conclusions, recommendations, findings, reports, or other action ordered by the agency, department or governmental authority involved.

Request for Production Number 34:

Produce all documents identified in your answer to Interrogatory No. 5, supra.

BNSF Response: BNSF states that it did not identify any documents in its response to Interrogatory Number 5.

Request for Production Number 35:

Produce all documents identified in your answer to Interrogatory No. 6, supra.

BNSF Response: BNSF states that it did not identify any documents in its response to Interrogatory Number 6.

Request for Production Number 36:

Produce all documents identified in your answer to Interrogatory No. 7, supra.

BNSF Response: As stated in response to Interrogatory No. 7, BNSF will produce the names of persons whose files were searched in response to these discovery requests.

Respectfully submitted,

Richard E. Weicher
Jill K. Mulligan
BNSF RAILWAY COMPANY
2500 Lou Menk Drive
Fort Worth, TX 76131
(817) 352-2353

Samuel M. Sipe, Jr.
Anthony J. LaRocca
Kathryn J. Gainey
STEPTOE & JOHNSON LLP
1330 Connecticut Avenue, N.W.
Washington, DC 20036
(202) 429-3000

ATTORNEYS FOR
BNSF RAILWAY COMPANY

January 8, 2010

COUNSEL'S EXHIBIT 2

BEFORE THE
SURFACE TRANSPORTATION BOARD

STB Finance Docket No. 35305

ARKANSAS ELECTRIC
COOPERATIVE CORPORATION – PETITION
FOR DECLARATORY ORDER

UNION PACIFIC RAILROAD COMPANY'S OBJECTIONS AND RESPONSES TO WESTERN COAL TRAFFIC LEAGUE, CONCERNED SHIPPERS AND ENTERGY'S FIRST SET OF INTERROGATORIES <u>AND REQUESTS FOR PRODUCTION OF DOCUMENTS</u>

Union Pacific Railroad Company ("UP") responds to Western Coal Traffic League's, Concerned Captive Coal Shippers', Entergy Arkansas, Inc.'s, Entergy Gulf States Louisiana, L.L.C.'s, and Entergy Services, Inc.'s (collectively, all five entities, "Propounding Parties") First Set of Interrogatories and Requests for Production of Documents ("Discovery Requests") as follows:

<u>GENERAL OBJECTIONS</u>

UP objects to each and every one of the Propounding Parties' Discovery Requests as noted below. In addition to its General Objections, UP's specific objections are stated at the beginning of the response to each request.

1. UP objects to the Discovery Requests because the Board, in its Decision, served on December 1, 2009, provided that discovery would only be permitted "among BNSF, AECC, and any other shippers potentially affected by the tariff, including shipper organizations that represent those shippers." *Arkansas Elec. Coop Corp.—Petition for Declaratory Order*, STB Docket No. 35305 (STB served Dec. 1, 2009) at 3. The Board did not permit discovery from

3826250 v2

discuss this matter with the Propounding Parties if this is of concern with respect to any particular answer.

INTERROGATORIES

INTERROGATORY NO. 1: Identify all consultants, consulting firms, and/or engineering companies that have been retained by UP and/or UP and BNSF jointly, to perform or prepare any studies, analyses, investigations, reports, and any and all field work or field monitoring activities (whether on UP property, BNSF property, jointly owned property, mine property, etc.), relating to the release and/or accumulation of coal dust and its potential or actual impacts on rail operations, track maintenance, rail economics or environmental concerns.

ANSWER: UP objects to Interrogatory No. 1 to the extent that it seeks information used in connection with other litigation, including but not limited to the identification of experts retained in other litigation, disputes and/or proceedings. UP further objects to this interrogatory because it is unreasonably cumulative and unnecessarily duplicative to the extent the information sought from UP was initially and also requested from BNSF.

Subject to and without waiving these objections and UP's General Objections, UP identifies the following entities as consultants or engineers that UP has retained, individually, outside of litigation: Simpson Weather Associates, Charlottesville, VA; Conestoga-Rovers & Associates, Farmers Branch, TX; Shannon & Wilson, Inc., Seattle, WA.

INTERROGATORY NO. 2: Please identify any penalties or consequences that UP has discussed, been advised of, or otherwise reviewed, relating to any UP trains operating on the Joint Line that fail to comply with Item 100 of BNSF's Price List 6041-B, including but not limited to any potential threat that BNSF may refuse to allow trains operated by UP to move over the Joint Line because of non-compliance with Item 100, as referenced at page 3 of UP's Petition.

ANSWER: UP objects to Interrogatory No. 2 as it misstates and mischaracterizes UP's Petition because UP's Petition is the best evidence of its content and terms. UP further objects to this interrogatory because it seeks legal conclusions, and necessarily requires the disclosure of counsel's mental impressions and/or information that is protected by the attorney/client privilege. UP also objects to this interrogatory as vague because the terms "penalties" and "consequences" are undefined and thus, answering this interrogatory would require UP to do so based on conjecture. UP further objects to this interrogatory as vague to the extent it seeks information about communications between UP and its customers about BNSF's intentions because the Propounding Parties are able identify any such communication—if any exists—they had with either UP or BNSF. UP also objects to this interrogatory to the extent it seeks information based on hearsay and/or speculation in that such information is neither relevant nor reasonably calculated to lead to the discovery of admissible evidence. UP also objects to this interrogatory as overly broad and unduly burdensome to the extent it requests UP to search for information based on pure speculation.

Subject to and without waiving these objections and UP's General Objections, UP states that BNSF has not indicated to UP what plans, if any, it has to enforce BNSF's Item 100 of BNSF's Price List 6041-B and that UP has received no information that BNSF intends to apply any penalties to UP trains operating over the Joint Line. UP refers Propounding Parties to UP's July 17, 2009 customer communication, wherein UP advised its customers that "BNSF has not indicated to UP that it plans to take steps to prevent UP from operating trains that do not comply" with BNSF's Item 100 or BNSF's operating rule, General Order No. 19. UP also refers Propounding Parties to BNSF's Response to Interrogatory No. 2 from BNSF's Responses and Objections to the First Set of Interrogatories and Requests for Production of Western Coal Traffic League, Concerned Captive Coal Shippers, Entergy Arkansas, Inc., Entergy Gulf States Louisiana, LLC, and Entergy Services, Inc.

<u>INTERROGATORY NO. 3:</u> Please identify, by name, title and address, the person(s) who prepared each answer to these Interrogatories and who reviewed and selected the

Dated: January 12, 2010

Respectfully submitted,

SHOOK, HARDY & BACON L.L.P.

By: ______________________

Joe Rebein, MO Bar #35071

2555 Grand Blvd.
Kansas City, MO 64108-2613
Telephone: 816.474.6550

J. Michael Hemmer, Vice President, Law
Louise Anne Rinn, Associate General Counsel
Union Pacific Railroad Company
1400 Douglas, STOP 1580
Omaha, NE 68179
Telephone: 402.544.3309

Attorneys for Union Pacific Railroad Company

COUNSEL'S EXHIBIT 3

REDACTED

COUNSEL'S EXHIBIT 4

REDACTED

BEFORE THE
SURFACE TRANSPORTATION BOARD

STB Finance Docket No. 35305

ARKANSAS ELECTRIC COOPERATIVE
CORPORATION—PETITION FOR
DECLARATORY ORDER

VERIFIED STATEMENT OF
DAVID CONNELL

TABLE OF CONTENTS

DC- 4	Joint Initiative Mitigation of Track Ballast Fouling, April 19, 2006
DC- 5	BNSF/UP Chemical Dust Suppression Agents Field Testing, 9/05-8/06
DC- 6	Ecofab Presentation, 2007
DC- 7	Coleman Aerospace Report and Email, 2008
DC- 8	Shannon & Wilson's Union Pacific Railroad Ballast Study: North Platte Division, dated July 30, 2008
DC- 9	UPRR's SPRB Coal Route: Capacity Improvements 2000-2009 Trackage
DC- 10	Shannon & Wilson's Union Pacific Railroad Ballast Study: North Platte Division, dated January 2010

Appendix:

DC- App. 1	Workpapers supporting calculation of rate of production for undercutting

VERIFIED STATEMENT OF DAVID CONNELL

My name is David Connell. I am the Vice President–Engineering of Union Pacific Railroad Company ("Union Pacific"). I was promoted to this position in 2008. I am responsible for the day-to-day operation of the Engineering Department, which includes overseeing track, bridge and signal maintenance and new construction.

I began my career with Union Pacific in 1983 and I have held a variety of positions with the company, including Director of Track Maintenance, General Director of Engineering Technology, Chief Engineer–Central Region, and Assistant Vice President–Engineering-Construction. I have a BS degree in Civil Engineering from North Carolina State University. I am a member of the American Railway Engineering and Maintenance-of-Way Association ("AREMA"), and have served on various AREMA committees, including Committee 5, Track. I also co-chair the American Association of Railroads (AAR) Heavy Axle Load, Engineering Research Committee. I recently served as chair of the Transportation Research Board's Committee on Railway Track System Design. I am also on the Advisory Board of the Mid-America Transportation Center, which steers research sponsored by the DOT over six affiliated university systems in the mid-west.

I. Introduction

Based on our experience in attempting to mitigate coal dust on Union Pacific's coal lines, and on the independent studies by the University of Illinois and the engineering firm of Shannon & Wilson, Inc. relating to coal dust in railway ballast, we have concluded that track maintenance alone is not a solution to the coal dust problems.

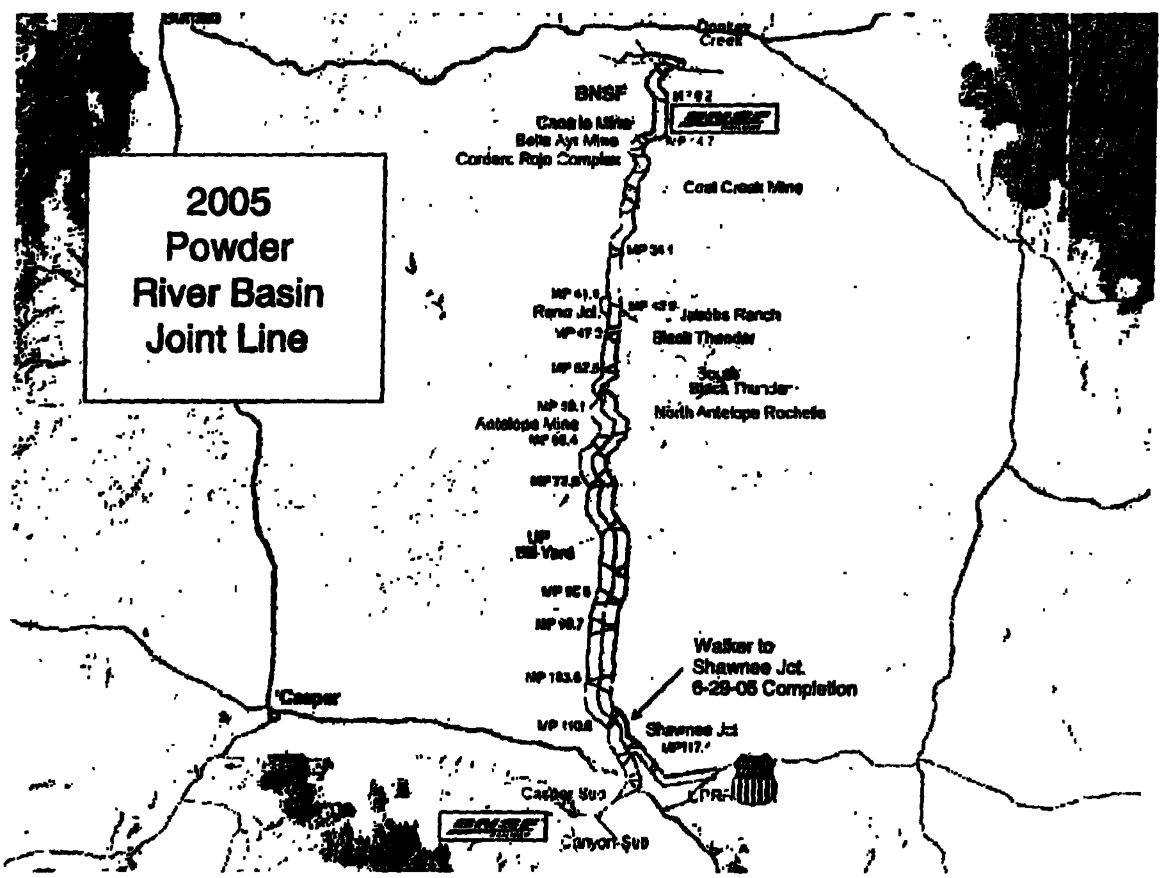
Coal dust is an unusually pernicious fouling agent that can quickly become a serious threat to track stability when it becomes wet. Undercutting does not remove all of the coal dust fines that are in the ballast and cannot be sustained at the rate that the coal dust is accumulating on the Union Pacific mainlines in Wyoming, Nebraska and Kansas. Further, undercutting, especially at the rates necessary to try to keep up with the accumulation rate, disrupts service to customers. After substantial investigation and study of the problem, our conclusion is that the best solution is to keep coal dust inside the rail cars (and out of the ballast) in the first place.

In this statement, I will begin with an overview of Union Pacific's coal history in the Southern Powder River Basin (SPRB). Second, I will address the properties of railroad ballast and fouling agents, such as coal dust, that can destabilize ballast. Third, I will discuss the 2005 derailments on the Joint Line and Union Pacific's subsequent investigation and first awareness of the seriousness of the problems posed by coal dust in the track bed, and the steps taken to prevent a recurrence of problems similar to those encountered in 2005. Fourth, I will summarize the results of research performed to date on methods of reducing the loss of coal dust during the transport of coal in rail cars. Finally, I will address what is known about the scope and rate of coal dust accumulation, and the cost implications to keep up with removal of the coal dust at the pace at which it is accumulating.

II. Overview of Union Pacific's SPRB Coal Corridor

Union Pacific's rail system covers the western two-thirds of the United States. Currently, there are more than 32,000 miles of track in the Union Pacific rail system. More than 40% of Union Pacific's revenue ton-miles involve the transportation of coal, with the vast majority concentrated in our SPRB coal corridor, which extends from eastern Wyoming, across Nebraska and stretching into northeast Kansas.

Coal production first began in the mid-70s in the SPRB and has grown to approximately 344 million tons per year in 2009. The southern and largest portion of the SPRB is served by both Union Pacific and BNSF Railway using the 102-mile-long multiple track Joint Line that runs from Shawnee Junction, Wyoming, on the south to Caballo Junction, Wyoming, on the north. The illustration below shows the configuration of the Joint Line in 2005.



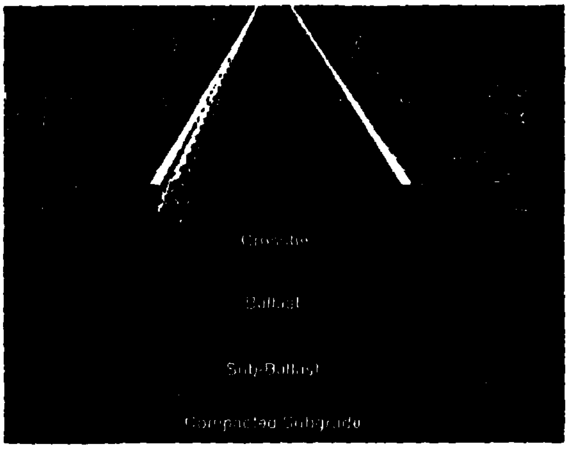
Union Pacific and BNSF each own 50% of this line under an ICC-approved Joint Line Operating Agreement. Under the Joint Line Agreement, BNSF operates, maintains and dispatches the Joint Line. Union Pacific has the right to operate trains over the line. BNSF, as the designated operator, inspects the Joint Line frequently and Union Pacific, as co-owner, participates in joint inspection trips to evaluate track conditions and discuss BNSF maintenance plans.

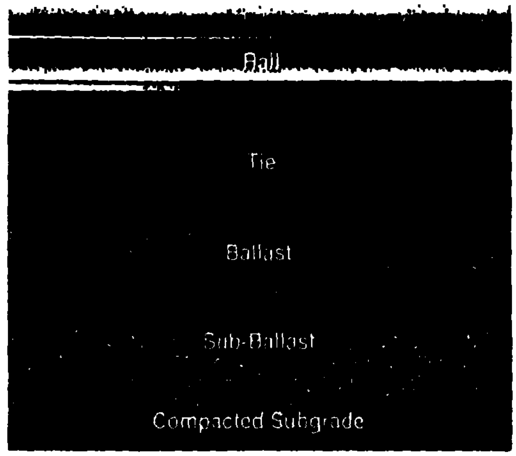
Between Union Pacific and BNSF, the railroads operate between 60 and 70 trainloads (or 120 to 140 loaded and empty trains total) daily over the line. Currently Union Pacific averages approximately 33 trainloads. Maintenance and operating costs are allocated to each railroad in proportion to each railroad's usage of the Joint Line. In 2009, Union Pacific paid roughly of these costs. (Glass VS at p. 2).

Union Pacific provides the locomotive power, crews and track infrastructure to transport unit coal trains to and from the coal mines to our customers. Customers negotiate directly with the mines to purchase the coal and most maintain their own sets of coal cars for transporting the coal. Union Pacific then pulls the unit trains to the mines where they are loaded by mine operators. Once loaded at mines, Union Pacific is notified that the trains are available for transport to our customers' plants or to distant interchange points or river terminals where trains are turned over to other railroads or barges to move the remainder of the way.

III. Composition of Heavy-Haul Lines

Because of its weight, coal is transported over heavy-hail rail lines. The illustrations below depict the typical constitution of our heavy-haul rail lines along the SPRB corridor. These rail lines are constructed with continuously welded steel rails that are supported on pre-stressed concrete ties spaced at two-foot centers. The pre-stressed concrete ties are typically supported on a minimum of 12 inches of granite ballast placed over a minimum of 12 inches of sub-ballast on the subgrade.





A critical component of the railroad track structure is the ballast. Railroad ballast is uniform-graded coarse aggregate placed between and immediately underneath the crossties. Ballast provides load distribution between ties and the subgrade and facilitates drainage to quickly move away any moisture that may fall on the track. Ballast supplies both structural support and drainage for the heavy loads applied by trains.

IV. The 2005 Derailments and the Repair of the Joint Line

On May 14, 2005, a BNSF loaded coal train derailed at milepost 76.9 on the Joint Line. Less than 24 hours later and 14 miles away, a Union Pacific loaded coal train derailed. The occurrence of back-to-back derailments, accompanied by the sudden appearance of widespread instability throughout the Joint Line, were shocking – especially for track on which the Federal Railroad Administration (FRA) geometry car inspection had found few defects less than two weeks before the derailments. The suddenness, scope and severity of the damage were unprecedented in the experience of the engineering personnel of both BNSF and Union Pacific. As we tried to understand the root cause of the May 2005 Joint Line failure, Union Pacific began to learn how coal dust poses a unique and especially severe threat to rail ballast integrity. I will briefly review a chronology of the events that led to the derailments in 2005 and the measures that have been taken since then to attempt to ensure that such impairments to service do not occur in the future.

A. Appearance of Coal Dust in 2002-2003 and Efforts to Remove

BNSF inspectors began to notice accumulations of coal dust on the Joint Line in 2002-2003. The coal dust was observed primarily in the areas of switches and bridges and it was noted that these areas were starting to require increased maintenance. The levels of coal dust around the Joint Line also were resulting in spontaneous fires along the right-of-way that were of concern both to BNSF and to local fire departments whose crews would be dispatched to the fire scenes.

As a result of the 2003 annual joint inspection by BNSF and Union Pacific, it was determined that additional resources were needed to clean up the coal dust in the areas of the bridges and the switches. Both railroads approved additional funding for this work and BNSF forces worked to remove the coal dust and repair the areas where the track was unstable.

B. Improved Performance on Joint Line in 2004-early 2005

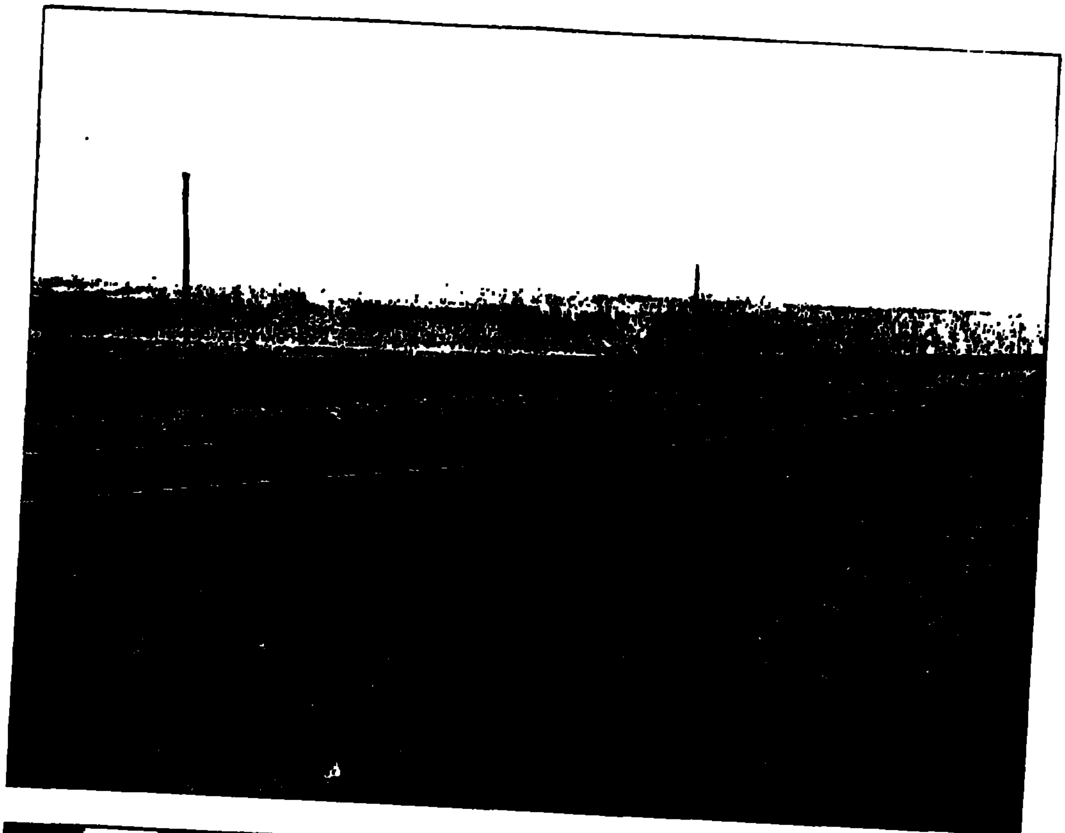
Throughout 2004, overall loadings increased, and slow orders decreased as the extra work authorized in 2003 was being completed. The reduction in the number of slow orders, and the increase in the relative speed allowed where slow orders were in place, was an indication of the safe and stable condition of the track at that time. In October 2004, the two railroads conducted a joint inspection of the Joint Line and noted significant improvements with respect to the presence of coal dust. Union Pacific engineering personnel were impressed with how good the track appeared.

In the first quarter of 2005, Union Pacific moved record volumes of coal out of the SPRB. The FRA conducted a geometry car inspection in early May 2005 on the Joint Line. The geometry car readings confirmed a very low incidence of track defects, thus indicating the track was in good and serviceable condition.

C. Impact of Heavy Precipitation and Coal Dust on Joint Line in Spring 2005

In late April-early May 2005, there was a major blizzard that shut down the SPRB mines and the Joint Line. This was followed by other significant snow and rain events, including a blizzard followed by rain on May 11. This precipitation was particularly significant because this area had been suffering through a prolonged (almost 10 year) and historically severe period of drought which masked the impacts of the coal dust.

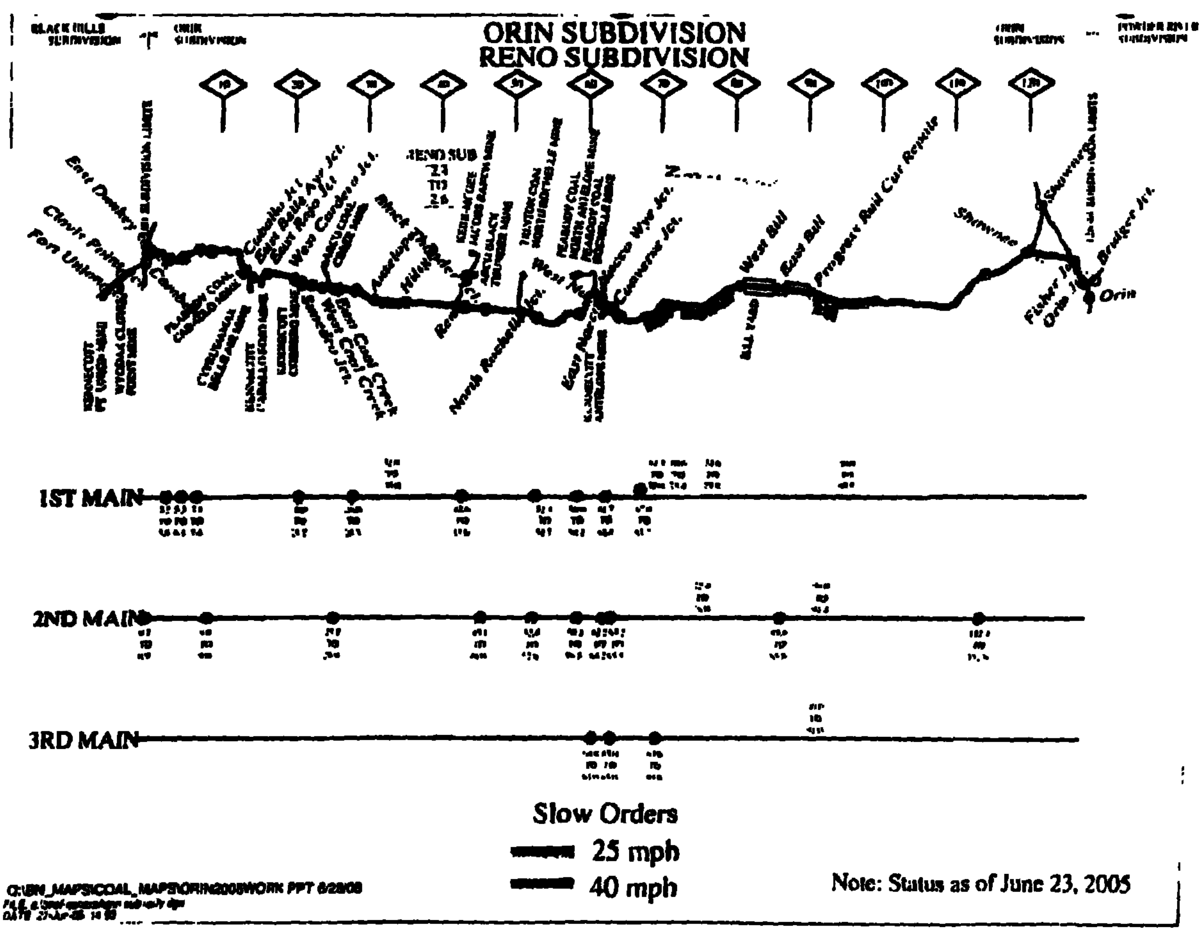
As noted above, on May 14 and 15, 2005, there were two major derailments on the Joint Line. At the time of these two derailments, inspectors noted widespread track instability and issued numerous slow orders. Representative photos of the Joint Line taken shortly after the derailments are shown below.



As the first photo shows, the rails were literally "wavy," as the supporting ballast and infrastructure had been compromised. As shown by the second photo, inspectors found many sections with broken concrete ties and widespread muddy conditions on the track. The third photo shows how the coal dust had permeated many sections of the ballast and drainage of the ballast was severely impeded. When trains ran over the track and the ballast could not support the weight, concrete ties were damaged, which increased the stress on adjoining ties. Based on careful review of the track structure, it was determined that the root cause of the instability of the ballast was excessive coal dust that had become unstable when mixed with the substantial precipitation that had occurred on the Joint Line.

D. Restoration Efforts and Resulting Delays

BNSF and Union Pacific determined that extraordinary measures would be needed to restore the track stability. Numerous slow orders were put in place throughout the Joint Line, both to ensure safe passage due to the track conditions, and to accommodate the extraordinary restoration that was needed. The volume of coal loadings fell and trains were slowed while the track was restored. The following map shows the location, number and degree of slow orders as of the end of June 2005, some five weeks after the derailments.



During the course of several months, BNSF used undercutters to undercut and clean the ballast structure. As of May 2005, the 102-mile Joint Line was comprised of approximately 250 track miles. Approximately 93 miles of out-of-face undercutting and 162 miles of shoulder ballast and cleaning were initiated in 2005 and continued into 2006. These efforts have continued on other parts of the coal corridor since 2006. In addition, it has become necessary for BNSF to return to some portions of the Joint Line that were undercut and cleaned in 2005 – 2006 and clean them again due to the rapid accumulation of coal dust.

E. Union Pacific's and BNSF's Communications and Conclusions Regarding the Joint Line

At times, not unlike co-owners of any section of track, Union Pacific and BNSF have disagreed over the operation of the Joint Line, including such things as the timing of adding additional capacity. After the May 2005 derailments occurred, Union Pacific initially expressed concern over whether BNSF had adequately carried out its duties as operator of the Joint Line. In the wake of the derailments, both railroads investigated the root cause of the failure of the Joint Line, and worked diligently to restore the track to operation.

Upon reflection and after thorough investigation and study, Union Pacific has concluded based on what it has learned about the pernicious nature of coal dust, that (1) BNSF was adequately maintaining the Joint Line prior to the May 2005 derailments, (2) the accumulation of coal dust at levels that could threaten the integrity of the ballast throughout the Joint Line was not readily detectable prior to the 2005 derailments, and (3) the potential for sudden and widespread deterioration of the track following heavy precipitation was neither known nor knowable prior to the 2005 derailments.

V. Studying Coal Dust in Railroad Track Structure

The events of 2005 have led to investigations and studies to try to understand the harmful nature of coal dust and its impact on the ballast system. Both BNSF and Union Pacific have studied coal dust and have concluded it is a particularly pernicious foulant.

In this section, I will explain the purpose of railroad ballast and the effects of coal dust as a fouling agent on ballast, particularly when saturated. I will also discuss the problems associated with coal dust even when accumulation is not readily apparent. Finally, I will address the results of recent studies that have looked at ways of reducing the deposition of coal dust on the track bed.

A. Coal Dust and Ballast

Let me start by explaining why coal dust is so harmful to the ballast. Shear strength is an important component of ballast performance. Shear strength is the characteristic of compacted ballast that allows the ballast to distribute the load to the sub-ballast between crossties. Heavy-haul railroads typically use 1" to 2" granite with multiple fracture faces for ballast. Friction exists when one stone contacts another. The friction is the key to shear strength. If friction is lost, the shear strength is lost and components like rails or ties may become unstable.

When foreign matter fouls the ballast, shear strength is compromised and the ballast can lose the ability to perform its function. Foulants can include worn pieces of ballast, soil, sand, or coal dust, among other materials. These foulants fill the voids between the ballast particles and lubricate the friction interfaces between the stones, thus reducing stone-to-stone friction and lowering shear strength of the ballast. If the voids become too filled with foulants, ballast particles can lose contact and vertical water drainage is impeded, which will further reduce the shear strength and thus load-bearing capacity of the ballast.

Researchers have examined the properties of fouled railroad ballast. Historically, the most common ballast foulant has been degraded ballast itself that is worn down by the forces being placed on the ballast section by the loads from passing trains.[1] However, based on a more recent study by the University of Illinois, coal dust has become a more significant foulant.

B. Problems Caused by Coal Dust in Ballast

Professor Erol Tutumluer at the University of Illinois has investigated the effect of coal dust on ballast structure. Dr. Tutumluer's laboratory findings are the first detailed examination of the mechanical properties of coal dust. (Dr. Tutumluer's March 15, 2009 article, entitled Laboratory Characterization of Fouled Railroad Ballast Behavior, is attached as Ex. DC- 1).

Dr. Tutumluer's research indicates a relationship between ballast shear strength, coal dust contamination, and moisture content. Dr. Tutumluer has determined and reported that the shear strength of railroad ballast is significantly compromised by coal dust. Specifically, Dr. Tutumluer reports: "Coal dust was by far the worst fouling agent for its impact on track substructure and roadbed and caused the most drastic shear strength decreases especially at high fouling levels." (Ex. DC- 1 at 8). In sufficient quantities, coal dust can result in decreased stability, and ultimately loss of track gauge and proper geometry. According to Dr. Tutumluer, even more drastic strength reductions can be realized when dry coal dust, which has never been saturated or soaked in the field

---

1 Selig, E.T. and J.M. Waters, *Track Geotechnology and Substructure Management*, Thomas Telford Publications, 1994.

and therefore having a high suction potential, is subjected to inundation and 100% saturation. (Id.) This is true because exposure of coal dust to moisture significantly reduces the friction component of the shear strength and can cause significant reduction in load bearing capacity. In other words, if coal dust accumulates while it is dry and is then exposed to precipitation, its danger as a fouling agent increases both quickly and significantly.

So we know that coal dust is harmful. What we don't know is exactly where it can be found in the track bed. Based on our experience in inspecting the Joint Line in 2004, we understand that even ballast that looks clean can have unacceptable levels of coal dust below the surface. Thus, if we assume that we have good track conditions based on surface appearance, coal dust can still be a hidden problem, which can quickly become unstable and muddy when it rains or snows.

In light of the destructive effects of coal dust, BNSF and Union Pacific commissioned Simpson Weather to study the rate of deposition of coal dust on the Joint Line track structure and to study means to contain the dust. They have done extensive studies of coal dust for Norfolk Southern. They also have been studying coal dust on the Joint Line for more than five years.

Simpson Weather's research has indicated that unless further mitigation measures are employed, coal dust will continue to accumulate on the Joint Line at very high rates. (UP/BNSF Orin Subdivision Dustfall Collector Network Sample Data, Nov. 2009, Ex. DC- 2 at 8993).

C. Reducing Coal Dust Deposition

Simpson Weather's research also indicates that there are several means available to reduce coal dust and prevent it from fouling track structure. One of these measures involves changing the profile in which the coal is loaded into each rail car from uneven loads with sharp edges above the car sills to more bread-loaf shaped, uniform loads. Simpson Weather found that the bread-loaf shaped loads were not as susceptible to "dusting" during transport. (BNSF/UP Coal Load Groomed Profile Field Testing, Sept–Dec 2005, Ex. DC- 3 at 68). Most of the mines have changed their loading chutes to contour the loads. But even with this change, loads are somewhat inconsistent in their forms.

Following the 2005 derailments, the National Coal Transportation Association (NCTA) formed three committees to study different means of mitigating the loss of coal dust during rail transport. One committee focused on coal cars themselves, while another focused on the profile of the loaded coal in the car, and the third committee focused on the use of surface sprays to reduce the loss of dust from the moving car. While the NCTA's coal car committee did not suggest that holes in cars were a major source of coal dust in the track bed, it remains the case that customers can repair rail cars to close holes and seams in order to better seal them to ensure that coal and coal dust do not fall from the bottom of the cars onto the track.

The NCTA committee that focused on the load profile reached a conclusion similar to that reached by Simpson Weather about the benefits of grooming the coal profile in a bread-loaf shaped form within the car to reduce dust loss during transport. (Joint Initiative Mitigation of Track Ballast Fouling, April 19, 2006, Ex. DC- 4 at 9686).

Further, both Simpson Weather and the NCTA committee focusing on the use of surface sprays determined that surfactants can be sprayed onto the surface of the coal to bond it together and make it less susceptible to blowing off during transportation. (BNSF/UP Chemical Dust Suppression Agents Field Testing, 9/05-8/06, Ex. DC- 5 at 48, Ex. DC- 4 at 9682). Finally, there are ongoing studies of the possibility of either covering the rail car or compressing the coal in the rail car (i.e., shaking the coal fines away from the surface) to further aid efforts to keep it in the car and off of the track structure. (Ecofab Presentation, 2007, Ex. DC- 6 at 8565-68; Coleman Aerospace Report and Email, 2008, Ex. DC- 7 at 9957-58, 58127-139).

VI. The Scope and Impact of Coal Dust

The problem with coal dust extends not only to the Joint Line but also to lines beyond the Joint Line owned and maintained by Union Pacific. Union Pacific has retained Shannon & Wilson, Inc., an expert engineering firm, to determine coal dust levels on Union Pacific's main coal lines. Shannon & Wilson obtained samples of ballast along almost 660 miles of rail line. They have determined that coal dust is present throughout this expanse of track. (See Shannon & Wilson's Union Pacific Railroad Ballast Study: North Platte Division, dated July 30, 2008, Ex. DC- 8 at 3). This is true even though some of this track is hundreds of miles from the Joint Line where the rail cars are loaded.

It is disturbing to learn how much coal dust has permeated the ballast even though much of the track inspected was double or triple-track installed or completely rebuilt (i.e., the line was shifted to widen track centers, and new rail and concrete ties were installed and new ballast laid) relatively recently. After Union Pacific completed the triple track North Platte to Gibbon project in late 1999, it continued the Project Yellow III capacity expansion to double-track from Shawnee Jct. to O'Fallons, install a fourth main between O'Fallons and North Platte, and install double track on the

Marysville subdivision east of Gibbon. This project was only completed in 2009. (See UPRR's SPRB Coal Route: Capacity Improvements 2000-2009 Trackage, Ex. DC- 9). Yet coal dust has found its way into and comprises as much as 20% of the fines volume of Main Track 2 nearly 600 miles beyond the Joint Line.

Shannon & Wilson obtained samples from the shoulders of Union Pacific's main line track in 2008 and from the shoulder and center of the tracks in 2009 to determine what percentage of foulant was coal dust as opposed to other foulants. The 2009 follow up to the 2008 Shannon & Wilson study determined that coal dust continues to be deposited onto the Union Pacific line. (See Shannon & Wilson's Union Pacific Railroad Ballast Study: North Platte Division, dated January 2010, Ex. DC- 10 at 4-5). The coal dust that has been deposited across the expanse of Union Pacific's coal corridor is necessitating that Union Pacific undercut more often and more miles.

The industry standard for ballast undercutting/cleaning is every 8 to 20 years on heavy tonnage railroads. Historically, Union Pacific would anticipate a need to undercut a main line track once every 10 to 15 years. With the impact of coal dust on its tracks, Union Pacific is anticipating it must now undercut on a much shorter cycle, potentially once every six years. Further, in areas of heavy coal dust concentration like bridges or switches, it anticipates the need to undercut as often as once every three years.

In addition to the potential coal dust causes for track-related problems, coal dust removal efforts also interfere with Union Pacific's service to its coal customers. The presence of maintenance workers on the rail lines reduces track capacity that is available for moving coal customers' cars, resulting in service delays. For example, based on a six-year average undercutting cycle of Union Pacific's Joint Line-originating coal network (totaling 1590 track miles), Union Pacific would need to undercut an average of 265 miles per year on this corridor. Undercutters average .75 or 1.5 miles per day, depending on whether the track is returned to service each night. Therefore, it would take between 177 and 363 working days to undercut 265 miles of track. (DC App.1). The working season in this zone is about 214 days. In order to accomplish this extensive amount of undercutting, Union Pacific would have to undercut an average rate of 1.24 miles every day of the working season. Due to machinery and gang down time, and necessary movement from one job site to another, it is unlikely that Union Pacific could sustain this amount of annual undercutting perpetually. If coal dust volumes continue to grow, it will become a severe and intolerable strain.

VII. Conclusion

In sum, even a modest amount of coal dust in the track bed can become serious if it becomes wet. It is also important to note that when you undercut the track it does not remove all of the coal dust, and over time coal dust will continue to build up in spite of undercutting. Further, undercutting does have an impact on Union Pacific's coal customers because it disrupts traffic flow and may slow down service to our customers.

Another problem that we are dealing with is an inability to determine exactly where the coal dust can be found. The fact that the ballast looks clean and in good condition is not an indication that there is no coal dust that needs to be remediated. Oftentimes, our inspectors only determine there is a need to remove coal dust when an area becomes soft because of moisture and rails become misaligned, in other words, after the damage is done.

Based on our ongoing experiences in repairing ballast damaged by coal dust, we have concluded the best long term solution is to find ways to keep the coal dust from blowing from the cars and onto the track structure. We are working closely with a variety of engineers and our customers to find ways to accomplish containment of the coal dust. We already have persuaded customers and the mines to shape the profile of the loads in the coal cars in a manner that softens the sharp edges that have blown away in the past and this has appreciably reduced the loss of coal dust during transport. BNSF is currently running trials in the Joint Line to test the effectiveness of surfactants that can be sprayed on the car loads. We also are finding some promise in the compression of coal in the cars to create a better load profile and to lessen dusting during transport.

We are committed to continuing to work with our customers to come up with solutions that keep the coal dust in the cars and out of the ballast.

VERIFICATION

I, David Connell, Vice President - Engineering of Union Pacific Railroad Company, declare under penalty of perjury that the foregoing is true and correct to the best of my knowledge.

Executed on 12 day of March, 2010.

GENERAL NOTARY-State of Nebraska
DEBORAH L. McMILLIN
My Comm. Exp. Sept. 8, 2012

David Connell

Notary Public, State of Nebrask

Exhibit DC-1

Publication Copy **Manuscript 09-2065**

LABORATORY CHARACTERIZATION OF FOULED RAILROAD BALLAST BEHAVIOR

Accepted for Publication by AR060 Railway Maintenance Committee

Journal of Transportation Research Record

by

Hai Huang - Graduate Research Assistant
Phone: (217) 244-6064 / E-mail: hhuang14@illinois.edu

Erol Tutumluer - Professor
(Corresponding Author) / Ph: (217) 333-8637
E-mail: tutumlue@illinois.edu / Fax: (217) 333-1924

and

William Dombrow - Graduate Research Assistant
Phone: (217) 333-6973 / E-mail: dombrow@illinois.edu

Department of Civil and Environmental Engineering
University of Illinois at Urbana-Champaign
205 North Mathews, Urbana, Illinois 61801

Word Count: 4,448 words + 2 Tables (2*250) + 10 Figures (10*250) = 7,448

March 15, 2009

ABSTRACT

Fouling refers to the condition of railroad ballast when voids in this unbound aggregate layer are filled with relatively finer materials or fouling agents commonly from the ballast aggregate breakdown, outside contamination such as coal dust from coal trains, or from subgrade soil intrusion. Effects of the different fouling agents on ballast aggregate shear strength were recently studied at the University of Illinois. Through the use of a large direct shear (shear box) device, the strength properties of both clean and fouled ballast samples were determined when three types of fine materials, i.e., coal dust, plastic clayey soil and mineral filler, were added to clean ballast samples at various percentages by weight of ballast under both dry and wet (mostly optimum moisture content) conditions. Realistic sample preparation procedures were conducted to closely simulate field fouling scenarios. Test results showed that when the coal dust fouling percentage increased, the ballast shear strength steadily decreased. Wet fouling was found to exacerbate this trend. Results of ballast samples fouled with clay and mineral filler also showed decreasing trends in strength properties; however, coal dust was by far the worst fouling agent for its impact on track substructure and roadbed. Approximately 15% coal dust fouling by weight of ballast was statistically significant to cause considerable strength reductions. In the case of ballast fully fouled with wet coal dust at 35% optimum moisture content, the friction angles obtained were as low as the friction angle of coal dust itself.

Key Words: Railroad track, ballast, aggregate, fouling, coal dust, plastic clay, mineral filler, stability, shear strength, laboratory testing.

INTRODUCTION

Railroad ballast is uniformly-graded coarse aggregate placed between and immediately underneath the crossties. The purpose of ballast is to provide drainage and structural support for the loading applied by trains. As ballast ages, it is progressively fouled with materials finer than aggregate particles filling the void spaces. Methods specifically used to assess track ballast condition only deal with checking visually for evidence of fouling, pumping and water accumulation (ponding) at ditches and shoulders. Additionally, ballast sampling and testing for fouling through laboratory sieve analyses generally provide some insight into the compositions of the larger aggregate particles and the amount of fines. Nonetheless, for a better evaluation of the serviceability and proper functioning of the existing ballast layer, ballast strength needs to be characterized for different percentages of fine materials, such as plastic soil fines, mineral filler, and more recently coal dust coming from coal trains, which can fill the voids and cause ballast fouling.

Since rail transport, particularly a unit train, provides the most efficient means of transporting bulk commodities such as coal, the role of rail lines in coal transport has always been predominant. In 2005, two derailments occurred in the Burlington Northern Santa Fe/Union Pacific (BNSF/UP) joint coal line in Powder River Basin (PRB) in Wyoming, the largest source of incremental low-sulfur coal supplies in the U.S., which threatened to interrupt the supply of coal to power plants. Both of the derailments were suspected to be attributed by coal dust fouling, where coal dust spilled over the ballasts and accumulated moisture, allegedly resulting in the loss of strength of the track. In both places where derailments happened, ballast was heavily fouled by coal dust.

This paper presents findings from a comprehensive laboratory-testing program recently initiated at the University of Illinois with the objective to study effects of different fouling agents, i.e., mineral filler, plastic clayey soil and coal dust, on railroad ballast strength. Using large direct shear (shear box) tests, strength and deformation characteristics of granite type ballast material were investigated for clean ballast and ballast fouled by different agents at various stages under both dry and wet conditions. The shear strength properties such as cohesion intercept and friction angle are linked to field ballast fouling levels to better assess the impact of fouling on track instability and ultimately loss of track support leading to derailments.

BALLAST FOULING AND ITS MECHANISM

Fouling materials in ballast have been traditionally considered not favorable for railroad ballast performance. Early research studies reported that around 70% of the fouling materials were from ballast breakdown (*1,2,3*). Railroad company internal studies also noted that almost all fouling fines in the railroad track were commonly from aggregate breakdown (*4*). According to Selig and Waters (*5*), ballast breakdown on the average accounts for up to 76% of the ballast fouling followed by 13% infiltration from subballast, 7% infiltration from ballast surface, 3% subgrade intrusion, and 1% due to tie wear.

Selig and Waters (*5*) proposed two indices to describe ballast fouling: (i) fouling index is the sum of the percent by weight of ballast sample passing the 4.75 mm (No. 4) sieve plus the percent passing the 0.075 mm (No. 200 sieve) and (ii) percentage of fouling is the ratio of the dry weight of material passing 9.5 mm (3/8 in.) sieve to the dry weight of total sample. They also proposed that the particles retained on 0.075 mm (No. 200 sieve) are treated as "coarse fouling materials" and particles passing 0.075 mm (No. 200 sieve) are "fine fouling materials" (*5*).

Raymond (*6*) suggested that if fouled ballast had to be used, the liquid limit of the fines should be less than 25 to maintain the function of drainage. Raymond also (*7*) found that the aggregate breakdown was significantly influenced by the type and especially hardness of the mineral aggregate. Harder aggregates had fewer breakdowns than softer aggregates did. Later on, Raymond (*10*) noted that the wear of tie was more significant at the worst fouled track locations, possibly due to the abrasive effects of the slurry formed by fouling fines and water.

Chiang (*8*) conducted a series of ballast box repeated loading tests on fouled ballast. Test results indicated that ballast settlement typically increased as the amount of fouling material in ballast increased. Similarly, Han and Selig (*9*) also conducted ballast box tests to evaluate the impact of fouling on ballast settlement. They concluded that the degree of ballast fouling indeed had a major impact on the ballast settlement. With an increase in the percentage fouling, both the initial and final ballast settlements increased significantly. Investigations on the strength of fouled ballast and studies on the fouling mechanism, however, have been somewhat limited to date.

In terms of the stability and load carrying ability of the fouled ballast layer, three volumetric phases can be identified for the different conditions of fine materials filling the void space (see Figure 1). Phase I shows a clean or very slightly fouled ballast sample with almost all aggregates establishing contact with each other at the aggregate surface to sufficiently carry the load (see Figure 1a). As shown in Figure 1b, phase II will have the voids in between contacting aggregates filled with enough amount of fine particles that could significantly reduce the strength, however, still maintaining aggregate to aggregate contact. Whereas, in a phase III fouled ballast condition, due to the excessive amount of fine particles, aggregate to aggregate contacts are mostly eliminated and the aggregate particle movements are then only constrained by the fine particles filling the matrix or voids between the particles (see Figure 1c).

As ballast in Phase III is no doubt unacceptable and needs immediate remedial action, ballast in Phase I and II is particularly worth studying from the aspect of how different fouling agents at different phases would affect ballast strength and therefore impact track stability. It is also of great importance to know the dividing line between phase I and II since it is also the suggested starting point of maintenance activities such as ballast cleaning. Hypothetically, if ballast aggregate particles are assumed to be spheres, it is possible to define the maximum size of the fouling materials through 3-dimensonal packing order computations for large and small spheres. Accordingly, Equation 1 defines the radius "*r*" of a single fouling particle approximated as a sphere to fit in between three large contacting spherical particles, each having a radius "*R*," without separating them.

$$r = \left(\sqrt{\frac{32}{27}} - 1\right)R \qquad (1)$$

Considering that the maximum size of ballast aggregates is often limited to $2R$=76 mm (=3 in.), the largest diameter of a single fouling particle can then be 6.7 mm (0.26 in.), which is smaller than 9.5 mm (3/8 in.) suggested by Selig and Waters (*5*).

CLEAN AND FOULED BALLAST STRENGTH BEHAVIOR

Materials Tested

The ballast material tested was a granite aggregate obtained from Gillette, WY and commonly used in the PRB joint line railroad track structures as the ballast layer. Figure 2 shows the grain size distribution of the granite sample with a specific gravity of 2.62 tested in compliance with ASTM C 117 test procedure. The granite aggregate size distribution conforms to the typical AREMA No. 24 ballast gradation having a maximum size (D_{max}) of 63.5 mm (2.5 in.), a minimum size (D_{min}) of 25.4 mm (1 in.), and an average particle size corresponding to 50 percent passing by weight (D_{50}) of approximately 45 mm (1.77 in.).

From the average size of the clean ballast (45 mm), an average particle fouling size of 4 mm was chosen in this study based on Equation 1. Accordingly, the three types of fouling materials studied with this granite type ballast aggregate were: (i) coal dust, (ii) refractory clay representing a cohesive fine-grained subgrade soil, and (iii) mineral filler obtained from the crushing operations of the same granite aggregate. Figure 2 shows the typical gradations and Table 1 lists the engineering properties of these fouling materials with the moisture-density information obtained from the standard Proctor ASTM D 698 test procedure. Note that the coal dust sample tested in this study was also collected from the PRB Orin line milepost 62.4 and was sampled on March 10, 2007.

Testing Apparatus

Direct shear strength tests were performed on the reconstituted clean and fouled granite aggregate samples. Figure 3 shows the large shear box equipment used for testing at the University of Illinois. The test device is a square box with side dimensions of 12 in. (305 mm) and a specimen height of 203 mm (8 in.). It has a total 102 mm (4-in.) travel of the bottom 152 mm (6-in.) high component which is large enough for ballast testing purposes to record peak shear stresses. The vertical (normal direction) and horizontal load cells are capable of applying and recording up to 50-kN load magnitudes. The device controls and the data collection are managed through an automated data acquisition system controlled by the operator through a built-in display and the test data are saved on to a personal computer.

Sample Preparation

Clean ballast *samples* were prepared in the lower shear box to the condition similar to the field according to the following steps:

1. Place aggregates in the lower box by lifts (usually two 76 mm lifts).
2. For each lift, use vibratory compactor on top of a flat Plexiglas compaction platform and compact until no noticeable movement of particles is observed (see Figure 4).
3. Record the weight of aggregate used.
4. Place upper ring (76 mm high) on top of lower box. Align ring with sides and back edge of box (opposite of block) and fill with single lift of ballast and compact (see Figure 4).

Coal dust fouled granite ballast samples were prepared similar to the clean sample procedure by spreading coal dust on the ballast surface and spraying water, if needed. The individual steps are as follows:

1. Obtain clean aggregates of the same weight as previously recorded.
2. Compact ballast sample into the lower box in two lifts.
3. Obtain prescribed weight of coal dust and water (see Figure 5).
4. Spread coal dust over compacted ballast evenly in two lifts (half of material each lift). Shakedown material using vibratory compactor after each lift. If test is conducted with wet fouling material (for example, at the optimum moisture content or OMC), pour proportional amount of water over ballast after shakedown of each lift (see Figure 5). Note that this preparation procedure realistically simulated the actual coal dust accumulation in the ballast layer due to vibration caused by train loading.
5. Step 4 in the clean sample preparation procedure.

Granite samples fouled with clay were prepared following a different procedure to simulate this time subgrade intrusion. The individual steps are as follows:

1. Obtain clean aggregates of the same weight as previously recorded.
2. Obtain described weight of clay and water.
3. Place the clay in the bottom of the lower box. If test is conducted with wet clay, thoroughly mix clay with water before placing them in the lower box.
4. Place aggregates over the clay and compact in two lifts.
5. Step 4 in the clean sample preparation procedure.

For preparing granite samples fouled with mineral filler, the clean ballast and the mineral filler with designated weights were pre-mixed before placement in the lower box. The goal was to simulate the actual ballast breakdown conditions in the field. Aggregate breakdown could take place with chipped pieces and mineral filler uniformly filling the voids in ballast layer.

Before testing, the box and ring assembly were placed into the shearing apparatus. Lower box was clamped in place and load bearing plate was placed on ballast but inside upper ring. Air-bladder was placed on bearing-plate, air supply opened and normal pressure set using an in-line pressure regulator (see Figure 6). The load cell recording applied shear force was adjusted directly against the upper ring. The Labview data logger software was initiated to record normal and shear forces during testing. The loading speed was set to an input shear rate of 12.2 mm/min. (0.48 *in./min.*), which is approximately 4% strain per minute and the tests were run until the shear force output peaked or 15% strain has occurred.

Sample Volumetrics

After sample preparation, volumetric properties of the shear box sample were calculated based on the granite aggregate properties. It is worth noting that, for all tests, the same amount of material was used to prepare approximately the same number of aggregate contacts and the similar aggregate skeleton. That is to say, the voids available for fouling material to fill in were kept the same in all cases. This void space was found for the clean granite sample to be 43% of the total volume, which corresponds to a void ratio of 0.75 or 75% of the aggregate volume.

ASTM C29 test procedure was used for finding porosity or air voids with the known values of the specific gravity and box volume and the weight of ballast compacted.

For the coal dust fouling case, 25% coal dust by weight of aggregate was found to completely fill in the voids of the clean granite thus referred to here as "fully coal dust fouled" condition after sample preparation. Similarly, 32% clay by weight of aggregate and 40% mineral filler by weight of aggregate were observed to completely fill in the same void space of the clean granite for the clay and mineral filler fully fouled conditions, respectively.

Direct Shear Test Results

The ballast samples were sheared horizontally in the shear box under target normal pressures of 172, 241, 310 kPa (25, 35, 45 psi), typical ballast layer confining pressures, so that the relationships between the normal stress and shear stress could be established. The maximum shear stress at failure under each applied normal pressure was recorded from each test. This maximum shear stress typically occurred when approximately 10% shear strain was reached during testing. The shear strength $\tau_{max} = C + \sigma_n * \tan\Phi$ (where C is the cohesion intercept, σ_n is the applied normal stress, and Φ is the internal friction angle) expression was then developed for each ballast sample tested at a corresponding fouling fines content and moisture state.

Figure 7 shows the maximum shear stresses predicted under the applied normal stresses during shear box testing for coal dust fouling cases in comparison to the clean granite test results. As the applied normal stresses increased, the maximum shear stresses at failure or simply shear strength τ_{max} also increased primarily influenced by the ballast fouling percentage and the moisture condition of the coal dust, i.e., dry or wet at OMC = 35%. As expected, the highest shear strength values were obtained from the clean ballast at all applied normal stress levels. When ballast samples were fouled, the shear strengths typically decreased. For all the samples tested, wet coal dust fouling resulted in lower shear strengths when compared to those obtained from dry coal dust fouling. The lowest shear strength values were recorded for the fouling level of 25% by weight (fully fouled) of ballast when wet coal dust was at 35% moisture content.

Figure 8 shows the maximum shear stresses predicted under the applied normal stresses during shear box testing for clay fouling cases in comparison to the clean granite test results. Limited data were obtained due to the difficulties encountered during sample preparation especially for wet clay fouled cases. According to the test results the clean ballast sample still gave the highest strength. With clay being the fouling agent, the trend of decreasing strength with increasing fouling percentage could not be observed as clearly as in the case of coal dust fouling. In the clay fouling cases, the cohesion intercept (C) in the strength equation increased and the friction angle (Φ) typically decreased with the increasing fouling percentage, which made shear strength of samples less sensitive to varying normal stresses and confining pressures as expected. This effect was even more significant in the wet clay fouling cases, since wet clay served as a lubricant with overall much lower friction angles (Φ) obtained compared to that of the clean granite sample. It however still makes sense since the cohesion increased because of the clay paste in the voids supplies some bonding strength whereas the friction angle decreased because of the lubricating effect of clay paste within the aggregate-aggregate contact.

Figure 9 shows the maximum shear stresses predicted under the applied normal stresses during shear box testing for mineral filler fouling cases in comparison to the clean granite test results. In the dry case, results showed very similar trend to clay fouled case. Once again, the clean ballast sample gave the highest shear strength. In the dry fouling cases, the cohesion intercept C in the strength equation increased and the friction angle Φ typically decreased with the increasing fouling percentage, similar to the general trend observed for clay fouled samples. However, for the wet mineral filler tests at only 11% OMC, samples at all fouling levels behaved very close to dry conditions with the data points almost falling in the same line thus indicating that mineral filler as a fouling agent is not as sensitive to moisture as the cohesive clay.

Figure 10 compares under wet conditions the maximum shear stresses obtained from the clean granite with those of the coal dust, clay, and mineral filler fouled samples at 5%, 15%, and 25% by weight of ballast. Note that for the 25% clay fouled samples, clay moisture content was at the Liquid Limit (LL) of 37% instead of OMC, which is very close to 35% OMC of the coal dust fouled samples. Yet, the wet coal dust sample fouled at 25% gave the worst case scenario with the lowest shear stress values (biggest drop in Figure 11) among all the samples tested. Then came the wet mineral filler fouled at 25% by weight of ballast and the wet clay fouled at 15% by weight of ballast, as indicated with the dashed lines in Figure 10. This implies that railroad ballast layers fouled with coal dust contamination are at much higher risk of causing track instability and failures especially after heavy precipitation when compared to ballasts fouled due to mineral filler accumulation from aggregate breakdown or even cohesive subgrade soil intrusion.

Since the coal dust fouling was found to be the most detrimental case, a statistical analysis was performed for the significance of the different coal dust levels affecting the critical stages of ballast fouling. As described early in this paper, it is important to determine at what fouling level a significant drop in strength would be realized. In another word, there is a need to determine the reasonable dividing line between Phase I and II. For this purpose, an "F test" type statistical approach was used to evaluate the differences between the strength lines graphed in Figure 7. With a value of significance (p-value) of 0.0014 (much less than 0.05), 15% coal dust fouling was found to significantly decrease the strength of ballast. As all other strength lines in Figure 7 are below the 15% dry coal dust fouling line, 15% coal dust by weight is considered to be the critical stage of coal dust fouling in terms of ballast shear strength.

Table 2 lists cohesion intercepts (C) and friction angles (Φ) obtained from the ballast testing program. High correlation coefficients, R^2 values, were typically obtained for the established shear strength equations except for two mineral filler samples. The clean granite typically had the highest friction angle Φ of 46.6 degrees except for 47.7 degrees obtained for the low 5% dry mineral filler sample. For the case of 25% wet coal dust fouling, the friction angle computed is as low as 34.5 degrees. This value is very close to the friction angle of 33.5 degrees, obtained from a parallel research study (*11*), for the pure coal dust direct shear samples tested at OMC. Similarly, a low cohesion intercept of 35 kPa (5.1 psi) is close to the very low unconfined compressive strength of 24 kPa (3.5 psi) also obtained for the coal dust shear strength properties (*11*). This implies that the shearing action for the 25% coal dust fouled sample was mainly resisted in the direct shear apparatus by the wet coal dust governing the behavior. Again, one should note that 35% OMC condition does not represent fully saturated coal dust state. After soaking or 100% saturation, soil suction would be destroyed thus resulting in even lower strengths and unstable ballast conditions.

Table 2 also lists for direct comparison purposes the shear strength values computed under normal stress levels of 200 and 300 kPa (29.0 and 43.5 psi), typical field railroad ballast stress conditions experienced. Most of the trends already mentioned and their effects can be clearly seen by comparing the computed shear strength values. In the case of mineral filler fouled ballast, strength values from both dry and wet tests were very close which may suggest that the 11% optimum moisture had a minor effect on mineral filler fouling. On the other hand, the clay fouled ballast samples at OMC give higher strength values than the dry clay fouled samples, which implies that clayey soils at OMC have higher shear strength properties. Since most geomaterials compacted at OMC usually give the best mechanical properties, future research will need to also investigate fouled ballast behavior when moisture content increases beyond optimum conditions.

SUMMARY AND CONCLUSIONS

Large-sized shear box direct shear laboratory tests were conducted at the University of Illinois on granite ballast samples obtained from the Powder River Basin (PRB) joint line in Wyoming to measure strength and deformation characteristics of both clean (new) and fouled ballast aggregates with three different fouling agents, i.e., coal dust also obtained from the PRB joint line, plastic clay, and nonplastic mineral filler from crushing of the same granite aggregate, at various stages of fouling. The grain size distribution of the aggregate conformed to the typical AREMA No. 24 ballast gradation with a maximum size (D_{max}) of 63.5 mm (2.5 in.) and a minimum size (D_{min}) of 25.4 mm (1 in.). Each fouling material was mixed with clean aggregates for achieving fouling levels of 5%, 15%, 25%, and sometimes up to 40% by weight of ballast under dry and wet, mostly optimum moisture content (OMC), conditions. The coal dust material was spread on the clean aggregate specimen and vibrated on top to achieve its percolation into the voids in an effort to realistically simulate coal dust falling off the trains into the ballast layer in the field. The plastic refractory clay and the mineral filler were mixed with granite aggregates by means of different sample preparation techniques again to simulate realistic field fouling scenarios of subgrade intrusion and aggregate breakdown, respectively.

From the direct shear tests, the highest shear strength values were obtained from the clean ballast samples at all applied normal stress levels, which were representative of typical stress states experienced in the ballast layer under train loading. When ballast samples were fouled, the shear strengths always decreased. This was mostly apparent with lower friction angles and cohesion intercepts. Wet fouling generally resulted in lower ballast shear strengths when compared to those obtained from dry coal dust fouling. Primarily due to increasing cohesive nature, i.e., cohesion intercepts, with increasing fouling percentages, plastic refractory clay fouled samples exhibited slight shear strength increases under both dry and wet conditions. However, samples fouled with mineral filler at 5%, 15%, and 25% were somewhat insensitive to the low 11% moisture content increase from the dry condition and resulted in similar shear strength values.

Coal dust was by far the worst fouling agent for its impact on track substructure and roadbed and caused the most drastic shear strength decreases especially at high fouling levels. Through statistical evaluation, 15% dry coal dust fouling by weight of ballast was shown to be significant to cause critical fouling and decrease considerably the ballast strength. For the case of 25% wet coal dust fouling by weight of ballast, the lowest shear strength properties, internal friction angle and cohesion, obtained were equivalent to those properties of the coal dust itself at 35% OMC. Note that even more drastic strength reductions can be realized when dry coal dust, never been saturated or soaked in the field and therefore having a high suction potential, is subjected to inundation and 100% saturation.

It is still difficult to make unique conclusions on ballast fouling due to the differences between laboratory and field conditions and difficulties in sample preparation process. This study is a first step of trying to better understand fouling mechanism and its effect to the ballast strength and stability. Further studies as well as different methods of investigations are needed to fully understand ballast fouling.

ACKNOWLEDGEMENTS

The authors would like to thank Burlington Northern Santa Fe (BNSF) Railroad Company for providing the financial support needed to carry out this research study. The authors would also like to thank Mr. Hank Lees with BNSF for sharing his valuable knowledge and experience on the research topic and for providing help and support with obtaining materials. The assistance of Kivanc Avrenli on the coal dust tests is greatly appreciated. The contents of this paper reflect the views of the authors who are responsible for the facts and the accuracy of the data presented herein. This paper does not constitute a standard, specification, or regulation.

REFERENCES

1. Selig, E.T., B.I. Collingwood, and S.W. Field. Causes of Fouling in Track. *AREA Bulletin 717*, 1988.
2. Collingwood, B.I. An Investigation of the Cause of Railroad Ballast Fouling. *Master of Science Degree Project Report No. AAR88-350P*. University of Massachusetts, 1988.
3. Selig, E.T., V. DelloRusso, and K.J. Laine. Sources and Causes of Ballast Fouling. *Report No.R-805. Association of American Railroad (AAR)*, Technical Center, Chicago, 1992.
4. CN (Canadian National) Rail. Ballast Performance in Concrete Tie Track. *Prairie Region. Edmonton. CN, Geotechnical Service*. Internal Report, 1987.
5. Selig, E.T. and J.M. Waters. *Track Geotechnology and Substructure Management*. London, Thomas Telford Publications, 1994.
6. Raymond, G.P. Design for Railroad Ballast and Sub grade Support, *Journal of the Geotechnical Engineering Division*, January, 1978.
7. Raymond, G.P. Railroad Ballast Load Ranking Classification, *Journal of geotechnical Engineering Division*, October, 1979.
8. Chiang, C.C. Effects of Water and Fines on Ballast Performance in Box Tests. *Master of Science Degree Project Report No. AAR89-366P*. University of Massachusetts, 1989.
9. Han, X. and E.T. Selig. Effects of Fouling on Ballast Settlement. *Proceeding of the 6th International Heavy Haul Railway Conference*, Cape Town, South Africa, April, 1997.
10. Raymond, G.P. Track and Support Rehabilitation for a Mine Company Railroad. *Canadian Geotechnical Journal*, Vol. 37, 2000.
11. Tutumluer, E., W. Dombrow, and H. Huang. Laboratory Characterization of Coal Dust Fouled Ballast. *AREMA 2008 Annual Conference and Exhibition*, Salt Lake City, UT, 2008.

LIST OF TABLES

LIST OF FIGURES

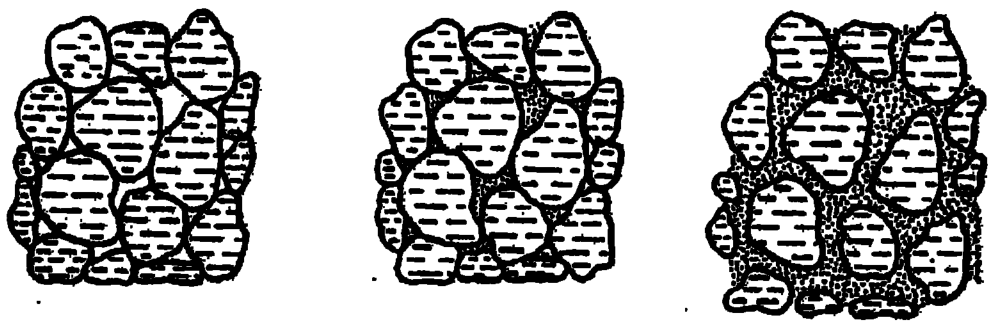
TABLE 1 Engineering Properties of the Selected Fouling Materials

	Specific Gravity	Liquid Limit (%)	Plastic Limit (%)	Optimum Moisture Content or OMC[2] (%)	Maximum Dry Density[2] (kg/m^3)	Passing 0.075 mm or No. 200 sieve (%)
Coal Dust	1.28	91	50	35	874	24
Refractory Clay	2.60	37	19	16	1,806	64
Mineral Filler	2.62	NP[1]	NP[1]	11	2,193	8

[1]: Nonplastic; [2]: Obtained from standard Proctor ASTM D 698 test procedure.

TABLE 2 Shear Box Direct Shear Strength Test Results

Fouling Agent	Percentage by Weight of Clean Ballast (%)	Moisture Condition (see Table 1)	$\tau_{max} = C + \sigma_n * \tan\Phi$		Correlation Coefficient, R^2	Shear Strength τ_{max} (kPa)	
			Cohesion "C" (kPa)	Friction Angle (Φ)		200 kPa Normal Stress	300 kPa Normal Stress
Clean	0	Dry	72	46.6	0.96	283	389
Coal Dust	5	Dry	80	44.4	0.99	276	374
	15	Dry	93	36.2	0.99	239	312
	25	Dry	75	36.6	0.98	224	298
	5	OMC	61	44.7	0.99	259	359
	15	OMC	77	37.7	0.99	231	309
	25	OMC	35	34.5	0.97	173	242
Clay	5	Dry	44	40.5	0.99	215	300
	15	Dry	131	31.2	0.99	252	313
	25	Dry	59	39.5	0.99	224	307
	32	Dry	114	33.7	0.97	247	314
	5	OMC	61	44.1	0.95	255	352
	15	OMC	85	38.0	0.99	241	319
	25	LL	144	36.1	0.98	290	363
Mineral Filler	5	Dry	0	47.7	0.99	195	305
	15	Dry	41	41.6	0.93	219	308
	25	Dry	94	34.6	0.85	232	301
	40	Dry	116	35.7	0.71	260	332
	5	OMC	40	42.6	0.98	224	316
	15	OMC	26	43.4	0.97	215	309
	25	OMC	66	38.0	0.98	222	300



(a) Clean ballast (Phase I) (b) Partially fouled ballast (Phase II) (c) heavily fouled ballast (phase III)

FIGURE 1 Critical ballast fouling phases

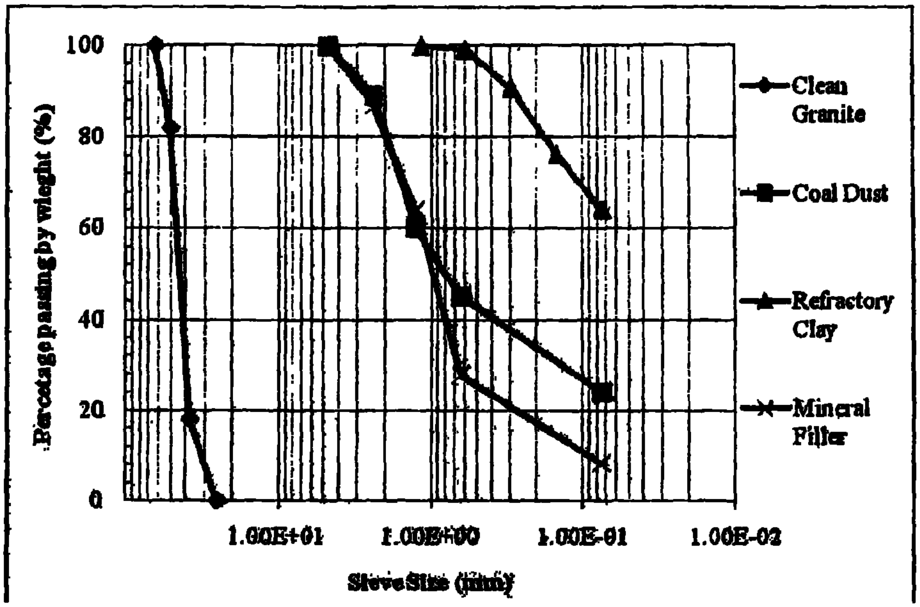


FIGURE 2 Grain size distributions of the clean ballast and fouling materials

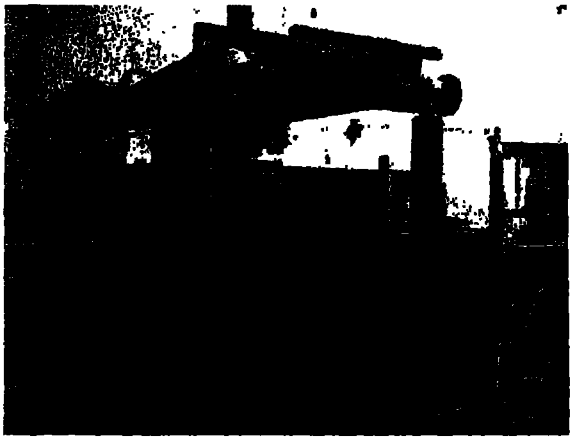


FIGURE 3 The direct shear strength test equipment at the University of Illinois

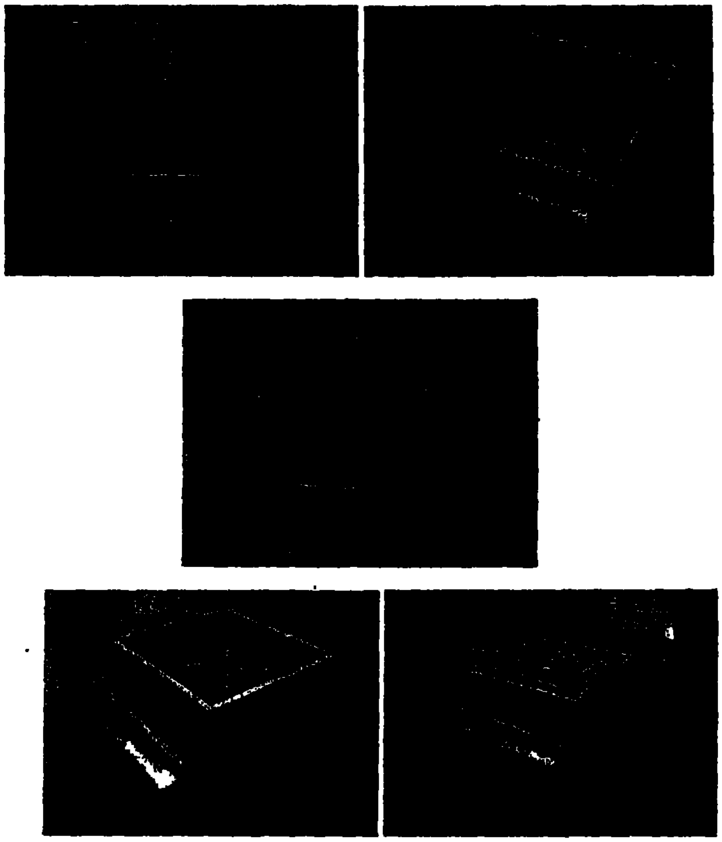


FIGURE 4 Stages of ballast compaction and loading upper ring

FIGURE 5 Mixing coal dust as the fouling material

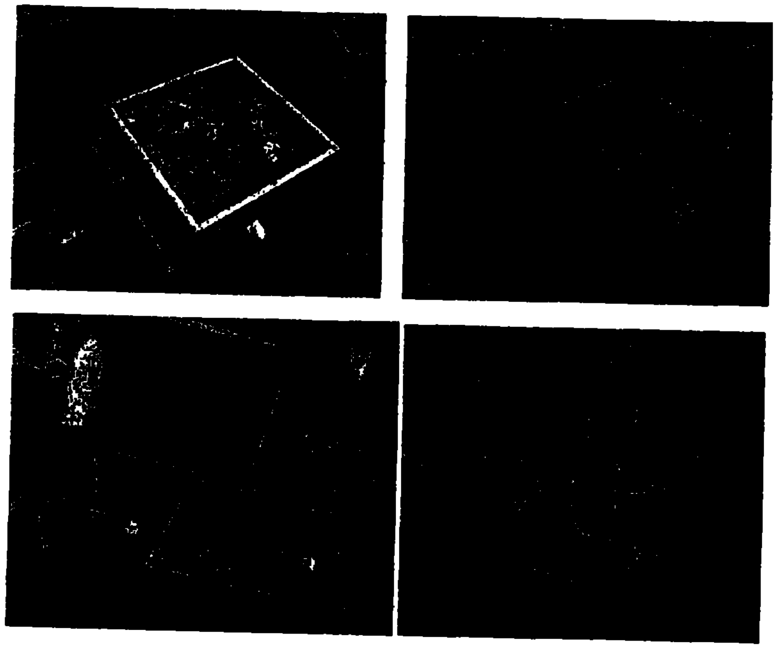


FIGURE 6 Setting-up the direct shear box apparatus

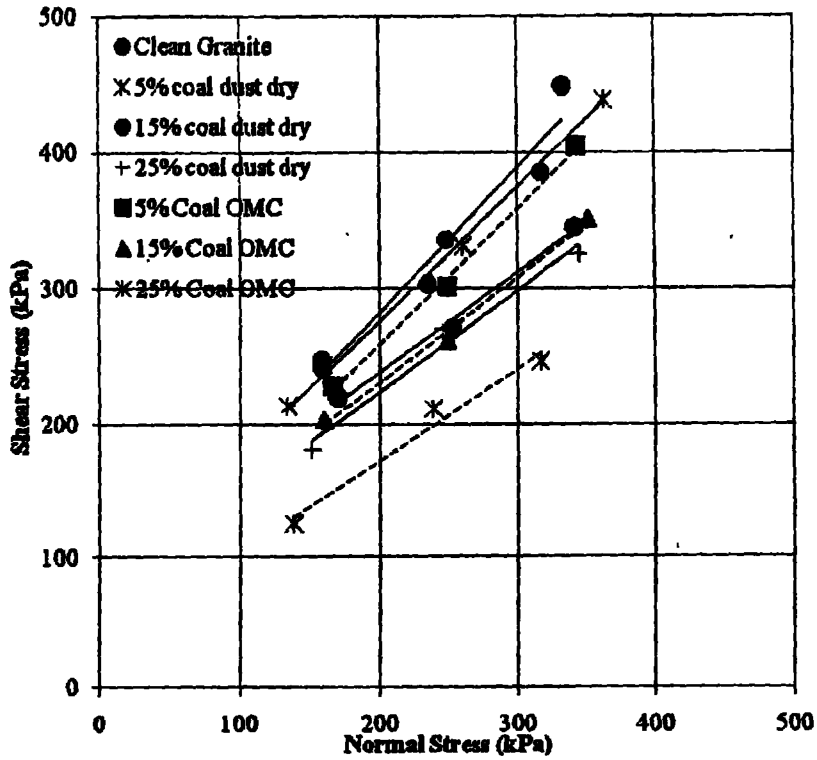


FIGURE 7 Direct shear box test results of coal dust fouled ballast samples

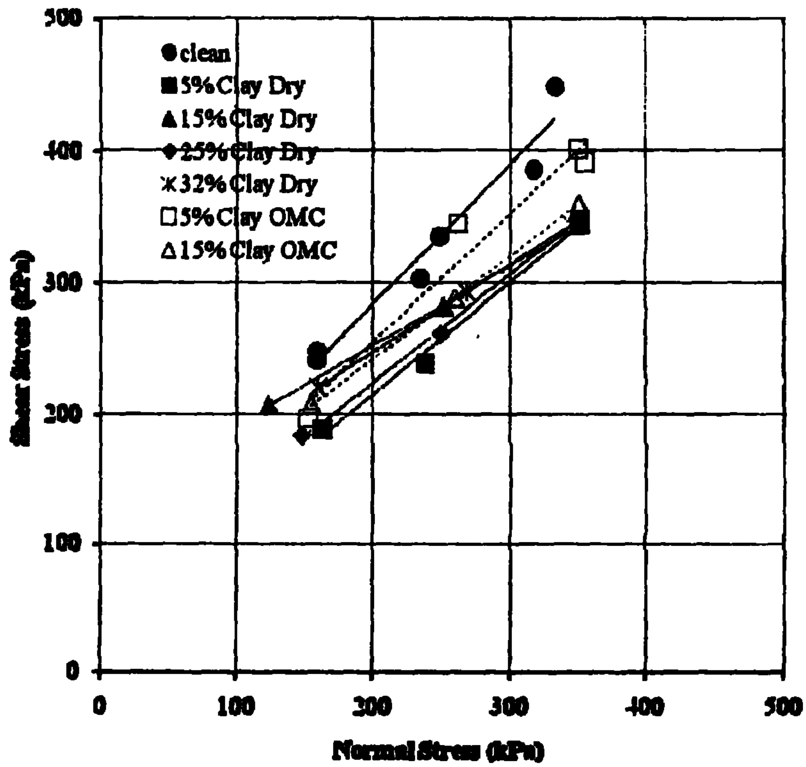


FIGURE 8 Direct shear box test results of clay fouled ballast samples

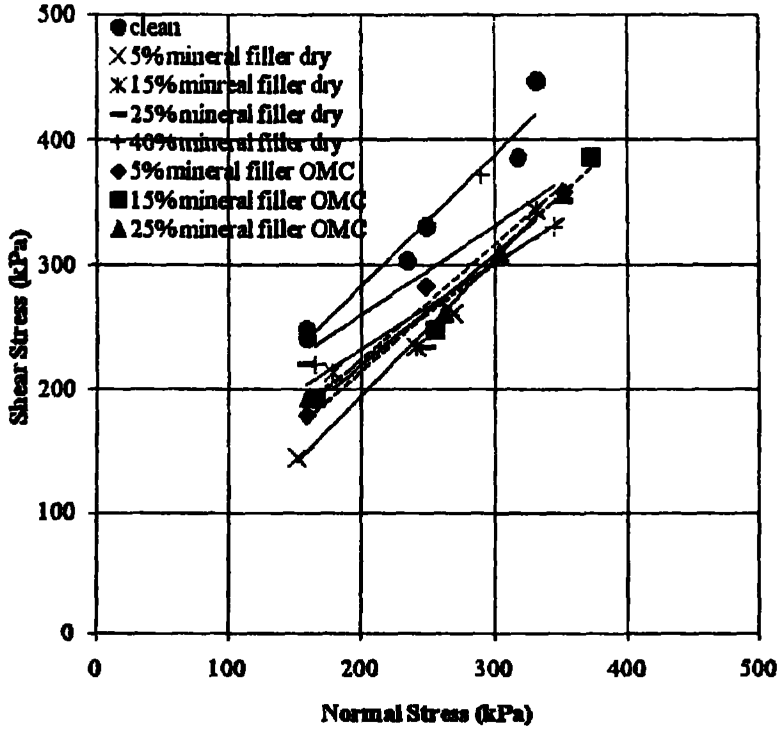


FIGURE 9 Direct shear box test results of mineral filler fouled ballast samples

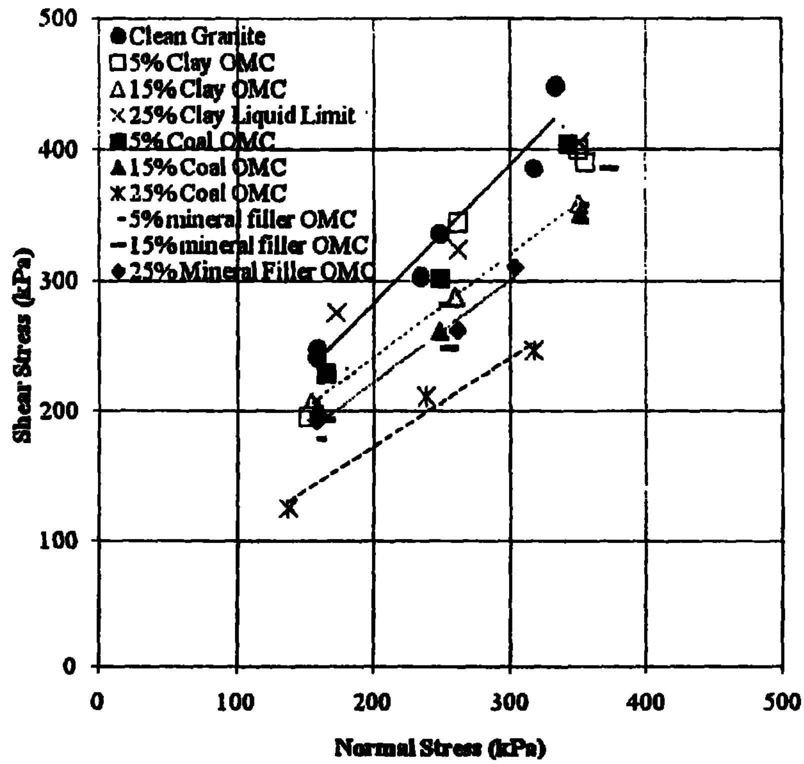


FIGURE 10 Comparisons between three fouling scenarios under wet conditions

Exhibit DC-2

REDACTED

Exhibit DC-3

REDACTED

Exhibit DC-4

REDACTED

Exhibit DC-5

REDACTED

Exhibit DC-6

REDACTED

Exhibit DC-7

REDACTED

Exhibit DC-8

REDACTED

Exhibit DC-9

UPRR's SPRB Coal Route

Capacity Improvements 2000 to 2009 Trackage

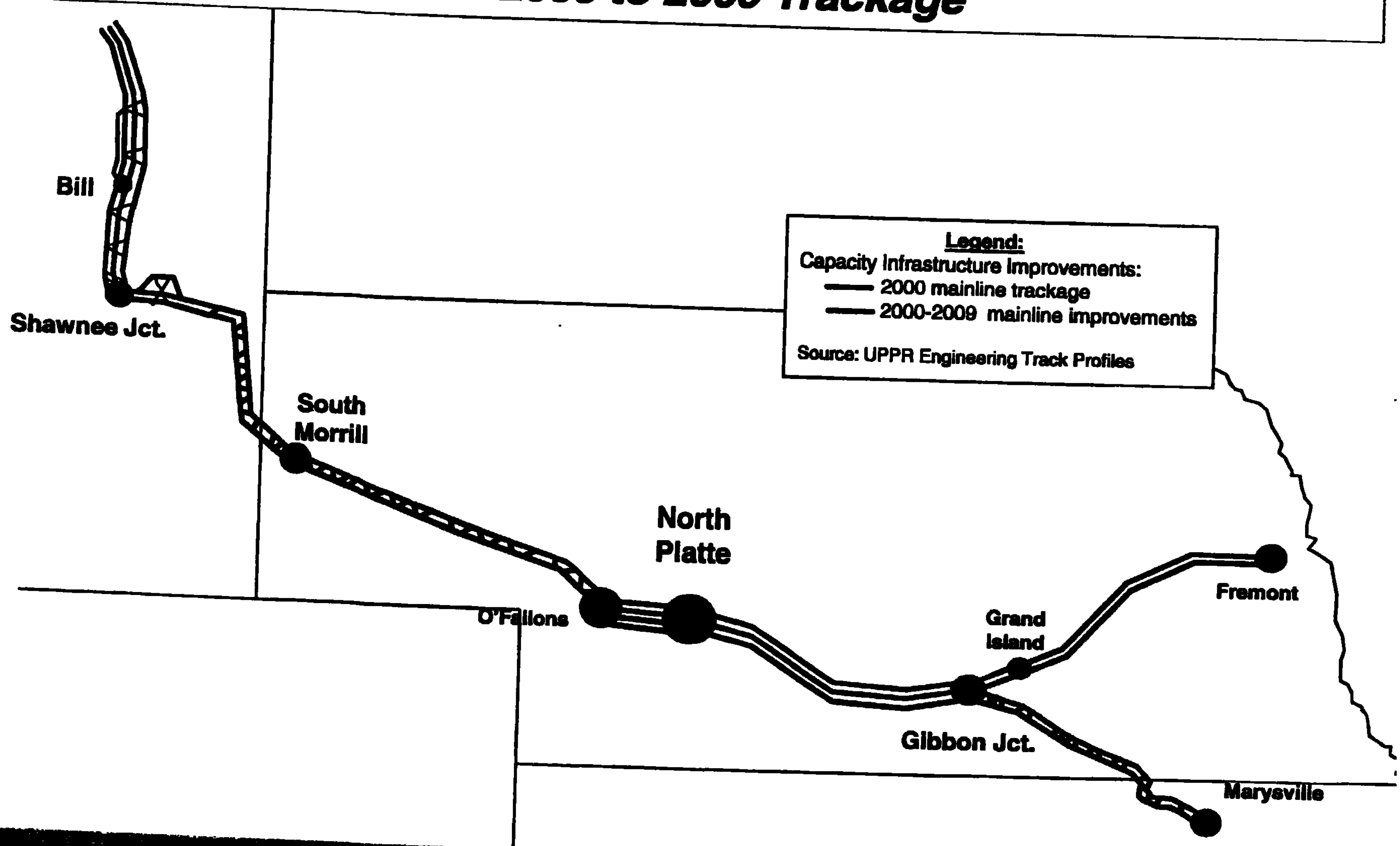


Exhibit DC-10

REDACTED

DC – App. 1

Track miles on UP's SPRB Coal Corridor

From	To	Route Miles	Track Miles
Shawnee Jct	Gibbon	396.86	948.24
Gibbon	Fremont	136.35	272.70
Gibbon	Menoken Jct	214.84	369.80
		748.05	1,590.74

This includes the miles through North Platte Terminal. It terminates at Fremont on the east end of the Columbus Sub, and at Menoken Jct, which is at MP73 on the Kansas Sub on the west edge of Topeka.: This includes all or portions of Powder River, South Morrill, Sidney, North Platte, Kearney, Columbus, Marysville and Kansas subdivisions.

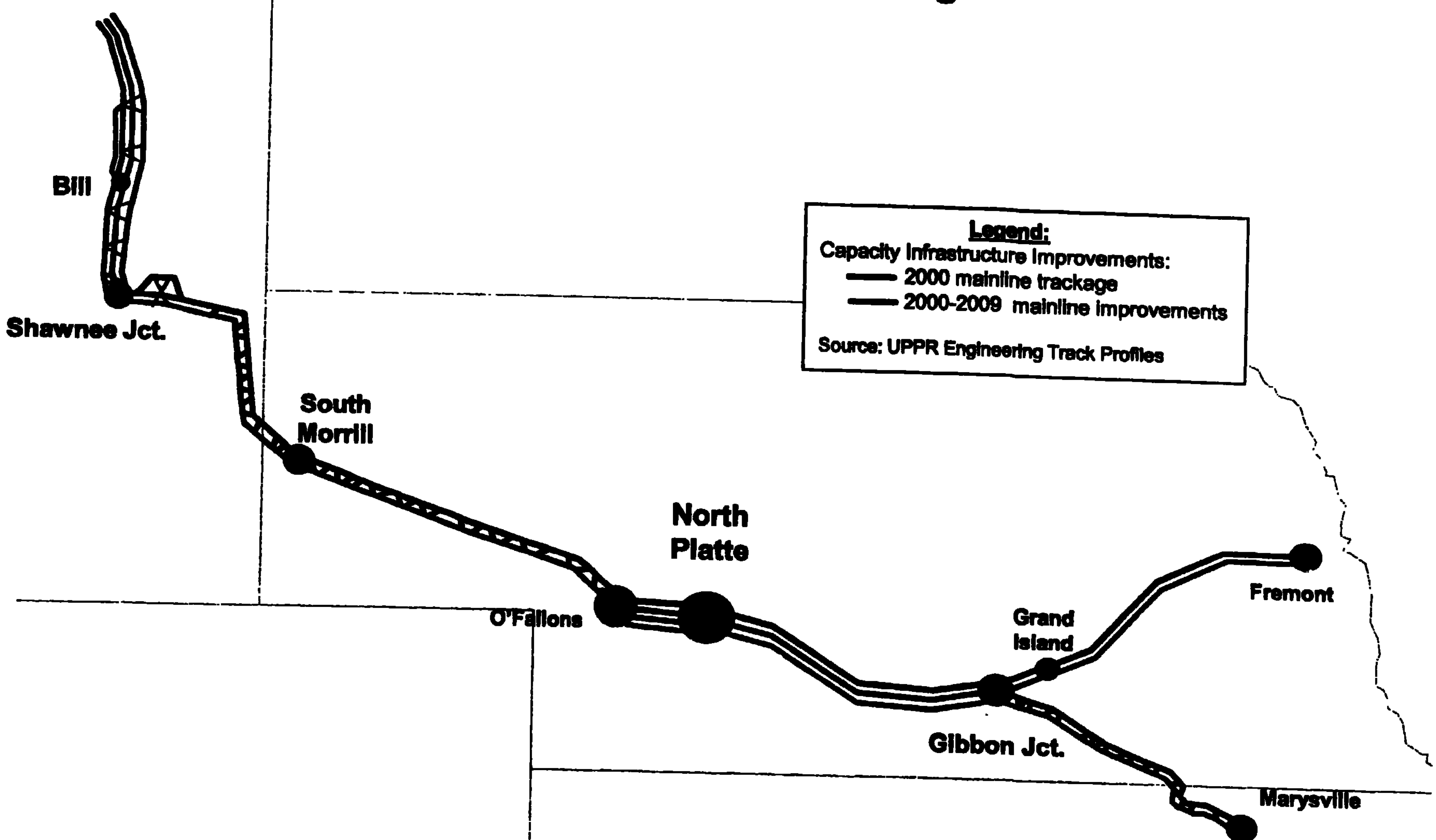
Per the Shannon & Wilson study, the recommendation is a 6 year undercutting cycle on average within the study limits, which are the same limits as above. It is an average, so one would expect that undercutting might be required more on the west end than on the east end. By this logic, we would need to undercut an average of 1590/6=265 miles per year in this corridor.

Undercutters will average 1.5 miles per day if allowed to stay cut in to the track overnight, or 0.75 miles per day if track is returned to service each night. So depending on track availability, it would take between 177 and 353 working days to undercut 265 miles. (265/.75 = 353.33 and 265/1.5 =176.66)

The working season in this zone is approximately April 15 to November 15, or about 214 days. In order to undercut 265 miles in 214 days, it would require an average rate of 1.24 miles per day every day of the working season. Two large undercutters would most likely need to be used in order to obtain the required production, especially as traffic levels continue to rebound.

UPRR's SPRB Coal Route

Capacity Improvements 2000 to 2009 Trackage



	SUBDIVISION	RTE_CLAS_CODE	FIRSTMAINMILES	SECONDMAINMILES
1	POWDER RIVER SUB	C	106.11	106.11
2	POWDER RIVER SUB	S	0	0
3	POWDER RIVER SUB	SubTotal	106.11	106.11
4	Grand Total	SubTotal	106.11	106.11
1	SOUTH MORRILL SUB	C	165.75	165.75
2	SOUTH MORRILL SUB	S	0	0
3	SOUTH MORRILL SUB	SubTotal	165.75	165.75
4	Grand Total	SubTotal	165.75	165.75
1	SIDNEY SUB	C	8.55	8.55
2	SIDNEY SUB	S	0	0
3	SIDNEY SUB	SubTotal	8.55	8.55
4	Grand Total	SubTotal	8.55	8.55
1	NORTH PLATTE TERMINAL	C	10	10
2	NORTH PLATTE TERMINAL	S	0	0
3	NORTH PLATTE TERMINAL	SubTotal	10	10
4	Grand Total	SubTotal	10	10
1	KEARNEY SUB	C	137.5	137.5
2	KEARNEY SUB	S	0	0
3	KEARNEY SUB	SubTotal	137.5	137.5
4	Grand Total	SubTotal	137.5	137.5
1	COLUMBUS SUB	C	105.3	105.3
2	COLUMBUS SUB	S	0	0
3	COLUMBUS SUB	SubTotal	105.3	105.3
4	Grand Total	SubTotal	105.3	105.3
1	MARYSVILLE SUB	C	144.84	145.42
2	MARYSVILLE SUB	S	0	0
3	MARYSVILLE SUB	SubTotal	144.84	145.42
4	Grand Total	SubTotal	144.84	145.42
1	KANSAS SUB	C	70	9.54
2	KANSAS SUB	S	0	0
3	KANSAS SUB	SubTotal	70	9.54
4	Grand Total	SubTotal	70	9.54

THIRDMAINMILES	OTHERMAINMILES	BRANCHMAINMILES	TOTLMAINMILES	RUNNINGTRACKMILES
0	14.69	0	226.91	0
0	0	0	0	2.94
0	14.69	0	226.91	2.94
0	14.69	0	226.91	2.94
0	2	0	333.5	0
2.31	4.25	0	6.56	6.62
2.31	6.25	0	340.06	6.62
2.31	6.25	0	340.06	6.62
0	16.75	0	33.85	0
0	0	0	0	0.58
0	16.75	0	33.85	0.58
0	16.75	0	33.85	0.58
6.58	1.49	0	28.07	0
0	0	0	0	8.442
6.58	1.49	0	28.07	8.442
6.58	1.49	0	28.07	8.442
106.45	0	0	381.45	0
0	0	0	0	11.45
106.45	0	0	381.45	11.45
106.45	0	0	381.45	11.45
0	0	0	210.6	0
0	0	0	0	15.68
0	0	0	210.6	15.68
0	0	0	210.6	15.68
0	0	0	290.26	0
0	0	0	0	8.54
0	0	0	290.26	8.54
0	0	0	290.26	8.54
0	0	0	79.54	0
0	0	0	0	18.72
0	0	0	79.54	18.72
0	0	0	79.54	18.72

WAYSWITCHMILES	YARDSWITCHMILES	TOTLSPRTMILES
0	0	0
2.232	2.769	7.941
2.232	2.769	7.941
2.232	2.769	7.941
0	0	0
4.4	37.615	48.635
4.4	37.615	48.635
4.4	37.615	48.635
0	0	0
0.29	0.597	1.467
0.29	0.597	1.467
0.29	0.597	1.467
0	4.75	4.75
4.07	299.184	311.696
4.07	303.934	316.446
4.07	303.934	316.446
0	0	0
13.89	45.5	70.84
13.89	45.5	70.84
13.89	45.5	70.84
0	0	0
6.8	21.97	44.45
6.8	21.97	44.45
6.8	21.97	44.45
0	0	0
2.79	27.75	39.08
2.79	27.75	39.08
2.79	27.75	39.08
0	0	0
0.75	3.12	22.59
0.75	3.12	22.59
0.75	3.12	22.59

REDACTED

VERIFIED STATEMENT OF
DOUGLAS GLASS

Introduction

My name is Douglas Glass. I am Vice President and General Manager-Energy of Union Pacific Railroad Company ("Union Pacific"). I was promoted to this position in April 2005. I am responsible for the marketing and sale of transportation of coal to utility and industrial customers.

I began my career with Union Pacific in 1976 and have held a variety of positions during the past 33 years, all in Union Pacific's Marketing and Sales Department. In June 2003, I became Senior Assistant Vice President, Business Development and held this position until promoted to my current position. I have two bachelor's degrees (marketing and economics) from the University of Colorado, a master's degree in business administration, finance, from the University of Nebraska-Omaha, and attended Harvard University's Program for Management Development.

The Energy business unit manages all commercial aspects of Union Pacific's coal business, including coordinating the operation of the rail network to provide coal deliveries to our customers. My introduction to, and subsequent experience in the Energy business unit, provide me an appreciation on the impact coal dust has on our coal rail network and service to our coal customers.

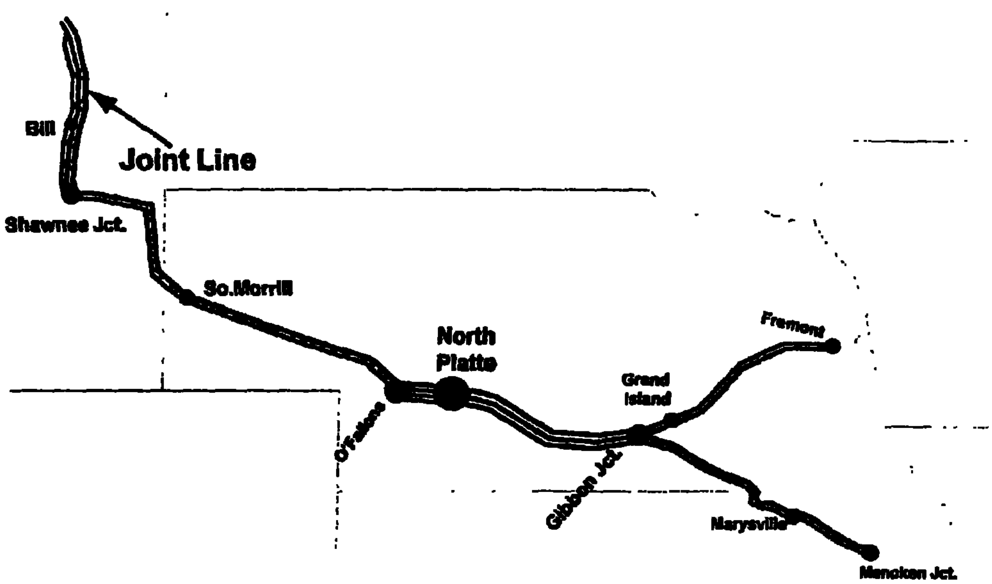
I begin with an overview of Union Pacific's coal transportation system on the Joint Line and then describe Union Pacific's relationship with Arkansas Electric Cooperative Corporation ("AECC"). Next, I summarize Union Pacific's coal dust concerns. I then explain the importance of adopting reasonable rules that insure customers assume appropriate responsibility for keeping their lading in the railcars. I next explain why AECC's concern that its trains would be stopped is misplaced. Finally, I describe the "chilling" impact that a Board decision finding the BNSF tariff rules unreasonable would have on Union Pacific's collaborative efforts with its customers to develop coal dust prevention methods.

Overview of Union Pacific's Transportation of Coal from Wyoming's Powder River Basin

Union Pacific and BNSF each own 50% of the Joint Line, a 102-mile stretch of railroad used to serve ten sub-bituminous coal mines and transport over 350 million tons of coal from Wyoming's Southern Powder River Basin (SPRB) throughout the U.S. Both railroads have the right to operate trains over the line. These ten coal mines are jointly served by both BNSF and Union Pacific. Under the ICC-approved Joint Line Agreement entered into by BNSF's and Union Pacific's predecessors, BNSF is the operating carrier of the Joint Line. Each railroad pays 50% of all capacity-related projects on the Joint Line, and each railroad shares maintenance and operating costs in proportion to each railroad's usage of the Joint Line. Union Pacific's share for these expenditures was in 2009. As a result, Union Pacific pays the share of the cost of mitigating coal dust on the Joint Line. In addition, Union Pacific bears 100% of the costs associated with mitigating coal dust on its coal network beyond the Joint Line.

The transportation of coal to Union Pacific's energy customers is a significant component of our business. Union Pacific transports coal from the SPRB for customers over the Joint Line and its own lines to destinations in 23 states across the western two-thirds of the United States. In 2009, approximately 75% of the coal shipped by Union Pacific originated in the SPRB. Union Pacific transported in excess of 175 million tons of SPRB coal in 2009 over the Joint Line, and we currently average approximately 33 SPRB train loads daily. Union Pacific's average length of haul for a typical coal train is over 950 miles. Our Joint Line-originating coal network spans approximately 533 route miles running from Shawnee Junction in eastern Wyoming to Fremont, Nebraska or 612 route miles south on our Kansas Subdivision to Menoken Junction, just west of Topeka, Kansas. The track miles between Shawnee Junction and Fremont and Gibbon Junction to Menoken Junction total nearly 1600.

The Core of Union Pacific's Coal Network



Union Pacific's Relationship with AECC

Arkansas Electric Cooperative Corporation ("AECC"), the shipper who asked the Board to initiate this proceeding, is a customer of Union Pacific. AECC owns an interest in three coal-fired power plants, all of which are subject to long-term

49 U.S.C. § 10709 contracts with Union Pacific. Those power plants include the White Bluff plant at Redfield, Arkansas, the Independence plant at Newark, Arkansas, and the Flint Creek plant at Gentry, Arkansas. Union Pacific moves all of the coal for these power plants under contract. As described in more detail below, the coal transported by Union Pacific for these plants—AECC's coal—is not subject to BNSF tariff rules.

Union Pacific's Concern about Track Problems Arising from Coal Dust

Coal dust has created service difficulties on the Joint Line and left unchecked, threatens service difficulties in the future. David Connell, Union Pacific's chief engineer, describes how coal dust is unusually dangerous as a fouling agent because of how quickly it compromises the track bed when mixed with water. (Connell VS at 13-14.) Coal dust, in sufficient quantities, is known to compromise the track structure and roadbed, which can result in decreased stability, and ultimately loss of track gauge and proper geometry. (Connell VS at 13.) Location-specific coal dust mitigation efforts cannot practically remove all the coal dust in the roadbed (Connell VS at 14) and because track capacity is affected while those mitigation efforts are underway, the prudent solution to the coal dust problem is to keep the coal dust in the railcars during transportation. This does not just apply to coal, but is true for every commodity transported by rail—the product must be confined to the railcar or container.

Coal dust emissions foul ballast in the track bed and cause other track-related problems. (Connell VS at 12-13.) Absent rules for keeping coal dust confined to the railcars, Union Pacific has been compelled to adopt more aggressive mitigation efforts to remove coal dust from the ballast on its lines. These efforts include activities such as more frequent and extensive undercutting, shoulder cleaning and switch repair and replacement. As a result, the cycle for undercutting and switch cleaning schedules is being significantly shortened. (Connell VS at 17.) In addition to the potential for track-related problems, coal dust removal efforts disrupt Union Pacific's coal transportation by delaying trains and reducing track capacity because maintenance crews must be on the rail lines more often operating under maintenance curfews. With a six-year cycle and approximately 1,600 track miles, Union Pacific would have to average 265 miles of undercutting a year. Based on the average production pace and the fact that undercutting can only be done when the ground and track is not frozen, our Engineering Department has concluded that it is unlikely that we could sustain this amount of undercutting every year perpetually. (Connell VS at 18.) I also understand that coal dust cannot be completely removed from the ballast by simply undercutting, which increases the likelihood of further track-related problems in the future.

Increased maintenance and undercutting efforts to remove coal dust will ultimately result in increased cycle times and reduce the velocity of rail and customer car assets, impeding Union Pacific's customer service. Additionally, undercutting efforts over hundreds of miles of coal corridor each year are unsustainable and would not remove all coal dust. Because the coal dust can be so pernicious, particularly when combined with water (Connell VS at 13-14), the best and most logical solution is for shippers to take steps that keep their lading (in this case, coal) in their railcars and off of the railroad's right-of-way.

Rules That Require a Customer to Load Freight so That it Remains in the Car Are Reasonable

Railroads are responsible for transporting all types of freight over their lines. Shippers are responsible for loading their freight into cars in a manner so that it remains in the car, instead of falling or blowing out of the car and onto the track and creating safety hazards to other trains or damaging the integrity of the rail carrier's track or right-of-way. Coal shippers are no different than other rail customers in this respect. Accordingly, it is logical and should be a common sense practice for railroads to adopt reasonable rules that require their customers to keep coal and coal dust off the railroad's right-of-way – especially given the pernicious nature of coal dust. Similar to all other products hauled by the railroad industry, the coal shippers bear responsibility to insure that the coal remains in the railcar once it leaves the mine.

Coal dust is an unusually harmful foulant to the railroad track structure and supporting ballast, due to its unique characteristics, its fine granular shape and its reaction when exposed to water. (Connell VS at 13-14.) Even though we are engaged in undercutting efforts to remove coal dust, the fact remains that coal dust is still accumulating on the Joint Line and on UP's coal routes at disturbing rates. (Connell VS at 17.) Of even greater concern, coal dust that permeates the ballast is often not visible to the naked eye, requiring a complex and periodic sampling process to confirm the amount of and rate of dust accumulation over time. (Connell VS at 14.)

Union Pacific has various loading rules that we have adopted for other traffic so that our customers' freight stays in the railcars. For example, woodchip customers are required to use netting to keep woodchips from flying out of railcars. Similarly, customers moving steel or iron scrap in open gondolas are required to secure their loads with tarp. We have rules for soda ash moving in covered hoppers where failure to adequately secure the bottom gates allows a granular caustic substance to be deposited in the track bed that can cause signal failures and prematurely age ties, ballast, and roadbeds. These examples are common sense railroad rules requiring shippers to take necessary steps and precautions that ensure their freight stays in the car. Like they have with other types of freight, railroads should be permitted to adopt reasonable rules as to their coal customers to prevent coal (including coal dust) from leaving the railcar and accumulating on the right-of-way.

AECC's Concern That its Trains Will be Stopped Is Misplaced

In its petition, AECC expressed concern that BNSF, under authority of its tariff rules (Items 100 and 101 of BNSF's Tariff 6041-B), would refuse to let AECC's trains operate over the Joint Line if the coal dust emissions from any train exceeded BNSF's tariff rules. (AECC Pet. for Decl. Order at 1-2.) AECC's concern is misplaced. BNSF tariff rules cannot apply to Union Pacific customers any more than a Union Pacific tariff rule could be applied against another railroad's customer.

Further, BNSF has not advised anyone at Union Pacific that it would stop Union Pacific trains under the tariff at issue if such trains emit too much coal dust, nor has BNSF told Union Pacific that it would enforce the tariff's provisions against Union Pacific. In fact, the tariff rules that AECC questions make no mention of refusing to allow trains that do not comply to move. Accordingly, BNSF's tariff rules (Tariff 6041-B Items 100 and 101) are not expected to disrupt or impact Union Pacific's transportation of AECC's SPRB coal to its coal-fired power plants (or those of other Union Pacific customers).

Although AECC did not mention BNSF's coal dust operating rule, General Order No. 19 (Orin Subdivision Timetable Amendments, adopted in January 2009), in its Petition, Union Pacific is subject to BNSF operating rules while on the Joint Line and under the authority of the Joint Line Agreement. While we do not share AECC's belief that BNSF would or could stop Union Pacific trains from operating over the Joint Line under that rule, we would be even more concerned than AECC if BNSF ever tried. Such an attempt would threaten Union Pacific service to other customers besides AECC, deprive us of revenue, and disrupt our operations. But BNSF has not stated that it plans to enforce this rule by stopping Union Pacific trains. Indeed, similar to BNSF's tariff rules, nowhere in its coal dust operating rule does BNSF state that it will stop trains on the Joint Line if the trains exceed their dust emission standard.

Moreover, stopping trains on the Joint Line would be extremely disruptive on such a busy corridor. Since the train must already be running on the Joint Line in order to pass the Track Station Monitor ("TSM") at mile post ("MP") 90.7 in order to be "caught", the only way BNSF could stop the train would be to hold it on the Joint Line. This would be counterproductive, especially since by the time the BNSF dispatcher could learn of the violation, contact the train crew, and the engineer could stop a 15,000-ton train moving at 40 m.p.h. or more the train would be approaching or past the end of the Joint Line at Shawnee Junction MP 117.1.[1] But in the hypothetical situation that this operating rule would be enforced by restricting Union Pacific trains, we would vigorously object and pursue any remedies before the Board.

Ruling That Prohibits or Restricts Coal Dust Emission Rules Would Chill Development of Prevention Techniques

Preventing the deposit of coal dust on the railroad right-of-way is better than perpetually removing it afterwards. Prevention, however, requires action by coal shippers since railroads cannot implement prevention measures unilaterally. Union

1 In fact, all of the Joint Line mines are located on the northern half of the Joint Line, but the monitoring station is located near the southern end where Union Pacific's trains exit the Joint Line. Thus, BNSF would not seem to have any reason to stop the train before it reached Union Pacific's lines. (*See also* VS Connell at 3, illustration.)

Pacific is committed to working with its customers to explore and to implement effective prevention measures. However, our ability to do so will be compromised if the Board determines that BNSF cannot adopt rules to inhibit coal dust dispersion or imposes unduly restrictive conditions on such rules. In this section, I will discuss why shipper participation is essential to prevent the dispersion of coal dust, how Union Pacific is pursuing collaborative efforts to develop effective measurement and prevention measures, and how prior collaboration has delivered mutual benefits.

Prevention requires active customer involvement because the shippers own the coal, the shippers own virtually all of the railcars used on the Joint Line, and the trains are loaded by the shippers' coal suppliers before they are released to Union Pacific for transport. These ownership interests effectively eliminate any steps that Union Pacific can take unilaterally to keep coal in the car while moving over its lines.

Ultimately, we aim to incent our customers to take reasonable steps to prevent coal dust from being left behind on our track. Currently, we are pursuing that objective by exploring alternative techniques for reducing coal dust emissions and developing venues for providing timely information to customers and the coal mines about the profile and performance of individual trains relative to all trains handled.

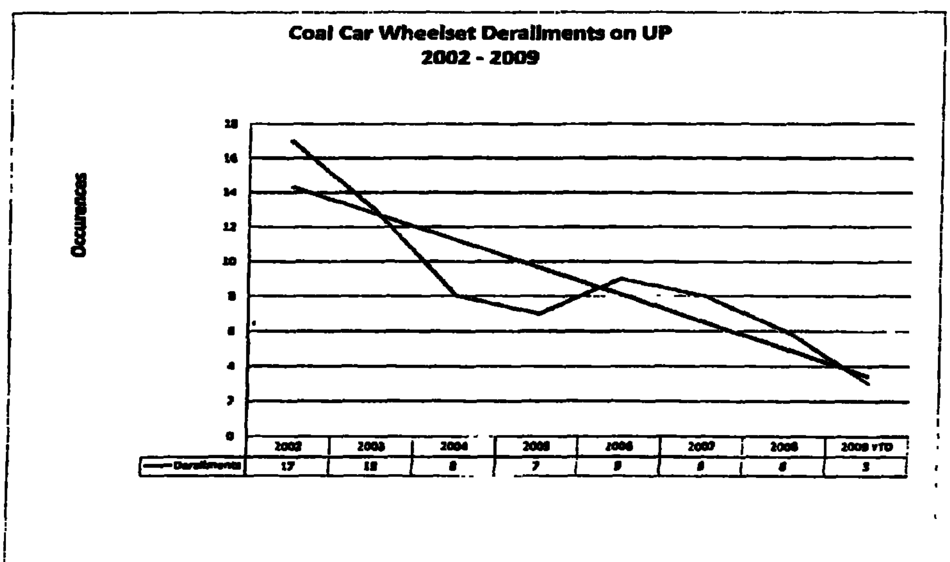
In addition to other options, such as application of chemical surfactants, grooming and shaping of railcar load profiles that were studied earlier, we are currently evaluating both load compression and car covers as alternative methods for coal dust prevention. One manufacturer is planning to introduce a mechanical system that can compact the coal in each railcar, lowering the coal profile and compressing the small grains of coal dust tighter within the car, thereby preventing the fines from blowing off the top of the car. We are interested in field testing this system in cooperation with one or more of our customers and are communicating with the manufacturer on its readiness to engage in a broad-based field test. We are also working with two other vendors on the development of car covers, and have discussed testing the covers in unit train service later this year.

Union Pacific also has several projects underway for sharing information with our customers and their coal producers on issues concerning coal dust. First, coal dust event data (Integrated Dust Values or IDV.2 data) collected at TSMs on the Joint Line at MP 90.7, as well as Union Pacific's own line near South Morrill, NE to be installed at MP 154.75-155, will be made available to our customers and mines on virtually a real-time basis via a secured customer website. The data will allow our customers and Union Pacific to observe the amount of coal dust deposited by their trains, relative to all coal trains, and to identify conditions that may cause a higher frequency of coal dusting events as well as the existence.

Later this year, we will begin sharing visual information on how well railcars are loaded and profiled to resist particles blowing off the top of the railcars. This will provide producers and customers with feedback to improve consistency and uniformity of load profiling techniques. By the second quarter of this year, Union Pacific, in conjunction with BNSF, intends to install a laser system (Coal Car Load Profiling System-CCLPS) on the Joint Line at MP 90.7. This system, along with the camera-monitoring device that Union Pacific and BNSF installed at the same location, will provide real-time feedback on the load profiles of each carload in the train for every train handled on the Joint Line by Union Pacific. Customers and their mines will be able to access data on their loaded cars via a secured customer website. We are completing the pilot program portion of this project and expect that the data will be available to all customers later this year.

Union Pacific's past collaborative efforts with customers have delivered improved safety and reliability. We anticipate the same for our coal dust prevention efforts. Union Pacific has succeeded in working with its customers in the past to improve rail service reliability, productivity, velocity and safety initiatives because we recognize that most opportunities cannot be achieved unilaterally. Union Pacific's processes involve research and development, education and exchange of information, followed by ongoing discussion in a collaborative environment. (Due to antitrust and competitive concerns, many of these discussions must take place on an individual customer basis.) Some examples of our past improvements that involved rail and customer cooperation include the deployment of distributed power, higher capacity coal cars, longer trains, expanded unloading infrastructure at customers' plants, and improved mechanical inspections and repairs.

Union Pacific's enhanced car inspection and maintenance guidelines and rules are a good example of how, through a combination of tariff rule changes, cooperation and negotiations, Union Pacific, along with its customers, has been able to improve rail safety and reliability by implementing rules that resulted in the reduction of equipment-related derailments. In 2002, Union Pacific conducted a comprehensive mechanical evaluation of heavy-haul cars in response to a significant number of broken wheel and axle derailments. As a result of its research, Union Pacific adopted several improvements on its system coal cars that operate in heavy-haul traffic. With the goal of further reducing equipment-caused incidents, in April 2005, we also reached out to our customers and asked that they voluntarily adopt certain inspection and repair standards on their cars (related to broken wheels, axles, and hot bearings). The following year, Union Pacific incorporated the new railcar inspection standards as recommendations for its then current contracts and adopted its new rail inspection standards to apply to all new commercial agreements with Union Pacific, effective November 1, 2006. Finally, we published the standards as requirements effective January 1, 2008. As a result of these initiatives and the collaborative efforts of our customers, derailments attributable to coal car wheel set issues moving along Union Pacific lines decreased significantly—from seventeen in 2002 to only six in 2008. Our approach to coal dust is no different.



Ongoing customer communications and collaborative relationships are vital to our efforts to find solutions to coal dust emissions and provide long term, superior service to our coal customers. A Board decision that finds BNSF's tariff rules are unreasonable or one that sets forth a narrow standard of what constitutes a reasonable practice will discourage customer participation in coal dust discussions and "chill" our efforts to reach agreement with customers on how they can effectively and efficiently reduce their coal dust emissions. Even those customers who would ordinarily be progressive and cooperative, will be discouraged from supporting the reduction of coal dust emissions out of fear that such cooperation will put them at a competitive disadvantage against those who refuse to do anything.

VERIFICATION

I, Douglas Glass, Vice President and General Manager-Energy of Union Pacific Railroad Company, declare under penalty of perjury that the foregoing is true and correct to the best of my knowledge.

Executed on 12 day of March, 2010.

Douglas Glass

Signed before me this 12th day of March 2010.

GENERAL NOTARY - State of Nebraska
MAUREEN FONG HINNERS
My Comm. Exp. Dec. 5, 2011

Maureen Fong Hinners

Technical Memorandum

MIDWEST RESEARCH INSTITUTE

March 12, 2010

To: Mr. Joseph Rebein, Shook, Hardy & Bacon LLC

From: Gregory E. Muleski

Subject: Project No. 311023.1.001, "Review of Coal Emissions from Rail Cars"

This memorandum summarizes findings from a review of information that Shook, Hardy & Bacon (SHB) provided about coal dust monitoring along the Joint Line rail corridor in Wyoming. The line is used to transport coal from mines in the Southern Powder River Basin (SPRB) and it is jointly owned by BNSF and Union Pacific.

Introduction

My name is Gregory E. Muleski. I have been employed as a Principal Environmental Engineer at Midwest Research Institute (MRI) in Kansas City, Missouri since 1981. As an independent, not-for-profit institute, MRI delivers innovative thinking and unbiased results to its customers, both large and small. Since its founding in 1944, MRI has completed over 16,000 projects for over 5,000 clients. Environmental engineering services have been a core competency of MRI for over 50 years. MRI is internationally recognized as expert in the field of open dust source emission characterization and control.

In addition to a bachelor's degree in mathematics, I hold a bachelor's, a master's and a Ph.D. in engineering science. Since joining MRI, I have specialized in the measurement and modeling of open dust sources. I have over 25 years of direct experience characterizing fugitive dust for coal and other materials in field and laboratory studies. I have personally conducted over 900 fugitive dust field tests on two continents. I have served as Program Manager for a multiple year field evaluation of Powder River Basin coal mine emission factors and dispersion modeling as required by Section 234 of the Clean Air Act Amendments (CAAA) of 1990. In this capacity, I designed a follow-on field evaluation study for mines combining extensive long-term air quality and meteorological monitoring with intensive short-term, source-directed testing. I also directed the collection and reporting of ambient monitoring results for use in evaluating available dispersion models.

In addition to my work in the Powder River Basin, I have also conducted studies in South America where I developed and performed three large-scale field testing programs (1997, 2003, and 2010) of wind erosion and material handling operations at two major industrial facilities in Brazil. Other work included a thorough air quality review for coal mining company Carbones del Cerrejón LLC. The objectives were to (a) perform an independent assessment of the air quality management program at Cerrejón's mine in La Guarjira, Colombia and (b) advise on methods to improve the process.

I also have experience testing fugitive dust mitigation techniques. I conducted tests to characterize the effectiveness of control measures applied to wind erosion of steam coals, metallurgical coals, petroleum coke, and other materials in open storage and/or rail cars, as well as conducted multiple feasibility studies of wind fences to prevent large particles from depositing onto resort and residential property downwind of coal and other material storage piles in Brazil.

Due to my extensive field work experience in modeling, measurement and control of fugitive coal dust emissions, I was asked by Shook, Hardy and Bacon (SHB) to provide expert analysis on the issue of fugitive coal dust measurement and mitigation on the Joint Line rail corridor. SHB asked that, after reviewing several research studies and presentations, I report on the validity and effectiveness of (a) track side monitoring (TSM) techniques developed by Simpson Weather Associates and (b) the "integrated dust value" (version 2, or "IDV.2") obtained from TSM. I was also asked to comment on fugitive coal dust mitigation techniques that might be employed.

Executive Summary

The Joint Line rail corridor, co-owned by BNSF Railway and Union Pacific Railroad, is used to transport coal from mines in the Southern Powder River Basin. Coal dust is accumulating in and along the Joint Line's road bed. Coal dust works its way into the ballast and interferes with normal drainage and diminishes the vertical shear strength of the track under normal load conditions by passing trains.

A number of studies have been undertaken to not only characterize the loss of coal dust from rail cars but also to evaluate the effectiveness of control measures aimed to reduce the loss. After review of these studies and documents about coal dust monitoring along the Joint Line rail corridor in Wyoming, several conclusions can be drawn.

1. A rail car filled with coal is susceptible to wind erosion resulting in coal dust becoming incorporated into the airflow above the car. Larger coal dust particles will be deposited on and around the track road bed. Smaller particles will become suspended in the air and will disperse as they travel downwind before they can be detected by the track side monitor. The dusting problem is accentuated if the coal surface is higher than the car sidewalls. Furthermore, as additional track is added within the Joint Line (both triple and quad track) more dust that once would have deposited off to the side downwind is now being deposited near tracks.

2. There is a relationship between airborne dust measured by Simpson Weather at the track side monitors (TSM) and the particles that deposit on the right-of-way. Large particles are necessary to suspend coal particles detected at the trackside monitor. However, those larger particles cannot remain suspended in the air and will deposit on the right-of-way. Assuming comparable wind conditions between two events on the same track, one would conclude that the event with the higher IDV.2 value corresponds to more mass being deposited on

the right-of-way. Furthermore, as more tracks are added to the Joint Line, there is greater opportunity for coal dust to fall onto the track structures.

3. There exist several viable and proven methods to characterize the effectiveness of measures used to mitigate fugitive coal dust from wind erosion. Control measures include: covering the railcar; compaction of the coal surface; the application of suppressant/surfactant sprays; and profile modification of the coal load's profile (shape).

Ballast Fouling by Coal Dust on the Joint Line and on UP Main Line

Ballast fouling by coal dust occurs along the Joint Line. The work of Dr. Erol Tutumluer of the University of Illinois describes his analysis of ballast taken from the Joint Line. Dr. Tutumluer's report concludes that coal dust contributes significantly to ballast fouling.

Additionally, the engineering firm of Shannon & Wilson, Inc. has been engaged by Union Pacific to measure the coal dust levels on its main coal lines. Two Shannon & Wilson reports (dated July 30, 2008 and January 2010) have found that the level of coal dusting tends to decrease with increasing distance from the coal mines. Shannon & Wilson, though, did find measureable quantities of coal dust throughout the Union Pacific track that it measured.

These studies are consistent with my views about coal and wind erosion during transportation. The most significant erosion from railcars occurs immediately after an untreated load first reaches a travel speed above the surface's "threshold velocity." As the erodible material is depleted, the rate of emission decreases. However, the erosion potential can be restored when the surface is disturbed (for example, by starts and stops or rough spots causing material to tumble down in the railcar). For that reason, one could expect coal dust to be lost throughout the trip. This conclusion is supported by Shannon & Wilson's findings.

Ballast Fouling by Coal Dust Appears to be a Recent Problem

Coal dust fouling of ballast along the Joint Line appears to be a recent and increasing problem. This is due in part to a continual rise in the volume of rail traffic on the Joint Line over the past two decades.[1] Increased rail traffic equates to increased deposition of coal dust along the right of way. Furthermore, BNSF and UP have added dual, triple and quad rail lines to the corridor (Figure 1). This increase in track structure means dust that would have fallen off to the side can now deposit onto adjacent track structures where it may contribute to ballast fouling.

---

[1] Slide "UP-AECCBN-0008024" illustrates the growth in coal shipments along the Joint Line.

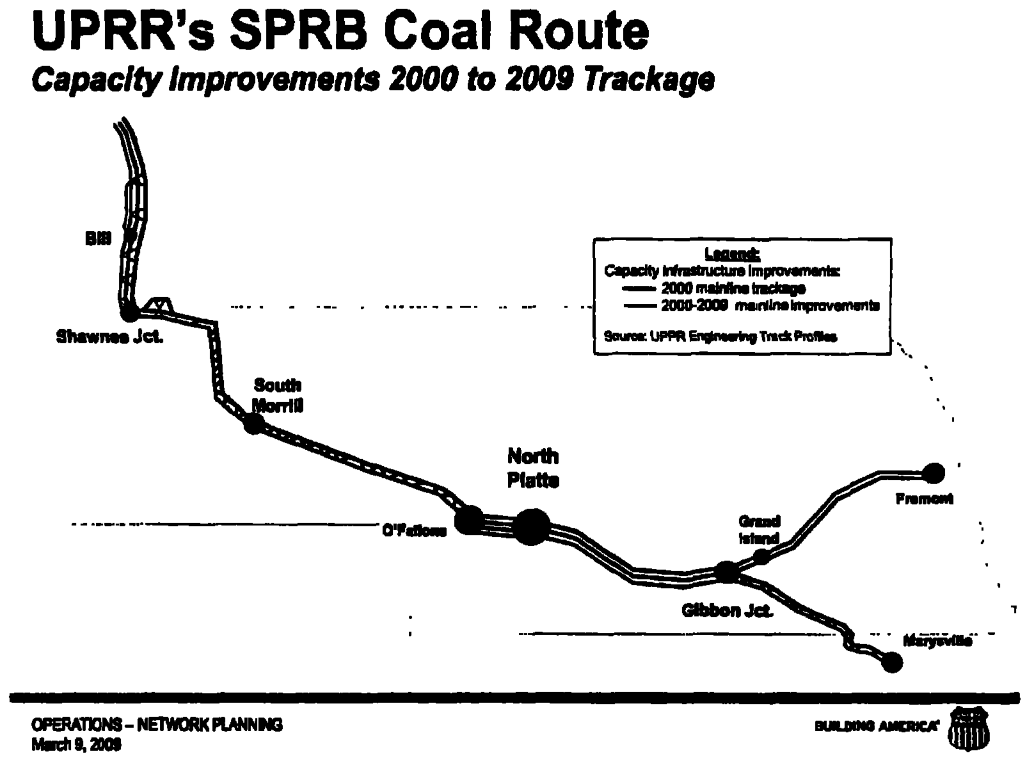


Figure 1. UPRR's capacity improvements to the SPRB

Fugitive Coal Dust from Open Rail Cars

A primary source of coal loss is falling or blowing from the top of open rail cars. Although improperly sealed or defective bottom dump doors on a coal car can result in coal loss during transit, coal blowing from the open rail cars is fundamentally a wind erosion source in which particles are drawn into the airflow above the car.[2] Figure 2 illustrates how the train travel speed and the ambient wind combine to produce the effective air speed "seen" or experienced by the coal surface. In the absence of high ambient winds, one would reasonably approximate the effective speed to be the same as the train travel speed.

[2] "Entrainment" is a general term that describes loose surface material becoming incorporated into a fluid (air or water) flowing over the surface.

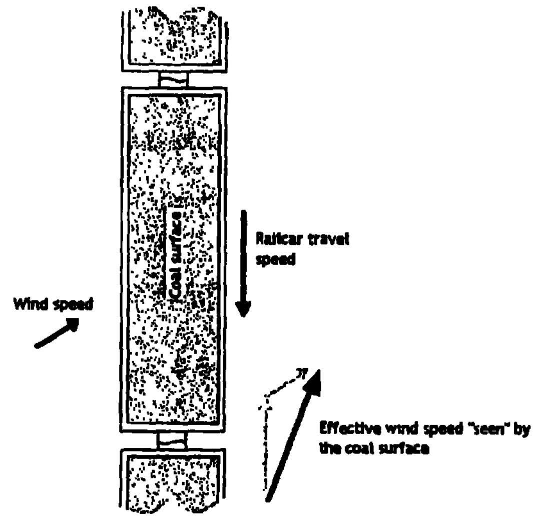


Figure 2. Combination of travel speed and ambient wind

Research into wind erosion and/or "aeolian processes" has been ongoing since at least the 1940s. It has long been recognized that not only are different-sized particles transported by different means (suspension, saltation and creep) but also that the movement of relatively large (~ 100 μm and larger) particles is necessary to initiate and to sustain wind erosion (Figure 3). Creep occurs when loose particles roll along the bed surface but never become airborne. Slightly smaller particles undergo saltation, a word whose Latin root means leaping or dancing. Saltation occurs when particles become airborne (up to a height of roughly 1 meter) and are carried a short distance before falling back on the bed surface. When the particles fall back, they dislodge smaller particles which can remain suspended in the air. Particles that are sufficiently small are transported by suspension and can travel a considerable distance away from their source.

In the context of coal blowing from rail cars, the movement of the car at 20 to 25 mph[3] is sufficient to initiate creep and saltation of large coal particles as well as suspension of smaller coal particles in the airstream. Saltating particles can travel from the forward cars down the length of the train, creating an "avalanche" of more and more suspended particles.

Once the train has left the vicinity of the monitoring location, the ambient winds control the dispersal of dust at the location. Large particles fall to the ground ("dustfall") while smaller particles remain suspended and are transported downwind. The large particles that settle to the ground are among those that may contribute to ballast fouling. Certain variables can increase the amount of material that is deposited. If coal is loaded above the top rails of the coal car, there is a greater surface area susceptible to wind erosion. Additionally, the surface profile of the coal load

[3] Threshold velocity information for western coal may be found in (a) Table 10-3 of the report entitled *Improved Emission Factors for Fugitive Dust From Surface Coal Mining Sources* (EPA-600/7-84-048) and (b) Table 13.2.5-2 in AP-42 Section 13.2.5 ("Industrial Wind Erosion") of EPA's *Compilation of Air Pollutant Emission Factors* (http://www.epa.gov/ttn/chief/ap42/ch13/index.html). Note also that, in more recent tests, I have used a real-time aerosol monitor to supplement my visual determination of the onset of erosion. Using this technique, I have determined coal threshold velocities as low as 17 mph.

can affect the amount of coal lost. Both loose coal on the sills or a higher coal surface will increase the chance that a saltating or creeping particle leaves the railcar and deposits onto the ground.

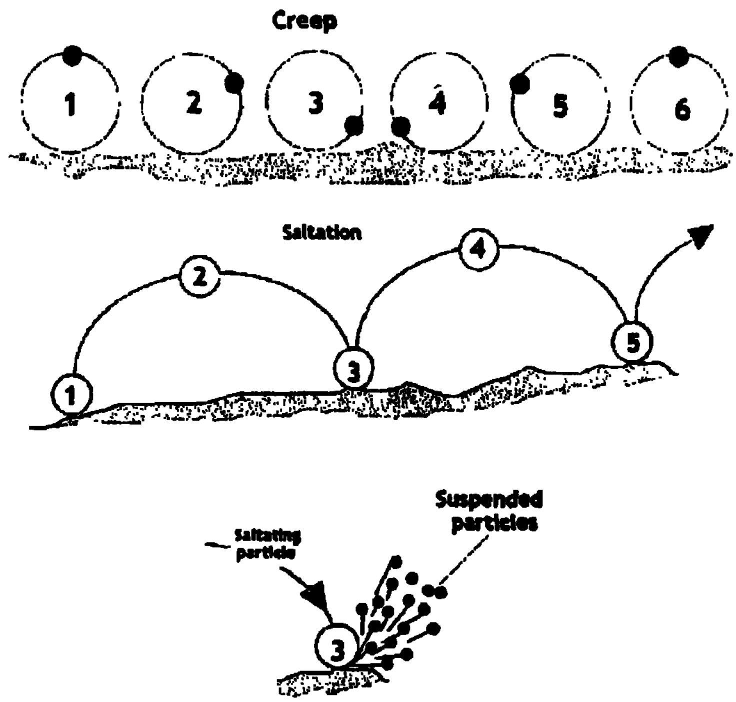


Figure 3. Means of coal dust particle transport

Track Side Monitoring by Met One E-Sampler

The Simpson Weather materials that I have reviewed describe various sampling programs instituted to detect and monitor fugitive coal dust from passing trains on the Joint Line rail corridor. I discussed general features of Track Side Monitoring (TSM) with SWA personnel during February 24, 2010 and March 9, 2010 telephone conversations. TSM equipment is mounted on a tower about 60 to100 ft east and west of the Joint Line tracks. This equipment includes Met One E-Sampler monitors. The E-Sampler is a real-time instrument for detecting suspended particles which enter the detector. The tower also contains a R. M. Young propeller anemometer to monitor wind speed and direction, temperature and relative humidity sensors, and a data logger. There is a precipitation gauge as well as several dustfall collectors nearby.

Towers are placed on both the East and West side of the Joint Line at mile marker 90.7. The location of the TSM at mile 90.7 was dictated by many factors including access to utility services, security, ease of maintenance as well as ambient conditions along the line. Furthermore, the towers could not interfere with access for necessary railway maintenance; for that reason, the towers needed to be located away from the tracks. MRI recognizes the need to balance competing requirements and has concluded that the location is reasonable for the testing performed. These factors are similar to the ones that MRI has considered in its location of field testing equipment.

Coal particles that deposit in the immediate vicinity of the tracks are much larger than those that remain suspended and can be captured by the E-Sampler 60 to 100 ft away. The larger particles fall in the vicinity of the track due to creep (in the case of overloaded cars where particles can simply roll out) and saltation (Figure 4)[4]. The smaller coal dust particles remain suspended in the airstream as a dust cloud which passes the E-Sampler (Figure 3).

Once particles become suspended in the airstream, ambient wind controls the direction and dispersion of the dust particles. Some fraction of the suspended dust may also deposit before reaching the TSM location. If a high concentration of suspended coal dust is detected at the TSM at the time of a passing train, then the larger particles (which were necessary to initiate and sustain erosion) will have deposited closer to the rail line as part of the same train passage event.

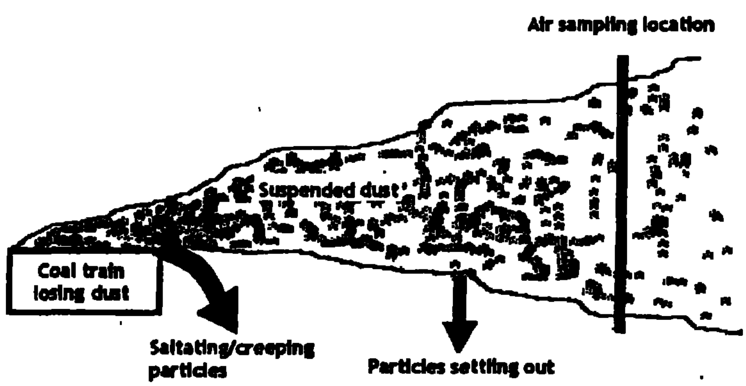


Figure 4. Coal dust dispersion by creep, saltation and suspension from moving coal cars.

---

[4] Gravitational settling velocity is described in Baron and Willeke, *Aerosol Measurement: Principles, Techniques and Applications*. For illustration in the context of trackside monitoring, the following terminal settling velocities are found for (assumed spherical) coal particles (with a density $\rho = 1.5$ g/cm^3):

Diameter (µm)	Terminal Velocity (cm/s)	Time (s) to Fall 14 ft *	Distance (ft) Traveled While Falling 14 ft *
50	11	40	600
100	45	9.5	140
150	100	4.3	63
200	180	2.4	35
250	280	1.5	22
300	410	1.0	,2

*Fall distance of 14 ft chosen to approximate height of railcar. Distance traveled estimate assumes a 10 mph horizontal wind.

The Integrated Dust Value

The Integrated Dust Value is a measurement developed by SWA to indicate the dust "signature" for a passing train as detected by the TSM. Of particular interest in my review was an evaluation of the scientific merits of the integrated dust value (IDV.2) developed from data collected by the TSM. SWA personnel have described the general approach used to calculate the IDV.2 to MRI. Essentially, the concentration of dust detected by the E-Sampler is integrated over time (after making allowances for the locomotives) to provide a single dust characterization for a passing train. The concept of integrating time data is common. Increases in IDV.2 should be correlated with increases in the amount of dust detected by the E-Sampler. Because (a) airborne dust at the sampling location is due to erosion of the coal surface and (b) large (saltating) particles are necessary for erosion, it is reasonable to assume that, with comparable wind conditions between any two events on the same track, the event with the higher IDV.2 value corresponds to more mass being deposited on the right-of-way.

Mitigation Techniques

There exist several viable methods to mitigate fugitive coal dust formation due to wind erosion. I draw upon my years of experience testing fugitive dust mitigation techniques applied to wind erosion of steam coals, metallurgical coals, petroleum coke, and other materials in open storage and/or rail cars.

Coal compaction is a valid means to control erosion. The Coleman report focuses on a specific version of this technique involving a vibratory roller. In my experience, less intensive compaction using a simple frame-mounted roller of the type shown in Figure 5a, may be just as effective in preventing coal losses.[5] Compaction reduces the surface area available for erosion and smoothes the surface to reduce shearing from the air. Another viable technique involves spraying the surface of the coal with a material that assists in crusting or binding loose material together. The effectiveness of spraying is likely to decrease because of weathering over a period of two to four days. Control due to compaction of the surface may also decrease over time. Covering the coal very effectively prevents wind erosion by isolating the coal surface from the wind.

Other methods of remediation have already been implemented to some degree. Recently, the method with which some coal is loaded into the cars was altered slightly to change the top profile of the bed from an angular load to a more bread loaf shape. The resulting load profile may lower dust generation. The inclusion of "non-erodible" elements has been shown to reduce erosion in storage piles and open areas

[5] The compaction roller shown in Figure 5a is the third station in a three-part process after load-out. The coal surface is first struck level with V-shaped implement. The surface is then sprayed with water (as seen in the background of Figure 5a) and finally compacted.

(a) (b)

Figure 5. Coal surface compacted by a frame-mounted roller.

Summary and Conclusions

Based on the materials reviewed and my own experience with coal dust experimentation and control, several conclusions can be drawn. A rail car filled with coal, traveling at or above 20-25 mph is susceptible to wind erosion resulting in coal dust being entrained into the airflow above the car. At a fixed TSM location, the larger coal dust particles will deposit on and around the track road bed while the smaller particles will remain suspended in the air and can travel toward the track side monitor. The general description of how the IDV.2 value is calculated appears to be a reasonable method to characterize airborne dust from a single train passage. Assuming comparable wind conditions for two events on the same track, one would reasonably expect that the event with the higher IDV.2 will result in more dust deposited. Finally, several viable and proven methods exist to mitigate fugitive coal dust from wind erosion, including covering, compaction, the application of suppressant/surfactant sprays, and profile modification.

Verification

I, Gregory E. Muleski, Ph.D., Principal Engineer with Midwest Research Institute, declare under penalty of perjury that the foregoing is true and correct to the best of my knowledge.

Executed on the 12th of March, 2010.

Gregory E. Muleski, Ph.D.

Document Reviewed by Dr. Muleski

Document Name	Bates Prefix	bates # from	bates # to
Summary of Data Analyses: BNSF and UP Study	BNSF_COALDUST_	20817	20851
Argus Coal Weekly (Volume 4, 28, 13 July 2007)	BNSF_COALDUST_	20596	20601
MP 90.7 TrackSide Monitor (TSM) (Orin Subdivision) Exceedance Trains Dust Report Summary	BNSF_COALDUST_	18326	18342
Monthly Rept on Activities Related to the Monitoring and Control of Fugitive Dust Emissions in the Powder River Basin for Burlington Northern Santa Fe Railway and Union Pacific Railroad (Covering period October - November 2006)	BNSF_COALDUST_	19741	19744
Monthly Rept on Activities Related to the Monitoring and Control of Fugitive Dust Emissions in the Powder River Basin for Burlington Northern Santa Fe Railway and Union Pacific Railroad (Covering period March 2007)	BNSF_COALDUST_	21611	21617
Monthly Rept on Activities Related to the Monitoring and Control of Fugitive Dust Emissions in the Powder River Basin for Burlington Northern Santa Fe Railway and Union Pacific Railroad (Covering period April 2007)	BNSF_COALDUST_	21710	21716
Monthly Rept on Activities Related to the Monitoring and Control of Fugitive Dust Emissions in the Powder River Basin for Burlington Northern Santa Fe Railway and Union Pacific Railroad (Covering period May 2007)	BNSF_COALDUST_	37225	37233
Monthly Rept on Activities Related to the Monitoring and Control of Fugitive Dust Emissions in the Powder River Basin for Burlington Northern Santa Fe Railway and Union Pacific Railroad (Coving period November 2007)	BNSF_COALDUST_	40149	40150
Monthly Rept on Activities Related to the Monitoring and Control of Fugitive Dust Emissions in the Powder River Basin for Burlington Northern Santa Fe Railway and Union Pacific Railroad (Covering period December 2007)	BNSF_COALDUST_	40203	40204
Monthly Rept on Activities Related to the Monitoring and Control of Fugitive Dust Emissions in the Powder River Basin for Burlington Northern Santa Fe Railway and Union Pacific Railroad (Covering period January 2008)	BNSF_COALDUST_	40710	40711
Monthly Rept on Activities Related to the Monitoring and Control of Fugitive Dust Emissions in the Powder River Basin for Burlington Northern Santa Fe Railway and Union Pacific Railroad (Covering period February 2008)	BNSF_COALDUST_	40721	40722
Monthly Rept on Activities Related to the Monitoring and Control of Fugitive Dust Emissions in the Powder River Basin for Burlington Northern Santa Fe Railway and Union Pacific Railroad (Covering period May 2008)	BNSF_COALDUST_	40400	40401
Monthly Rept on Activities Related to the Monitoring and Control of Fugitive Dust Emissions in the Powder River Basin for Burlington Northern Santa Fe Railway and Union Pacific Railroad (Covering period June 2008)	BNSF_COALDUST_	40425	40426

Document Name	Bates Prefix	bates # from	bates # to
Monthly Rept on Activities Related to the Monitoring and Control of Fugitive Dust Emissions in the Powder River Basin for Burlington Northern Santa Fe Railway and Union Pacific Railroad (Covering period July 2008)	BNSF_COALDUST_	40531	40532
Monthly Rept on Activities Related to the Monitoring and Control of Fugitive Dust Emissions in the Powder River Basin for Burlington Northern Santa Fe Railway and Union Pacific Railroad (Covering period August 2008)	BNSF_COALDUST_	57313	57314
Monthly Rept on Activities Related to the Monitoring and Control of Fugitive Dust Emissions in the Powder River Basin for Burlington Northern Santa Fe Railway and Union Pacific Railroad (Covering period September 2008)	BNSF_COALDUST_	57782	57783
Monthly Rept on Activities Related to the Monitoring and Control of Fugitive Dust Emissions in the Powder River Basin for Burlington Northern Santa Fe Railway and Union Pacific Railroad (Covering period October 2008)	BNSF_COALDUST_	57970	57971
Monthly Rept on Activities Related to the Monitoring and Control of Fugitive Dust Emissions in the Powder River Basin for Burlington Northern Santa Fe Railway and Union Pacific Railroad (Covering period November 2008)	BNSF_COALDUST_	57976	57977
Monthly Rept on Activities Related to the Monitoring and Control of Fugitive Dust Emissions in the Powder River Basin for Burlington Northern Santa Fe Railway and Union Pacific Railroad (Covering period December 2008)	BNSF_COALDUST_	58157	58158
Joint Line Map	BNSF_COALDUST_	3161	
Coal Compaction Report Coleman Aerospace	UP-AECCBN-	9825	9837
Shannon & Wilson 7-3-2008 (Native File)	UP-AECCBN-	10275	
Overview of UP Dustfall Collector Network along North Platte Division	UP-AECCBN-	6799	6807
Coal Dust Mitigation Test Nov. 15, 2007	BNSF_COALDUST_	43452	43509
Coal Dust Threshold Performance Stanadard Oct. 9, 2007	BNSF_COALDUST_	39332	39348
Coal Dust Performance Stanadard Sept. 6, 2007	BNSF_COALDUST_	1753	1760
Zeta - Tech January 2007	BNSF_COALDUST_	19747	19762
Coal Car Duct Reduction	BNSF_COALDUST_	20486	20510
National Coal Transportation Association 6-19-2007	BNSF_COALDUST_	37144	37148
NCTA Ballast Fouling Committee	BNSF_COALDUST_	22096	22102
BNSF 9532 11-2-05 (Native File)	BNSF_COALDUST_	22995	
BNSF 5729-2 (Native File)	BNSF_COALDUST_	22996	
BNSF 9902 (Native File)	BNSF_COALDUST_	22997	
UP 6053 11-3-05 (Native File)	BNSF_COALDUST_	23002	
UP 6498_2 11-3-05 (Native File)	BNSF_COALDUST_	23003	
UP 6530 11-2-05 (Native File)	BNSF_COALDUST_	23004	

Document Name	Bates Prefix	bates # from	bates # to
UP 6695 11-2-05 (Native File)	BNSF_COALDUST_	23005	
UP 6732 11-2-05 (Native File)	BNSF_COALDUST_	23006	
BNSF - UP Chemical Dust Suppression Agents Field Testing September 2005	BNSF_COALDUST_	64500	64505
BNSF - UP Coal Load Groomed Profile Field Testing September 2005	BNSF_COALDUST_	64150	64166
BNSF - UP Field Testing Passive Collec. & RTEPS Dusting Events Sum. May 7 2007	BNSF_COALDUST_	65206	65220
BNSF Coal Dust Detec. Equip. in Powder River Basin December 2007	BNSF_COALDUST_	43548	43564
BNSF Coal Dust Detec. Equip. in Powder River Basin July 2009	BNSF_COALDUST_	59322	59339
BNSF Coal Dust Detection Equip. in Powder River Basin October 2009	BNSF_COALDUST_	60192	60209
BNSF TrackSide Monitor Troubleshooting August 9 2009	BNSF_COALDUST_	59882	59902
BNSF-UP Fld. Test. pass. Collec. Bttm. Collec. &RTEPS Loss vs. Dis.Aug. 24 2007	BNSF_COALDUST_	21093	21122
Coal Car Load Profiling System (CCLPS) Update October 29 2009	BNSF_COALDUST_	60215	60224
Coal Dust Mitigation Testing Results & Performance Standard Nov. 15 2007	BNSF_COALDUST_	63755	63810
Descrip. of Impro. to BNSF-UP Trackside Mon Integ. Dust Val cal. log. Oct.9 2007	BNSF_COALDUST_	39361	39372
Dustfall Monitoring Network for the Orin Sub January 19 2007	BNSF_COALDUST_	21358	21367
Powder River Basin Fugitive Coal Dust on Orin Subdivision July 12 2007	BNSF_COALDUST_	37339	37353
Powder River Basin Fugitive Coal Dust oon Orin Subdivision April 16 2007	BNSF_COALDUST_	64275	64292
Test Equip. to Use during Jacobs Ranch Body Treat. In-tran. Dust Red.Fld.Test Ju	BNSF_COALDUST_	59267	59271
Update on dustfall at MP90 & MP558 (thru August 2006) September 8 2006	BNSF_COALDUST_	61280	61285
Proposed Improvements to BNSF/UP TrackSide Monitor Integrated Dust Value Calculation	BNSF_COALDUST_	20580	20591
Train 1_0002 (Native File)	BNSF_COALDUST_	22999	
Train 2_2 (Native File)	BNSF_COALDUST_	23000	
Train 3 with comparison graph_0006 (Native File)	BNSF_COALDUST_	23001	
Shannon & Wilson Jan. 2010	UP-AECCBN-	13428	13538
3.25.08email	BNSF_COALDUST_	62600	
3.27.08Qualtec	BNSF_COALDUST_	62612	62614
3.28.08 response	BNSF_COALDUST_	62615	
52808email	BNSF_COALDUST_	44408	
june1108email	BNSF_COALDUST_	62712	62713
6/2/2008	BNSF_COALDUST_	44417	44420
Qualtec3.25.08email	BNSF_COALDUST_	44109	44110
Qualtec 3.27.08	BNSF_COALDUST_	75990	75993
Smarter Solutions	BNSF_COALDUST_	75992	75925
SSinitial analysis	BNSF_COALDUST_	44409	44411
UP-AECCBN-0008024 (Native File)	UP-AECCBN-	8024	

Document Name	Bates Prefix	bates # from	bates # to
Public documents			
Improved Emission Factors for Fugitive Dust From Western Coal Mining Sources PB84170802			
TRB-09-2065 Huang et al - Publication Copy			
AREMA 2008 Conf Paper by Tutumluer et al			
EPA Coal PB284-297			
New Hampshire Study			
Subcommittee Coal study Virginia			
Environmental Progress			
Aerosol Measurement: Principles, Techniques and Applications, Baron and Willeke			
Pleadings			
10-22-09 Ltr to Anne K. Quinlin from John H. LeSeur			
BNSF Reply to AECC's Pet for Declaratory Order			
Pet of UP Railroad Co to Intervene			
Petition of AECC for a Declaratory Order			
Reply of UP Railroad Co to Western Coal Req for Leave to Intervene			

CERTIFICATE OF SERVICE

I hereby certify that on this 16th day of March, 2010, I have served a copy of the above Opening Evidence and Argument of Union Pacific Railroad Company and accompanying Verified Statements via Federal Express on the following parties of record:

John H. LeSeur
Slover & Loftus LLP
1224 17th Street, N.W.
Washington, D.C. 20036
Counsel for Western Coal Traffic League
jhl@sloverandloftus.com

(HIGHLY CONFIDENTIAL AND PUBLIC REDACTED VERSIONS.)

C. Michael Loftus
Slover & Loftus LLP
1224 17th St., N.W.
Washington, D.C. 20036
Counsel for Concerned Captive Coal Shippers
cml@sloverandloftus.com

(HIGHLY CONFIDENTIAL AND PUBLIC REDACTED VERSIONS.)

Frank J. Pergolizzi
Slover & Loftus LLP
1224 17th Street, N.W.
Washington, D.C. 20036
Counsel for Entergy Arkansas, Inc., Entergy Gulf States Louisiana, L.L.C., and Entergy Services, Inc.
fjp@sloverandloftus.com

(HIGHLY CONFIDENTIAL AND PUBLIC REDACTED VERSIONS.)

Sandra L. Brown
Thompson Hine LLP
1920 N Street, N.W., Ste. 800
Washington, D.C. 20036
Counsel for AES Shady Point, Inc., Ameren Energy Fuels and Services Company, and Texas Municipal Power Agency
Sandra.Brown@ThompsonHine.com

(HIGHLY CONFIDENTIAL PUBLIC REDACTED VERSIONS.)

Kelvin J. Dowd
Slover & Loftus LLP
1224 17th St, N.W.
Washington, D.C. 20036
Counsel for Consumers Energy Company
kjd@sloverandloftus.com

(HIGHLY CONFIDENTIAL AND PUBLIC REDACTED VERSIONS.)

Paul R. Hitchcock
CSX Transportation, Inc.
500 Water Street
Jacksonville, FL 32202
paul_hitchcock@csx.com

(PUBLIC REDACTED VERSION.)

Michael F. McBride
Van Ness Feldman, P.C.
1050 Thomas Jefferson Street, N.W.
Suite 700
Washington, D.C. 20007
Counsel for American Public Power Association, Edison Electric Institute, and National Rural Electric Cooperative Association
mfm@vnf.com

(HIGHLY CONFIDENTIAL AND PUBLIC REDACTED VERSIONS.)

G. Paul Moates
Sidley Austin LLP
1501 K Street, N.W.
Washington, D.C. 20005
Counsel for Norfolk Southern Railway Company
pmoates@sidley.com

(HIGHLY CONFIDENTIAL AND PUBLIC REDACTED VERSIONS.)

Samuel M. Sipe, Jr.
Steptoe & Johnson LLP
1330 Connecticut Avenue, N.W.
Washington, D.C. 20036
Counsel for BNSF Railway Company
ssipe@steptoe.com

(HIGHLY CONFIDENTIAL AND PUBLIC REDACTED VERSIONS.)

Eric Von Salzen
McLeod, Watkinson & Miller
One Massachusetts Avenue, N.W.
Suite 800
Washington, D.C. 20001
Counsel for Arkansas Electric Cooperative Corporation
evonsalzen@mwmlaw.com

(HIGHLY CONFIDENTIAL AND PUBLIC REDACTED VERSIONS.)

Paul Samuel Smith
U.S. Department of Transportation
1200 New Jersey Ave., S.E.
Room W94-316 C-30
Washington, D.C. 20590
Counsel for Department of Transportation
paul.smith@dot.gov

(HIGHLY CONFIDENTIAL AND PUBLIC REDACTED VERSIONS.)

Charles A. Steadman
L.E. Peabody & Associates, Inc.
1501 Duke Street
Alexandria, VA 22314

(HIGHLY CONFIDENTIAL AND PUBLIC REDACTED VERSIONS.)

Thomas W. Wilcox
GKG Law, P.C.
1054 Thirty-First Street, N.W.
Washington, D.C. 20007
Counsel for National Coal Transportation Association and TUCO Inc.
twilcox@gkglaw.com

(HIGHLY CONFIDENTIAL AND PUBLIC REDACTED VERSIONS.)

/s/ Joe Rebein
Attorney for Union Pacific Railroad Company