MORRISON | FOERSTER

2000 PENNSYLVANIA AVE., NW
WASHINGTON, D.C.
20006-1888

TELEPHONE: 202.887.1500
FACSIMILE: 202.887.0763

WWW.MOFO.COM

231739

January 25, 2012

Writer's Direct Contact
(202) 887-1519
DMeyer@mofo.com

VIA PAPER FILING

Cynthia T. Brown
Chief, Section of Administration
Office of Procedures
Surface Transportation Board
395 E Street, S.W.
Washington, D.C. 20423-0001

Re: ***Union Pacific R.R. – Petition for Declaratory Order – Finance Docket No. 35504***

Dear Ms. Brown:

Enclosed for filing in the above-referenced docket are an original and ten copies of the Opening Evidence and Argument of Norfolk Southern Railway Company, together with three compact discs containing electronic copies.

Please date stamp the extra copy provided and return it with our waiting messenger.

Thank you for your assistance.

Sincerely,

David L. Meyer /AV

David L. Meyer

Enclosures

cc (with attachment): David L. Coleman, Esq.
John M. Scheib, Esq.

dc-666270

231739

BEFORE THE
SURFACE TRANSPORTATION BOARD

RECEIVED
2012
MANAGEMENT
STB

STB Finance Docket No. 35504

UNION PACIFIC R.R. – PETITION FOR DECLARATORY ORDER

OPENING EVIDENCE AND ARGUMENT
OF
NORFOLK SOUTHERN RAILWAY COMPANY

ENTERED
Office of Proceedings
JAN 25 2012
Part of
Public Record

David L. Coleman
John M. Scheib
James A. Hixon
Norfolk Southern Railway Company
Three Commercial Place
Norfolk, VA 23510

David L. Meyer
Anand Viswanathan
Morrison & Foerster, LLP
2000 Pennsylvania Ave., N.W.
Washington, D.C. 20006

Attorneys for Norfolk Southern Railway Company

Dated: January 25, 2012

TABLE OF CONTENTS

EXHIBITS

Exh. 1: *CF Industries, Inc. v. Indiana & Ohio Ry., Point Comfort Ry., & Michigan Shore R.R.*, STB Finance Docket No. 35517, Opening Evidence of Dow Chemical Co. (Jan. 13, 2012)

Exh. 2: *Common Carrier Obligation of Railroads – Transportation of Hazardous Materials*, STB Ex Parte No. 677 (Sub-No. 1), Comments of Paul Orum (July 22, 2008) (attaching Center for American Progress study "Toxic Trains and the Terrorist Threat")

Exh. 3: Lewis M. Branscomb, et al., *Rail Transportation of Toxic Inhalation Hazards: Policy Responses to the Safety and Security Externality*, Harvard Kennedy School (Feb. 2010)

Exh. 4: Jonathan B. Tucker, *The Future of Chemical Weapons*, The New Atlantis, No. 26 (Fall 2009/Winter 2010)

Exh. 5: Theodore Karasik, *Toxic Warfare*, RAND (2002)

Exh. 6: "'Chlorine Bomb' Hits Iraq Village," BBC News (May 16, 2007), *available at* http://news.bbc.co.uk/2/hi/middle_east/6660585.stm (E

Exh. 7: *Common Carrier Obligation of Railroads – Transportation of Hazardous Materials*, STB Ex Parte No. 677 (Sub-No. 1), Written Testimony of Ass'n of American Railroads (July 10, 2008)

Exh. 8: *CF Industries, Inc. v. Indiana & Ohio Ry., Point Comfort Ry., & Michigan Shore R.R.*, STB Finance Docket No. 35517, Comments of American Chemistry Council (Jan. 13, 2012)

Exh. 9: *Common Carrier Obligation of Railroads – Transportation of Hazardous Materials*, STB Ex Parte No. 677 (Sub-No. 1), Written Statement of Dow Chemical (July 10, 2008)

Exh. 10: *Common Carrier Obligation of Railroads – Transportation of Hazardous Materials*, STB Ex Parte No. 677 (Sub-No. 1), Supplemental Comments of Agricultural Retailers Ass'n, et al. (Aug. 21, 2008)

Exh. 11: *Common Carrier Obligation of Railroads – Transportation of Hazardous Materials*, STB Ex Parte No. 677 (Sub-No. 1), Written Testimony of Union Pacific Railroad Co. (July 15, 2008)

Exh. 12: UPS Tariff/Terms and Conditions of Service for Package Shipments in the United States, § 3.8, *available at* http://www.ups.com/media/en/terms_service_us.pdf

Exh. 13: ABF Rules and Special Service Charges (ABF 111-AD) (July 25, 2011), Item 973: Transportation of Hazardous Materials or Substances, *available at* http://www.abfs.com/resource/ABF111/Items/item973.asp

Exh. 14: Matson Logistics, Inc., Customer Services Agreement, § 7, *available at* http://www.matson.com/logistics/pdf/Logistics_Terms_and_Conditions.pdf

Exh. 15: Rail-Bridge Corp. Rules Circular, Item 6, *available at* http://www.railbridge.com/Rules/Rail-Bridge-Rules-Circular_0500.asp

Exh. 16: FedEx Ground Tariff, p. 7, *available at* http://images.fedex.com/us/services/pdf/SG_GroundTariff_2012.pdf

Exh. 17: FedEx Hazmat Shipping Guide, at 1-3, *available at* http://images.fedex.com/us/services/pdf/HazmatShippingGuide.pdf

Exh. 18: Conway Tariff Item 180-30, *available at* https://www.con-way.com/en/truckload/_FileLibrary/PageFile/121/Rules_Tariff.pdf

Exh. 19: YRC, Tariff 100, Item 540 – Explosives and Other Dangerous Articles, *available at* https://my.yrc.com/dynamic/national/servlet?CONTROLLER=com.rdwy.ec.rexcommon.proxy.http.controller.PublicProxyController&redir=/TFD617&TAG=1TFA9402160904177600&DATE=01/18/2012

BEFORE THE
SURFACE TRANSPORTATION BOARD

STB Finance Docket No. 35504

UNION PACIFIC R.R. – PETITION FOR DECLARATORY ORDER

OPENING EVIDENCE AND ARGUMENT
OF
NORFOLK SOUTHERN RAILWAY COMPANY

Norfolk Southern Railway Company ("NS") submits this Opening Evidence and Argument in response to the Board's decision served December 12, 2011.

INTRODUCTION

This proceeding concerns the reasonableness of the indemnification provisions in Union Pacific's ("UP's") tariff for the movement of toxic-by-inhalation ("TIH") and poison-by-inhalation ("PIH") hazardous commodities (which for convenience we refer to collectively as "TIH" commodities). UP's tariff generally requires that a shipper indemnify UP for any liability associated with UP's transportation of the shipper's TIH commodity that is not caused by UP's negligence.

NS believes that UP's tariff provisions are unquestionably reasonable. Board precedent gives railroads "wide latitude" to adopt tariff provisions aimed at fostering safe and efficient transportation and recouping costs associated with the transportation services they provide to shippers. *See Nat'l Grain & Feed Ass'n v. Burlington Northern R.R. Co.*, 8 I.C.C.2d 421 (1992) ("*Nat'l Grain & Feed*"), *aff'd in part sub nom. Nat'l Grain & Feed Ass'n v. United States*, 5 F.3d 306 (8th Cir. 1993).

The need for such latitude is particularly great in the context of TIH commodities, which pose unique risks for the railroads that must transport them. TIH commodities are inherently dangerous because the commodities themselves are toxins and poisons. Unlike accidents that spill coal, steel, lumber and most other commodities, which can cause a mess on the right-of-way that has to be cleaned up, releases of TIH commodities can kill people. Deadly releases can result from acts of God, terrorist attack, motorist misconduct at grade crossings, and many other scenarios beyond the reasonable control of any railroad.

In this context, UP's indemnity provisions fall soundly within the scope of railroads' reasonable discretion. Although NS does not take the position that UP's tariff is the only acceptable approach, NS believes that approach is a reasonable one, for two primary reasons.

First, the significant liability risks addressed by UP's tariff are ones that the railroad cannot take reasonable steps to avoid. Those risks are inherent in these dangerous commodities and are imposed on railroads when shippers demand TIH transportation. It is entirely reasonable for railroads to allocate a portion of these liability risks to the shippers that create them. The Board has made clear that railroads do not have the option of avoiding these risks by refusing to transport TIH commodities on their networks. Shippers know these risks are real, and they seek to shift them to railroads as soon as they can by getting cars loaded with TIH commodities off their property, and onto railroad property, as quickly as possible.[1] When railroads move these commodities, they take extraordinary precautions today, and they would continue to do so even if shippers bore responsibility for liability risks that railroads cannot reasonably control. In this context, it is important to note that UP's indemnity provisions do not apply to liabilities caused by the railroad's negligence. As a result, UP's tariff provisions require only that shippers bear the inherent risks arising from their own choices to manufacture, use, and transport TIH commodities.

Second, UP's tariff provisions unquestionably foster safety and efficiency. Shippers' decisions affect the level of risks society faces from TIH transportation. For example, armed with the common carrier obligation, shippers have demanded that TIH commodities be shipped whenever and wherever they choose, without regard to the available, lower-risk options. In case after case, shippers have demanded that railroads move TIH commodities thousands of miles across their networks – and through population centers – when the same commodities could have been obtained from sources closer to the destination.[2] NS believes shippers (and their customers) are making

---

[1] *CF Industries, Inc. v. Indiana & Ohio Ry., Point Comfort Ry., & Michigan Shore R.R.*, STB Finance Docket No. 35517 ("FD 35517"), Opening Evidence of Dow Chemical Co. (Jan. 13, 2012) ("Dow FD 35517 Evidence") (Exh. 1 hereto) at 24.

[2] For example, in Finance Docket No. 35219, a manufacturer of chlorine demanded that it be moved over 1,000 miles to destinations in Texas and Louisiana, despite the fact that there were alternative sources closer to these destinations. *Union Pacific R.R. — Petition for Declaratory Order*, STB Finance Docket No. 35219 (served June 11, 2009) at 1-2. UP's evidence in that proceeding showed that "the facilities in both Allemania and Plaquemine [Louisiana] have alternate chlorine sources accessible by rail within 70 miles without routing through any [high-threat urban areas ("HTUAs")], and that the facilities in Houston and Dallas have alternative chlorine sources within 300 miles (with potential sources located in the Houston metropolitan area) that would not require transport through other HTUAs or large cities." Similarly, in the pending *Canexus* proceeding, a manufacturer of chlorine is demanding rail service for a

(footnote continued on next page ...)

decisions about the use and transportation of TIH commodities that are not optimal for society because they have no incentive to internalize the risks associated with moving TIH commodities long distances across the Nation's rail network. UP's tariff serves the public interest by reasonably providing shippers with incentives to consider a subset of these risks when they demand TIH transportation.

I. THE LEGAL STANDARD REQUIRES THAT UP'S TARIFF BE REASONABLE, NOT PERFECT

The Board commenced this proceeding to determine whether indemnification provisions of the sort UP has included in its tariff are within the range of a rail carrier's discretion to impose reasonable conditions on the transportation of highly-dangerous TIH commodities. UP's Petition proceeds from the premise that railroads may not turn down a shipper's request to move TIH commodities between any origin and any destination. *See* UP Petition, at 7. Under 49 U.S.C. § 11101(a), however, the railroads' common carrier obligation to move TIH commodities upon reasonable demand does not foreclose carriers from imposing reasonable terms and conditions on such transportation. *Union Pacific R.R. – Petition for Declaratory Order*, STB Finance Docket No. 35219 (served June 11, 2009) at 3 n.12; *see also Common Carrier Obligation of Railroads – Transportation of Hazardous Materials*, STB Ex Parte No. 677 (Sub-No 1) (served Apr. 15, 2011) at 4 n.8.

(... footnote continued from previous page)

movement of thousands of miles from North Vancouver, British Columbia to destinations in Arkansas. Illinois, and eastern Texas, despite the fact that there are alternative sources much nearer than British Columbia. *See Canexus Chemicals Canada L.P. v. BNSF Ry. – Emergency Service Order*, STB Finance Docket No. 35524 (served Oct. 14, 2011) at 1.

The reasonableness of a railroad's terms and conditions is judged under 49 U.S.C. § 10702. It is well established that carriers have flexibility to establish any terms that are "reasonable" under the circumstances, and they may adapt those terms "in response to changing circumstances." *Arkansas Electric Coop. Corp. – Petition for Declaratory Order*, STB Finance Docket No. 35305 (Mar. 3, 2011) at 11. Board precedent gives railroads "wide latitude" to adopt tariff provisions aimed at fostering safe and efficient transportation and recouping costs associated with the transportation services they provide to shippers. *See Nat'l Grain & Feed*, 8 I.C.C.2d at 434 (approving car cancellation penalty as "a reasonable response to a real problem"); *see also N.A. Freight Car Ass'n v. BNSF Ry.*, STB Docket No. 42060 (Sub-No. 1) (served Jan. 26, 2007) ("Promotion of cost recovery and efficient equipment utilization are not unreasonable purposes.").

The Board is not being asked in this proceeding to *prescribe* any railroad terms or conditions. The Board therefore need not and should not find that the indemnification provisions in UP's tariff reflect the *only* approach railroads may take to address the extraordinary risks associated with the transportation of TIH commodities. UP's indemnification provisions are surely *one reasonable approach* for dealing with these issues, but they are only one such approach. There may well be other approaches, some of which may be superior in certain respects. In evaluating the reasonableness of UP's tariff, NS urges the Board to give railroads the latitude they need. The quest for perfection should not be an obstacle to incremental progress.

II. THE BOARD SHOULD EXERCISE ITS AUTHORITY TO PROVIDE GUIDANCE ON THE REASONABLENESS OF INDEMNIFICATION PROVISIONS SUCH AS THOSE IN UP'S TIH TARIFF

The question raised in this proceeding is a narrow one that is squarely within the Board's authority to resolve. The Board "has jurisdiction to determine whether the terms and conditions under which railroads transport TIH material are reasonable." *Union Pacific R.R. – Petition for Declaratory Order*, STB Finance Docket No. 35219 (served June 11, 2009) at 3 n.12 (citing *Consolidated Rail Corp. v. ICC*, 646 F.2d 642 (D.C. Cir. 1981); *Akron, Canton & Youngstown R.R. Co. v. ICC*, 611 F.2d 1162, 1169 (6th Cir. 1979)). The Board should exercise that jurisdiction here to find that UP's tariff provisions regarding indemnification for the transportation of TIH commodities are reasonable.

The Board should not be deterred by the possibility that its ruling might not resolve every issue associated with the indemnification UP's tariff requires. For example, as shippers pointed out in Ex Parte No. 677 (Sub-No. 1), indemnification provisions contained in a railroad tariff would have to be enforced in the courts. NS believes that UP's indemnification provisions raise no enforcement issues,[3] but, as the Board explained in its decision commencing this proceeding, "UP ... does not seek a ruling from the Board regarding enforceability under state tort law, but rather the reasonableness of its tariff provisions under 49 U.S.C. § 11101 and 49 U.S.C. § 10702. ... [T]here is no reason why the Board should not resolve the ICA challenge, a matter

[3] *E.g.*, *Dwyer v. Goldman Sachs Headquarters LLC*, -- F. Supp. 2d --, 2011 WL 3629192, at *8 (S.D.N.Y. 2011) (no bar to enforcement of an indemnification provision where the parties seeking indemnification were not negligent).

committed to the Board's primary jurisdiction." *See, e.g., Pejepscot Indus. Park, Inc. v. Maine Cent. R.R.*, 215 F.3d 195, 205-06 (1st Cir. 2000)."[4]

III. UP'S TARIFF PROVISIONS ARE REASONABLE AS A MEANS OF ALLOCATING THE EXTRAORDINARY BUT HARD-TO-QUANTIFY RISKS THAT RAILROADS FACE WHEN THEY MUST TRANSPORT TIH COMMODITIES

UP's indemnification provisions are a reasonable means of allocating to shippers (at most) a portion of the *actual liability risks* that a railroad is required to bear as a result of shipper decisions to demand transportation of inherently dangerous TIH commodities. Board precedent has consistently allowed railroads to establish terms and conditions of service that are designed to allocate to shippers the burdens associated with the common carrier rail service those shippers demand. *See, e.g., N.A. Freight Car Ass'n v. BNSF Ry.*, STB Docket No. 42060 (Sub-No. 1) (served Jan. 26, 2007) (carrier's storage charges were reasonable because "they compensate the railroad for use of its assets (*i.e.*, the space on its track or at its yards)").

Tariff provisions are especially appropriate (and reasonable) when they seek to allocate burdens to the specific shippers whose service creates those burdens, rather than spreading those burdens across a broader group of shippers. *Cf. PPL Montana, LLC v. The Burlington Northern & Santa Fe Ry.*, STB Docket No. 42054 (served Mar. 24, 2003) at 5 (rate reasonableness principles "provide[] for cost sharing (the grouping of traffic to share the joint and common, *i.e.*, unattributable, costs of providing rail service), but

---

4 Shippers who challenged the Board's authority to adopt the liability limitations proposed by AAR in Ex Parte No. 677 (Sub-No. 1) acknowledged that the Board does have authority to decide the reasonableness of a carrier's proposed tariff provisions. *See, e.g., Common Carrier Obligation of Railroads – Transportation of Hazardous Materials,* Ex Parte No. 677 (Sub-No. 1) ("EP 677-1"). Comments of Westlake Chemical Corp. (July 10, 2008), at 9-10.

denounce[] cross-subsidization (the recovery of a shipper's attributable costs from other shippers").

UP's indemnification provisions reasonably further this objective without diminishing the care that UP is required to take when it transports TIH commodities, and without imposing on shippers any burdens that are not inherent in the risks posed by their decisions to transport these dangerous commodities.

A. UP Has Acted in the Face of Very Real and Unique Risks Associated with Transporting TIH Commodities

There is no room for serious debate about the unique dangers posed by TIH commodities, and the potentially catastrophic consequences of an unintentional release of any TIH commodity anywhere or anytime, including while it is being transported by rail. TIH commodities are not like other commodities, spillage of which may be messy and costly, but not deadly. The record is replete with evidence of the extreme dangers associated with releases of TIH commodities, some of which have been used in wartime as weapons of mass destruction.[5] Accidental releases of TIH commodities in the United States have taken lives and caused injury even when they took place in remote rural

---

[5] *See, e.g.*, EP 677-1, Comments of Paul Orum (July 22, 2008) (attaching Center for American Progress study "Toxic Trains and the Terrorist Threat") ("Orum EP 677-1 Comments") (Exh. 2 hereto); Lewis M. Branscomb, et al., *Rail Transportation of Toxic Inhalation Hazards: Policy Responses to the Safety and Security Externality*, Harvard Kennedy School (Feb. 2010) ("Branscomb Study") (Exh. 3 hereto) at 23-27; Simon Jones, *World War I Gas Warfare Tactics and Equipment* (2007) (discussing extensively the use of chlorine as weapon in World War I): Jonathan B. Tucker, *The Future of Chemical Weapons*, The New Atlantis, No. 26 (Fall 2009/Winter 2010) (Exh. 4 hereto) at 4-5, 13-14, 26-28; Theodore Karasik, *Toxic Warfare*, RAND (2002) (Exh. 5 hereto) at 21-22; "'Chlorine Bomb' Hits Iraq Village," BBC News (May 16, 2007), *available at* http://news.bbc.co.uk/2/hi/middle_east/6660585.stm (Exh. 6 hereto).

areas.[6] Fortunately, the Nation has thus far been spared a release in a highly populated area, such as that which took the lives of thousands in Bhopal, India in 1984. Such a release likely would cause extensive loss of life. No matter what caused such a calamity – whether an accident, an act of God, or a terrorist attack – the railroad transporting the TIH commodity would face enormous potential liability even if there was nothing it realistically could have done to prevent the release.

B. Railroads Cannot Avoid the TIH-Related Risks to Which UP's Indemnity Provisions Apply – They Are Already Doing All They Can to Prevent Releases of TIH Commodities and They Will Continue to Do So

The liability risks addressed by UP's indemnification provisions are ones that railroads cannot take reasonable steps to avoid. UP's tariff provisions do not allocate to shippers any risks that are not actually and inevitably created by the danger inherent in the TIH commodity that the federal government requires railroads to transport. *See* 49 U.S.C. § 11101(a); *Union Pacific R.R. – Petition for Declaratory Order*, STB Finance Docket No. 35219 (served June 11, 2009). Given the magnitude of the risks associated with transporting TIH commodities, NS and other railroads have and will continue to have every incentive to exercise the utmost care when they are required to provide such transportation. Indemnification of the sort UP's tariff requires would not lead railroads to behave any less safely.

---

[6] *See* EP 677-1, Written Testimony of Ass'n of American Railroads (July 10, 2008) ("AAR EP 677-1 Testimony"), at 16-17 (describing fatalities and injuries caused by TIH releases in Graniteville, SC; Minot, ND; and Macdona, TX) (Exh. 7 hereto); Branscomb Study (Exh. 3) at 5, 16-21.

First, the federal government has established an extensive array of detailed regulatory mandates addressing the safe handling of TIH commodities. Dow and the American Chemistry Council ("ACC") have detailed in Finance Docket No 35517 the extensive federal regulatory mandates imposed by FRA, TSA, PHMSA, and other agencies when shippers insist that railroads transport TIH commodities.[7] In the ACC's words, "the regulations governing the rail transportation of TIH commodities are comprehensive and have been developed over a nearly 100 year period."[8] That extensive regulatory regime governs myriad railroad practices involving TIH transportation, including how to route trains, how to interchange TIH cars with other railroads; how to monitor TIH cars when they are not moving; where to place TIH cars in a train; the type of train control system to use beginning in 2015 when moving TIH shipments; and many more.[9] Railroads must comply with these regulations whether or not they are exposed to tort liability for TIH-related releases.[10]

---

7 *See* FD 35517, Comments of American Chemistry Council (Jan. 13, 2012) ("ACC FD 35517 Comments") (Exh. 8 hereto) at 4; Dow FD 35517 Evidence") (Exh. 1) at 11-14; AAR EP 677-1 Testimony at 12, 27-28 (Exh. 7).

8 ACC FD 35517 Comments (Exh. 8) at 4. ACC cites no authority for the "100 year" history of these regulations, but there is no question that they are both extensive and comprehensive.

9 *See e.g.*, 49 C.F.R. Parts 171-180; 49 C.F.R. Parts 200-244; 49 C.F.R. 1580; The Rail Safety and Improvement Act of 2008, Pub. L. No. 110-432, Sec. 104(a), 122 Stat. 4848, 4856-57 (enacted Oct. 16, 2008) (requiring Positive Train Control PTC installation). The Board has previously relied on this extensive regulatory framework in ruling that railroads may not refuse TIH shipments. *See Union Pacific R.R. – Petition for Declaratory Order*, STB Finance Docket No. 35219 (served June 11, 2009) at 5-6 ("DOT states that it has developed and enforces a 'comprehensive regulatory framework applicable to the rail transportation of hazardous materials,' which 'effectively mitigate[s] the safety risk associated with rail transportation of hazardous materials.' Similarly, TSA states that, along with DOT, it has 'established comprehensive regulatory programs to address' the safety and security risks of transporting

(footnote continued on next page ...)

Second, from NS's perspective the potential for tort liability is only one of the many harms a railroad would suffer in the event of a TIH-related calamity on its rail network. Such an event would threaten the lives of NS's employees and neighbors, it would disrupt the rail operations upon which NS's success depends, and it could prompt a legislative or regulatory backlash that might impose untold burdens on NS and other railroads. Indemnification is a step forward, but would not fully compensate for these harms. As a result, so long as railroads remain legally obligated to transport TIH commodities in their trains, they will take extraordinary steps to avoid any TIH-related catastrophe regardless of the degree to which they face potential tort-related liability.

Third, UP's indemnification provisions do not eliminate the railroad's exposure to potentially significant tort liability for TIH-related incidents. UP has opted to exclude from its indemnification provisions liability arising from the railroad's own negligence.

(... footnote continued from previous page)

chlorine by rail, and that '[w]hen rail shipments conform to the TSA and DOT regulations, the risks of transporting chlorine by rail are appropriately mitigated and such movements can take place without posing unnecessary safety and security risks.'").

[10] NS is not content merely to comply with these extant federal regulations. If there are other reasonable and efficient steps that would further reduce the risks of a TIH commodity release, NS is eager to explore them. Tragically, many shippers have resisted efforts by railroads to adopt additional safeguards against accidental releases of TIH commodities. Shippers have argued that the extensive regime of safety regulations applicable to rail transportation of TIH commodities ensure that railroads take an adequate level of care. *See* Dow FD 35517 Evidence at 11-14 (Exh. 1). Shippers should not be permitted to take a contrary position in this proceeding. Specifically, shippers should be estopped from arguing here that railroads would exercise insufficient care in their rail operations in the event TIH shippers were required to bear some portion of the potential liability associated with TIH releases that are not caused by railroad negligence. Such a position would be both wrong and disingenuous in light of the positions shippers have taken in demanding TIH transportation.

See UP Tariff 6607, Item, 50-D(1); 60-D.[11] Under UP's provisions – or any that retained liability for certain types of incidents or in the event of culpability on the railroads' part[12] – railroads would have no assurance that they would be "held harmless" in the event of any catastrophic release. As a result, they would retain strong incentives to do anything they could – regardless of the likelihood they would be found culpable – to avoid such an event.

C. UP's Indemnification Provisions Are a Reasonable Approach to Allocating TIH-Related Liability-Related Risks

It is entirely reasonable for railroads to seek to allocate some portion of these inherent TIH transportation risks to the shippers whose demands for service create them. Indemnification is a reasonable means of achieving this objective. In the somewhat analogous context of liability risks created by Amtrak's demand to operate trains carrying passengers on trackage owned by a freight railroad – where the presence of those passengers imposes attendant risks of liability in the event they are injured or killed in a rail accident – the Board has recognized that risks of "liability for residual damages arising out of Amtrak operations is an incremental cost for which [the railroad] is entitled to compensation." *Amtrak-Springfield Terminal* at 160. In that decision, the Board also concluded that it was not practical to calculate the precise dollar amount of compensation

---

[11] UP's tariff expressly provides that indemnification will not apply to any "arising from railroad's sole negligence or fault in the performance of transportation services" or, in the case of liabilities arising from the fault or both the railroad and its customer, any liabilities "allocated to the railroad in proportion to railroad percentage of responsibility."

[12] The Board has previously required indemnification for all liabilities except those caused by the carrier's "gross negligence or willful and wanton misconduct." *Application of the National Railroad Passenger Corp. under 49 U.S.C. 24309(a) – Springfield Terminal Ry., Boston & Maine Corp. & Portland Terminal Co.*, 3 S.T.B. 157, 162 (1998) ("*Amtrak-Springfield Terminal*").

"necessary to cover the risk of residual damages," and so ordered Amtrak to either "fully indemnify" the railroad or "purchase appropriate insurance to cover [the railroad's] assumption of liability for *all* such losses (*i.e.*, without deductibles or low caps)." *Id.* at 161.

UP's indemnification approach is likewise a reasonable one in the context of TIH shipments. First, TIH-related liability risks are a real burden imposed by the shipping decisions of TIH shippers. NS operates trains carrying hundreds or thousands of different commodities every day. TIH shipments account for less than one percent of NS shipments, but transporting them creates vastly disproportionate risks for NS. NS recognizes that presently the common carrier obligation requires that railroads transport TIH commodities upon demand.[13] But honoring that obligation should not require railroads to bear uncompensated burdens. Requiring indemnification from these shippers goes part of the way – though only part – towards allowing railroads *to avoid* risks that are not created by their own shipping decisions, while still providing the TIH transportation services that shippers demand.

Second, to date the Board has not provided guidance on how, if at all, its rate regulatory regime will account for these TIH-related liability risks.[14] The regime must do that if it is to fully compensate railroads for the transportation they provide shippers. In

---

[13] As noted below, many transportation providers who have the option refuse outright to participate in the transportation of TIH commodities. *See* pages 26-27, below. Railroads do not have that privilege.

[14] *See* Branscomb Study (Exh. 3) at 15 ("[T]he current regulatory scheme means that the risks of carrying a product that could cause billions of dollars in damage and impose potentially huge liability on a railway in the event of a release are rarely reflected adequately in rail transportation rates.").

the meantime, UP's indemnification approach militates against this problem; it allocates a portion of that risk that is most clearly attributable to a particular shipper's transportation and that arises because of the inherently hazardous and deadly characteristics of TIH commodities.

Third, as in the *Amtrak-Springfield Terminal* decision, the potential for railroads to obtain insurance against potential TIH-related liabilities is unrealistic and unsatisfactory as a way of covering these risks. NS is self-insured to a meaningful degree, and it therefore always bears the risk that a TIH release will result in an uninsured loss. *See Amtrak-Springfield Terminal* at 160 ("the fact that [the railroad] chooses to self-insure for a portion of its own operations does not mean that it should assume the same liability for Amtrak's operations"). Moreover, the amount of insurance available in the market to a railroad is limited,[15] and to the extent insurance is available it is not specific to TIH-related events. Insurance that TIH shippers would obtain would be far more focused on potential liabilities associated with TIH releases, and would more accurately reflect those costs. Under these circumstances, indemnification – possibly backed up by insurance shippers might choose to obtain to cover these risks – is a reasonable approach.

IV. UP's Indemnification Provisions Give Shippers Appropriate Incentives to Act Responsibly and Take into Account Some of the Risks Associated with TIH Transportation

UP's indemnification provisions are reasonable not merely because they provide for a partial allocation to shippers of the actual liability risks that railroads must bear

---

[15] *See* AAR EP 677-1 Testimony (Exh. 7) at 21.

when they transport TIH commodities. Those provisions are also reasonable because they provide efficient and socially beneficial incentives for shippers (and the customers of those shippers who consume TIH commodities) to consider the risks associated with transporting TIH commodities. Presently, shippers do not bear the full liability risks associated with their decisions to place TIH commodities on the Nation's rail network, and thus lack socially optimal incentives to minimize both the volume of those shipments and the distance those commodities must be transported.

The Board has routinely upheld as reasonable tariff provisions that require cost-effective and commercially reasonable steps that promote safety and efficiency.[16] Under the standard applied in the Board's cases, UP's tariff provisions are plainly reasonable. They are a "reasonable response to a real problem:"[17] the calamitous risks to the public associated with a release of TIH commodities. The only way to prevent those harms is "containment" – *i.e.*, avoiding such releases in the first place. As the Board held in *Arkansas Electric*, where a substance (coal dust) far less dangerous than TIH commodities was involved, steps designed to avoid such releases are reasonable even if "increased revenues have covered the increased costs" associated with a release. That is

---

16 Most recently, in *Arkansas Electric Coop. Corp.—Petition For Declaratory Order*, STB Docket No. FD 35305 (served Mar. 3, 2011) at 9, the Board explained that "coal dust containment efforts that are appropriately calculated to produce reliable and efficient service [are] reasonable." *See also, e.g., N.A. Freight Car Ass'n v. BNSF Ry.*, STB Docket No. 42060 (Sub-No. 1) (served Jan. 26, 2007) (finding storage charges reasonable in part because "they encourage more efficient use of freight cars on its system"); *Nat'l Grain & Feed*, 8 I.C.C.2d at 434 (approving car cancellation penalty as "a reasonable response to a real problem: overbooking of cars. . . . [O]verbooking distorts the true demand for railcars and makes it impossible to plan and manage its car supply properly.").

17 *Nat'l Grain & Feed*, 8 I.C.C.2d at 434.

because railroads have leeway to take actions designed to minimize the "risk of harm to the environment," and "containment is the only way to protect the environment and communities along the right of way." *Id.* at 9. Far more clearly than with coal dust, preventing releases of TIH commodities is an appropriate goal of railroad tariff provisions.

A. Shipper Decisions Play a Role in Level of TIH Risks

There is no doubt whatsoever that the decisions of TIH shippers and the customers they supply play a key role in determining the level of risk associated with the transportation of TIH commodities on the Nation's rail network. Even when everyone involved has taken all reasonable steps to prevent an accidental (or attack-related) release from occurring, the movement of TIH commodities on the Nation's rail network involves inherent risks that an accident caused by a third party, an act of God, or a terrorist attack will result in a catastrophic release. The shippers (and their customers) who decide to make, use, and ship TIH commodities directly affect the level of those risks by determining how often and how far TIH commodities must travel on the rail network:

- The decisions of shippers and their customers determine the shipping patterns of TIH commodities, and in turn the need for TIH commodities to travel long distances by rail and traverse the urban areas where a TIH release would cause the most harm. When a receiver decides to buy from a seller thousands of miles away instead of one nearby, it creates more risks than necessary. When a seller decides to ship its TIH commodity to a far-away customer rather than arranging to obtain the commodity through a swap agreement with a producer closer to the destination, it generates unnecessary risk. As Dow explained, the "number of TIH movements" and the "miles traveled per movement" directly affect the level of risk, and in turn "can be affected by shipper sourcing decisions."[18]

- The decisions of shippers and their customers also determine whether TIH commodities need to be transported at all. When the user of a TIH commodity decides to continue buying that commodity (and having it delivered by rail) instead of switching to available alternatives that are safer to transport, it generates unnecessary risk.[19]

As a 2010 study of TIH-related transportation risks by Harvard's Kennedy School of Government concluded, "[t] he most desirable solution in preventing chemical releases is to reduce or eliminate the hazard where possible, not to control it. This can be achieved by modifying processes where possible to minimize the amount of hazardous material used, replace a hazardous substance with a less hazardous substitute, or minimize transportation by co-locating production and use." Branscomb Study (Exh. 3) at 57. Only shippers (and their customers) can achieve this goal.

---

[18] EP 677-1, Written Statement of Dow Chemical (July 10, 2008) ("Dow EP 677-1 Statement") (Exh. 9 hereto) at 2 (shippers can reduce risks by redesigning their supply chains); *see also, e.g.*, footnote 2 above; EP 677-1, Supplemental Comments of Agricultural Retailers Ass'n, et al. (Aug. 21, 2008) (Exh. 10 hereto) at 28-29 (acknowledging that "TIH shipping community" can "reduce the risk of TIH transportation by rail" by "tak[ing] steps to reduce the route-miles traveled by TIH materials"); Orum EP 677-1 Comments (Exh. 2); EP 677-1, Written Testimony of Union Pacific Railroad Co. (July 15, 2008) ("UP EP 677-1 Testimony") (Exh. 11 hereto) at 8-9; AAR EP 677-1 Testimony (Exh. 7) at 23.

[19] Dow EP 677-1 Statement (Exh. 9) at 2 (shippers can reduce risks by evaluating ways to convert highly hazardous products to less hazardous derivatives); UP EP 677-1 Testimony (Exh. 11) at 6-8; AAR EP 677-1 Testimony (Exh. 7) at 21-23; Orum EP 677-1 Comments (Exh. 2); Branscomb Study (Exh. 3) at 57.

And those decisions are beyond the control of the railroads that must transport TIH commodities on demand. Railroads are not allowed to refuse tendered shipments based on their view that a move between a particular origin and destination is unnecessarily long, would unnecessarily require movement through dense population centers, or would necessitate the use of relatively light-density lines. *See Union Pacific R.R. – Petition for Declaratory Order*, STB Finance Docket No. 35219 (served June 11, 2009) at 5-6. These are decisions that the Board effectively has left with the shipper.

B. UP's Indemnification Provisions Give Shippers Appropriate Incentives to Internalize the Costs of their Shipping Decisions

It is in the public interest – and certainly reasonable – for these shippers (and their customers) to have reasonably calibrated incentives to make decisions that reflect the inherent risks of shipping TIH commodities by rail. The Board should advance the public interest by approving UP's reasonable indemnification provisions. Those provisions spell out for TIH shippers that they will bear some portion of any TIH-related liability imposed on the railroad for events outside of the railroad's control and that arise from the inherent characteristics of TIH commodities. That obligation will give these shippers reason to take cost-effective steps to reduce those risks. Shippers will in turn reflect these liability risks in the prices they charge to their customers, perhaps by charging customers located farther away higher prices than others to reflect the additional shipping risks. And the incentives created by UP's indemnification obligation will never be excessive, since UP's tariff would not allocate to the shipper any risk beyond the actual liabilities that might be imposed on the railroad when it is forced to transport the shipper's TIH commodity.

It is well established that parties in a position to affect the risk (*i.e.*, the externalities) that society faces from some activity – here TIH transportation – will not make optimal decisions unless they bear the risks their decisions create. As the 2010 study by Harvard's Kennedy School concluded, "[a] key obstacle to minimizing the risks of TIH products is that the external costs of risk are not included in the decision making process of the supply chain participants." This principle led the authors to suggest, as their "first action recommended[,] that the supply chain participants should estimate the cost of risk and internalize it into the price of their products." Branscomb Study (Exh. 3) at 65; *see also id.* at 29. This point is one of general application. *See, e.g.*, Guido Calabresi, *The Costs of Accidents: A Legal and Economic Analysis*, at 70 (1970) ("Failure to include accident costs in the prices of activities will, according to the theory, cause people to choose more accident-prone activities than they would if the prices of these activities made them pay for these accident costs, resulting in more accident costs than we want."); A. Mitchell Polinsky and Steven Shavell, *The Uneasy Case for Product Liability*, 123 Harv. L. Rev. 1437, 1460 (April 2010) ("[B]y causing the prices of products to properly reflect accident risks, product liability will lead consumers to purchase the socially ideal quantities of risky products.").

As such, shippers should bear the risk of liability arising from the rail transportation of TIH commodities that their shipping decisions create. Given the difficulty railroads would have reflecting those risks in the freight rates they charge (*see* page 18 above), an approach that allocates those risks through indemnification is efficient and certainly reasonable. *Cf. Amtrak-Springfield Terminal* at 161.

The reasonableness of UP's tariff provisions does not turn on whether in response any particular shipper would (or should) make any particular change in its activities so as to reduce the risk of TIH-related liability. The point is that those shippers would have better incentives to make the right, socially-optimal decisions when they demand TIH transportation.

V. Indemnity Provisions Are Commonplace When Hazardous Commodities are Transported by Other Unregulated Modes

The reasonableness, efficiency, and "commercial availability"[20] of indemnification provisions is confirmed by the fact that unregulated transporters of hazardous materials, and specifically TIH commodities, routinely demand that shippers of those commodities share the liability risks associated with potential accidents and releases.[21] Commercial practices in unregulated transportation settings – where transportation service providers are not encumbered by the common carrier obligation and regulation of their rates and practices –illustrate efficient, market-driven allocations of risk in the transportation of hazardous commodities. Many transportation providers that do not expressly prohibit shipment of TIH commodities are unwilling to do so unless shippers indemnify them for *all* liabilities associated with such transportation, even those that may arise from negligence on the carrier's part. For example, UPS's standard tariff provides: "The shipper agrees to indemnify, defend, and hold harmless UPS, its parent corporation, and affiliated companies, their officers, directors, employees, agents, and

---

20 *Arkansas Electric* at 5.

21 In addition, as noted above, the Board itself has required indemnification when railroads are forced to allow Amtrak to carry passengers on their lines, thereby imposing elevated risks of liability. *Amtrak-Springfield Terminal* at 160; *see* pages 17-18, above.

their successors and assigns, from all claims, demands, expenses (including reasonable attorney's and consultants' fees), liabilities, causes of action, enforcement procedures, and suits of any kind or nature brought by a governmental agency or any other person or entity *arising from or relating to the transportation of a Hazardous Materials package.*"[22] ABF Freight System's tariffs are similar. They provide that it "*may* accept shipments of hazardous materials or substances" but does so only subject to a host of requirements, including that "any and all liability for damages resulting from the hazardous material *shall be borne by the Customer.*"[23]

Transportation brokers that arrange transportation of hazardous commodities similarly demand indemnification. For example, Matson Logistics "shall have no liability in connection with the transportation of hazardous material."[24] And Rail Bridge's standard terms provide that it "shall have no liability in connection with the transportation, and all obligations under the above-referenced documentation shall be borne by Shipper, who shall defend, indemnify and hold harmless RBC, its parent and affiliates including attorney's fees, from any liability arising from any actions or

---

22 UPS Tariff/Terms and Conditions of Service for Package Shipments in the United States, § 3.8, *available at* http://www.ups.com/media/en/terms_service_us.pdf (Exh. 12 hereto) (emphasis added).

23 ABF Rules and Special Service Charges (ABF 111-AD) (July 25, 2011), Item 973: Transportation of Hazardous Materials or Substances, *available at* http://www.abfs.com/resource/ABF111/Items/item973.asp (Exh. 13 hereto) (emphasis added).

24 Matson Logistics, Inc., Customer Services Agreement, § 7, available at http://www.matson.com/logistics/pdf/Logistics_Terms_and_Conditions.pdf (Exh. 14 hereto).

transactions of any Shipper or any customers or principal of Shipper or anyone acting for Shipper."[25]

Such practices are not uniform, as one would expect in an unregulated marketplace. Some transportation providers who do not have a statutory common carrier obligation to handle TIH shipments simply refuse to transport such commodities under any circumstances. FedEx Ground, for example, "does not accept for transportation ... inhalation hazards."[26] Conway does not accept any shipments of toxins or "poison gas," which include TIH commodities like chlorine and anhydrous ammonia.[27] And Yellow Roadway similarly does not accept for shipment in any quantity materials classified as "Toxic Inhalation Hazard Material Zone A."[28] Others no doubt work out risk-sharing arrangements on a private, contractual basis. But the fact that many providers of TIH-related transportation do require indemnification by the shippers for potential liability risks shows that the risk-sharing achieved by indemnification is often efficient and commercially reasonable.

---

25 Rail-Bridge Corp. Rules Circular, Item 6, *available at* http://www.railbridge.com/Rules/Rail-Bridge-Rules-Circular_0500.asp (Exh. 15 hereto).

26 FedEx Ground Tariff, p. 7, *available at* http://images.fedex.com/us/services/pdf/SG_GroundTariff_2012.pdf (Exh. 16 hereto); *see also* FedEx Hazmat Shipping Guide, at 1-3, *available at* http://images.fedex.com/us/services/pdf/HazmatShippingGuide.pdf (Exh. 17 hereto).

27 Conway Tariff, Item 180-30, *available at* https://www.con-way.com/en/truckload/_FileLibrary/PageFile/121/Rules_Tariff.pdf (Exh. 18 hereto).

28 YRC Tariff 100, Item 540 – Explosives and Other Dangerous Articles, *available at* https://my.yrc.com/dynamic/national/servlet?CONTROLLER=com.rdwy.ec.rexcommon.proxy.http.controller.PublicProxyController&redir=/TFD617&TAG=1TFA9402160904177600&DATE=01/18/2012 (Exh. 19 hereto).

CONCLUSION

For the reasons set forth above, the Board should declare that UP's tariff provisions, and other similar indemnifications applicable to TIH commodities, are reasonable under 49 U.S.C. §§ 11101 and 10702. UP's tariff provisions allow the railroad to allocate to the shipper a portion of the extraordinary risk of liability imposed on it by the shipper's transportation demand, without lessening the railroads' incentives to take extraordinary safety precautions in transporting TIH commodities. UP's tariff provisions also serve the public interest by giving shippers and their customers appropriate incentives to internalize the risks associated with their use and transportation of TIH commodities.

Respectfully Submitted,

David L. Meyer /AV

David L. Coleman
John M. Scheib
James A. Hixon
Norfolk Southern Railway Company
Three Commercial Place
Norfolk, VA 23510

David L. Meyer
Anand Viswanathan
Morrison & Foerster, LLP
2000 Pennsylvania Ave., N.W.
Washington, D.C. 20006

Attorneys for Norfolk Southern Railway Company

Dated: January 25, 2012

CERTIFICATE OF SERVICE

I, Anand Viswanathan, certify that on this date a copy of the Opening Evidence and Argument of Norfolk Southern Railway Company, filed on January 25, 2012, was served by email or first-class mail, postage prepaid, on all parties of record in accord with the service list set forth in the Board's decision served January 23, 2012.

Anand Viswanathan

Dated: January 25, 2012

STB Finance Docket No. 35504

UNION PACIFIC R.R. – PETITION FOR DECLARATORY ORDER

**OPENING EVIDENCE AND ARGUMENT
OF
NORFOLK SOUTHERN RAILWAY COMPANY**

EXHIBIT 1

PUBLIC VERSION – CONFIDENTIAL MATERIAL REDACTED

231688

BEFORE THE
SURFACE TRANSPORTATION BOARD

CF INDUSTRIES, INC.	)	
Complainant,	)	
v.	)	**Docket No. FD 35517**
INDIANA & OHIO RAILWAY COMPANY, POINT COMFORT AND NORTHERN RAILWAY COMPANY, AND MICHIGAN SHORE RAILROAD, INC.	)	ENTERED Office of Proceedings JAN 13 2012 Part of Public Record
Defendants.	)	

OPENING EVIDENCE
OF THE DOW CHEMICAL COMPANY

The Dow Chemical Company ("Dow") hereby submits its Opening Evidence in the above-captioned proceeding pursuant to the procedural schedule issued by the Surface Transportation Board ("Board") on September 30, 2011. As described below, the challenged special train service or priority train service proposal[1] ("PTS proposal") established by Defendants is an unreasonable practice in violation of 49 USC § 10702 and cause Defendants to violate their common carrier obligation under 49 USC § 11101.

I. Summary of Argument.

The PTS proposal was designed by a small group of railroad executives with apparently no expertise in tank car design, derailments, or tank car ruptures. It was designed without any empirical studies or testing of any kind, and without the assistance of experts or outside

[1] Defendants have repeatedly taken issue with the terminology used by Complainants to described the challenged provisions. See, e.g., Defendants' Motion to Dismiss at p. 4 (filed May 5, 2011); Defendants' Response to Complainants' Supplemental Information at p. 5-6 (filed Oct. 31, 2011). Defendants have also claimed that they can moot this entire proceeding simply by renumbering the challenged tariff while making slight modifications. See Defendants' Motion to Dismiss at p. 4 (filed May 5, 2011). The Board has not been, and should not be, distracted by this obfuscation.

consultants. The Board should reject Defendants' *ad hoc* attempt to superimpose requirements in an area already comprehensively regulated by several federal agencies that have spent decades of painstaking analysis and scientific studies, with voluminous public comment, to develop the current regulatory regime. There is no evidence that the challenged PTS proposal increases safety in any way. In short, it is an arbitrary, wasteful provision[2], and the Board should find the PTS proposal to be an unreasonable practice that results in a violation of the common carrier obligation.

II. Identity and interest of Dow.

A. Identity of Dow.

Dow is a diversified chemical company that harnesses the power of science and technology to constantly improve what is essential to human progress. Dow offers a broad range of innovative products and services to customers in more than 175 countries, helping them to provide everything from fresh water, food, and pharmaceuticals to paints, packaging, and personal care products. In order to provide many of these essential products and services, Dow both produces and uses hazardous materials, including materials that are classified as toxic inhalation hazards or poison inhalation hazards ("TIH/PIH" materials). The broad range of products that Dow produces span virtually every industry, including railroads, and make possible approximately 90% of the goods people use every day.

Dow has developed a culture of safety and responsibility that pervades all of its activities. This culture has generated a long track record of innovation and investment to improve Dow's safety performance in the production, use, and transportation of hazardous materials. Dow recognizes the risks inherent in transporting hazardous materials and is continually designing and re-designing its supply chain to minimize those risks. This includes efforts to reduce or

---

[2] Atchison Railway Company v. United States, 232 U.S. 199, 217 (1914).

eliminate the shipment of highly hazardous materials, continually optimize sourcing and routing of those materials, improve shipping containers, monitor their location and condition in transit, and enable effective emergency preparedness and response. Currently, 20 percent of Dow's 2.2 million product shipments annually are regulated as hazardous materials or dangerous goods. Dow's collaborative efforts with carriers across all transportation modes have achieved an incident-free rate of 99.97 percent and earned it award recognition in the last few years from Norfolk Southern Railway, CSXT, BNSF, Kansas City Southern Railway, Canadian Pacific Railway ("CP"), and Canadian National Railway ("CN") for leadership and performance in safety practices. For its efforts and performance in 2011, Dow expects to receive safety awards from CN, CP, CSXT, and the Union Pacific Railroad.

Dow's major manufacturing sites in the United States are located in Texas, Louisiana, Michigan, California, and West Virginia. These sites, and others around the country, are dependent upon railroads for the safe, secure, and reliable transportation of raw materials and products. Dow's business model is built on the fact that rail transportation of hazardous materials represents the safest, most efficient, most economical, and most socially acceptable way to transport large volumes of these materials long distances over land.

Safety is a crucial goal for Dow in all aspects of its business. Dow has been a leader in ensuring the safe handling and transport of TIH/PIH commodities such as chlorine. {

}[3] For example, Dow has been at the forefront of the science-based effort to create a next generation chlorine tank car. This effort has consisted

[3] Pursuant to the Protective Order in this proceeding, information contained within single brackets {...} has been designated "CONFIDENTIAL," and information contained within double brackets {{...}} has been designated "HIGHLY CONFIDENTIAL."

of extensive empirical evidence regarding how tank cars impact, how releases occur, and what design elements create the safest tank car possible.

Dow has also participated actively in the Advanced Tank Car Cooperative Research Program and the implementation of advanced GPS and sensor tracking technologies on chlorine tank cars. In conjunction with its goals, Dow continues to work on redesigning its supply chain to reduce rail shipments of chlorine. Dow strongly supports community emergency preparedness and response through TRANSCAER®, an acronym for Transportation Community Awareness and Emergency Response, a voluntary national outreach effort that trains more than 20,000 people annually to prepare for and respond to emergencies in the unlikely event of a chemical transportation incident in their local communities. Dow supports continuous improvement in reducing the potential risks associated with shipping TIH/PIH by rail, but Dow does not agree with changes to existing safe operating practices if such changes have not been tested and shown to increase safety.

B. Interest of Dow in this proceeding.

Dow receives rail service from the Huron and Eastern Railway ("HESR"), a RailAmerica subsidiary, for shipments of chlorine and anhydrous hydrogen chloride ("AHCl") from interchange with CN at Durand, Michigan to a Dow facility in Midland, Michigan. HESR has attempted to implement the PTS proposal on Dow's chlorine and AHCl shipments. Significant discussions have occurred between Dow and HESR/RailAmerica regarding the proposed application of the PTS requirements on these shipments. More recently, another RailAmerica subsidiary, the Indiana & Ohio Railway ("IORY"), also has imposed the PTS proposal upon inbound shipments to a Dow facility in Cincinnati.

III. Governing Law.

A. Unreasonable Practice.

As described further below, evaluation of the PTS proposal under the circumstances at issue in this case reveals that it is an unreasonable practice. A comprehensive regulatory regime already governs the safety of hazardous materials rail transportation, and is managed by the Federal Railroad Administration ("FRA"), the Pipeline and Hazardous Materials Safety Administration ("PHMSA"), and the Transportation Security Administration ("TSA"). There is no evidence that the PTS proposal increases safety beyond that already provided by the existing comprehensive regulatory regime.

Where such a comprehensive safety regime already exists and is administered by other federal agencies, precedent requires that a railroad proposing additional safety measures specifically show that the existing regime is insufficient. Consolidated Rail Corporation v. Interstate Commerce Commission, 646 F.2d 642, 648-652 (D.C. Cir. 1981) ("Conrail"). Defendants have not even begun to attempt to meet this standard. Therefore, the PTS proposal is an unreasonable practice.

B. Common Carrier Obligation Violation.

Railroads have a common carrier obligation under 49 U.S.C. § 11101 to serve shippers on their rail lines. Pejepscot Industrial Park, Inc. d/b/a Grimmel Industries – Petition for Declaratory Order, STB Docket No. 33989, slip op. at 14 (STB served May 15, 2003). (finding that, where there is no embargo or abandonment, railroad "had an absolute duty to provide rates and service...upon reasonable request, and that its failure to perform that duty was a violation of section 11101"; see also Tanner & Co. et al. v. Chicago, Burlington & Quincy R.R. Co., 53 I.C.C. 401, 406 (1919); Pacolet Mfg. Operating Allowance, 210 I.C.C. 475, 477 (1935).

The common carrier obligation is perhaps the most basic and foundational tenet of federal rail transportation law. See Common Carrier Obligation of Railroads, Transcript of Public Hearing at 33-34, STB Ex Parte No. 677 (April 24, 2008) (statement of Chairman Nottingham) (Noting that the common carrier obligation goes back to Roman law and stating that "the heart of the Board's mission is our responsibility to serve as a forum for resolving disputes...regarding whether...the railroads are carrying out that obligation to provide service on reasonable request.") (internal quotes omitted).

The Board has the authority to determine that tariff or contract provisions unlawfully interfere with the common carrier obligation. Railroad Ventures, Inc. – Abandonment Exemption – Between Youngstown, OH and Darlington, PA, in Mahoning and Columbiana Counties, OH and Beaver County, PA, STB Docket No. AB-556 (Sub-No. 2X), slip op. at 3 (served Jan. 7, 2000) ("contractual restrictions that unreasonably interfere with common carrier operations are deemed void as contrary to public policy"). The Board can also determine that preconditions are unlawful if they must be met by a shipper to obtain rail service. Pejepscot Industrial Park – Petition for Declaratory Order, STB Docket No. 33989, slip op at p. 13 (served May 15, 2003) (stating that a "rail carrier cannot make its service contingent upon guaranteed profits from that service or upon the shipper's advance funding of repairs to the rail line over which the service would then be provided"); Parrish & Heimbecker, Inc. – Petition for Declaratory Order, STB Docket No. 42031 (served May 26, 2000) (finding tariff surcharge to be an unreasonable practice). See also United States v. Baltimore & Ohio R.R. Co., 333 U.S. 169, 177 (1948).

As described further below, the PTS proposal unlawfully interferes with the common carrier obligation because it establishes numerous unreasonable preconditions and restrictions on rail service for certain shippers.

C. The Board should apply the Conrail standard to this proceeding.

1. Unlike the two cases cited by Defendants, the facts surrounding the PTS proposal are similar to Conrail.

Defendants assert that reliance on Conrail is "not supported by the facts." Response to Complainants' Supplemental Information at p. 17 (filed Oct. 31, 2011) ("Response"). Defendants then describe certain differences between the Conrail case and the issue now before the Board in this proceeding, but Defendants have completely ignored numerous other facts that show the similarity between Conrail and this proceeding. The Board can and should look to Conrail to find that (1) Defendants have the burden of proof regarding the reasonableness of the challenged PTS proposal; and (2) a cost-benefit analysis should be used in evaluation of the PTS proposal.

The particular issue before the ICC[4] and the Court of Appeals in the appeal by Conrail of that decision is no different than the issue before the Board today. Specifically, the issue before the ICC was "whether the railroads' voluntary attempt to institute and charge for additional safety measures not mandated by DOT or NRC is 'reasonable' under the Interstate Commerce Act." Conrail, 646 F.2d at 650 (n. 16). Similarly, the issue before the Board today is whether Defendants' PTS proposal creating additional safety measures for hazardous materials transportation, at significant cost, is "reasonable" under ICCTA given the comprehensive safety regulation in this field by the Department of Transportation ("DOT"), FRA, TSA, and PHMSA.

[4] Trainload Rates on Radioactive Materials, Eastern Railroads, 362 ICC 756 (1980).

Cases cited by Defendants do not prove otherwise. Unlike both Conrail and the facts surrounding the PTS proposal, neither North American Freight Car[5] nor AECC[6] dealt with safety measures applied to transportation of hazardous commodities where other federal agencies had been directed by Congress to ensure safe transportation and, consequently, had already established a comprehensive regulatory regime of safety measures. The two cases cited by Defendants dealt with new tariffs (1) assessing demurrage and storage charges for empty private rail cars (NAFCA), and (2) creating performance standards applicable to dust emissions from loaded coal trains (AECC). Neither case dealt with safety and, crucially, there is no comprehensive federal regulatory regime covering either demurrage/storage charges or coal dust emissions from trains.

2. The burden of proof should be on Defendants.

It is true that the burden of proof is customarily on the complainant in unreasonable practice cases. NAFCA, slip op. at 5. However, the specific circumstances of this case are akin to those in Conrail and, therefore, the burden of proof should be on Defendants just as it was on the railroads in Conrail.

In NAFCA, the Board described several distinctive facts that showed Conrail was "not analogous" to the BNSF storage and demurrage charges at issue in NAFCA. While Defendants claim that the current dispute over the challenged PTS proposal is similarly not analogous to Conrail (Response at 17), even a cursory evaluation of NAFCA shows that two of the Conrail facts mentioned by the Board are also present in the Board evaluation of the PTS proposal. First, "the extra services for which the railroad was attempting to charge extra, which were purportedly

[5] North American Freight Car Association v. BNSF Railway Company, STB Docket No. 42060 (Sub-No. 1) (served Jan. 26, 2007) ("NAFCA").
[6] Arkansas Electric Cooperative Corporation – Petition for Declaratory Order, STB Docket No. 35305 (served March 3, 2011) ("AECC").

required for safety reasons, were not required by the Department of Transportation (DOT) and the Nuclear Regulatory Commission (NRC), which had primary jurisdiction over safety." NAFCA, slip op. at 5. This is identical to the PTS proposal, which is ostensibly for safety reasons despite not being required by either the FRA or PHMSA, which have primary safety jurisdiction. Second, "DOT and NRC had determined that the transportation was safe without the additional special services applied by the railroads." NAFCA, slip op. at 5. Again, FRA and PHMSA have specified certain requirements for safe transportation of hazardous materials, and the PTS provisions are not among them.

Defendants claim that the Staggers Act "shifted the burden of proof to the shipper", but this is an overstatement. As the court noted in Conrail, it was not the statute that controlled the determination of the burden of proof but, instead, the specific facts at issue: "the burden is on them to show that, for some reason, the presumptively valid DOT/NRC regulations are unsatisfactory or inadequate in their particular circumstance." Conrail, 646 F.2d at 650.[7] It is exactly this showing that the Board should require of Defendants – that the presumptively valid FRA/PHMSA regulations are unsatisfactory or inadequate given the particular circumstances of Defendants' operations.

Congress has not specifically defined what constitutes an unreasonable practice. WTL Rail Corporation – Petition for Declaratory Order and Interim Relief, STB Docket No. 42092, slip op. at 6 (served Feb. 17, 2006). Consequently, the Board has broad discretion regarding determination of unreasonableness, and the Board applies that discretion in a "fact-specific" inquiry on a case-by-case basis. WTL, slip op. at 6. See also Granite State Concrete Co., Inc. v. Surface Transportation Board, 417 F.3d 85, 92 (1st Cir. 2005) (the Board "has been given broad

[7] Indeed, later court decisions show that the Conrail precedent was considered, but not applied, simply due to the particular facts at issue and not because of the Staggers Act. North American Freight Car Association v. Surface Transportation Board, 529 F.3d 1166, 1174 (n. 7) (D.C. Cir. 2008).

discretion to conduct case-by-case fact-specific inquiries to give meaning to these terms, which are not self-defining, in the wide variety of factual circumstances encountered"). Defendants request that the Board follow the burden of proof determination from NAFCA (where the Board decided that complainants had the burden) based on the "facts and circumstances" of this case (Response at 18), but Defendants' request is only feebly supported. As described above, the current situation, unlike NAFCA and AECC, is quite similar to the factual scenario in Conrail.

In sum, then, the Board's statement in NAFCA applies with equal force to the PTS proposal: "the court placed the burden on the railroads to prove that the presumptively valid regulations were unsatisfactory or in adequate in their particular circumstances." NAFCA, slip op. at 5. The same considerations apply here, and the Board should find that Defendants have the burden of proof.

3. The Board should determine whether the PTS Proposal is reasonably commensurate economically with the problem it purports to address.

Evaluation of the reasonableness of the PTS proposal should not occur without consideration of the costs required for PTS. As the Board recently stated, "any tariff provision must be reasonably commensurate economically with the problem it addresses." AECC, slip op. at 6. Although the Board has determined that a formal cost-benefit analysis ("CBA") is not always warranted (AECC, slip op. at 6), the specific facts at issue here regarding the PTS proposal indicate that a CBA is appropriate. Unlike the situation in AECC, the history of TIH/PIH tank car safety includes decades of extensive scientific and data-focused analyses. Most of this analysis has not only included quantification of costs and benefits, but is available publicly because the analyses occurred in the public arena via rulemaking proceedings of PHMSA, FRA, and other agencies. In short, it is entirely appropriate to compare the costs and benefits of the PTS proposal. The Board should evaluate whether the PTS proposal produces safety benefits which are "commensurate" with their cost. Conrail, 646 F.2d at 648. The Board should also determine whether the PTS proposal represents an "economical means of achieving the expected safety benefit" when compared with other possible safety measures. Conrail, 646 F.2d at 648.

IV. Argument.

As shown below, the PTS proposal is an unreasonable practice in violation of 49 USC § 10702 and it causes Defendants to violate their common carrier obligation under 49 USC § 11101. The PTS proposal unreasonably purports to mandate certain rules in an area already extensively covered by federal regulations. It does so without any supporting analysis or evidence regarding the safety impact of the challenged provisions, let alone the relationship of the claimed benefits to the costs involved. All relevant facts reveal that the PTS proposal is an unreasonable practice that unlawfully impedes provision of common carrier rail service.

In addition to the Opening Evidence provided herein, Dow also supports the evidence filed by the American Chemistry Council ("ACC") and The Chlorine Institute ("TCI"). Dow is a member of both ACC and TCI.

A. The PTS proposal is an unreasonable practice.

1. A comprehensive federal regulatory safety regime for hazardous materials rail transportation already exists.

a. The Department of Transportation manages a comprehensive system of TIH/PIH transportation regulation.

Congress has directed DOT to establish and oversee a comprehensive system for promoting and ensuring railroad safety, particularly with regard to the transportation of TIH/PIH commodities. Railroad safety is governed by 49 USC § 20101 *et seq.*, which addresses a wide variety of railroad equipment and operations issues. The purpose of these statutes "is to promote safety in every area of railroad operations and reduce railroad-related accidents and incidents." 49 USC § 20101. See also 74 FR 1772 ("[t]he Secretary...has authority over all areas of railroad transportation safety"). Similarly, hazardous materials transportation is governed by 49 USC § 5101 *et seq*. As directed by Congress, the Secretary of Transportation "shall prescribe regulations for the safe transportation, including security, of hazardous material in intrastate, interstate, and foreign commerce." 49 USC § 5103(b)(1). The Secretary of Transportation has delegated its authority in these areas to the Federal Railroad Administration, 49 CFR § 1.49, and the Pipeline and Hazardous Materials Safety Administration, 49 CFR § 1.53.

As the Board knows, the regulations established by FRA, PHMSA, and TSA are extensive. See, e.g., CSX Transportation, Inc. – Petition for Declaratory Order, STB Docket No. 34662, slip op. at 3 (served March 14, 2005). "FRA promulgates and enforces a comprehensive regulatory program" at 49 CFR Parts 200-244, covering virtually all aspects of the rail industry, including areas such as: track, communications, rolling stock, end-of-train marking, safety glazing, incident reporting, locational requirements for the dispatch of U.S. rail operations, safety integration plans, operating practices, alcohol and drug testing, locomotive engineer certification, and workplace safety. 74 FR 1772.

The regulatory scheme established by PHMSA is no less impressive. See 49 CFR Parts 171-180. PHMSA regulations have categorized hazardous materials into various classes based on risk, and each class must be packaged, handled, marked, labeled, and placarded according to the regulations. 74 FR 1771-1772. Additionally, PHMSA regulations cover communications, emergency response information, training requirements, and "operational requirements applicable to each mode of transportation." 74 FR 1772. PHSMA regulations also cover handling of rail cars and the positions of cars in trains. 49 CFR § 174.82 *et seq*.

PHMSA recently issued new regulations regarding rail routing of hazardous materials shipments in order to increase safety. 49 CFR § 172.820. See also 73 FR 20752; 73 FR 72182. Notably, the final rule included provisions which "clarif[ied] rail carriers' responsibility to address in their security plans issues related to en route storage and delays in transit." 73 FR 72182.

Finally, TSA[8] administers regulations imposing chain of custody requirements and other security-related mandates on parties involved in rail transportation of hazardous materials. 49 CFR § 1580.100 *et seq.* See also 73 FR 72130.

b. PHMSA recently revised PIH tank car standards and operating practices.

On April 1, 2008, PHMSA issued a Notice of Proposed Rulemaking ("NPRM"), proposing "enhanced tank car performance standards and operating limitations designed to minimize the loss of lading from tank cars transporting PIH materials in the event of an accident." 73 FR 17820. This NPRM was the culmination of multi-year "comprehensive review of design and operational factors that affect rail tank car safety" undertaken jointly by PHMSA and FRA. 73 FR 17819. Several public meetings were held, comments were sought, and research was conducted. It was only "after careful review and consideration of all of the relevant research and data, oral comments at the public meetings, and comments submitted to the docket" that PHMSA issued the NPRM. 73 FR 17820.

DOT believed that its two-pronged approach – focusing on both operating conditions and puncture-resistance – "represent[ed] the most efficient and cost-effective method of improving the accident survivability of these cars." 73 FR 17820. This concern about cost-effectiveness reflected the Regulatory Impact Analysis ("RIA") prepared by PHMSA. In the RIA, PHMSA

[8] Unlike FRA and PHMSA, TSA is in the Department of Homeland Security.

calculated the expected costs and benefits of the proposal over a 30-year time period, pursuant to several different scenarios. 73 FR 17850-17852. To assist in the development of the proposal, FRA analyzed data from 40 years of chlorine incidents. Among other things, FRA found that "no catastrophic losses of chlorine occurred at speeds below 30 mph." 73 FR 17821.

The final rule promulgated by PHMSA deviated somewhat from the NPRM. 74 FR 1770. After evaluating comments filed in response to the NPRM, PHMSA determined that interim tank car standards were necessary. Thus, the final rule included specific commodity-specific design standards for tank cars constructed after March 16, 2009, but these standards were less ambitious than those originally proposed in the NPRM. 74 FR 1783. Similarly, the final rule did not include the 30 mph speed limit for unsignaled ("dark") territory, but the rule did include an overall 50 mph speed limit for all loaded PIH tank cars. 74 FR 1781. The 50 mph speed limit is notable because PHMSA found that the car-to-car impact speed is "approximately one-half of the initial train speed." 73 FR 17821. Consequently, a maximum speed of 50 mph would result in car-to-car impact speeds of only 25 mph.

c. Defendants have not shown that the existing regulations need to be supplemented, or that the ample rulemaking processes were an insufficient forum to address Defendants' concerns.

Defendants are not writing on a clean slate with the PTS proposal. There are voluminous pre-existing safety requirements in this area which resulted from decades of study, analysis, and public comment. The Board should not ignore this "broader reality" of TIH/PIH transportation. Parrish & Heimbecker, Inc. – Petition for Declaratory Order, STB Docket No. 42031, slip op. at 3 (served May 25, 2001) (railroad practice found unreasonable where it ignored the "broader reality" of how transportation plays a role in business decision-making). Cf. Radioactive

Materials, Special Train Service, Nationwide, 359 ICC 70, 74-75 (1978) (special trains not found to be safer).

Defendants have not shown any particular, localized issues applicable to the shortline railroads at issue in these consolidated proceedings that would require measures in addition to those established by PHMSA, FRA, and TSA in their comprehensive regulatory framework. 49 CFR § 174.20(a). See also Conrail, 646 F.2d at 650 ("The railroads may indeed seek to prove the reasonableness of additional safety measures, but the burden is upon them to show that, for some reason, the presumptively valid DOT/NRC regulations are unsatisfactory or inadequate in their particular circumstance.").

Similarly, Defendants have not shown that the PHMSA, FRA, and TSA rulemaking processes were and are an insufficient forum to address any concerns that Defendants may have. Conrail 646 F.2d at 652 ("the railroads have had, and will continue to have, ample opportunity to petition both the NRC and DOT for review of their respective regulations in this area").

2. Defendants have not provided any evidence that the elements of the PTS proposal actually increase safety.

The PTS proposal is an unreasonable practice, and causes a violation of the common carrier obligation, because Defendants have not shown that the PTS proposal results in any safety benefits. Where a comprehensive federal safety regime administered by other agencies already exists, the burden is on the railroad proposing new requirements to show that the "presumptively valid" regulations "are unsatisfactory or inadequate" in the railroad's particular circumstances. Conrail, 646 F.2d at 650. This showing has not been made.

There has been no analysis showing that the PTS proposal results in any increase in safety compared to "normal" rail operations. In fact, there has been no analysis whatsoever. Defendants claim to have a safety objective, but there is no analysis showing that the objective is met by the PTS proposal. Defendants engaged in only the most cursory decision-making process possible, simply relying on their own beliefs, wisdom, and experience in the railroad industry. RailAmerica spent considerable time and effort in determining how to price the new PTS proposal, but no time or effort in determining if PTS is safer, or whether the specific elements in the PTS proposal are actually safer than any of the innumerable other possible elements of a new TIH/PIH handling tariff.

{{

}}

{{

}}

{{

}}

[9] {{ }}

[10] Exhibits 3-5, 21, and 23 are transcript excerpts from a deposition with James Shefelbine, the Vice President of Marketing for RailAmerica. The cover pages of the transcript are included with Exhibit 3.

In essence, Defendants are asking that shippers simply trust Defendants' inherent wisdom, but this is exactly the sort of position that was rejected in Conrail. 646 F.2d at 647-648.

In fact, the PTS proposal actually runs contrary to the real-world evidence developed at the Florida East Coast Railway ("FEC"), a former sister company to RailAmerica. {{

}}

3. The PTS proposal decreases safety.

Given that Defendants have engaged in no analysis whatsoever, it is not surprising that PTS can result in less safe train operations compared to normal rail operations. {{

}}

---

[11] {{ }}

{{

}} In other words, compliance with the PTS proposal could result in violating federal safety regulations such as 49 CFR § 174.14(a) (cars must be moved within 48 hours) and 49 CFR § 174.14(b) (cars shall not be held for forwarding instructions). Furthermore, Defendant RailAmerica has previously recognized that reducing the operating efficiency of trains carrying hazardous materials can "hinder safe rail operations." Comments of RailAmerica, Inc., CSX Transportation, Inc. – Petition for Declaratory Order, STB Docket No. 34662 (filed Feb. 16, 2005).

PTS could also reduce the safety of AHCl shipments, which are time-sensitive. Shippers of AHCl must always be vigilant regarding the transit time of cars carrying AHCl due to the danger of over-pressurization in the rail car. The PTS provision that mandates no more than three TIH/PIH rail cars per train could lengthen transit times of AHCl cars by forcing shippers or railroads that interchange with Defendants to hold onto AHCl cars for a longer period of time. In other words, if a given train of Defendants already had three TIH/PIH cars in it, then additional cars would have to wait for a second or even third train so as not to violate the three-car limit. This over-pressurization danger occurs not only with loaded AHCl cars, but also cars that have any significant amount of AHCl – such as a "heel" car. When these AHCl cars are held at a location with no capability to vent the car, then delays caused by PTS undoubtedly increase safety concerns.

4. Defendants refused Dow's offer to engage in a safety analysis.

Defendants' witness claimed that RailAmerica was "dismayed and disappointed by the shippers' unwillingness to engage in a conversation" and the lack of "shipper input" regarding TIH/PIH shipments. Verified Statement of James Shefelbine, p. 24 of Defendants' Response. While Dow cannot speak for the other parties involved in this proceeding, the "dismay" and "disappoint[ment]" expressed by Defendants certainly does not and cannot apply to Dow. As described below, Dow spent months discussing Defendants' desire to implement the PTS proposal. {

} Crucially, Dow offered to participate in an empirical study to determine if Defendants' proposal met the safety goals ascribed to it. Defendants refused this offer, however, and went forward with the PTS proposal without any empirical support, and without input from the FRA (the agency with primary responsibility for rail safety).

Dow's commitment to empirically-supported safety measures is exemplified by the significant dialogue between Dow and RailAmerica during 2010 and 2011. Dow first learned of RailAmerica's plan to implement new operating rules for TIH/PIH shipments in July 2010. Communication with RailAmerica occurred in July 2010 and November 2010, but Dow obtained only limited information regarding the RailAmerica plan. {

}

{

}

{

}

{

}

{ :

}

{

} The parties therefore reached an impasse.

{{

}} Moreover, Defendants' establishment of the PTS proposal completely ignores the decades of intense study and analysis by numerous federal agencies, such as the FRA and PHMSA, studies and analysis that were subject to grueling public comment, unlike the closed-door development of the Defendants' PTS proposal by the seven-member Team. Defendants claim that the complainants do not recognize the "eminently logical" proposition that slower speeds are safer (Response at 14), yet {{

}} Still, there is no support for operating PTS trains at all, much less at speeds below which most RailAmerica subsidiaries operate their regular train service.

5. The PTS proposal is an unreasonable practice due to the burdensome requirements placed on shippers.

The mandate that PTS trains can contain no more than three cars of TIH/PIH commodities is completely at odds with the nature of the rail business. Shippers such as Dow cannot control the irregular and random nature of either customer purchases or transportation timing. Where the shipper originates the shipment with a RailAmerica subsidiary, requiring the shipper to tender no more than three cars at a time might result in holding loaded TIH/PIH rail cars at the shipper's facility. Where the shipper receives inbound shipments from a RailAmerica railroad, the shipper cannot control the variation in transportation time that may result in bunching (delivery of many cars at one time).

In response to these concerns, Defendants have, incredibly, asserted that "Complainants do control...the routing of the [Class I] trains." Response at 12 (n. 5). Nothing could be further from the truth. "The routing protections provided to rail carriers by section 10705 are longstanding and...confer on each railroad the initial discretion to choose the routes it will use to respond to requests for service." Central Power & Light Company v. Southern Pacific Transportation Company, 2 STB 235, 241 (1997). Moreover, TSA routing protocols further define and limit the routes that railroads use. 73 FR 20752 (April 16, 2008).

In the same footnote, Defendants have claimed that Complainants can control the timing of rail car hand-offs by Class I railroads to AGR simply by adjusting the time at which Complainants tender their shipments to the Class I railroads. This claim ignores those situations where Complainants are the consignees only, and not the consignors.[12] Moreover, regardless of the time that Complainants may tender cars to the Class I railroads, bunching of rail cars still

[12] Even where Complainants are consignors, limiting the number of TIH/PIH shipments that can be tendered to Defendants might cause delays and result in safety concerns due to issues such as the over-pressurization risk in AHCl cars. See Section IV.A.3.

occurs. See, e.g. Ex. 9 (e-mail from Harry Shugart). Complainants do not control the operations of Class I railroads, nor do Complainants control the weather, maintenance needs and scheduling, and any of the innumerable other factors that affect rail operations and the time that rail cars reach AGR.

6. PTS has become a profit center for Defendants.

The national transportation policy seeks to promote efficiency and sound management of railroads. 49 USC § 10101(3), (4), (5), and (9). Although Complainants are not challenging the specific rate level charged by Defendants for any particular movement, rate-related issues can be instructive in determining the reasonableness of a railroad practice. See, e.g., Rail Fuel Surcharges, STB Ex Parte No. 661, slip op. at 7 (served Jan. 26, 2007). {

} {{

}}

As shown above, the PTS surcharge does much more than merely recover Defendants' costs of providing PTS. Given the profit enhancing impact of PTS, the "surcharge" is misleading and an unreasonable practice. Rail Fuel Surcharges, slip op. at 7 ("We believe that imposing rate increases in this manner, when there is no real correlation between the rate increase and the increase in fuel costs for that particular movement to which the surcharge is applied, is a misleading and ultimately unreasonable practice.").

Indeed, many elements in the PTS proposal are already followed by RailAmerica subsidiaries. For example, AGR and certain other RailAmerica subsidiaries are limited to 10 mph due to the applicable FRA track class involved. Ex. 23. The PTS proposal mandates that TIH/PIH rail cars must be inspected upon interchange from another carrier, which is already an FRA requirement. 49 CFR § 174.9(a). This begs the question of what, exactly, the PTS charges are intended to cover. Cf. Atchison Railway Company v. United States, 232 U.S. 199, 217 (1914) ("Neither party has a right to insist upon a wasteful or expensive service for which the consumer must ultimately pay.").

B. The PTS proposal causes Defendants to violate the common carrier obligation.

Under 49 USC § 11101(a), common carrier railroads must provide rail service on "reasonable request." As described above in Section IV.A, the PTS proposal places unreasonable limitations on rail transportation of TIH/PIH commodities and, therefore, the PTS proposal causes defendants to violate the common carrier obligation.

Rail is the most effective and lowest risk mode of land transport for large volumes of hazardous materials over long distances. Therefore, the common carrier obligation is integral to the safe transportation of hazardous materials. Without the common carrier obligation, many in the rail industry have made it absolutely clear that they would not haul TIH/PIH materials at all, and might also refuse to haul other categories of hazardous material. The consequences would compromise public safety and the overall public welfare because these hazardous materials either would move by a less safe mode or not at all. Akron, Canton & Youngstown Railroad Company v. Interstate Commerce Commission, 611 F.2d 1162, 1168 (6th Cir. 1979).

Defendants claim that the PTS proposal "provide[s] requirements for the safe movement of TIH/PIH over the [Defendants'] Railroads." See Reply filed by Defendants (June 6, 2011). In the related proceeding, Defendants stated that the PTS proposal "reduc[es] the danger" in handling "extremely dangerous" commodities. See Answer filed by Defendants in STB Docket No. 42129 (May 5, 2011). These statements are contrary to existing precedent regarding the common carrier obligation. Akron, 611 F.2d at 1169 ("a carrier may not ask the Commission to take cognizance of a claim that a commodity is absolutely too dangerous to transport, if there are DOT and NRC regulations governing such transport, and these regulations have been met"). Defendants have not shown that the additional requirements in the PTS proposal are warranted under the circumstances at issue. 49 CFR § 174.20(a). See also Conrail, 646 F.2d at 650; Akron, 611 F.2d at 1169. Therefore, the PTS proposal causes a violation of the common carrier obligation.

As described above, a comprehensive federal regulatory safety regime for rail transportation of hazardous materials already exists. The PTS proposal places unnecessary further preconditions on shippers in order to obtain rail service. The Board can and should find that these preconditions unlawfully restrict the common carrier rail service. Pejepscot, slip op at p. 13. A rail line owner may not "enforce conditions upon its use which conflict with the power of Congress to regulate railroads so as to secure equality of treatment of those whom the railroads serve." United States v. Baltimore & Ohio R.R. Co., 333 U.S. 169, 177 (1948). The PTS proposal should be found an unlawful limitation on the common carrier obligation.

V. Conclusion.

For all the reasons stated above, Defendants' PTS proposal is an unreasonable practice in violation of 49 USC § 10702 and causes Defendants to violate their common carrier obligation under 49 USC § 11101. Injunctive relief is appropriate under 49 USC § 721(b)(4).

Respectfully Submitted

Jeffrey O. Moreno
David E. Benz
Thompson Hine LLP
1920 N Street, N.W., Suite 800
Washington, D.C. 20036
(202) 331-8800

Counsel for The Dow Chemical Company

January 13, 2012

Certificate of Service

I hereby certify that on this 13th day of January 2012, a copy of the foregoing Opening Evidence of Dow Chemical Company was served by electronic delivery and first-class mail, postage prepaid, on counsel for Defendants at:

Louis E. Gitomer, Esq.
Suite 301
600 Baltimore Avenue
Towson, MD 21204

Lou@lgraillaw.com

The foregoing was also served via first-class mail, postage prepaid, on all other members of the service list.

David E. Benz

Exhibits

All Exhibits are redacted.

STB Finance Docket No. 35504

UNION PACIFIC R.R. – PETITION FOR DECLARATORY ORDER

OPENING EVIDENCE AND ARGUMENT
OF
NORFOLK SOUTHERN RAILWAY COMPANY

EXHIBIT 2

222863

Comments of Paul Orum

before the

Surface Transportation Board
Public Hearing on Rail Transportation of Hazardous Materials

Docket # EP-677-1

July 22, 2008

Thank you for the opportunity to comment on rail transportation of hazardous materials. I am here to comment on one aspect of hazardous materials on the rails, namely, the opportunity to get them off the rails through the use of less hazardous chemicals and processes.

The Department of Homeland Security and numerous others have warned that a terrorist could target toxic inhalation hazard (TIH) substances with catastrophic consequences In 2007, I wrote a report, "Toxic Trains and the Terrorist Threat," as a consultant to the Center for American Progress This report documented the opportunity to eliminate chlorine gas rail shipments to water utilities.

I am submitting that report today for the record. In brief, this report documented two-dozen water utilities that affordably converted off chlorine gas, formerly delivered by rail, since 2001. Alternatives include converting wastewater plants to ultraviolet light and drinking water plants to liquid bleach (purchased or generated on-site).

But water utilities are just one industry. Other examples of changes that can eliminate TIH rail shipments include:

- Bleach manufacturers can replace chlorine gas by rail with on-site production of chlorine from salt and electricity without bulk gas storage. This change would take thousands of chlorine gas shipments off the rails – possibly a third of all chlorine rail shipments.

- Food processors that receive sulfur dioxide gas by rail for wet corn milling, cherry brining, or beet sugar processing can switch to sodium bisulfite or generate sulfur dioxide on-site with a sulfur burner.

- Wastewater utilities can also replace anhydrous sulfur dioxide gas with sodium bisulfite.

- Manufacturers of surfactants used in soaps and detergents can replace sulfur trioxide gas by rail with a sulfur burner to generate sulfur trioxide on-site.

- Secondary aluminum smelters that use chlorine gas by rail for fluxing to remove impurities from aluminum alloys can switch to nitrogen gas injection with solid magnesium salts

- Manufacturers that receive chlorine gas by rail to produce ferric chloride for use in water treatment can use dilute liquid hydrochloric acid (below 36 percent) and oxygen to produce ferric chloride from scrap steel

- Paper mills that receive chlorine gas by rail for bleaching pulp can switch to chlorine free bleaching (e.g., sodium hydrosulfite and hydrogen peroxide) or to chlorine dioxide produced on-site without bulk storage

- Various manufacturers can and do collocate near producers and receive TIH chemicals by pipeline.

These are just a few example of how to reduce the amount of TIH chemicals shipped by rail and reduce direct and indirect costs and liability in the process.

Converting facilities off rail shipments need not shift the danger to truck transport. For example, most one-ton cylinders of chlorine shipped by truck are used in water treatment. These facilities can generate the chlorine they need on-site or use liquid bleach

The STB asks for "specific suggestions on how to resolve the liability issue." Not shipping TIH substances by rail will resolve the greater part of the liability issue.

The STB seeks to identify the "unique costs of transporting TIH chemicals" and "how railroads should recover those costs." Requiring facilities that produce or receive TIH materials by rail to cover liability insurance commensurate with the hazard would add an important incentive to use and develop feasible alternatives.

At present, the chemical industry simply shifts risks to rail carriers. One water utility is investing over $100 million into structures to contain a railcar release of chlorine gas This only incompletely protects the utility, since an attack may destroy the building, and does nothing to protect the railcar in transit.

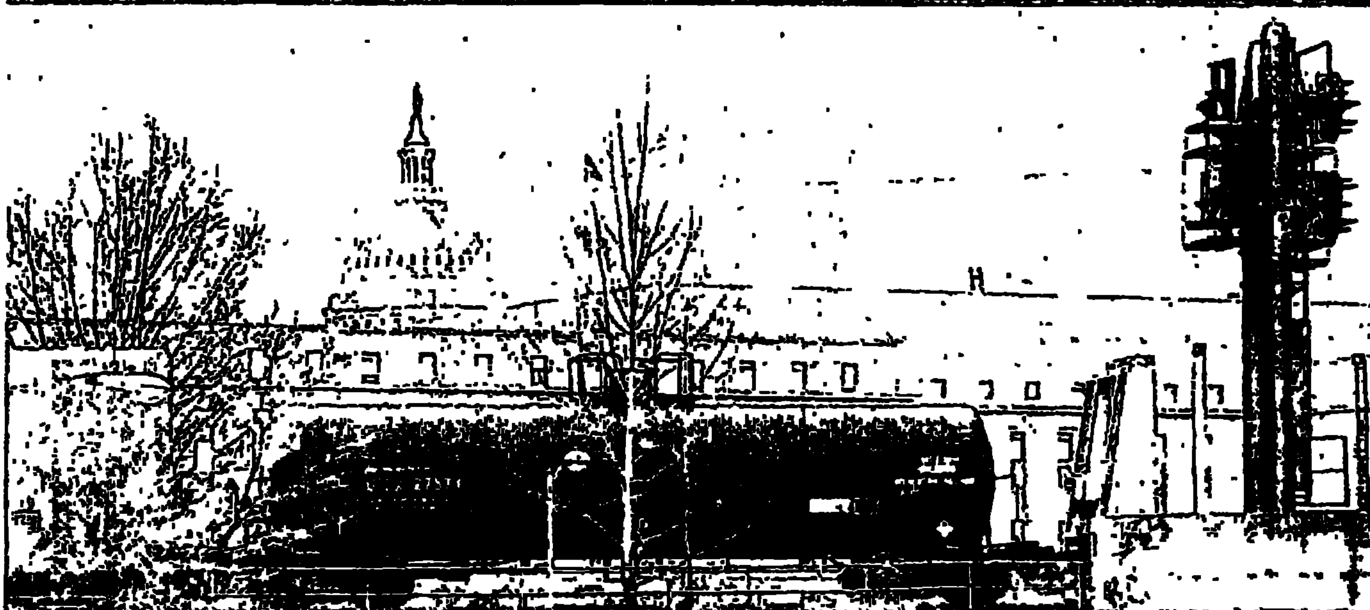
Rail carriers are in turn unable to effectively price such risks into what they charge customers. If railroads can charge liability fees on TIH rail shipments, it creates a market-based incentive for chemical producers and users to adopt proven alternatives. This should improve the overall financial condition of the railroads, since they face potentially catastrophic exposure from TIH shipments that represent a tiny portion of their overall business.

The STB asks, "what constitutes a reasonable request to transport TIH chemicals?" If there are commercially feasible alternatives that can eliminate the need to transport the TIH by rail, then at some point it is no longer reasonable to use rail shipments.

Attachment:
Center for American Progress, "Toxic Trains and the Terrorist Threat: How Water Utilities Can Get Chlorine Gas Off the Rails and Out of American Communities," 2007.

Center for American Progress

Toxic Trains and the Terrorist Threat



How Water Utilities Can Get Chlorine Gas Off the Rails and Out of American Communities

Paul Orum

Progressive Ideas for a Strong, Just, and Free America

TOXIC TRAINS AND THE TERRORIST THREAT

How Water Utilities Can Get Chlorine Gas Off the Rails and Out of American Communities

By Paul Orum

Reece Rushing, Project Manager
Director of Regulatory and Information Policy,
Center for American Progress

April 2007

Contents/April 2007

Executive Summary

Each year, thousands of tons of highly toxic chlorine gas travel by rail in the United States to drinking water and wastewater treatment facilities and other industries. These massive railcars traverse some 300,000 miles of freight railways, passing through almost all major American cities and towns. A rupture of one of these railcars could release a dense, lethal plume for miles downwind, potentially killing or injuring thousands of people.

The Department of Homeland Security and numerous security experts have repeatedly warned that terrorists could use industrial chemicals as improvised weapons of mass destruction — and indeed, terrorists recently attacked and blew up several trucks carrying chlorine in Iraq. In this respect, railcars of chlorine gas represent a distinct national security vulnerability. Yet Congress and the Bush administration have not acted to eliminate unnecessary uses of chlorine gas railcars even where undeniably affordable and practical alternatives exist.

To examine this vulnerability and encourage action, the Center for American Progress surveyed water utilities that still receive chlorine gas by rail, as well as utilities that since 1999 have eliminated chlorine railcars by switching to a less hazardous disinfectant. Our major findings are shown in the box on page 3.

Just 37 drinking water and wastewater treatment facilities still receive chlorine gas by rail. More than 25 million Americans live in harm's way near these facilities,[1] while millions more live in cities and towns along the rail delivery routes.

The good news is this vulnerability can be removed. Since 1999, some 25 water utilities that formerly received chlorine gas by rail have switched to safer and more secure water treatment options, such as liquid bleach or ultraviolet light. These alternative treatment options eliminate the danger of a catastrophic toxic gas cloud. As a result, more than 26 million Americans who live near these facilities are safer and more secure.

These conversions also remove the threat to communities along rail delivery routes. Railroads, by their nature, are wide open and largely insecure, providing easy access to railcars — as evidenced by the graffiti that frequently marks them (see photo on page 15). This makes it practically impossible to provide security commensurate with the risk presented by railcars of chlorine gas.

The only way to truly protect communities is to get unnecessary toxic cargoes off the tracks. Converting to safer alternatives for water treatment does that.

There continues to be some progress in this direction. At least six water utilities that now use chlorine-gas railcars are in the process of converting operations. Nonetheless, many others contacted by this survey have no plans to change.

Cost was a frequently cited reason for not converting. But the survey found such conversions are affordable even at large facilities, costing no more than $1.50 per person served each year—or the price of a bag of potato chips—and often much less. Put another way, a single day's expenditures on the war in Iraq could cover construction costs of converting the remaining U.S. water utilities off chlorine gas railcars. Cost is not a sufficient justification to continue to jeopardize American communities with massive railcars of chlorine gas.

State and local governments may provide incentives for water utilities to switch from chlorine gas. But communities along the rails have little or no local control over toxic trains that pass by homes, workplaces, and schools. The plant conversions identified in this report are positive, but without a national strategy, these communities will be much less secure than they should be.

Washington, D.C., for example, quickly converted its sewage treatment plant from chlorine gas railcars to liquid bleach in the aftermath of the Sept. 11, 2001, terrorist attacks. But hazardous chemicals, including chlorine gas, are still being transported by rail through the District just a few city blocks from the U.S. Capitol building—an intended target on 9/11.

In response, the city government sought to reroute toxic trains around the city. The Bush administration, however, has backed a lawsuit to block local control, arguing that local governments lack legal authority to protect citizens by rerouting trains.

The story is the same in other cities that have converted water utilities from chlorine-gas railcars, such as Cleveland and Indianapolis. Despite converting, these cities are still at risk from chlorine-gas railcars headed to other cities that have not converted, such as Minneapolis and Nashville.

A comprehensive solution can only come from the federal level. In fact, judges in the ongoing litigation over rerouting in Washington, D.C., have encouraged the Bush administration to develop a national strategy to address the security and safety dangers involved in the manufacture, use, and transportation of chlorine gas and other hazardous chemicals. Unfortunately, the administration and Congress have largely ignored this advice.

After years of inaction, and under growing public pressure, temporary and cosmetic chemical security legislation was enacted in October 2006 requiring the Department of Homeland Security to promulgate chemical-plant security regulations by April 4, 2007. But the legislation exempts water utilities, does not address transportation security concerns, and neglects safer and more secure technologies. Thus, among other shortcomings, DHS's new regulations will do nothing to address the risk posed to tens of millions of Americans by unnecessary rail shipments of chlorine gas to water utilities.

To address this danger and other chemical hazards, Congress must create meaningful national incentives. Among other actions, federal security standards should

- Require chemical facilities to review and use available, cost-effective technologies that significantly reduce or eliminate serious emergency chemical release hazards.
- Target assistance to help water utilities convert from chlorine gas, including facilities that discontinued chlorine gas after Sept. 11, 2001.
- Give the Department of Homeland Security full authority to safeguard chemical infrastructure and the public, with appropriate roles for other governmental agencies, and
- Require chemical facilities to account for transportation risks—including the possibility of a catastrophic chemical release—in developing security assessments and plans.

Taking these actions would remove unnecessary toxic cargoes from the nation's railways and communities. The danger is immense, and the solutions are clear. What we need now is action.

Major Findings

The Center for American Progress surveyed 62 water facilities that receive chlorine gas by rail or previously received chlorine gas by rail. These facilities treat an average of five billion gallons of drinking water and four billion gallons of wastewater each day, and serve more than 45 million people in two dozen states and the District of Columbia.[2] The survey identified facilities that have eliminated chlorine gas railcars, but also found others that have no plans to do so. Major survey findings include:

- **Only 24 drinking water and 13 wastewater facilities still use *rail shipments* of chlorine gas.** These facilities are found in California, Florida, Kansas, Kentucky, Louisiana, Michigan, Minnesota, Missouri, Nebraska, South Carolina, Tennessee, Texas, Utah, and Virginia. These facilities endanger more than 25 million Americans who live nearby, and millions more near railways that deliver the chlorine gas.
- **At least six drinking water and 19 wastewater facilities have eliminated *rail shipments* of chlorine gas since 1999 by switching to a less hazardous disinfectant.** These facilities are found in California, the District of Columbia, Florida, Georgia, Indiana, Kentucky, Louisiana, Maryland, Michigan, Minnesota, New Jersey, New York, Ohio, Oregon, Pennsylvania, and Washington. Some 26 million people in nearby communities and millions more along rail delivery routes are no longer threatened by chlorine gas from these facilities. Additional water utilities eliminated chlorine gas rail shipments prior to 1999.[3]
- **Of facilities that still receive *rail shipments* of chlorine gas, at least four drinking water and two wastewater plants have definite plans to convert from chlorine gas to a safer, more secure disinfectant.** These facilities are found in Colorado, Florida, Kentucky, Louisiana, South Carolina, and Virginia. By converting, they will remove the threat to more than five million people living nearby, and millions more along their rail delivery routes. Several more such facilities are planning to convert within a few years, and others are evaluating alternatives.[4]
- **Chlorine gas rail shipments travel long distances through populated areas.** Some 16 chlorine production sites sell chlorine by rail to the merchant market. The profusion of freight rail lines precludes identifying specific routes between producers and water utilities. The locations of producers and chlorine-gas-using water utilities, however, make clear that rail shipments often cover hundreds or even thousands of miles.
- **General cost estimates provided by 20 water facilities indicate that switching from chlorine gas to a safer, more secure disinfectant is affordable.** Conversions at these facilities cost no more than $1.50 per person served each year—or the price of a bag of potato chips—and often cost much less. A single day's expenditures on the war in Iraq could easily have paid to convert these 20 facilities off chlorine gas.

Dangerous State of Play

Chemical Railcars Pose Serious Hazards

Exposure to chlorine gas can severely burn the eyes, skin, and lungs, and can be fatal. When released from a railcar, compressed chlorine expands rapidly into a ground-hugging poison gas cloud. A single ruptured railcar of chlorine gas can release a dense, lethal plume from 14 miles to 25 miles downwind in worst-case conditions.[5] In large urban areas thousands of people could be killed or seriously injured in these conditions.

The Department of Homeland Security estimates that a major chlorine railcar spill could kill 17,500 people.[6] A Naval research lab likewise found that such a spill could quickly cause 100,000 serious injuries or deaths under a scenario involving large holiday crowds.[7]

This risk is especially worrisome given the vulnerability of railcars. A RAND Corp. database of worldwide terrorist incidents recorded over 250 attacks against rail targets from 1995 to 2005.[8] Insurgents in Iraq have recently targeted trucks carrying chlorine gas with several deliberate attacks.[9]

The graffiti on many railcars attests to their vulnerability. A survey of rail workers reported widespread lax security at rail yards.[10] Investigative news reports repeatedly show easy access to chemical facilities and rail cargoes.[11] A *Pittsburgh Tribune* reporter recently found so little security he could leave his business card on dozens of railcars and locations.[12]

Railcars may travel or sit near schools, hospitals, homes, and downtowns with only nominal security, if any. The railroad carrier may simply park the chlorine railcar outside the water utility fence on an unpredictable schedule, leaving it for the facility to retrieve. Rail security regulations are minimal, yet because federal rules preempt state and local requirements, chemical railcars passing through communities are largely exempt from local control.

Major chlorine rail spills are infrequent but can be deadly. Chlorine rail spills killed eight people in Youngstown, Fla., in 1978, 17 people in Montanas, Mexico in 1981, three people near San Antonio, Texas in 2004, and nine people in Graniteville, S.C., in 2005. Since 1990, the National Response Center has recorded over 160 mostly-minor spill reports involving railroads and chlorine, or more than one every six weeks.[14]

Such spills reveal the overall vulnerability of the system. But a calculated terrorist rupture of a single chlorine-gas-filled railcar could have far worse consequences, potentially poisoning an entire community.

New Interim Chemical Security Rules Won't Fix the Problem

Many federal agencies and others have warned that terrorists could use chemical facilities as pre-positioned weapons of mass destruction.[15] Yet there are almost no federal chemical security requirements. Congress enacted temporary legislation in October 2006 that requires the Department of Homeland Security to promulgate interim, stopgap chemical security requirements by April 1, 2007.[16]

But this new law is seen as an incomplete measure that will ultimately be replaced by comprehensive legislation. It has significant shortcomings that leave millions of Americans vulnerable. In particular, the new regulations

> *"We are happy not to have the chlorine gas there. In the end it was a no-brainer to switch."*
>
> ***Bill McKeon, Chief-Wastewater, Philadelphia Water Department, Philadelphia, Pa.***

- Exempt drinking water and wastewater plants and other types of facilities.
- Do not require facilities to address the dangers, security costs, and potential liabilities of transporting extremely hazardous materials to or from their facilities, and
- Ignore cost-effective safer technologies that are the most effective way to reduce the attractiveness of chemical facilities as terrorist targets.

These regulations are too focused on physical security at facilities and do not do enough to emphasize supply chain security. Better fencing, lighting, and access controls are important, but insufficient, particularly if the delivery of hazardous materials to or from a facility travels by rail through a major urban center.

In 2006, the Transportation Security Administration released draft voluntary action items for securing rail transportation of toxic inhalation materials such as chlorine gas. Yet the voluntary recommendations lack enforcement, are vague on key elements (such as protecting railcars in transit), and are silent on feasible opportunities to take hazardous cargoes off the rails.

The Bioterrorism Act of 2002 provided substantial federal funding to drinking water facilities to conduct vulnerability assessments but did not require these facilities to reduce any hazards or otherwise improve security. Similarly, there are no significant federal security standards for wastewater plants.

Homeland Security Presidential Directive 7 designated the U.S. Environmental Protection Agency as the lead agency to oversee security at drinking water and wastewater facilities.[17] The EPA could require preventive security at water utilities under the general duty clause of the Clean Air Act. The Bush administration, however, blocked a specific proposal developed by EPA and the then Office of Homeland Security (now DHS) to use this authority to establish federal chemical security standards.[18]

Less Hazardous Alternatives Are Available

In 2006 the National Research Council reported that "the most desirable solution to preventing chemical releases is to reduce or eliminate the hazard where possible," including by modifying processes or replacing hazardous materials with less hazardous substitutes.[19] Two years ago, the Center for American Progress recommended an action plan for safeguarding hazardous chemical facilities using these techniques,[20] and one year ago released survey findings that documented some 284 facilities across diverse industries that had switched to less acutely hazardous options.[21]

The Association of American Railroads supports development of less hazardous products and technologies as substitutes for highly hazardous materials. In congressional testimony, the association explained that chlorine gas and other "toxic inhalation hazard," or TIH, chemicals comprise just 0.3 percent of all rail shipments, but railroads face potentially ruinous liability from hauling these chemicals, which they are required to carry. For this reason, the railroads "strongly support efforts aimed at finding and utilizing inherently safer technologies" as substitutes for hazardous materials, especially TIH" that are shipped by rail.[22]

Roughly two-thirds of large U.S. wastewater utilities already use a disinfectant chemical other than chlorine gas, or plan to stop using chlorine gas.[24] At least 160 large U.S. public drinking water systems already use liquid bleach.[?] In last year's survey, the Center for American Progress identified more than 200 drinking water or wastewater facilities that had eliminated chlorine gas since 1999—a sample of similar changes at many water utilities nationwide.[25] Most of these water facilities switched to liquid bleach, while others use ultraviolet light.

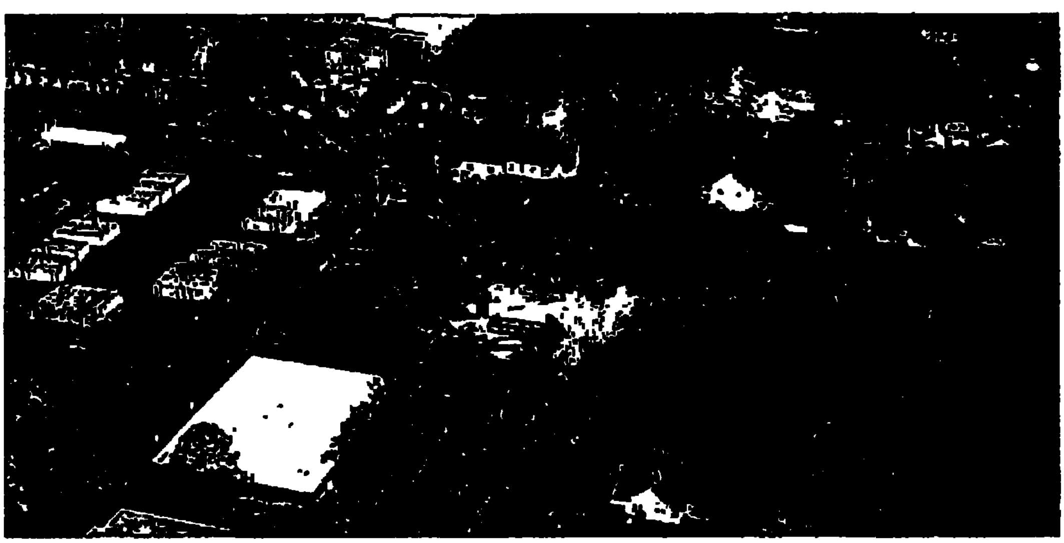
Last year's report noted that approximately 1,700 drinking water plants and 1,150 wastewater facilities report extremely hazardous substances, primarily chlorine gas, under EPA's Risk Management Planning program. This year's survey report focuses on just those water utilities that recently have received chlorine gas by rail.

Utilities that eliminate chlorine gas may replace other hazardous chemicals. Some wastewater facilities remove chlorine from effluent by using anhydrous sulfur dioxide, a dangerous toxic gas. These facilities frequently replace anhydrous sulfur dioxide with less hazardous sodium bisulfite. Similarly, some drinking water facilities replace anhydrous ammonia, a toxic gas, with aqueous ammonia, a less hazardous alternative.

Replacement Chemicals Can Be More Safely Produced

Water utilities can buy concentrated bleach in bulk as sodium hypochlorite, or generate dilute bleach on-site from salt and electricity. Recent high prices for chlorine make on-site generation increasingly attractive even for larger water utilities. Several facilities surveyed in this report are considering or adopting on-site bleach, while others are considering or adopting ultraviolet light. Both options eliminate bulk transportation of extremely hazardous substances and greatly reduce overall transportation needs.

In our survey for this report, we found many utilities that eliminated chlorine gas now buy bulk sodium hypochlorite bleach. One argument against converting water utilities to bleach is that it simply shifts the danger to bleach manufacturing facilities,



A freight train derailed on Jan. 6, 2005 in Graniteville, S.C., rupturing a railcar of chlorine gas. The leaking gas visible in the photo above killed nine people, sent 500 to the hospital with breathing problems, and caused more than 5,000 to evacuate for several days. (U.S. EPA)

"We are very glad the chlorine gas is gone. It's an achievement. It used to be our number one employee concern."

Ray Flasco, Water Supply Division Manager, Akron Water Supply Plant, Kent, Ohio

which typically make hypochlorite from bulk rail shipments of chlorine gas. Producers, however, can manufacture hypochlorite using "just-in-time" technology, in which chlorine gas is created and promptly used only in small amounts, eliminating the danger of a catastrophic gas release.

This process is used in Asia, Australia, Europe, and a few U.S. locations.[1] Further industrial-scale production is under development in the United States.[17] Currently some 94 manufacturers across the country produce sodium hypochlorite for use in industrial or household products.[2] Full conversion to producing hypochlorite without bulk chlorine gas would eliminate thousands of rail shipments each year and take millions of Americans out of harm's way.

Producing hypochlorite bleach from bulk chlorine gas is currently marginally cheaper than using safer and more secure methods—but only insofar as companies do not pay the full costs of security and liability insurance for a potential catastrophic chlorine release. Requiring producers that use bulk chlorine gas to internalize these costs would immediately make large-scale production using safer and more secure methods cost-competitive.

Major Survey Findings

Few Water Utilities Still Use Chlorine Gas Railcars

Only 21 drinking water and 13 wastewater facilities still use *rail shipments* of chlorine gas. Yet because of these few facilities, thousands of tons of deadly chlorine gas pass through major American cities. Some 25 million Americans live within range of a worst-case toxic gas release around these facilities, and millions more live along rail delivery routes. Among these 37 facilities are:

- St. Paul Regional Water Services-McCarron, Maplewood, Minn., 1.3 million people at risk
- Kansas City, Missouri Water Treatment Plant, 720,000 people at risk
- Omohundro Water Treatment Plant, Nashville, Tenn., 973,663 people at risk
- East Bank Wastewater Treatment Plant, New Orleans, La., 726,185 people at risk*
- Central Regional Wastewater System, Grand Prairie (Dallas), Texas, 3.9 million people at risk

For a complete list see Appendix A on page 16 and the map on page 11.

Many Water Utilities Have Switched to Safer, More Secure Alternatives

At least six drinking water and 19 wastewater facilities have eliminated *rail shipments* of chlorine gas by switching to a less hazardous disinfectant since 1999. As a result, more than 26 million people no longer live within range of a chlorine gas release from these facilities, and additional millions are no longer in danger from rail shipments to these facilities. Among these 25 facilities are:

- Wyandotte Wastewater Treatment Facility, Wyandotte, Mich., 1.1 million people no longer at risk
- Baldwin Water Treatment Plant, Cleveland, Ohio, 1.4 million people no longer at risk

* [illegible] Katrina [illegible]

- Metropolitan Wastewater Treatment Plant, St. Paul, Minn., 520,000 people no longer at risk
- Joint Water Pollution Control Plant, Carson, Calif. (Los Angeles County), 210,000 people no longer at risk
- White River Water Treatment Plant Indianapolis, Ind., 968,579 people no longer at risk

For a complete list see Appendix B on page 18 and the map on page 11. Additional water utilities eliminated chlorine gas rail shipments prior to 1999.[illegible]

Some Additional Water Utilities Are Eliminating Chlorine Gas

Of the 37 water facilities that still use chlorine railcars, at least four drinking water and two wastewater plants are currently converting to a safer, more secure disinfectant with at least partial construction planned by 2008. Completing these conversions will cut chemical hazards for five million people who live nearby and many others along freight railways. Facilities with well-developed plans to convert include:

- Metro Wastewater Reclamation District, Denver, Colo., 925,000 people at risk
- City of Richmond Water Purification Plant, Richmond, Va., 704,640 people at risk
- Carrollton Water Purification Plant, New Orleans, La., 892,320 people at risk**

Several other facilities may convert within a few years, and others are evaluating alternatives. Two other facilities (in Stockton and San Jose, Calif.) occasionally use liquid bleach as an available backup, but are evaluating more serviceable long-term solutions such as ultraviolet light.

** Population before hurricane Katrina

Chlorine Gas Railcars Travel Over Long Distances

Each year, approximately 15,000 shipments of chlorine gas travel by rail in the United States. These shipments may travel over more than 400,000 miles of freight railways across the country.[illegible] Rail lines pass through almost all major American cities and towns.

The 16 chlorine production sites listed in Appendix C reportedly sell chlorine by rail to water utilities through the merchant market. Usually, a distributor company moves the chlorine gas from the original manufacturer to the water utility. These rail shipments may travel long distances—hundreds or even thousands of miles—passing through densely populated cities and towns. There is no legal requirement to use the closest supplier or the safest route.

The large water utilities covered by this report account for only a small portion of the chlorine on the rails—but are by their nature located in or near large cities or towns. Producers also ship to chlorine packaging locations and sodium hypochlorite bleach production facilities. Additional destinations include PVC plastics producers, some paper mills, and chemical manufacturers. Roughly two-thirds of chlorine is never shipped, but rather is used on-site in chemical manufacturing or is moved by pipeline to nearby facilities. For this very reason, chemical manufacturers may co-locate to avoid shipping chlorine gas.[illegible]

The profusion of freight rail lines precludes identifying specific routes between producers and water utilities. However, the map on page 11 illustrates the long distances that rail shipments must travel between manufacturers and the few water utilities that still receive chlorine gas by rail.

"As a plant operator it's a weight off your shoulders if you don't have that risk of chlorine gas."

Nick Frankos, Plant Manager, Back River Wastewater Plant, Baltimore, Md.

Utilities Cited a Number of Reasons for Switching

Personnel at water facilities that eliminated chlorine gas were generally relieved to be rid of it and considered the change an achievement. Reasons and advantages for switching included: improving safety and security, meeting discharge requirements, reducing liability exposure, cutting costs of preventive maintenance, training, emergency planning, and regulatory compliance, mitigating on-site security costs associated with chlorine gas, and previous experience with chlorine leaks.

"Maintenance cost… priceless! No special training or emergency repair kits to keep on hand. We do all our repairs in-house where chlorine required an outside contractor. The Fire Department loves us. No more emergency drills and training."

John Garvin, Operation and Maintenance Manager, Regional Water Resource Agency, Owensboro, Ky.

Most surveyed facilities that have not converted are evaluating disinfectant options. These facilities cited as potential obstacles costs of capital and replacement chemicals, the large size of the utility and needed chemical volumes, storage space and shelf life of liquid bleach, requirements to maintain backup disinfection capability, and the need for reliable information on alternatives.

Some facilities also noted investments in chlorine-gas security, such as containment buildings, sensors, and scrubbers. Such sunk costs may create a disincentive to further change, yet do nothing to protect incoming rail shipments.

Conversion Costs Are Manageable

Twenty facilities provided general information on the construction and operating costs of converting off chlorine gas railcars. Switching these facilities to a safer, more secure disinfectant is affordable, costing no more than \$1.50 per year per person served — the price of a bag of potato chips—even without accounting for important cost savings. Many facilities are spending well less than that amount. Examples are described in the box on pages 12–13.

Cost figures varied widely depending on facilities' specific circumstances and the information available to respondents. Some facilities, for example, needed to upgrade aging infrastructure, others did not. While many respondents were able to estimate construction and chemical costs, most found it difficult to compile information on *avoided* costs from readily available sources. Some facilities, however, identified important savings in preventive maintenance, emergency planning, employee training, regulatory compliance, future site security, or other factors.

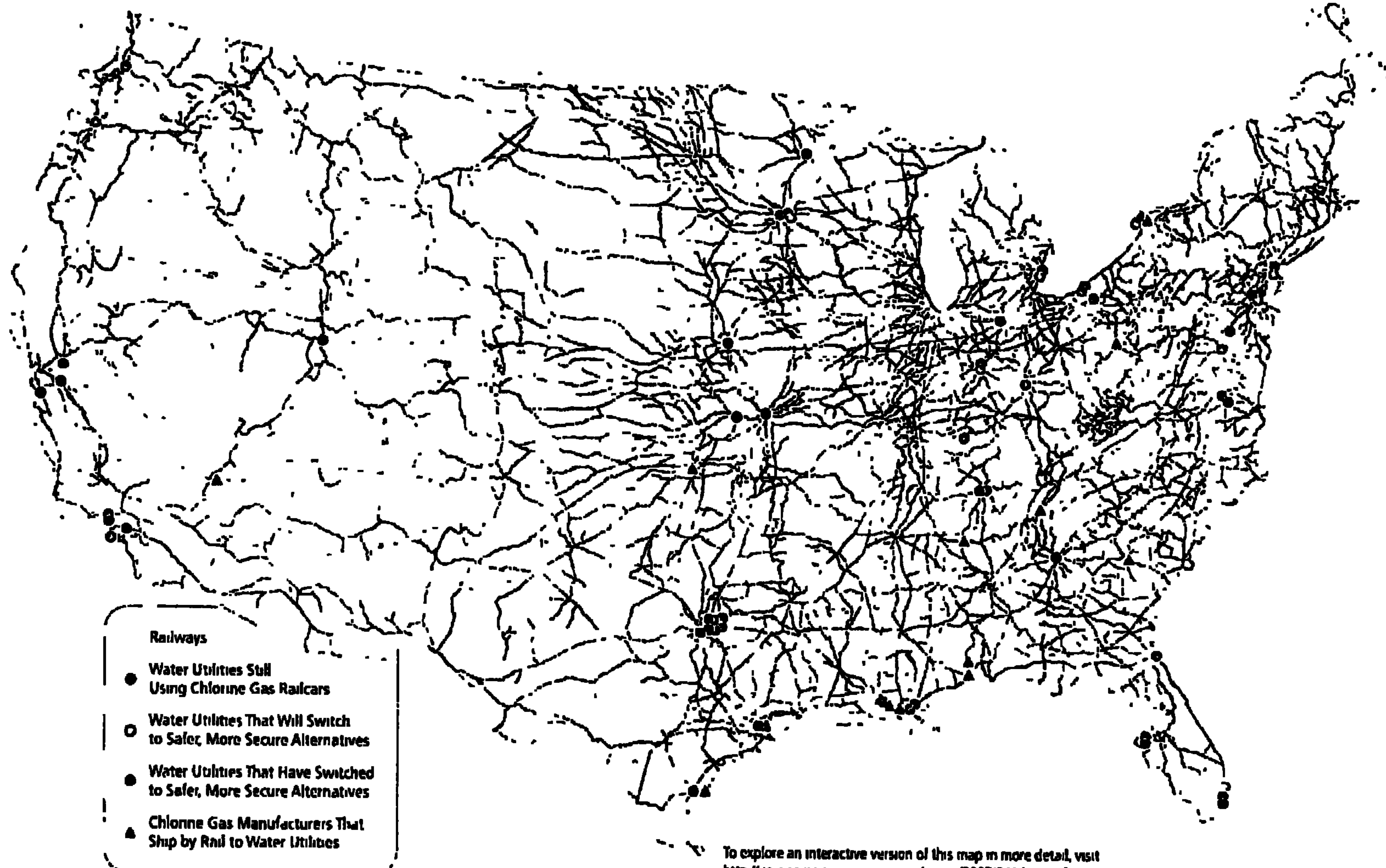
Facilities using chlorine gas face new demands to upgrade physical security to protect against a possible terrorist attack. Current practices include at best such meager physical security measures as better fences, vehicle gates, lights, employee identification, and cameras. Some facilities may also have enclosures and gas scrubbers that attempt to contain an emergency release. Converting from chlorine gas mitigates these costs while providing superior protection to employees and surrounding populations.

After all, there is little reason to believe that current security practices would be able to withstand a well-executed attack by an armed intruder. Nor does enhanced physical security do anything to protect railcars in transit to the facility.

The Government Accountability Office is currently conducting a review of costs associated with conversion of water utilities to less hazardous chemicals. This GAO report is expected in spring 2007.

Unnecessary Rail Shipments of Chlorine Gas Endanger Millions

Shown are 37 water utilities that still receive chlorine gas by rail. Distributors ship railcars of chlorine gas from 16 manufacturers to these utilities—frequently over long distances and through densely populated areas. Also shown are 75 water utilities that since 1999 have eliminated railcar shipments of chlorine gas by converting to safer, more secure alternatives for water treatment. Millions of people along railroads are no longer endangered by chlorine gas shipments to these utilities. Of utilities that still receive chlorine gas by rail, at least six more have firm plans to convert from chlorine gas within two years.



To explore an interactive version of this map in more detail, visit http://www.americanprogress.org/issues/2007/04/chemical_security_report.html

Conversion Costs at Specific Facilities

These 20 water utilities were able to convert from chlorine gas railcars to effective alternatives at a reasonable cost.[32] A single day's expenditures on the war in Iraq could have easily paid for all these conversions.

- **The Metropolitan Wastewater Treatment Plant in St. Paul, Minn.,** switched from chlorine gas railcars to liquid bleach in late 2005. The aging plant required upgrades that were projected to cost about the same whether staying with chlorine gas or switching to liquid bleach. Actual construction cost $7.8 million, and chemical costs increased $85,000 per year. Annual operating costs of preventive maintenance, energy, and emergency preparedness decreased about $65,000, while in-plant security decreased an estimated $35,000. The entire metropolitan wastewater system serves about 2.4 million people; annual conversion costs, including otherwise necessary construction, are about 20 cents per person served.

- **The Columbia Boulevard Wastewater Treatment Plant in Portland, Ore.,** switched from chlorine gas railcars to liquid bleach in 2005. Construction cost $4.4 million, and increased chemical costs are more than offset by operating savings anticipated from reduced need for maintenance, electric power, training, labor, and emergency planning. The facility serves some 550,000 people, who will benefit from the offset of operating costs in the long term.

- **The Akron Water Supply Plant in Kent, Ohio,** switched from chlorine gas railcars to liquid bleach in 2004. Construction cost about $1.1 million (or one-fourth the cost of a new chemical building) and operating costs increased about $65,000 per year, primarily to cover chemicals. The facility, however, avoided over $1.2 million in construction costs by eliminating chlorine gas. By switching, the facility avoided constructing a containment building to enclose railcars ($308,000), installing an emergency gas scrubber ($598,000), and upgrading certain process equipment such as a chlorine gas evaporator ($369,000). Even without considering avoided costs, the facility's 280,000 customers pay only approximately 50 cents more each year.

- **The Edward P. Decher Secondary Wastewater Plant in Elizabeth, N.J.,** switched from chlorine gas to liquid bleach in 2003. Construction upgrades cost $750,000 and chemical costs increased $291,000 from 2002 to 2004, while maintenance and training costs decreased an estimated $70,000 per year. The facility serves about 500,000 people; annual conversion costs are about 55 cents per person served.

- **The South Treatment Plant in Renton, Wash.,** switched from chlorine gas to liquid bleach in 2003. Construction cost $2.4 million, and chemical costs increased about $350,000 per year. The entire wastewater system serves about 1.4 million people; without accounting for any operating savings, annual conversion costs are less than 40 cents per person served.

- **The Western Lake Superior Sanitary District in Duluth, Minn.,** switched from chlorine gas to liquid bleach in 2006. Construction cost $1.6 million. Operating costs initially remained about the same, with increased chemical costs offset by decreased demurrage charges that resulted from keeping a chlorine railcar on site. A newly revised discharge permit will likely lengthen the disinfection season and increase chemical costs in the future. The facility serves 110,000 people; annual conversion costs are thus far about a dollar per person served.

- **Crescent Hill Water Treatment Plant in Louisville, Ky.,** is building an on-site generating facility for bleach disinfectant at an estimated capital cost of roughly $10 million. Accounting for depreciation, the facility estimates the cost of switching over from chlorine gas at about $500,000 annually. The entire water system serves about 850,000 people; estimated annual conversion costs are about 60 cents per person served.

- **The City of Richmond Water Purification Plant in Richmond, Va.,** is switching from chlorine gas railcars to liquid bleach in early 2007. Construction cost $1 ... million for a new building, about one-third directly linked to storage of liquid bleach. Chemical costs are anticipated to increase $450,000 per year. The facility serves about 500,000 people, without accounting for any operating savings, annual conversion costs are about $1 50 per person served.

- **Blue Plains Sewage Treatment Plant in Washington, D.C.,** switched from chlorine gas railcars to liquid bleach immediately after September 11, 2001 According to the plant's chief engineer at the time, the change adds about 25 cents per month to the average household customer's utility bill.[3]

- **The Nottingham and Baldwin drinking water treatment plants in Cleveland, Ohio** completed conversion from chlorine gas to liquid bleach in late 2002 and 2005, respectively Construction cost an estimated $2,475,000 for both plants, and chemical costs increased about $208,000 per year The Cleveland division of water serves some 1 5 million people, without accounting for any operating savings, annual conversion costs are less than 25 cents per person served

- **The Buckman Water Reclamation Facility in Jacksonville, Fla.,** switched from chlorine gas railcars to ultraviolet light in 2001 Construction cost $6 million, including about $1 million for unrelated upgrades Electricity costs increased about $150,000 per year over the previous cost of chlorine gas, but only if not considering recent dramatic chlorine price increases The entire wastewater system serves about 575,000 people, annual conversion costs are about 80 cents per person served

- **The Wyandotte Wastewater Treatment Facility in Wyandotte, Mich**, switched from chlorine gas railcars to ultraviolet light in 2000 Construction cost $8 million, and operating costs increased from about $320,000 to $350,000 each year The wastewater system serves about 415,000 people, annual conversion costs are about $1 30 per person served

- **The Mill Creek Wastewater Treatment Plant in Cincinnati, Ohio,** switched from chlorine gas railcars to liquid bleach in 2001 Constructing a temporary conversion cost less than $40,000, planned permanent construction is projected to cost less than $3 million Chemical costs increased about $290,000 per year The entire metropolitan sewer district serves about 800,000 people, without accounting for any operating savings, annual conversion costs are about 60 cents per person served

- **The City of Philadelphia** converted its Northeast, Southeast, and Southwest water pollution control plants from chlorine gas to liquid bleach Capital costs for conversion were $5 9 million for all three plants, and chemical costs increased about $275,000 per year After converting to liquid bleach, these facilities jointly save roughly $75,000 each year in reduced labor and risk management planning costs The entire wastewater system serves about 2 2 million people, annual conversion costs are about 25 cents per person served

- **Samuel S. Baxter Water Treatment Plant in Philadelphia, Pa.,** converted to liquid bleach in 2005 Construction costs were about $2 million, and chemical costs increased about $670,000 in 2006 Estimated savings on labor and emergency planning are at least $25,000 per year The entire drinking water system serves about 1 6 million people, annual conversion costs are less than 50 cents per person served

- **The Middlesex County Utilities Authority wastewater plant in Sayreville, N.J.,** switched from chlorine gas railcars to liquid bleach in 2001 Construction cost $1 3 million, and chemical costs increased from 2002 to 2006 about $1 5 million, as chlorine prices more than tripled The wastewater system serves some 800 000 people Discounting two-thirds of increased chemical costs for price change, and not accounting for any operating savings, annual conversion costs are still less than a dollar per person served

- **The Back River Wastewater Treatment Facility in Baltimore, Md.,** switched from chlorine gas railcars to liquid bleach in 2004 Construction cost $2 6 million, and chemical costs increased from 2003 to 2008 about $2 4 million, during which time chlorine prices more than doubled For this and other reasons the facility is planning further conversion to generating bleach on-site The entire wastewater system serves 1 3 million people Discounting one-half of increased chemical costs for price change, and not accounting for any operating savings, annual conversion costs are still less than a dollar per person served

Conclusion and Recommendations

More than five years after 9/11 and despite many credible warnings, the U.S. government has yet to enact policies that seriously reduce unnecessary chemical hazards. The Center for American Progress surveyed water utilities that still use chlorine gas railcars to examine systematic shortcomings in current federal chemical security policies, and to encourage Congress to enact policies that swiftly and efficiently remove unnecessary chemical hazards.

The survey shows that many large water utilities have converted from chlorine gas railcars to safer and more secure alternatives. These conversions remove terrorist targets at the facilities and on the rails, and make millions of Americans safer and more secure. Facility operators are relieved when the gas is gone, and often proud of helping to bring about the change.

The roughly three dozen water utilities that still receive chlorine gas railcars can also convert to safer alternatives, but many are not acting. At the same time, recently enacted interim chemical security legislation exempts water utilities, neglects transportation hazards, and ignores safer technologies. Millions of Americans remain unnecessarily at risk from a catastrophic chemical release.

To address this threat, Congress, the administration, and industry must make chemical security an urgent national priority, with the goal of transitioning to safer, more secure technologies. Specifically:

- Water utilities that still use railcars of chlorine gas or anhydrous sulfur dioxide should shift to safer and more secure treatment alternatives.
- Congress should require chemical facilities to review and use available, cost-effective technologies that significantly reduce or eliminate serious emergency chemical release hazards.
- Congress should target grants, loans, and other incentives to help water utilities convert from chlorine gas, including facilities that discontinued chlorine gas after September 11, 2001. Such assistance should not cover containment buildings and other physical security measures that are inherently incapable of protecting chlorine gas railcars at water utilities and in transit.

- The Department of Homeland Security should go back to Congress for full authority to safeguard chemical infrastructure and the public, with appropriate roles for other governmental agencies.

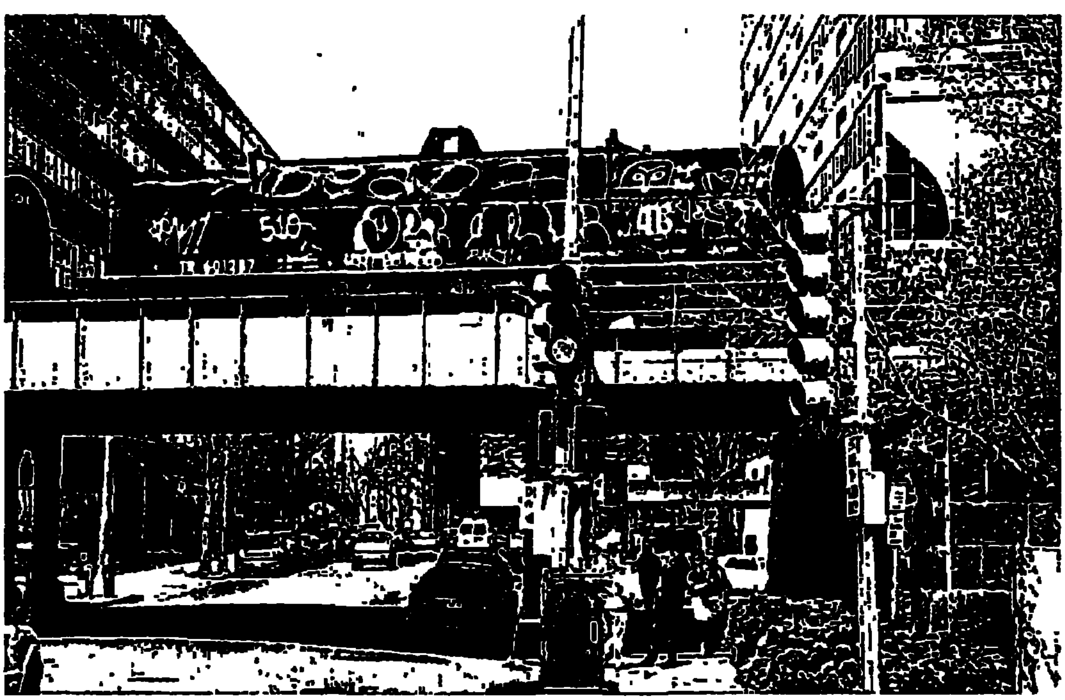
- Congress should require chemical facilities to account for transportation risks—including the possibility of a catastrophic chemical release—in developing security alternatives, assessments, and plans.

- Congress should require chemical facilities to involve appropriate employees when developing security alternatives, assessments, and plans.

- The Department of Homeland Security should develop methodologies to account for the impact of safer, more secure technologies on facility security, including the costs, avoided costs, and feasibility of alternatives.

- Manufacturers of liquid bleach should adopt production methods that do not require bulk transportation or storage of chlorine gas. Congress should require these facilities to carry sufficient liability insurance to cover a catastrophic chemical release.

These policy recommendations are reasonable and obtainable. They would impose only insignificant burdens on consumers, while delivering measurable improvements in safety and security. Indeed, many water utilities have already abandoned chlorine gas at affordable cost with effective results. Congress and the Department of Homeland Security have the responsibility to compel the swift conversion of the remaining water utilities that still receive chlorine gas by rail. The reasons to do so are self-evident in this report. Congress and DHS need only act.



A graffiti-covered rail tanker passes within blocks of the National Mall in Washington, D.C. (Jim Dougherty/Sierra Club)

Appendix A

WATER UTILITIES USING CHLORINE GAS RAILCARS

FACILITY NAME	CITY	STATE	FACILITY TYPE	APPROXIMATE FACILITY SIZE—MILLION GALLONS PER DAY (MGD)	CONVERSION STATUS	VULNERABILITY ZONE POPULATION*
Joseph Jensen Filtration Plant	Granada Hills	CA	Drinking water plant	750 MGD	Evaluating alternatives, no active plans to convert	1,700,000
F E Weymouth Water Treatment Plant	La Verne	CA	Drinking water plant	520 MGD	Evaluating alternatives, no active plans to convert	304,873
Los Angeles Aqueduct Filtration Plant	Sylmar	CA	Drinking water plant	600 MGD	Have looked at alternatives, no change forecast	290,000
Sacramento Regional Wastewater Treatment Plant	Elk Grove	CA	Wastewater plant	165 MGD	No apparent plans to convert	18,000**
San Jose/Santa Clara Water Pollution Control Plant	San Jose	CA	Wastewater plant	115 MGD	Evaluating alternatives including ultraviolet light, liquid bleach is available backup	245,000
City of Stockton Tertiary Treatment Plant	Stockton	CA	Wastewater plant	35 MGD	Occasionally using liquid bleach as backup, considering other alternatives including ultraviolet light	430,200
Metro Wastewater Reclamation District	Denver	CO	Wastewater plant	160 MGD	Switching to liquid bleach by end of 2007	925,000
Fiveash Water Treatment Plant	Fort Lauderdale	FL	Drinking water plant	70 MGD	Switching to generating bleach on-site or other alternative by about 2008	1,526,000
John E Preston Water Treatment Plant	Hialeah	FL	Drinking water plant	86 MGD	Developing plans to convert, possibly to on-site bleach, conversion likely within a few years	1,893,169
Alexander Orr Water Treatment Plant	Miami	FL	Drinking water plant	75 MGD	Developing plans to convert, possibly to on-site bleach, conversion likely within a few years	1,643,691
Hillsborough River Water Treatment Plant-Tampa, FL	Tampa	FL	Drinking water plant	85 MGD	Alternatives under consideration, conversion not imminent or planned	508,760
City of Tampa-Howard F. Curren AWTP	Tampa	FL	Wastewater plant	96 MGD	Has studied feasibility, no specific plans to convert	1,042,000
Topeka Water Treatment Plant	Topeka	KS	Drinking water plant	22 MGD	No plans to convert	173,925
Crescent Hill Water Treatment Plant	Louisville	KY	Drinking water plant	100 MGD	Switching to generating bleach on-site by about 2008–2009	675,100
Carrollton Water Purification Plant	New Orleans	LA	Drinking water plant	120 MGD	Switching to liquid bleach, likely in 2007	892,320
East Bank Wastewater Treatment Plant	New Orleans	LA	Wastewater plant	08 MGD (pre-Katrina)	Planning to convert eventually, timeline uncertain given major capital needs post-Katrina	726,185
Detroit WWTP-Chlorination/ Dechlorination Facility	Detroit	MI	Wastewater plant	700 MGD	No plans to convert	2,100,000

* Vulnerability zone figures submitted by [illegible] to EPA indicate [illegible] population [illegible] worst-case [illegible] release. These figures are not forecasts of potential casualties.
** [illegible]

Appendix A, continued

WATER UTILITIES USING CHLORINE GAS RAILCARS, CONTINUED

FACILITY NAME	CITY	STATE	FACILITY TYPE	APPROXIMATE FACILITY SIZE—MILLION GALLONS PER DAY (MGD)	CONVERSION STATUS	VULNERABILITY ZONE POPULATION*
St. Paul Regional Water Services McCarron	Maplewood	MN	Drinking water plant	50 MGD	No plans to convert	1,300,000
Fridley Filter Plant	Minneapolis	MN	Drinking water plant	85 MGD	No plans to convert	337,000
Kansas City Missouri Water Treatment Plant	Kansas City	MO	Drinking water plant	115 MGD	No plans to convert	720,000
Florence Water Treatment Plant	Omaha	NE	Drinking water plant	64 MGD	No plans to convert	390,000
North Charleston Sewer District WWTP Herbert Site	Charleston	SC	Wastewater plant	17 MGD	Switching to ultraviolet light, expected completion about summer 2007	365,213
Omohundro Water Treatment Plant	Nashville	TN	Drinking water plant	90 MGD	Evaluating options, no finalized plan to convert	973,663
Central Wastewater Treatment Plant	Nashville	TN	Wastewater plant	288 MGD	Evaluating options, no finalized plan to convert	965,468
O.N. Stevens Water Treatment Plant	Corpus Christi	TX	Drinking water plant	80 MGD	No plans to convert	360,000
Elm Fork Water Treatment Plant	Carrollton	TX	Drinking water plant	330 MGD	Evaluating alternatives, no specific plan to convert	790,000
Bachman Water Treatment Plant	Dallas	TX	Drinking water plant	150 MGD	Evaluating alternatives; no specific plan to convert	2,000,000
Eastside Water Treatment Plant	Sunnyvale	TX	Drinking water plant	440 MGD	Evaluating alternatives, no specific plan to convert	1,800,000
NTMWD Regional Water Treatment Plant	Wylie	TX	Drinking water plant	265 MGD	No plans to convert, evaluating options	137,517
Central Wastewater Treatment Plant	Dallas	TX	Wastewater plant	120 MGD	No plans to convert, preliminary cost analysis of alternatives	930,000
Central Regional Wastewater System	Grand Prairie	TX	Wastewater plant	150 MGD	No plans to convert	3,931,692
Rolling Hills Water Treatment Plant	Fort Worth	TX	Drinking water plant	100 MGD	Under review, investigating on-site generation of bleach	428,447
East Water Purification Plant	Houston	TX	Drinking water plant	225 MGD	No plans to convert, alternatives evaluation ongoing	1,300,000
Central Valley Water Reclamation Facility	Salt Lake City	UT	Wastewater plant	56 MGD	Evaluating options as part of facility upgrade	1,334,000
Hopewell Water Treatment Plant	Hopewell	VA	Drinking water plant	10 MGD	Currently under review, no apparent plans to convert	51,000
City of Richmond Water Purification Plant	Richmond	VA	Drinking water plant	132 MGD	Switching to liquid bleach, completing conversion early 2007	704,630
City of Richmond Wastewater Treatment Plant	Richmond	VA	Wastewater plant	60 MGD	Evaluating and testing alternatives, no clear timeline to convert	722,769

* Vulnerability zone figures submitted by facilities to EPA indicate residential populations within range of a worst-case toxic chemical release. These figures are not forecasts of potential casualties.

Appendix B

WATER UTILITIES NO LONGER USING CHLORINE GAS RAILCARS*

FACILITY NAME	CITY	STATE	FACILITY TYPE	APPROXIMATE FACILITY SIZE—MILLION GALLONS PER DAY (MGD)	CONVERSION STATUS	CONVERSION YEAR	FORMER VULNERABILITY ZONE POPULATION**
Joint Water Pollution Control Plant	Carson	CA	Wastewater plant	330 MGD	Switched to liquid bleach	2004	210,000
Blue Plains Wastewater Treatment Plant	Washington	DC	Wastewater plant	370 MGD	Switched to liquid bleach	2001	1,700,000
Buckman Water Reclamation Facility	Jacksonville	FL	Wastewater plant	41 MGD	Switched to ultraviolet light	2001	360,000
R M Clayton WRC	Atlanta	GA	Wastewater plant	80 MGD	Switched to ultraviolet light	2000	1,151,593
Fall Creek Water Treatment Plant	Indianapolis	IN	Drinking water plant	20 MGD	Switched to liquid bleach	2000	771,633
White River Water Treatment Plant	Indianapolis	IN	Drinking water plant	70 MGD	Switched to liquid bleach	2003	968,579
Water Pollution Control Plant	Fort Wayne	IN	Wastewater plant	50 MGD	Switched to liquid bleach	2006	330,000
Waste Water Treatment Plant, West	Owensboro	KY	Wastewater plant	8 MGD	Switched to liquid bleach	2001	90,000
Jefferson Parish East Bank WWTP	Harahan	LA	Wastewater plant	40 MGD (pre-Katrina)	Switched to liquid bleach	2003	790,000
Back River Wastewater Treatment Facility	Baltimore	MD	Wastewater plant	150 MGD	Switched to liquid bleach	2004	1,470,000
Wyandotte Wastewater Treatment Facility	Wyandotte	MI	Wastewater plant	45 MGD	Switched to ultraviolet light	2000	1,100,000
Metropolitan Wastewater Treatment Plant	St. Paul	MN	Wastewater plant	222 MGD	Switched to liquid bleach	2005	520,000
Western Lake Superior Sanitary District	Duluth	MN	Wastewater plant	43 MGD	Switched to liquid bleach	2006	128,293
Middlesex County Utilities Authority	Sayreville	NJ	Wastewater plant	120 MGD	Switched to liquid bleach	2001	10,740,000
Edward P Decher Secondary Wastewater Trmt Plant	Elizabeth	NJ	Wastewater plant	65 MGD	Switched to liquid bleach	2003	50,000
City of Niagara Falls Wastewater Treatment Plant	Niagara Falls	NY	Wastewater plant	32 MGD	Switched to liquid bleach	2003	1,100,000
Mill Creek WWTP	Cincinnati	OH	Wastewater plant	130 MGD	Switched to liquid bleach	2001	860,000
Nottingham Water Treatment Plant	Cleveland	OH	Drinking water plant	70 MGD	Switched to liquid bleach	2002	1,100,000
Baldwin Water Treatment Plant	Cleveland	OH	Drinking water plant	60 MGD	Switched to liquid bleach	2005	1,400,000
Akron Water Supply Plant	Kent	OH	Drinking water plant	38 MGD	Switched to liquid bleach	2004	411,356
Columbia Boulevard Wastewater Treatment Plant	Portland	OR	Wastewater plant	70 MGD	Switched to liquid bleach	2005	157,500
Southeast Water Pollution Control Plant	Philadelphia	PA	Wastewater plant	90 MGD	Switched to liquid bleach	2002	1,182,741
Northeast Water Pollution Control Plant	Philadelphia	PA	Wastewater plant	190 MGD	Switched to liquid bleach	2003	1,575,971
Samuel S Baxter Water Treatment Plant	Philadelphia	PA	Drinking water plant	165 MGD	Switched to liquid bleach	2005	787,271
South Treatment Plant	Renton	WA	Wastewater plant	80 MGD	Switched to liquid bleach	2003	650,000

* Facility converted since 1999 and [illegible]

** [illegible]

Appendix C

PRODUCERS OF CHLORINE GAS SHIPPED BY RAIL TO WATER UTILITIES

FACILITY NAME	CITY	STATE	FACILITY TYPE	VULNERABILITY ZONE POPULATION*
Olin Corp McIntosh, Alabama Plant	McIntosh	AL	Chlorine producer	42,758
Occidental Chemical Corporation, Mobile Plant	Mobile	AL	Chlorine producer	334,000
Occidental Chemical Corp, Muscle Shoals Facility	Muscle Shoals	AL	Chlorine producer	115,282
Olin Corporation Augusta, Georgia Plant	Augusta	GA	Chlorine producer	440,000
Occidental Chemical (formerly Vulcan Chemicals)	Wichita	KS	Chlorine producer	500,831
Occidental Chemical Corporation Convent Plant	Convent	LA	Chlorine producer	250,000
Occidental Chemical (formerly Vulcan Chemicals)	Geismar	LA	Chlorine producer	490,000
Occidental Chemical Taft Plant	Hahnville	LA	Chlorine producer	830,000
Pioneer Americas LLC	St Gabriel	LA	Chlorine producer	408,000
Pioneer Americas LLC	Henderson	NV	Chlorine producer	1,100,000
Olin Corporation Niagara Falls, New York Plant	Niagara Falls	NY	Chlorine producer	998,200
Occidental Chemical Corporation Niagara Plant	Niagara Falls	NY	Chlorine producer	1,100,000
Olin Chlor Alkali, Charleston Plant	Charleston	TN	Chlorine producer	258,000
Occidental Chemical Corporation Ingleside Plant	Gregory	TX	Chlorine producer	362,031
Oxy Vinyls, LP-Battleground Chlor Alkali Plant	La Porte	TX	Chlorine producer	2,300,000
PPG Industries, Inc., Natrium	New Martinsville	WV	Chlorine producer	97,585

* Vulnerability zone figures, submitted by facilities to EPA, indicate residential populations within range of a worst-case toxic chemical release. These figures are not forecasts of potential fatalities.

Appendix D: Methodology

After the Center for American Progress released survey findings last year that documented 284 facilities in diverse industries that have switched to less acutely hazardous chemicals or processes, we decided to conduct a follow-up survey of water utilities that receive rail shipments of chlorine gas. We undertook this survey for four primary reasons. First, 90-ton railcars of chlorine gas pose a distinct danger of a major chemical release. Second, large water utilities are typically located near major cities and thus endanger large numbers of people. Third, rail shipments of chlorine gas travel many miles through populated areas, putting even more people at risk. And finally, there are clean, readily available alternatives to chlorine gas, which means this vulnerability can be quickly addressed.

This survey shows where progress has been made, drawing attention to successful, cost-effective plant conversions, and where we still have security vulnerabilities, giving particular attention to rail vulnerabilities, which are too frequently left out of the chemical-security conversation.

The survey included drinking water or wastewater facilities that reported railcar amounts of chlorine gas under EPA's Risk Management Planning, or RMP, program at some time since the program began in June 1999. Several water utilities that discontinued chlorine gas railcars prior to 1999 were also surveyed. The survey consisted of telephone interviews and in some cases follow-up email communication.

For water utilities that still report chlorine gas in railcar amounts, the survey used unstructured questions about the facility's timeline and plans, if any, to convert to a safer and more secure disinfectant, as well as about facility size, population served, and potential obstacles to conversion. For facilities that had already switched or where conversion is underway, the survey also covered conversion costs. In some cases facility size and population figures are from facility Websites or EPA's Clean Watersheds Needs Survey.[illegible]

This survey report uses publicly available rail maps and population density figures to illustrate transportation concerns in shipping chlorine gas from manufacturing sites through distributors to water utilities. Chlorine production sites were identified through industry publications and EPA regulatory analysis documents covering the chlorine industry. Given the complexity and variability of suppliers and railways, the survey report does not link suppliers, distributors, and water utilities over specific rail routes.

Acknowledgments

Paul Orum wrote this survey report and interviewed personnel at the facilities it covers. Mr. Orum previously authored "Preventing Toxic Terrorism: How Some Chemical Facilities are Removing Danger to American Communities," published by the Center for American Progress in April 2006. He is the former director of the Working Group on Community Right-to-Know and currently works as an independent consultant on chemical safety and security issues.

Reece Rushing, director of regulatory and information policy at the Center for American Progress, provided editorial oversight and assisted in preparing the report. P.J. Crowley, senior fellow and director of national defense and homeland security at the Center for American Progress, also provided input and guidance on the report.

The photo on the cover is courtesy of Jim Dougherty/Sierra Club. The author and the Center for American Progress also thank Carol Andress of Environmental Defense for providing helpful comments, and greatly appreciate the cooperation of survey respondents at water utilities across the country.

Endnotes

1 Summary population at risk figures used in this report factor in overlapping vulnerability zones

2 Summary water treatment figures used in this report factor in overlapping service areas

3 The survey did not attempt to identify facilities that converted from chlorine gas railcars to a less hazardous disinfectant prior to 1999 but notes several wastewater facilities that had done so—the Southwest Wastewater plant in Philadelphia, Pa and the Southerly and Westerly plants in Cleveland Ohio In addition the Dalecarlia water plant in Washington, D C eliminated chlorine gas railcars in the 1980s and is planning long term conversion to a less hazardous disinfectant The survey identified three additional facilities that eliminated rail [illegible] since 1999 but that still use smaller containers while planning long term conversion to a safer and more secure disinfectant - the 23rd Avenue wastewater plant in Phoenix Ariz and the [illegible] water plant and [illegible] water plant in Cleveland, Ohio Other water utilities in Wheeling, W V, Erie Pa and St Louis Mo eliminated chlorine railcars since 1999 but have no current plans to fully convert to a less hazardous disinfectant

4 Two additional wastewater facilities in San Jose and Stockton, Calif, occasionally use less hazardous [illegible] such as a backup disinfectant

5 These dispersion distances are found in EPA's [illegible] Computer Aided Management of Emergency Operations (CAMEO) [illegible] National Oceanic and Atmospheric Administration and the U S Environmental Protection Agency The Chlorine Institute, Pamphlet [illegible] the Area Affected by a Chlorine Release (1998) [illegible] chlorine gas [illegible] rail car can [illegible] 14 8 miles [illegible] to life or health [illegible] healthy person must escape within 30 minutes [illegible]

6 Homeland Security Council and Department of Homeland Security, [illegible] Planning Scenario: Chemical Attack—Chlorine Tank Explosion [illegible])

7 U S Naval Research Laboratory, [illegible] before the City Council of the District of Columbia October 6 2003

8 U S Government Accountability Office GAO 05 851 Passenger Rail Security: Enhanced Federal Leadership Needed to Prioritize and Guide Security Efforts (September 2005)

9 "Militants Using Chemical Bombs in Iraq" *The New York Times*, February 21, 2007

10 International Brotherhood of Teamsters, High Alert: Workers Warn of Security Gaps on Nation's Railroads (Feb 2005)

11 Working Group on Community Right-to-Know, Chemical Plant Security Breaches in the News (February 2007)

12 "Terror on the Tracks," *Pittsburgh Tribune*, January 11 2007

13 The National Response Center is the federal point of contact for reporting oil and chemical spills NRC does not verify spill reports, which may range from very small to large

14 These entities include the Department of Homeland Security, Department of Justice Government Accountability Office Environmental Protection Agency Agency for Toxic Substances and Disease Registry, Army Surgeon General and Naval Research Laboratory Brookings Institution, Rand Corporation, PACE International Union, Center for Strategic and International Studies, and numerous investigative news reports

15 Department of Homeland Security Appropriations Act, 2007, Section 550

16 Transportation Security Administration, Recommended Security Action Items for the Rail Transportation of Toxic Inhalation Hazard Materials (March 30, 2006)

17 Homeland Security Presidential Directive/HSPD 7 Critical Infrastructure Identification, Prioritization, and Protection (December 17, 2003)

18 "Philip Perry and the Politics of Chemical Security" Art Levine, *Washington Monthly* March 2007

19 National Research Council, National Academy of Sciences, Terrorism and the Chemical Infrastructure: Protecting People and Reducing Vulnerabilities (May 2006)

20 Linda Greer for the Center for American Progress, New Solutions to Protect America: Securing Our Nation's Chemical Facilities (April 6, 2005)

21 Paul Orum for the Center for American Progress, Preventing Toxic Terrorism: How Some Chemical Facilities Are Removing Danger to American Communities (April 24, 2006)

22 Edward R. Hamberger, Association of American Railroads, Statement before the U.S. House of Representatives Committee on Transportation and Infrastructure, Subcommittee on Railroads (June 13, 2006)

23 U.S. Government Accountability Office, GAO-06-390, Securing Wastewater Facilities: Utilities Have Made Important Upgrades but Further Improvements to Key System Components May be Limited by Costs and Other Constraints (March 2006)

24 Reported disinfection treatments for public water systems serving more than 100,000 people. U.S. Environmental Protection Agency, Safe Drinking Water Information System (January 2007)

25 Paul Orum for the Center for American Progress, Preventing Toxic Terrorism: How Some Chemical Facilities Are Removing Danger to American Communities (April 24, 2006)

26 U.S. producers that can manufacture industrial sodium hypochlorite without bulk transportation or storage of chlorine gas include Odyssey Manufacturing (Tampa, Fla.), BleachTech (Seville, Ohio), and Kuehne Chemical (Delaware City, Del.). A leading manufacturer of equipment to produce sodium hypochlorite without bulk chlorine gas is Powell Fabrication and Manufacturing, marketed as UniChlor Technology.

27 KIK Custom Products, letter to the Honorable Ed Markey, Member of Congress (July 26, 2005)

28 Chlorine Institute, Pamphlet 10: North American Chlor-Alkali Industry Plants and Production Data Report 2005 (August 2006)

29 The survey did not attempt to identify facilities that converted prior to 1999, but notes three such municipal wastewater facilities [illegible]. These [illegible] are the Southwest Wastewater [illegible] plant [illegible] Philadelphia, Pa. [illegible] plants in Cleveland, Ohio. In addition, the Blue Plains wastewater plant in Washington, D.C. [illegible] chlorine gas railcars in the 1980s and is planning long-term conversion to a less [illegible].

30 Bill Johnstone for the Center for American Progress, New Strategies to Protect America: Terrorism and Mass Transit After London and Madrid (August 10, 2005)

31 "Akzo Takes Chlorine off the Rails, Relocating Output Addresses Transportation Concerns," Ian Young, Chemical Week, November 22, 2006

32 Conversion cost information was not available or incomplete from other facilities covered by the survey

33 Environmental Defense, Eliminating Hometown Hazards (2003)

34 Population served and [illegible] information is from EPA's [illegible]

35 U.S. Environmental Protection Agency, Economic Analysis of Air Pollution Regulations: Chlor-alkali Industry (August 2000); and Chlorine Institute, Pamphlet 10: North American Chlor-Alkali Industry Plants and Production Data Report 2005 (August 2006)

Center for American Progress

ABOUT THE CENTER FOR AMERICAN PROGRESS

The Center for American Progress is a nonpartisan research and educational institute dedicated to promoting a strong, just and free America that ensures opportunity for all. We believe that Americans are bound together by a common commitment to these values and we aspire to ensure that our national policies reflect these values. We work to find progressive and pragmatic solutions to significant domestic and international problems and develop policy proposals that foster a government that is "of the people, by the people, and for the people."

Center for American Progress
1333 H Street, NW, 10th Floor
Washington, DC 20005
Tel: 202.682.1611 • Fax: 202.682.1867
www.americanprogress.org

STB Finance Docket No. 35504

UNION PACIFIC R.R. – PETITION FOR DECLARATORY ORDER

OPENING EVIDENCE AND ARGUMENT
OF
NORFOLK SOUTHERN RAILWAY COMPANY

EXHIBIT 3

Rail Transportation of Toxic Inhalation Hazards: Policy Responses to the Safety and Security Externality

HARVARD Kennedy School
BELFER CENTER for Science and International Affairs

Lewis M. Branscomb, Mark Fagan, Philip Auerswald, Ryan N. Ellis, and Raphael Barclan

Belfer Center Discussion Paper #2010-01
Science, Technology, and Public Policy Program
Harvard Kennedy School
February 2010

Rail Transportation of Toxic Inhalation Hazards

Policy Responses to the Safety and Security Externality

Lewis M. Branscomb

Professor Emeritus, Harvard University and

Adjunct Professor, University of California, San Diego

*Mark Fagan**

Senior Fellow, Mossavar-Rahmani Center for Business and Government,

Harvard Kennedy School, Harvard University

Philip Auerswald

Professor, George Mason University

Ryan N. Ellis

Ph.D. Candidate, Department of Communication,

University of California, San Diego

Raphael Barcham

Research Assistant, Harvard Kennedy School, Harvard University

***Corresponding author: Mark_Fagan@hks.harvard.edu**

Abstract

Toxic inhalation hazard (TIH) chemicals such as chlorine gas and anhydrous ammonia are among the most dangerous of hazardous materials. Rail transportation of TIH creates risk that is not adequately reflected in the costs, creating a TIH safety and security externality. This paper describes and evaluates policy alternatives that might effectively mitigate the dangers of TIH transportation by rail. After describing the nature of TIH risk and defining the TIH externality, general policy approaches to externalities from other arenas are examined. Potential risk reduction strategies and approaches for each segment of the supply chain are reviewed. The paper concludes by summarizing policy options and assessing some of the most promising means to reduce the risks of transportation of toxic inhalation hazards. Four policy approaches are recommended: internalizing external costs through creation of a fund for liability and claims, improving supply chain operations, enhancing emergency response and focusing regulatory authority. It is further suggested that the Department of Transportation convene a discussion among stakeholder representatives to evaluate policy alternatives.

I. Introduction

Hazardous materials — industrial materials that are flammable, corrosive, toxic, explosive, or infectious — play a vital role in the U.S. economy. They are used by industries from farming and mining to manufacturing and pharmaceuticals, in the form of fertilizers, raw materials, fuels, and other essential inputs. Of all hazardous materials, toxic inhalation hazards (TIH) may be among the most dangerous.[1] Chlorine gas and anhydrous ammonia are the most common TIH chemicals; others include sulfur dioxide, ethylene oxide, and hydrogen fluoride, and a variety of other products that are important manufacturing inputs.[2]

After the terrorist attacks of September 11, 2001, the security of hazardous materials became increasingly salient in public concern and political debate. Release of toxic inhalation hazards, whether the result of attack or accident, could result in devastating consequences. Many hazardous chemicals are transported over long distances by rail, during which they are particularly vulnerable.[3]

Safety from accidents as well as security against attack are of concern. Toxic inhalation hazards were involved in a number of deadly rail accidents in the early part of this decade. They could have been far worse: all of the TIH accidents we describe in this paper occurred at night in areas of relatively sparse population, limiting the number of people exposed to the effects of the chemicals. A daylight TIH release in a densely populated area could have catastrophic consequences.

Movement of TIH materials through the supply chain creates risk for shippers, rail carriers, and the general public that is not quantified and is not adequately reflected in the costs, leaving a significant portion of the risk as an externality. Our focus, therefore, is on the TIH safety and security externality, that is, the consequences associated both with

---

[1] Toxic inhalation hazards are also sometimes called poison inhalation hazards (PIH).

[2] "Six toxic-by-inhalation (TIH) chemicals (ammonia, chlorine, SO2, hydrogen fluoride, fuming nitric acid and sulfuric acid) account for more than 90% of the total TIH transportation related risk. Chlorine and ammonia account for 70% and 84 % of the transported TIH material." Mark Hartong, Rajni Goel, and Duminda Wijesekera, "A Risk Assessment Framework for TIH Train Routing," <volgenau gmu.edu/~klaskey/OR680/MSSEORProjectsSpring08/RR_Group_09MAY2008/CIP_TIH_Submitted.pdf>, citing D.F. Brown; W.E. Dunn; and A J. Policastro, "A National Risk Assessment for Selected Hazardous Materials in Transportation ANL/DIS-01-1," Decision and Information Sciences Division (Argonne National Laboratory), U.S. Department of Energy, January 2001.

[3] The United States has over 140,000 miles of freight rail. Several hundred thousand workers handle over 1.2 million hazardous materials movements daily.

accidents and with deliberately perpetrated attacks. Improving "safety" means reducing the accident risk; improving "security" means reducing the terrorist risk. Accidents and deliberate attacks may result in similar consequences. Therefore many safety regulations and policies will also mitigate, to some degree, the consequences of a security breach. The domains of safety and security overlap with respect both to mitigation and to consequence.

This study focuses on potential means of reducing the risk of TIH rail transportation by developing a better understanding of the safety and security externality and proposing a more comprehensive approach to the way that TIH materials are handled. The risk mitigation actions of individual stakeholders, while positive, may not be enough. A focus on incorporating the safety and security externality into the entire TIH supply chain would allow the participants in that supply chain to assess risks more effectively and to make better plans for the safe transport, storage, and delivery of TIH.

What is the TIH Risk? Framing the Problem

TIH chemicals are among the most dangerous hazardous materials because they are very toxic and they can spread easily in the air if released. Nonetheless, TIH chemicals are economically essential. Over $660 billion worth of hazardous materials were transported in the United States in 2002, the latest year for which comprehensive data are available, with each shipment moving an average of 136 miles.[4] Without the movement of these hazardous materials, gas stations would close, crop yields would diminish, potable water prices would rise, and many manufacturing activities would come to a halt.

We focus in this paper on two of the most extensively used TIH products, chlorine and anhydrous ammonia. Chlorine gas is used for purifying potable and waste water at treatment plants throughout the country and is also used as a chemical intermediary in various manufacturing processes, for products ranging from PVC pipes to shampoo.[5] Anhydrous ammonia is the nation's dominant commercial fertilizer and is applied extensively throughout the country's main agricultural regions, particularly the Midwest farm states.

---

[4] U.S. Department of Transportation (DOT), Bureau of Transportation Statistics, "U.S. Hazardous Materials Shipments by Transportation Mode, 2002," <www.bts.gov/publications/national_transportation_statistics/html/table_01_56.html>.

[5] American Chemistry Council, "The Chlorine Tree," <www.chlorinetree.org>. But see Global Security Newswire, "Clorox to Halt Use of Chlorine at Bleach Production Sites," November 2, 2009, <gsn.nti.org/gsn/nw_20091102_6428.php>.

Most TIH chemicals are shipped from production locations to usage sites (although some are produced, stored, and used at a single site). Rail is generally preferred for long-distance transportation, since one rail tank car carries as much as four trucks. In 2007, almost two-thirds (64 percent) of TIH moved by rail, amounting to 105,000 rail-car shipments (TIH materials represent only a small portion of total hazardous materials transported by rail).[6] Rail transportation of TIH is generally believed to be safer than truck transportation, because a smaller number of shipments move along a fixed, dedicated network.

TIH rail transportation is not without risk. Deadly railway accidents involving TIH in Minot, North Dakota, in 2002, in Macdona, Texas, in 2004, and in Graniteville, South Carolina, in 2005 resulted in the evacuation of thousands of people, forced over 800 people to seek medical attention; and caused the deaths of 13 people.[7] The economic costs were staggering; the costs of the Graniteville accident were estimated at $126 million.[8] These accidents took place when relatively few people were exposed; a terrorist attack on TIH tank cars could have far worse results. One worst-case estimate predicted up to 100,000 deaths should a chlorine gas tank car be attacked and breached on the rail line that passes the Capitol Mall in Washington, D.C. during a major outdoor public event.[9] Although there have been no incidents of terrorist use of TIH in the United States, in Iraq in 2007 there were several attacks on chlorine containers carried by trucks.[10]

Rail transportation providers, aware of the danger, have undertaken risk-mitigation activities. Railroads have worked with the Department of Transportation to review and

---

[6] Testimony of Joseph H. Boardman, Administrator, Federal Railroad Administration (FRA), U.S. DOT, before the U.S. Senate Committee on Commerce, Science, and Transportation.

[7] See National Transportation Safety Board (NTSB) Railroad Accident Reports, <www.ntsb.gov/Publictn/R_Acc.htm>.

[8] FRA, "Regulatory Assessment; Regulatory Flexibility Analysis – Hazardous Materials: Enhancing Rail Transportation Safety and Security for Hazardous Materials Shippers" PHMSA-RSPA-2004-18730, April 2008, 7.

[9] Presentation of Dr. Jay Boris, U.S Naval Research Laboratory, to City Council, Washington D.C., October 6, 2003. This is a worst-case estimate based on specific climate conditions and a large outdoor event with many people in proximity to the release point. A less extreme scenario can be found in Anthony M. Barrett, "Mathematical Modeling and Decision Analysis for Terrorism Defense: Assessing Chlorine Truck Attack Consequence and Countermeasure Cost Effectiveness," PhD dissertation at Carnegie Mellon University, Department of Engineering and Public Policy, May 2009, discussed below.

[10] See Global Security Newswire, "U S. Soldiers Exposed to Chlorine in Iraq," June 4, 2007, <gsn.nti.org/gsn/GSN_20070604_51B827B8.php>.

improve tank car design standards. Special speed limits and increased inspections on corridors with high volumes of hazardous materials traffic are other ways that railroads are modifying their handling of hazardous materials. Partly thanks to these efforts, over 99.9 percent of rail HAZMAT shipments reach their destination without a release caused by an accident.[11] In addition, railroad carriers have sought to raise rates to attempt to cover their risk exposure and to encourage product substitution and shorter movements, although these efforts are complicated by common-carrier regulations. Indeed, railroad companies cannot, by themselves, solve the problem.

Reducing the risk of TIH transportation is complicated by the diversity of the actors and stakeholders involved. Chemical producers and users initiate and receive shipments. Railroads as the carriers may bear most of the liability in case of a release; many railroads, therefore, would prefer not to carry any TIH products, but their common-carrier obligations under federal law prevent them from refusing, and limit the extent to which they can raise rates.[12]

Trade associations representing the chemical companies and the railroads lobby Congress and the regulatory agencies on behalf of their respective industries. A variety of regulatory agencies at the federal level oversee TIH transportation. The Federal Railroad Administration (FRA) is part of the Department of Transportation (DOT). Railroads and their TIH cargoes are subject to regulations of the Pipeline and Hazardous Materials Safety Administration (PHMSA) and the Surface Transportation Board (STB), both of which are part of the Department of Transportation, as well as the regulations of the Transportation Safety Administration (TSA), which is part of the Department of Homeland Security (DHS).

---

[11] Association of American Railroads, "Hazmat Transportation by Rail: An Unfair Liability," <http://www.aar.org/InCongress/Safety%20and%20Security/~/media/AAR/PositionPapers/Hazmat%20by%20Rail%20September%202009.ashx>

[12] See, for example, the Surface Transportation Board (STB) decision affirming that Union Pacific (UP) was obligated to quote common-carrier rates and provide transportation service for chlorine to U.S. Magnesium LLC, although the railway argued that "the transfer would pose 'remote, but deadly, risks' as the material passed through high-population cities such as Chicago, Houston and Kansas City " Quoted in Global Security Newswire, "Rail Firm Opposes Some Chlorine Shipments," Wednesday, March 25, 2009, <gsn.nti.org/gsn/nw_20090325_3045.php>. The railway argued that common-carrier requirements did not apply because U.S. Magnesium had solicited rates for an unreasonable move over long distances and that alternative sources of chlorine were available; but this argument was unsuccessful. STB Docket 35219, June 11, 2009.

State and local governments have some authority over the railroad lines that may carry TIH through their jurisdictions. Local emergency responders, including firefighters and police, will be on the frontlines of any incident.[13] A major stakeholder is the public, because the public at large would be endangered if there is a TIH release.

Many corporate participants in the TIH supply chain, for reasons both of corporate social responsibility and of prudent business-risk management, have looked for ways to mitigate TIH risks. Major producers of chlorine gas are exploring collocation of the facilities that produce and those that use chlorine, in order to minimize the need for transportation of chlorine. Clorox plans to begin phasing out use of chlorine at all seven of its U.S. bleach production facilities.[14] Dow Chemical, the Union Pacific railway, and the Union Tank Car Company are among the companies collaborating in the Next Generation Railroad Tank Car Project to design safer tank cars. Chemical producers, railroads, and public safety officials have combined their efforts to improve emergency response in the event of a TIH release. End users are looking for substitute products. In the past decade, a number of wastewater facilities and drinking water plants have switched from the use of chlorine gas and other toxic purification agents to less toxic alternatives, but as yet these represent a fairly small proportion of the number of facilities nationwide that still use hazardous chemicals.[15]

Industry efforts to improve safety have not yet allayed all public concerns. The District of Columbia City Council took action in 2005 to block TIH from moving through its jurisdiction. The Council sought to keep TIH off the main rail line that crosses the District and passes within one mile of the Capitol, the White House, the Pentagon, and National Airport. The ban was successfully challenged by CSX, the freight railroad involved, with support of the Department of Justice, which argued that a local-level regulation such as this one was preempted by federal regulation under the Commerce clause of the Constitution.[16] At the federal level, these security issues are under study. The regulator of railroad safety, the Federal Railroad Administration, issued new regulations in 2009 on tank car design, routing, and operational practices. The regulator

---

[13] Any of over 1 million first responders nationwide could be involved in a TIH incident.

[14] Global Security Newswire, "Clorox to Halt Use of Chlorine at Bleach Production Sites," November 2, 2009, <gsn.nti.org/gsn/nw_20091102_6428.php>.

[15] Paul Orum, *Preventing Toxic Terrorism: How Some Chemical Facilities are Removing Danger to American Communities*, Center for American Progress, April 2006.

[16] The U.S. Court of Appeals for the D.C. Circuit held that federal law preempted the city's effort to regulate the railroad. See CSX Transportation, Inc. v. Williams, United States Court of Appeals, D.C. Circuit, May 3, 2005, <bulk.resource.org/courts.gov/c/F3/406/406.F3d.667.05-5131.html>.

of railroad economics, the Surface Transportation Board, has heard arguments over whether the common-carrier obligation requires railroads to carry TIH traffic.[17] The Transportation Security Administration, which coordinates threat assessments and security inspections, issued new rail transportation security regulations in November 2008. Effective government regulation requires cooperation and coordination among all of these agencies.

Objectives and Outline

The primary objective of this study is to describe and evaluate the policy alternatives that might effectively mitigate the dangers of transportation of toxic inhalation hazards, by internalizing the negative externalities of the TIH supply chain. In addition, this paper aims to be summary of information on the characteristics and risks of the TIH supply chain, providing a single source for stakeholders and policymakers. Section II describes the TIH risk by explaining the scientific basis of TIH danger, the complexity of the supply chain, and the risk features of accidents and terrorist attacks. Section III defines the TIH externality and shows why it is difficult to quantify the TIH risk; it examines general policy approaches to externalities from other arenas, and explores their applicability to TIH. Section IV details potential risk reduction strategies and approaches for each leg of the supply chain — production, transportation, and use. Section V concludes by summarizing policy options and assesses some of the most promising means to reduce the risks of transportation of toxic inhalation hazards.

---

[17] See discussion below of the Union Pacific case brought before the STB by chlorine producer U.S. Magnesium. See Global Security Newswire, "Rail Firm Opposes Some Chlorine Shipments," Wednesday, March 25, 2009, <gsn.nti.org/gsn/nw_20090325_3045.php>.

II. Risks in Transportation of Toxic Inhalation Hazards

Security concerns following 9/11 brought into focus the danger posed by the presence of hazardous materials near population centers. In this section, we describe the chemical properties of certain chemicals that make them particularly hazardous. Then, we outline the risks involved in transportation along the supply chain from manufacture to end-user. We describe a particular challenge to internalizing the risk externality: common-carrier regulations imposed on railways prevent them from refusing to carry TIH, which they might prefer due to the risk, and from imposing higher rates for carrying TIH to reflect that risk. The section then describes a number of railway accidents, including three TIH accidents that resulted in fatalities, and two other accidents involving hazardous (but not TIH) materials that further illustrate the potential dangers. The distinctions between accidents and potential terrorist attack are described and their implications for policy are explored.

Chemical Properties of Toxic Inhalation Hazards

To understand the danger posed by TIH chemicals, it is useful to have a basic understanding of their chemical properties. This brief overview centers on chlorine and anhydrous ammonia, the most widely used and most transported TIH products.

Chlorine is a greenish-yellow noncombustible gas at room temperature and atmospheric pressure.[18] It is transported as a pressurized liquid. Chlorine gas is heavier than air, meaning that the gas settles into low areas when released into the open. It is chemically unstable and breaks down quickly when in contact with sunlight or water. Chlorine is used as a disinfecting agent for drinking water and waste water, and plays an important role in many manufacturing processes.

When chlorine is released into the air, it becomes very dangerous. Small doses irritate the eyes, skin, and respiratory tract; large concentrations of chlorine gas can kill people within minutes. If inhaled at very high concentrations, chlorine breaks down in the lungs to form hydrochloric acid that burns lung tissue, causing pulmonary edema and essentially causing drowning as liquid floods the lungs. The extent of chlorine poisoning depends on the quantity of gas, setting, time of exposure, and other circumstances. As

---

[18] For more information, see U.S. Department of Health and Human Services, Public Health Service, Agency for Toxic Substances and Disease Registry, "Draft Toxicological Profile for Chlorine," September 2007. < http://www.atsdr.cdc.gov/toxprofiles/tp172.pdf>

little as 3.5 parts per million (ppm) can be detected as an odor. The lowest lethal exposure is reported as 430 ppm for 30 minutes. Over shorter periods of time, exposure even to 15 ppm of chlorine causes throat irritation, while exposure to 50 ppm is dangerous, and exposure to 1000 ppm can be fatal after a few deep breaths. Frequent exposure to chlorine gas can degrade an individual's sense of smell; workers who have had occupational exposure to the gas are thus at greater risk of inhalational damage. The most effective countermeasure to exposure is to flush affected body parts with large quantities of water and move the victim to an unaffected area with clean air.

Anhydrous ammonia is a colorless gas characterized by a very sharp odor.[19] Anhydrous ammonia is lighter than air and invisible. It can be identified by its acrid odor, which is apparent even at very low concentrations. Ammonia is stored under pressure in rail tank as a liquid, but in the case of a rupture, the ammonia returns to a gaseous state and expands. Its primary use is as a fertilizer due to its high nitrogen content. It is applied directly and also used as a base for other fertilizer products.

Exposure to large quantities has severe health effects. Anhydrous means "without water," and anhydrous ammonia seeks water from any source, with corrosive results: its main toxic effect is severe burns to the moist parts of the body, such as the eyes, throat and lungs. Ammonia is less toxic at a given concentration than chlorine: exposure to greater than 50 ppm of ammonia causes mild irritation to the nose or throat. Exposure to 700 ppm or more causes such effects as coughing and severe eye irritation. Exposure to larger quantities can cause blindness and other severe or fatal injuries. Ammonia at 5,000 to 10,000 ppm is rapidly fatal to humans. The recommended response to ammonia release is to flood the area, and any persons affected, continuously with large amounts of water.

For these and other gases posing toxic inhalation hazard, the consequences of a release depend on the source, the surrounding terrain and meteorological conditions. The source determines the quantity of material released and duration of gas release. Meteorological conditions and the morphology of the surroundings influence the dispersion of the gas and the duration of exposure. These conditions include the amount of moisture in the air, wind direction and speed, amount of sunlight, terrain, and temperature. If the released TIH enters enclosed indoor environments, it can concentrate to fatal levels.

---

[19] For more information, see U.S. Department of Health and Human Services, Public Health Service, Agency for Toxic Substances and Disease Registry, "Toxicological Profile for Ammonia," September 2004. < http //www.atsdr cdc.gov/toxprofiles/tp126.pdf>

Given these variations in a TIH release, responders such as railway employees, firefighters, and police must be made aware of the nature of any release and of other local conditions so that they can deal effectively with it.

TIH Supply Chain

The complexity of the TIH supply chain poses challenges to chemical security and complicates any attempt at regulation, because stakeholders have divergent interests. The supply chains are different for each TIH chemical, involving diverse modes such as rail, truck, barge, and pipeline. In general, trucks carry the largest number of shipments, but rail moves more ton-miles.[20]

Producer-consumer geographical relations are also complicated. Chlorine, for example, is produced at chemical plants mostly concentrated in the southeast part of the country (see Figure 1) from which it is shipped to customer sites, such as water purification plants and other chemical plants. There are some cases in which chlorine is both produced and used at the same plant; this avoids exposure over long shipping times and distances. A chlorine user can sometimes also persuade a manufacturer to relocate nearby, in order to reduce transportation costs and risks.

The use of chlorine in large chemical plants and at water treatment sites results in a limited number of nodes in the transportation network (in contrast to the dispersed usage patterns of ammonia-based fertilizers described below). Even so, chlorine tank cars must travel significant distances. A tank car typically carries 90 tons of liquid chlorine. As Figure 1 shows, chlorine production is concentrated along the Gulf Coast and in a few other locations, but it is used at water treatment facilities and manufacturing sites all over the country. Many of these facilities are located in or near large cities, requiring chlorine transport through populated areas. This creates the need for long-distance carriage and potential exposure of large populations.

The economics of transportation favor rail transportation and indeed the majority of chlorine shipments in the United States are shipped by rail. The other safe and practical mode for long-distance transportation of chlorine is by barge, which is indeed considered to be safer than rail but is less available. Trucking companies are reluctant to offer long-

---

[20] Annual liquid chlorine transport by truck totals approximately 500,000 tons, but these shipments tend to travel shorter distances than chlorine transported by rail, and are often shipped in smaller quantities. See Barrett, "Mathematical Modeling and Decision Analysis for Terrorism Defense."

haul chlorine transportation services[21] and since, unlike railroads, motor carriers are not subject to common-carrier obligations, they are therefore free to accept or decline shipper requests to transport TIH products or to charge very high prices (but perhaps non-competitive) prices to do so. Due to these factors, an estimated 85 percent of long-distance chlorine movements occur by rail.[22]

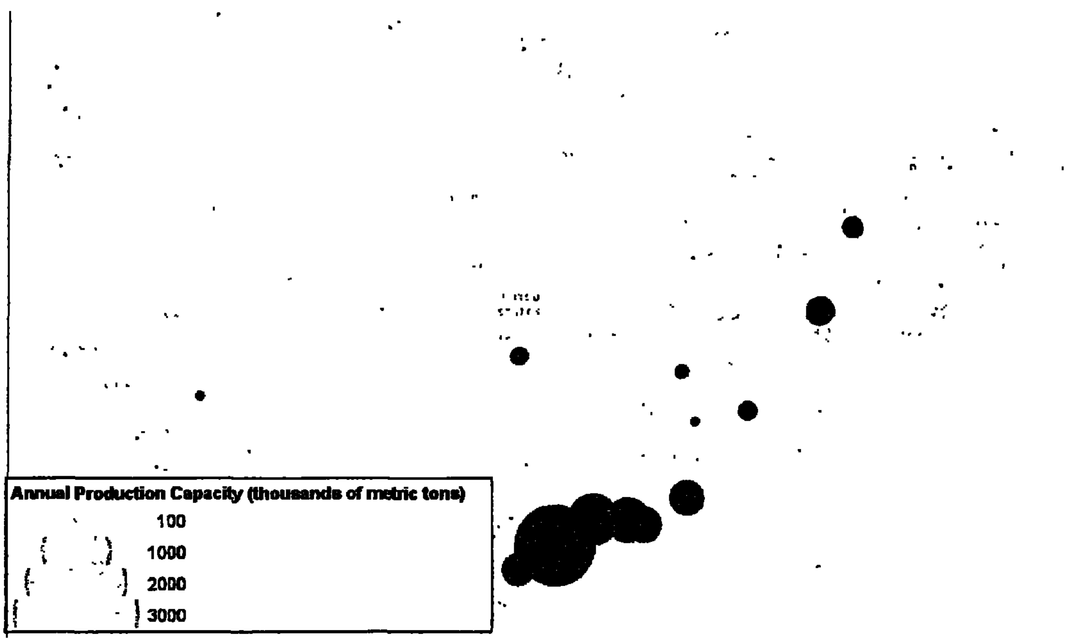


Figure 1: Major U.S. Chlorine Plants, by Annual Production Capacity. (Source: ATSDR, "Draft Toxilogical Profile for Chlorine," September 2007)

Ammonia is widely used throughout the main U.S. agricultural areas and thus, like chlorine, must be transported from a limited number of production and import locations to a large number of users. As Figure 2 shows, thirty-two plants in 19 states produced ammonia, with most production concentrated in Texas, Louisiana and Oklahoma, near sources of natural gas (the primary chemical feed stock for ammonia production).[23] A

---

[21] Statement of Stephen J. Lube, CSX Transportation, STB Docket No. NOR 42100.

[22] Estimate by the Chlorine Institute, May 31, 2006, <www.americanchemistry.com/s_acc/bin.asp?CID=634&DID=2467&DOC=FILE.PDF.> Also see E.I. DuPont de Nemours and Co., Complainant's Opening Evidence, STB Docket No. 42100, February 11, 2008.

[23] Deborah A. Kramer, U.S Geological Survey, Mineral Commodity Summaries, January 2005, p. 116, <minerals.usgs.gov/minerals/pubs/commodity/nitrogen/nitromcs05.pdf>.

large quantity of ammonia travels by pipeline and barge and most local distribution to farmers occurs by truck, but rail plays a vital long-haul transportation role.[24]

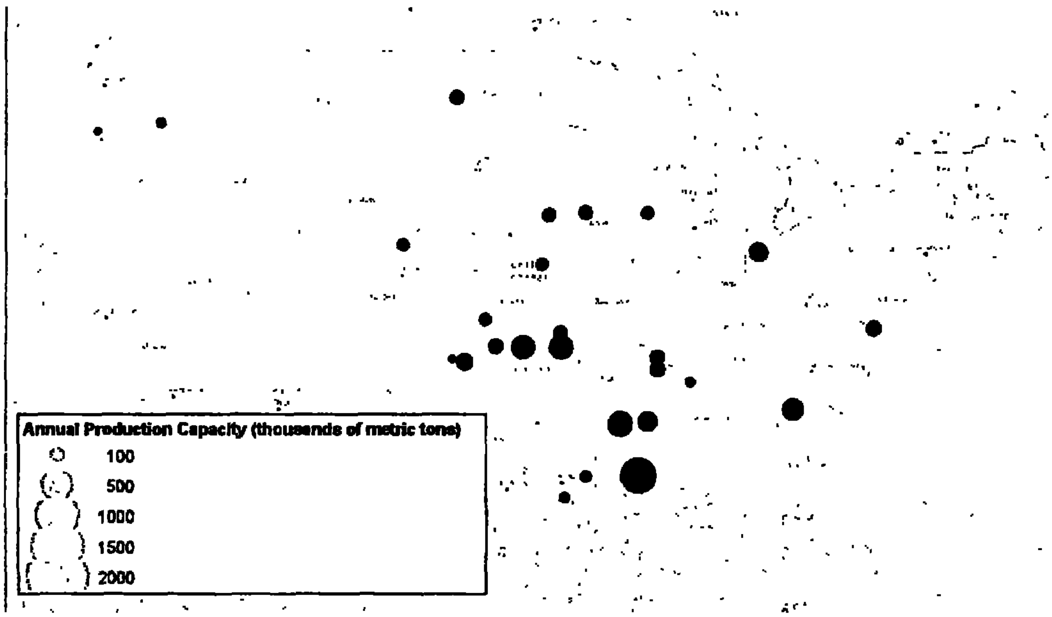


Figure 2: Major U.S. Ammonia Plants, by Annual Production Capacity (Source: D. Kramer, "Nitrogen", U.S. Geological Survey Minerals Yearbook, 2002)

Since various supply chain participants share responsibility for TIH transportation, this creates legal and liability complexity. A shipment of TIH may be owned by the producer of the shipment or by the end user, depending on the contractual arrangements. A railroad's contract for carriage may be with either the shipper or the receiver, or with an intermediary such as a broker. The railroad is almost never the legal owner of the product it is transporting, nor does the railroad typically own the tank car. Tank cars are mostly owned by the TIH shipper, or by a rail car leasing company.

Adding to these complexities, the shipment may be stored in a tank car for some time after delivery to the customer plant, waiting on a rail siding for unloading. There may be legal ambiguity over who is responsible for the contents of the tank car during this period. Seeking to resolve this ambiguity and ensure the continuous monitoring of hazardous materials involved, the Transportation Security Administration of the Department of Homeland Security set as a goal the establishment of a "secure chain of

[24] See, for example, Stephen J. Lube Statement, STB Docket No. NOR 42100. Major import locations for ammonia include Tampa, FL and Pascagoula, MS for shipment inland via truck and rail.

custody" for all TIH shipments, addressing this issue in a Rail Transportation Security Rule issued in November 2008.[25]

Rail Pricing Regulation

If railroads could impose higher prices for transporting TIH than for transportation of other, less risky materials, TIH rates might reflect more accurately the potential costs of the risk of TIH accidents or other releases. Higher prices would, all else being equal, tend to decrease the number of rail TIH shipments and the ton-miles transported. In this section, we describe how this possibility is complicated by the current rail pricing regime.[26]

It is difficult to know exactly how expensive it is to ship TIH materials. In most cases, rail rates are set by contract between the shipper and the railroad and are not published. These contract rates, driven by supply and demand as well as the relationship between the negotiating parties, are not subject to regulation, because the railroad is deemed to be acting as a private or contract carrier. However, if shipper and railroad are unable to agree on a contract rate, the railroad is required to publish a "common carrier rate" for the movement in question, without discrimination as to the identity of the shipper or the material being shipped.

Although contract rates are not published, the published common carrier tariffs for TIH shipments are several times greater than those for comparable non-TIH chemicals. In 2008 rate case between a chemical company and a railroad, there was evidence that the railroad quoted a rate of $9,173 (including fuel surcharge) for transporting a tank car of chlorine from Niagara Falls, NY to New Johnsonville, TN.[27] Common carrier prices posted on the railroad website for transporting one tank car of caustic soda (a frequently shipped material that is hazardous but is not a toxic inhalation hazard) reveals rates of $3,707–4,634 per car (depending on the size of the shipment) for the same distance.[28] Analysis of public tariffs shows that the additional increments for longer distances

---

[25] Rail Transportation Security Rule, Transportation Security Administration (TSA) of the U.S. Department of Homeland Security (DHS), 49 Code of Federal Regulation (CFR), Parts 1520 and 1580, Rail Transportation Security: Final Rule, November 26, 2008.

[26] The current rail pricing regulation regime is a result of the partial deregulation enacted under the Railroad Revitalization and Regulatory Reform Act of 1976 and the Staggers Act of 1980.

[27] DuPont Opening Evidence, STB Docket No. 42100.

[28] Movement of caustic soda from Niagara Falls, N Y., to New Johnsonville, Tenn., <www.Shipcsx.com>, consulted May 28, 2009.

increase more steeply for TIH shipments than for non-TIH shipments. The rate differential suggests that rail carriers may be trying to recoup part of the cost of the risk for TIH shipments, particularly over long hauls.

If a shipper wants to challenge a published rate, it brings a complaint before the Surface Transportation Board (STB), a three-member panel that is the economic regulator of the railroad industry.[29] Rate cases may be filed under one of several procedural methods. If the STB finds the carrier's rates to be excessive, the shipper is entitled to rate relief. However, calculations for STB adjudications are based on system-average costs that do not incorporate the unique handling and risk characteristics of TIH traffic.

Generally, the STB has shown itself to be more sympathetic to shippers than to rail carriers. In a recent chemical company complaint against a railroad concerning certain movements of chlorine, the STB ruled that the railroad's proposed rates were unreasonably high and ordered the railroad to establish lower rates and pay reparations to the shipper.[30] The railroad had failed to convince the STB to allow an adjustment for TIH chemicals that would more accurately have reflected the risks inherent in TIH transport. In a similar case in early 2009, a railroad refused to quote a rate for a shipment of chlorine on the grounds that this was not a reasonable movement request, given the availability of alternative chlorine manufacturers closer to the destination. When the case went before the STB as a common carrier case (rather than a rate case), the STB required the railroad to establish rates and to provide service for this shipment of chlorine.[31]

Thus, the current regulatory scheme means that the risks of carrying a product that could cause billions of dollars in damage and impose potentially huge liability on a railway in the event of a release are rarely reflected adequately in rail transportation rates. In other words, they remain externalities.

---

[29] "The STB is an economic regulatory agency charged with resolving freight railroad rate and service disputes, reviewing proposed rail mergers, rail line purchases, constructions and abandonments. The Board also oversees Amtrak's on-time performance and has jurisdiction over other matters." <www.stb.dot gov>.

[30] STB Decision Docket No. 42100, June 27, 2008. Whether an entity like DuPont qualified as a "small shipper" under the rules was a contentious topic in the STB hearings.

[31] See STB Docket No. 35219; see also Global Security Newswire, "Rail Firm Opposes Some Chlorine Shipments," Wednesday, March 25, 2009, <gsn.nti.org/gsn/nw_20090325_3045.php>. Note that a common carrier case is meant to establish whether the railroad can refuse to carry the traffic in question, while a rate case determines the tariffs the railroad may charge.

Accidents

An essential step towards ensuring secure transportation of TIH products is minimizing the risk of accidental releases. Recent events highlight issues that must be addressed as part of the risk-reduction process. Three fatal accidents involving TIH product release have taken place in the past decade: at Minot, South Dakota, in 2002, at Macdona, Texas, in 2004, and at Graniteville, South Carolina, in 2005. In addition, a 2001 accident in a tunnel near downtown Baltimore, Maryland, although causing no fatalities, showed the potential danger of a HAZMAT accident in an urban setting. A 1987 New Orleans case suggests the vast potential exposure to liability claims in the event of an incident. These events are described in this section.

Minot, North Dakota, January 2002: Anhydrous Ammonia Release

On January 18, 2002, at 1:37 AM (CST), a Canadian Pacific (CP) train derailed half a mile from the city limits of Minot, North Dakota. Of a total of 112 cars, 31 cars, numbers 4–34, derailed.[32] The train "consist" included 39 HAZMAT cars, including 15 tank cars of anhydrous ammonia that were positioned as cars 18 through 32. All of these cars derailed, and five of them ruptured catastrophically. Tank car fragments were propelled up to 1,200 feet from the track, and 146,700 gallons of anhydrous ammonia — almost the entire contents of the five tank cars — were released almost instantaneously. Ammonia vapor spread five miles downwind over an area where 11,600 people lived.

Within minutes of the accident, the conductor notified the Canadian Pacific dispatcher in Minneapolis, Minnesota, and called 911 on his cell phone. By 1:41 AM, less than five minutes after the accident, emergency service operators were telling residents who phoned seeking information to shelter-in-place, by staying in their homes, closing windows, running showers, and breathing through wet cloths. By 5:30 AM, the vapor cloud had begun to dissipate. Emergency responders then began to evacuate residents.

The National Transportation Safety Board, after an extensive investigation, blamed the accident primarily on an "ineffective Canadian Pacific Railway inspection and maintenance program that did not identify and replace cracked joint bars [on the rails]

---

[32] All information for this section, unless otherwise cited, from National Transportation Safety Board, "Derailment of Canadian Pacific Railway Freight Train 292-16 and Subsequent Release of Anhydrous Ammonia Near Minot, North Dakota — January 18, 2002," NTSB Railroad Accident Report NTSB/RAR-04/01, <www.ntsb.gov/publictn/2004/RAR0401.pdf>, hereafter cited as "NTSB Report—Minot."

before they completely fractured and led to the breaking of the rail at the joint."[33] Tank car failure also contributed: the five cars that experienced catastrophic failure were constructed of non-normalized steel, which was more prone to cracking at the low temperatures found at the time of the accident.[34]

Public notification issues affected the consequences: many residents did not hear the city's emergency broadcasts because of power outages, and did not hear warning sirens because they were too far away. Authorities were initially unable to communicate with local radio stations to request emergency broadcasts; the local television station had no staff on duty.

The accident caused one death, due to anhydrous ammonia inhalation; the victim had become disoriented while trying to flee the area immediately following the accident. Eleven residents suffered serious injuries; 322 train crew, residents, and first responders had minor injuries. Equipment damage reported to the NTSB totaled $2.5 million and environmental cleanup costs were $8 million. Valuation for property damage and casualties is not available.

Following the Minot accident, the NTSB made several recommendations to improve track inspections and maintenance. The NTSB also made recommendations for improved tank car safety, including a call for a comprehensive analysis to determine the impact resistance of the steels in the shells of tank cars constructed before 1989. Ultimately, the NTSB recommended development and implementation of tank car fracture toughness standards.

Macdona, Texas, June 2004: Chlorine Gas

At 5:03 AM (CDT) on June 28, 2004, near Macdona, Texas, a Union Pacific (UP) train traveling at 44 mph passed a stop signal and collided with the middle of a Burlington Northern Santa Fe (BNSF) train that was leaving the mainline and entering a siding.[35]

---

[33] Ibid., vi.

[34] Non-normalized steel was common in tank cars constructed before regulations were tightened in 1989. Normalization of steel is a metallurgic process by which the steel is heated to extreme temperatures and then air-cooled, increasing the metal's toughness and resistance to cracking at low temperatures. The outdoor temperature at the time of the Minot accident was -6°F. The anhydrous ammonia had been loaded at 40°F and was insulated. It was calculated that by the time of the accident, the temperature of the shell was 36°F and was thus below the ductile-to-brittle transition temperature for non-normalized steel.

[35] All information for this section, unless otherwise cited, from National Transportation Safety Board.

The four UP locomotive units and first 19 cars of that train were derailed, as were 17 cars of the BNSF train. The 16th car of the UP train, carrying liquefied chlorine gas, was punctured by the side of a UP flatcar that had derailed four cars ahead of it. As a result, 9,400 gallons of chlorine gas were released and formed a 1400-foot-diameter cloud, which then began to drift. The BNSF train crew notified both BNSF and UP dispatchers. It was later estimated that the chlorine concentration was 400,000 ppm near the accident scene, far above lethal levels (even 1000 ppm can quickly kill).

Within minutes of the accident, at 5:06 AM, a 911 call was made from a residence near the accident. For several hours, first responders and HAZMAT specialists arrived at the site. However, in part because of the high concentration of chlorine gas and due to the wreckage, it was not until 9:45 AM that an "entry team" in HAZMAT gear could begin attempting to rescue people trapped within the chlorine cloud. The accident resulted in three deaths, including the UP train conductor and two elderly local residents. The UP engineer, six emergency responders, and 26 residents were treated for injuries. Railroad equipment damages reported to the NTSB totaled $5.7 million; site cleanup costs were $150,000. Again, property damage values and compensation for victims is not publicly available.

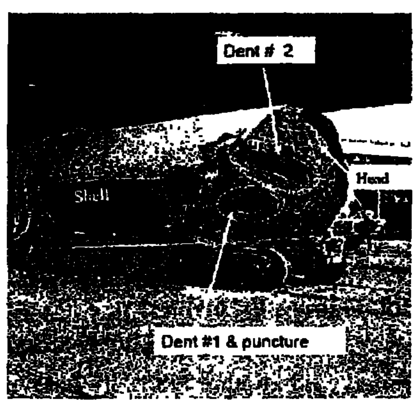


Figure 3: Head Puncture in Macdona Accident (DOT, 2007)

The NTSB concluded that neither the conductor nor the engineer of the UP train had fulfilled their duties. At the display of the "approach" signal, the engineer should have

---

"Collision of Union Pacific Railroad Train MHOTU-23 With BNSF Railway Company Train MEAP-TUL-126-D With Subsequent Derailment and Hazardous Materials Release Macdona, Texas June 28, 2004," Railroad Accident Report NTSB/RAR-06/03, <www.ntsb.gov/publictn/2006/RAR0603.pdf>, hereafter cited as NTSB Report—Macdona slowed the train to 10 mph in preparation for stopping to allow the BNSF train to proceed onto the siding. Instead, the engineer increased speed from 44 mph to 46 mph and continued to operate as if under a "clear" signal.

The NTSB blamed the "UP engineer's combination of sleep debt, disrupted circadian processes, limited sleep through the weekend, and long duty tours in the days before the accident," which, it said, "likely caused him to start the accident trip with a reduced capacity to resist involuntary sleep." The engineer (and other UP crew) likely experienced periods of sleep and were not sufficiently alert to respond correctly to the signals. The NTSB investigation also held that emergency responders had not reacted aggressively enough to rescue trapped residents: the road was blocked, but they had failed to consider alternatives.

The NTSB recommended that the Federal Railway Administration and the Union Pacific railroad study measures to limit crew fatigue. It also asked two unions — the Brotherhood of Locomotive Engineers and Trainmen, and the United Transportation Union — to raise awareness among their members regarding the importance of rest. The NTSB also suggested that the FRA consider revising certain operating measures; for example, the NTSB recommended positioning tank cars at the back of trains to minimize impact forces. It also reiterated recommendations made after the Minot accident to improve tank car design, although the tank cars involved at Macdona met the highest existing standards. The NTSB also noted that positive train control technology (discussed further below) could have prevented the Macdona accident.[36]

Graniteville, South Carolina, January 2005: Chlorine Gas

With nine deaths and over 500 injuries, the January 6, 2005, accident at Graniteville, South Carolina, was the most serious of the fatal railway releases of TIH.[37] Norfolk Southern (NS) train 192 collided with another NS train that was parked on a customer

---

[36] Positive Train Control (PTC) is the term used in the United States to designate a collection of systems designed to increase railroad safety by overriding the engineer's control of the train and automatically stopping the train in certain dangerous situations

[37] All information for this section, unless otherwise cited, from National Transportation Safety Board, "Collision of Norfolk Southern Freight Train 192 With Standing Norfolk Southern Local Train P22 With Subsequent Hazardous Materials Release at Graniteville, South Carolina — January 6, 2005," Railroad Accident Report NTSB/RAR05/04, <www.ntsb.gov/publictn/2005/RAR0504.pdf>, hereafter cited as "NTSB Report—Graniteville."

side track at 2:39 AM EST, derailing both locomotives and 16 cars of the moving train. Three tank cars containing chlorine derailed, one of which was punctured.

The side track on which the accident occurred served textile manufacturing facilities of Avondale Mills, Inc. Investigations showed that the crew of the parked train had completed their duties but had failed to realign the switch back to the mainline track from the industry side track. Track in this area is non-signaled, known as "dark" territory in the railroad industry. Authority to use track in this area is conveyed by the dispatcher in Greenville, South Carolina. Train 192, approaching at 48 mph, collided with the train parked on the side track. The punctured chlorine car released a chlorine vapor cloud that extended at least 2,500 feet to the north of the accident site, 1,000 feet to the east, 900 feet to the south, and 1,000 feet to the west.

Emergency responders were dispatched. A reverse 9-1-1 notification told nearby residents to shelter indoors until entry teams of emergency responders could evacuate people affected by the gas release.[38] An additional 5,400 people within a one-mile radius of the site were evacuated by law enforcement personnel. Over the next days, HAZMAT teams sealed the punctured car and removed hazardous materials from the site.

The accident caused nine deaths. Among the fatalities were the NS train engineer, six Avondale Mills employees, a truck driver, and a local resident. Approximately 554 people were taken to local hospitals, and 75 were admitted for treatment. All casualties were due to chlorine exposure; the NTSB concluded that the accident might have been non-fatal if not for the chlorine release. In addition, property damages reported to the NTSB totaled $6.9 million; a later FRA analysis estimated that the total cost of the accident was $126 million, including fatalities, injuries, evacuation costs, property damage, environmental cleanup, and track out of service.[39]

The NTSB investigation determined that the cause of the accident was the failure of the crew of the parked train to realign the switch after the crew completed its work. The crew, running up against its 12-hour duty limit, had rushed the completion of its tasks.

Following the accident, several railroads modified operating procedure to require that crews confirm the switch position to the dispatcher before signing off duty. The FRA

---

[38] Reverse 9-1-1 is a notification system by which authorities can initiate automated recorded calls to citizens to notify them of an imminent hazard.

[39] FRA, "Regulatory Assessment; Regulatory Flexibility Analysis – Hazardous Materials: Enhancing Rail Transportation Safety and Security for Hazardous Materials Shippers" PHMSA-RSPA-2004-18730, April 2008.

issued a safety advisory asking railroads to review switch procedures. In the face of repeated accidents throughout 2005 caused by misaligned switches, the NTSB viewed these measures as insufficient. Upon conclusion of its investigation of the Graniteville accident, NTSB recommended establishing mechanisms to remind crews of their duty to realign switches, such as an electronic device or a strobe light. The NTSB was also concerned that although train 192 was traveling under the speed limit, its speed did not give it sufficient time to react to the banner displaying the status of the misaligned switch. Therefore the NTSB suggested that reduction of train speeds in non-signaled territory be considered, to give train crews more time to react to misaligned switches.

Baltimore, July 2001: Tunnel Fire

The three accidents described above all occurred in areas of relatively sparse population and early in the morning. By contrast, a 2001 rail accident that involved hazardous materials (HAZMAT) but not toxic inhalation hazards (TIH) occurred in an urban setting in the middle of the afternoon. On July 18, 2001, eleven of sixty cars in a CSX freight train derailed while passing through the Howard Street Tunnel in downtown Baltimore, Maryland, at 3:08 PM EST.[40] The train included eight tank cars loaded with hazardous materials; four of these were among the cars that derailed. One of the derailed tank cars contained tripropylene, two cars hydrochloric acid, and one car di-phthalate. A leak in the car containing tripropylene resulted in a chemical fire. A break in a water main above the tunnel flooded both the tunnel and the streets above it. The tunnel collapsed. Damage and cleanup costs reported to the NTSB from this accident totaled $12 million.

Although there were no serious injuries or casualties, this incident illustrates the risks of rail transportation of hazardous materials through urban areas. It also underlines the challenges of emergency response.[41] The city sounded emergency sirens, but many

[40] See National Transportation Safety Board, "Railroad Accident Brief: CSX Freight Train Derailment and Subsequent Fire in the Howard Street Tunnel in Baltimore, Maryland, on July 18, 2001," <www.ntsb.gov/publictn/2004/RAB0408.pdf>, hereafter cited as "NTSB Report—Baltimore." The NTSB's investigation was unable determine the cause of the accident. Further information and sources in report prepared for DOT, "Effects of Catastrophic Events on Transportation System Management and Operations," <www.itsdocs.fhwa.dot.gov/jpodocs/repts_te/13754_files/13754.pdf>. See also Arnold M. Howitt and Herman B. Leonard, *Managing Crises: Responses to Large Scale Emergencies* (Washington, D.C.: CQ Press, 2009), pp. 201–233.

[41] Stephanie Shapiro, "CSX train fire sparks debate of stay or go," *The Baltimore Sun* <www.dailypress.com/features/arts/bal-to.disaster21jul21,0,4656728.story>. See also Howitt and Leonard, *Managing Crises*, pp. 201-233.

residents did not know that the sirens meant they were to return home to seek information from television and radio, which would have told them to shelter in place. Instead, many residents chose to evacuate the area.

"Human behavior has to be taken into consideration when managing an emergency or disaster," said John Bryan, retired chairman of the department of fire protection at the University of Maryland's engineering school. [42] Announcements about the threat must, he said, be specific. Public education and establishment of public trust in police and other emergency responders are essential so that residents will follow directions from the authorities in case of a HAZMAT or TIH incident.

New Orleans, 1987. Rail Yard Fire

A 1987 case illustrates the issues that arise when there are many players that might be blamed for a HAZMAT accident. In 1987, an unattended rail car in the CSX yard in New Orleans leaked butadiene, a petroleum product, causing a fire that prompted authorities to order road closings and large-scale evacuations.[43] There were no serious injuries or deaths, and minor injuries were not conclusively linked to the fire. Nevertheless in 1997, in a class action suit brought by nearby residents that charged negligence, a jury awarded plaintiffs compensatory damages of $2 million for actual harm, and imposed additional punitive damages totaling $3.4 billion. Named in the suit were CSX, which owned the track where the tank car was parked, the shipper, other railroads that had moved the tank car (including Alabama Great Southern Railway which had actually moved it to the CSX yard), and a previous owner of the tank car, Phillips Petroleum Company, which had improperly installed a gasket that was blamed for the leak (however, Phillips could not be found liable under certain terms of Louisiana HAZMAT law).

Most of the punitive damage award ($2.5 billion of the total $3.4 billion) was imposed on CSX, despite its argument that it did not make the problem tank car, did not own it, and did not install the faulty gasket. CSX had not loaded the butadiene, and did not even move the car after it was dropped off at CSX's interchange yard. CSX was the owner of the track where the tank car was parked, and was scheduled to move it later to Chattanooga, Tenn. Nonetheless, CSX faced a punitive damage claim of $2.5 billion, and additional punitive damages were awarded against other defendants, including the

---

[42] Shapiro, "CSX train fire sparks debate of stay or go."

[43] Carol Marie Cropper, "Jury in CSX Case Sent Angry Message with a $3.4 Billion Stamp," *New York Times*, September 15, 1997, <www.nytimes.com/1997/09/15/business/jury-in-csx-case-sent-angry-message-with-a-3 4-billion-stamp html>.

railroads that had moved the tank car, the shipper, and the tank car company GATX. The damage awards were challenged successfully on appeal and reduced from $2.5 billion to $850 million. Nonetheless, this case illustrates the potentially enormous liability exposure of railways carrying hazardous substances.[44]

Terrorism

Secure transportation of TIH chemicals requires protection against terrorist attacks as well as accidents. To date, no hazardous materials release from a railroad in the United States has been caused by a terrorist attack. The Federal Bureau of Investigation has reported, however, that terrorists are specifically interested in "targeting hazardous material containers" by attacks on rail cars on U.S. soil.[45]

Richard Falkenrath, former Deputy Homeland Security Adviser to President Bush and current Deputy Commissioner of Police, New York City, made this assessment of the severity of the terrorist threat of TIH transport through urban areas by rail and truck:

> Of all the various remaining civilian vulnerabilities, one stands alone as uniquely deadly, pervasive and susceptible to terrorist attack: industrial chemicals that are toxic when inhaled, such as chlorine, ammonia, phosgene, methyl bromide, and hydrochloric and various other acids. These chemicals, several of which are identical to those used as weapons on the Western Front during World War I, are routinely shipped through and stored near population centers in vast quantities, in many cases with no security whatsoever. A cleverly designed terrorist attack against such a chemical target would be no more difficult to perpetrate than were the September 11 attacks. The loss of life could easily equal that which occurred on September 11 — and might even exceed it. I am aware of no other category of potential terrorist targets that presents as great a danger as toxic industrial chemicals.[46]

---

[44] See "CSX Says Court Reduced Damage Verdict," *New York Times*, November 17, 1999, <www.nytimes.com/1999/11/17/business/csx-says-court-reduced-damage-verdict.html>.

[45] Richard Falkenrath, "We Could Breathe Easier: The Government Must Increase the Security of Toxic Chemicals in Transit," <www.washingtonpost.com>, March 29, 2005, p. A15.

[46] Falkenrath, "We Could Breathe Easier." However, railroad industry officials point out that it would be difficult for terrorists to coordinate an attack against a moving freight train, although perhaps less difficult against a stationary target.

Chlorine has been used as a weapon; it was used extensively in chemical warfare in World War I. In Iraq, insurgents have exploded small canisters of chlorine in trucks filled with explosives.[47]

An important distinction from accidental release is that a terrorist attack involving TIH could be deliberately targeted in such a way as to cause a high number of casualties. A worst-case scenario simulation performed at the Naval Research Laboratory concluded that if such an attack occurred during a celebration or political event in a setting similar to the National Mall, over 100 people per second might die, and up to 100,000 people could be killed within 30 minutes.[48] A July 2004 study by the Homeland Security Council (a White House office) estimated that even under less crowded conditions, a TIH attack in an urban area could result in as many as 17,500 deaths, 10,000 severe injuries, and 100,000 hospitalizations.[49]

A study by the National Research Council addressed a more conservative scenario: a terror attack on stored toxic chemicals in an industrial city, with a release of TIH materials in large (but unspecified) quantities.[50] The release was assumed to occur at midnight under mild meteorological conditions, resulting in a predicted 1,000 deaths and 22,000 injuries. The study also addresses release from a TIH rail car under similar circumstances, but it concludes that: "because of the quantity of chemical involved, multiple attacks at multiple sites would be required to produce numbers of casualties that would be considered catastrophic by the standards indicated in U.S. Department of

---

[47] In the attacks in Iraq, fewer people were killed by the chlorine than by the explosives. The deadliness of the released chlorine gas is thought to have been reduced by chemical reactions resulting from the high temperatures of the explosions The Iraq explosions were not "chlorine bombs," said Steven Kornguth, director of the biological and chemical defense program at the University of Texas in Austin. "They are putting canisters of chlorine on trucks with bombs, which then puncture the canisters and release the chemical," Kornguth said. "But it hasn't been very effective because the high temperature created by the bombs oxidizes the chemical, making it less dangerous."

[48] Boris presentation to D C. City Council; see also Jay Boris, "The Threat of Chemical and Biological Terrorism: Roles for HPC in Preparing a Response," *Computing in Science and Engineering*, Vol. 4, No. 2 (March/April 2002), pp. 22–32.

[49] "Planning Scenarios: Executive Summaries Created for Use in National, Federal, State and Local Homeland Security Preparedness Initiatives," The Homeland Security Council, July 2004, Scenario 8.

[50] National Research Council, Committee on Assessing Vulnerabilities Related to the Nation's Chemical Infrastructure, *Terrorism and the Chemical Infrastructure: Protecting People and Reducing Vulnerabilities* (Washington, D C · National Academies Press, 2006), also available online at <www.nap.edu/catalog/11597.html>.

Homeland Security (DHS) National Response Plan."[51] However, this conclusion seems implausible, as it assumes that terrorists would choose to attack at midnight; it is more likely that terrorists would choose to attack when streets are crowded. If so, this scenario would have predicted far more than 1,000 deaths.

The scale of potential fatalities is confirmed by the sophisticated and comprehensive analysis in a recent dissertation that examined the consequences of a 17 ton chlorine terror attack on a tanker truck.[52] The study takes as its base case the rupture of a tanker truck carrying 17 tons of liquid chlorine in a generic urban area during daylight. While the analysis of the effect of structures on the three-dimensional propagation of the chlorine plume is less detailed than the Boris study and is, unlike that study, not specific to a particular city, the behavioral model is more detailed, and accounts for both the rate at which people can escape from open spaces and the extent to which sheltering in place saves (or sometimes may cost) lives. In the absence of a fast and effective defense response and with 2.5 meters/second wind speed, and a specified wind stability, approximately 4,000 fatalities are estimated, half within 10 minutes, and up to 30,000 fatalities, half within 20 minutes, depending on the dose response model. Fatality consequences are found to be roughly proportional to the amount of chlorine released, so a ruptured 90 ton rail car would, under a reasonable range of conditions, kill approximately 5 times as many people as would release of 17 tons from a truck. Assumptions for this range of estimates (4,000 to 30,000 fatalities depending on dose-response assumptions) is based on an outdoor population density in the target area of only 7 percent of the total daytime population density, it suggests that the Boris estimate of up to 100,000 deaths from a successful rail car attack is not as excessive or unsubstantiated as some critics have claimed.

Intelligence about terrorist intentions and capabilities is highly uncertain, which makes it quite difficult to estimate the likelihood of a terrorist attempt to rupture a TIH tank car in a crowded urban area. Several scenarios are conceivable for terrorist attacks on TIH-carrying trains. An implanted explosive weapon might detonate a rail car, perhaps when the car is motionless and is not in a protected environment. Current procedures provide for inspection by railroad personnel to guard against this type of attack.

---

[51] According to the National Response Framework, "A catastrophic incident is defined as any natural or manmade incident, including terrorism, that results in extraordinary levels of mass casualties, damage, or disruption severely affecting the population, infrastructure, environment, economy, national morale, and/or government functions." U.S. Department of Homeland Security, "National Response Framework," January 2008, < http://www fema.gov/pdf/emergency/nrf/nrf-core.pdf>, p. 42.

[52] Barrett, "Mathematical Modeling and Decision Analysis for Terrorism Defense."

In another scenario, a projectile weapon might puncture a storage tank or a tank car. If someone attempted to do so with a rifle, release from the resulting small punctures would not be rapid; instead, a relatively slow release and dissipation of the product would limit the effect. More worrisome is the potential use of a heavier weapon, perhaps one delivering a shoulder-launched shaped-charge projectile from a great distance, which could create a large rupture.

Terrorists might attack infrastructure such as rails, bridges, or tunnels in order to derail TIH tank cars. The consequences are hard to predict; they would depend in part on whether the cars meet the current government standards for robustness, and on their location in the train. The effects of such an attack might be similar to the effects of an accidental derailment. It might be worse if terrorists chose time and place deliberately to expose a large population of potential victims to gas release. Planning for such an attack is not so easy, however, because of the uncertain schedule of most trains and the additional uncertainty of the presence or absence of a TIH tank car.

For terrorists to have high confidence that such an attack would be devastatingly successful, they would need access to tools comparable the computational meteorology tools used by the government to estimate consequences and plan responses. The attacker would need to know train loading, schedules, and routing information, and would have to find a time when one or more tank cars of TIH materials would pass up-wind of a large population, and when wind and moisture conditions were appropriate. Having confidence of optimizing such an attack would require a complex operation.

One means of discouraging such a terrorist attack is to deny the possibility of a lucrative target, by ensuring that rail cars transporting TIH never pass through highly populated areas, at least not when those populations are likely to be out of doors. Shipping TIH only at night, or rerouting around exposed populations, would greatly reduce the attractiveness of targets.[53]

Denial of an attractive target could also be enhanced by assuring a more effective response to attack, in order to mitigate death and injury. Key components of effective response include a very fast situational assessment, combined with means to warn people in exposed places and to give them appropriate directions for protective action (such as sheltering in place or evacuating in the safest direction). This would require a much better program of public education in disaster response behavior than is in place today in U.S. cities.

---

[53] This would, however, introduce significant operational complications for the railroads, discussed below in Section IV.

Currently the plan for responding to a TIH release assumes that emergency operations officials would have about 15 minutes to understand the nature of the threat, including meteorological and other information, and that first responders would therefore have 15 minutes to arrive on the scene prepared with appropriate equipment and information to mitigate the consequences.[54] However, this is not fast enough. There are simulation models that could provide essential information more quickly. The Office of Naval Research (ONR), for example, has constructed a simulation model called FAST3D-CT which can rapidly predict, with accurate details, the intensity and movements of a contaminant cloud, taking into account the specific morphology of the surrounding city streets and buildings.[55] However, it requires very fast computing facilities that are unavailable to most cities. The ONR team has found they can overcome this difficulty and greatly reduce the time to compute by running scenarios in advance for many cities, computing the consequences of a range of threats and meteorological situations. Then the detailed local conditions can be entered into a more modest computer to make the local corrections very rapidly. However the ONR model is not yet widely implemented.

Increasing the security of TIH transportation requires cooperation of the railways, the chemical industry, federal and state regulators, a challenge that is compounded by the ambiguity and uncertainty surrounding the magnitude of the risk, as the next section explores.

---

[54] Private communication to Lewis Branscomb from Jay Boris, Naval Research Laboratory, Washington DC, Spring 2009.

[55] Boris, "The Threat of Chemical and Biological Terrorism," Boris presentation to D.C. City Council.

III. Policies for Dealing with Externalities

The full societal cost of TIH transportation — including the risks of potential damage from accident or attack — is not reflected in the market prices for TIH products. A calculation of the full social cost of TIH transportation would include both the probabilistic costs of the consequences of TIH releases and the costs of countermeasures implemented to reduce the frequency and potential effects of a release. Economists described such costs as negative externalities. The discrepancy between the market price and social cost is the TIH safety and security externality.

The extent of the externalities — the degree of this misalignment of costs and benefits — is disputed among shippers and railroads. Railroads argue that rates for TIH, although they are already higher than those for other commodities, are not high enough to fully cover the probabilistic costs of an unintended release. Therefore, the railroads argue, they bear disproportionate risks while being forced to carry TIH by their common-carrier obligations.[56] Many shippers counter that shippers should not be responsible for the consequences if a release were to occur due to actions by railroad employees, such as at Graniteville, or is exacerbated by railroad equipment conditions, such as at Minot.

The public at large is endangered by transportation of TIH. As the accidents in Minot, Macdona, and Graniteville demonstrate, the potentially fatal consequences of TIH releases during rail transportation may fall upon the general public and, in this sense, external costs of TIH materials are borne by the public. The government and thus, ultimately, the tax-paying public also bears a portion of the costs of preparing for a possible TIH incident, including public education, emergency preparedness and specialized equipment and training, as well as the costs of emergency response and cleanup after a TIH release.

A sense of the risk from TIH transportation accidents can be drawn from the actual TIH release events described above. The damage valuations reported to the NTSB relating to train equipment range from $2.5 million in the case of the Minot accident to $12 million in the Baltimore case, with additional environmental cleanup costs ranging from $150,000 (Macdona) to $8 million (Minot). However these figures exclude casualties, private property damage, and interruption of business, which are necessary to evaluate the total value of all losses to the society from the accidents in question. In the case of the

[56] The railroads view TIH transportation as a "bet-the-company" risk, which they are unwilling to take on at any price. In this, the railroads demonstrate significant risk aversion.

Graniteville accident, the FRA estimated that the total cost of the accident, including loss of life, injuries, and evacuation costs, was $126 million. [57] This figure gives a more accurate sense of the magnitude of TIH costs. Indeed, total costs in all of the cited cases could -- under different circumstances -- have been far higher. The Graniteville accident, for example, took place in a rural setting, at an early morning hour. If a similar accident had occurred in an urban area in the daytime, there might be many casualties and severe economic disruptions, while a successfully targeted terrorist attack could have even more catastrophic effect.

If the TIH risk could be quantified and incorporated into the price of TIH products and their transportation, this would allow stakeholders to make economically rational decisions concerning production, use, and shipping of TIH chemicals. Better understanding of the sources of the risk would facilitate setting rational priorities for various risk-reduction strategies.

However, quantification of the TIH risk presents formidable challenges that hinder the development of comprehensive policies to deal with the externality. The challenges of quantification stem in part from the high degree of uncertainty surrounding possible TIH rail accidents, and the even greater unpredictability of a potential terrorist attack. Fatal TIH releases are generally considered to be low-probability high-consequence events, which difficult to predict but produce potentially devastating effects if they do occur.

Acknowledging these difficulties, in this paper we define the risk as the product of:

1. the probability of an accident or terrorist attack that results in a TIH release; and,
2. the probable consequences of a release, if one occurs.

This is the definition used by the U.S. Department of Transportation in its 1989 HAZMAT transportation guidelines (revised in 1994) and it is generally accepted as the starting point for risk calculation.[58]

---

[57] FRA, "Regulatory Assessment; Regulatory Flexibility Analysis – Hazardous Materials. Enhancing Rail Transportation Safety and Security for Hazardous Materials Shippers" PHMSA-RSPA-2004-18730, April 2008.This analysis values fatalities at $27 million, injuries at $35 million, evacuation costs at $10.5 million, property damage costs at $6.9 million, environmental cleanup costs at $150,000, and track out of service time at $46 million.

[58] U.S. Department of Transportation, Federal Highway Administration, Office of Highway Safety, "Guidelines for Applying Criteria to Designate Routes for Transporting Hazardous Materials," FHWA-SA-94-083, September 1994.

The first component of risk, the probability of an incident of TIH release, is based on a number of factors. This discussion will focus on the risk stemming from accident, because the risk of terrorism is nearly impossible to quantify and will be discussed separately. The presence or absence of TIH cars in a train is not a major factor in the probability of an accident.[59] The probability of an accidental release is a function of the time and distance of exposure to risk, the quality of track and its signaling system, operating conditions (such as speed, single or double track, train routing, train control, train consist), quality of the rolling stock, and other factors. Human factors also play a role in many train accidents. Human errors exacerbated by excessive fatigue can be minimized by regulating working hours. At grade crossings where highway traffic intersects with rail tracks, many accidents are caused by motorists; such accidents are outside the railroads' control, and would be very difficult to quantify.

In the event of an accident, the second factor, the severity of the consequences, depends on various elements. The impact of a release will be influenced by the quantity of product released and the nature and toxicity of the specific chemical involved. The dispersion of the gas will be affected by the atmospheric conditions at the time of release, including the temperature, moisture in the air, and wind direction and speed. The spread of gas from the release site is also affected by the morphology of the terrain, the density of buildings, and the shape and direction of streets. Injuries and deaths caused by the release will depend on the number of persons and the duration of their exposure to the plume, which is a function of density of persons within the area, the size of the plume at toxic levels, and the speed at which persons affected can escape toxic levels. These factors are a function of time of day, the distance of that population from the release, the effectiveness of public response to emergency instructions, the rate at which people can move to safety, and the effectiveness of shelter-in-place.

The above elements of risk are relevant to a particular place and circumstance. To quantify risks for accidents in a network of rail links connecting many sources and delivery points of rail traffic, one must sum over the entire transit of a TIH train from loading point to product delivery. On the other hand, one could imagine dividing each link of a route into segments, each of which represents a different level of probability of accidents and the level of consequences based on the probabilistic analysis of a typical set of circumstances within each segment. The lowest risk segments could be analyzed by more simplistic assumptions, and the risk of the entire link could then be combined,

---

[59] Human errors exacerbated by excessive fatigue can be minimized by regulating working hours. At grade crossings where highway traffic intersects with rail tracks, many accidents are caused by motorists; such accidents are outside the railroads' control, and would be very difficult to quantify.

based on length of the link and duration of exposure to accident. Conceptually, this allows a calculation of risk in terms of possible casualties. Practically, such a calculation would require gathering a broad range of information. As a practical matter, the result would be dominated by the higher risk segments on each link, and in urban areas at least one could expect a more complete risk analysis to be done by the local emergency operations authorities in the urban area in question. Perhaps more important, such an analysis would be used to compare the sensitivity of estimated risk and consequences to each of the analytical elements, thus supporting decisions on strategies to reduce risk.

Policy Experience from Externalities Other Than Shipping Hazardous Materials.

Lessons for dealing with the transportation of TIH and its safety and security externalities can be sought in policies that have addressed other externalities in the past. A variety of regulatory instruments seek to internalize external costs and protect the public. These include taxes such as the gasoline tax, emissions standards and market-based controls including cap-and-trade regimes (such as the Acid Rain Program), and limitations on liability and insurance schemes employed for nuclear reactors, oil spills, or bank deposits.

Perhaps the simplest way of addressing a situation in which private actors do not take into account the public consequence of their actions is to tax an offending activity or subsidize a beneficial activity. Taxes designed to change behavior (in contrast to taxes designed to raise revenue) are known as "Pigouvian" taxes, after the early twentieth century English economist Arthur Cecil Pigou. Pigouvian taxes work when an increase in the price of any existing good, service, or input into a production process leads to a decrease in its use. The magnitude of the change in usage generated by a Pigouvian tax depends on the availability of good substitutes, as well as the overall cost share of the input. As a consequence, while policy can predictably affect behavior through a Pigouvian tax, the magnitude of the impact will depend on the particulars of the situation. The better the available substitutes, the more effective the Pigouvian tax. An example might be the tax deductions granted owners of buildings installing green energy facilities during the Carter administration.

If the externality has the potential to be mitigated by new technology, policy could support research and development. The difference between this sort of subsidy and a Pigouvian subsidy is that an R&D subsidy is provided in an entirely different market from the one in which the external effect is present. In a technology-based approach for TIH, for example, a government-funded R&D program would subsidize firms that seek new approaches to accomplish industrial tasks while using smaller quantities of TIH chemicals. This type of policy strategy faces at least four obstacles. The first is the inherently uncertain nature of research, given that technical solutions cannot be counted on to materialize when they are needed. Second, and related, long time horizons may be necessary to research new technical options and put them into practice. Such timeframes put outcomes outside of the scope of accountability for corporate leaders, directors of federal agencies, or elected officials. Third, systems integration challenges confront industry supply chains. Modification of such large, complex technical systems can result in unintended consequences. The generic challenge of transitioning an invention into a market-ready innovation is exacerbated here by the difficulty of embedding an innovation into these complex systems. Fourth, absent regulatory restrictions or Pigouvian taxes on the existing technology, the incentive to adopt a new technology may be insufficient to induce its creation and adoption.

Taxes (sticks) and research subsidies (carrots) may be supplemented by other policy instruments. The arena of environmental regulation provides several examples. The government might simply limit the use of a toxic substance. For example, the Clean Air Act Extension of 1970 empowered the EPA to set binding emissions limits on new sources of specified common air pollutants. The EPA was required to base standards on the "best technological system of continuous emission reduction," that is, the state of the art in pollution control.

It can be a major challenge for the owner of an industrial facility to satisfy a complex set of federal environmental requirements imposed by different regulators with little or no coordination. While an inherent logic supported the notion that firms should utilize the "best available technology," the unintended consequence of such an approach was to create an incentive for regulated industries to oppose the development of new and improved anti-pollution technologies.

The challenge, therefore, was to achieve the desired aim of reducing the overall quantity of pollutants emitted into the environment while providing firms with incentives to achieve those reductions at the lowest cost. The approach to regulation that eventually resulted was the model of emissions trading, also known as cap-and-trade. In these programs, a mandatory emissions cap is set. Each emissions source, such as a power plant, must choose its own preferred avenue of compliance with standards. Each is permitted to trade its emissions allowances, which are priced by the market. This is coupled with a strict monitoring and inspection regime. This type of market-based solution creates incentives for companies to search for efficient solutions.

Perhaps the most successful experience with emissions trading programs have been the cap and trade programs for Sulfur dioxide (SO_2) and Nitrogen oxides (NOx), both administered by the EPA. SO_2 trading under the Acid Rain Program began in 1995, and initially targeted a subset of coal-burning power plants, later expanding to include more power plants.[60] Each year, a set number of allowances for permitted tons of SO_2 are distributed by the EPA, which makes a limited number of further allowances available at auction. These allowances may then be bought, sold, or saved for future use. In 2007, the total value of the SO_2 allowance market was approximately $5.1 billion, with an average nominal price of $325 per ton and 4,700 transactions moving 16.9 million allowances.[61] The goal of the Acid Rain Program is to reduce SO_2 emissions to 8.95 million tons, or 50 percent of 1980 levels, in 2010 (the cap as of 2000 was 9.5 million tons). Meanwhile, the NO_x cap-and-trade program successfully reduced emissions to 60 percent below 1990 levels by 2002.[62] However there is a fundamental difference between these pollutants and TIH in that whereas risk is evenly distributed across the population in the former case, only a fraction of the population is exposed to TIH release.

In situations where a dangerous good is also important to the public interest, a liability or insurance scheme can distribute the risk. For example, the Price-Anderson Act was enacted in 1957 to facilitate the development of the nuclear power industry.[63] The Act, which required reactor licenses involving technical and operational requirements, created a federal pool of funds to compensate victims of a nuclear accident that might take place at any point in the supply chain, including transportation, storage, or reactor operation. To fund the Act, reactor licensees are required to have $300 million in private insurance; that sum is periodically revised based on the available amount of insurance.[64] In addition, in case of an incident with a cost exceeding $300 million, licensees would be obliged to contribute further at a rate of up to $10 million per year for each reactor, up to a maximum of $95.8 million. This creates a virtual secondary insurance pool of over $10 billion. If damages from a nuclear accident were to exceed the primary and secondary insurance coverage thus created, the government would, under the Price-Anderson Act have to propose a compensation scheme, which would require Congressional approval. The fund, administered by the Nuclear Regulatory Commission, has disbursed more than $200 million since 1957, $71 million of this related to the 1979 Three Mile Island accident.

---

[60] U.S. Environmental Protection Agency (EPA), <www.epa.gov/captrade/documents/arbasics.pdf>.

[61] EPA, <www.epa.gov/captrade/allowance-trading.html>.

[62] Established in 1999 among a group of northeastern and mid-Atlantic states, the NO_x program regulates emissions of power-generating facilities and industrial boilers during ozone season. See EPA, <www.epa.gov/captrade/documents/nox.pdf>.

[63] For background on the Price-Anderson Act, see GAO, "Nuclear Regulation: NRC's Liability Insurance Requirements for Nuclear Power Plants Owned by Limited Liability Companies," GAO-04-654, May 2004.

[64] All nuclear liability policies are written by American Nuclear Insurers [see note above.].

Oil spills have also been tackled by federal regulation through a liability mechanism. The 1989 Exxon Valdez oil spill was a catalyst for the Oil Pollution Act of 1990. It authorized the creation of the Oil Spill Liability Trust Fund, managed by the National Pollution Funds Center. The OSLTF is financed by industry via a tax of $0.05 per barrel of imported oil, interest on the Fund principal, assessed penalties, and cost recovery from responsible parties. The fund totaled a maximum of $2.7 billion as of 2005.[65] The OSLTF can be used for federal cleanup costs and to meet damage claims by government entities, corporations, or individuals.[66] If an accident occurs, the responsible party must cover cleanup and claims up to its liability limit (except that liability for a spill due to gross negligence is not capped).[67] Liability limits for accidents vary by vessel size; for example, the liability limit for a tank vessel of more than 3,000 gross tons is the greater of $3,000 per gross ton or $22 million.[68] Beyond the liability limit, responsible parties may present claims to the OSLTF for additional funding. However, the funds available from the OSLTF are limited to $1 billion per incident. The Oil Pollution Act also set operational mandates relating to vessel construction, crew licensing and manning, and contingency planning in order to reduce the risk of future accidents. This is similar in concept to the licenses required of reactors by the Price-Anderson act, combining technical and operational requirements with a financial liability scheme.

Other models may be found in the financial arena. An example of an insurance scheme is the Federal Deposit Insurance Corporation (FDIC), an independent government agency created in 1933 during the Great Depression to insure private accounts in commercial banks against bank failures.[69] Individual deposits are insured up to $100,000 (in late

---

[65] The Oil Spill Liability Trust Fund (OSLTF) is described at <http://www uscg mil/npfc/About_NPFC/osltf.asp>.

[66] U.S. Department of Homeland Security, U.S. Coast Guard, "Oil Spill Liability Trust Fund (OSLTF) Funding for Oil Spills," January 2006.

[67] Other exceptions to the liability cap include failure to report the incident and violation of federal regulations: see U.S. Code Title 33, Chapter 40, Subchapter 1, Section 2704 "Limits on liability," <http //frwebgate access.gpo.gov/cgi-bin/getdoc.cgi?dbname=browse_usc&docid=Cite.+33USC2704>. However the responsible party is not liable for costs and damages if the spill is caused by an act of God, an act of war, government negligence, or act or omission of a third party: see U.S Code Title 33, Chapter 40, Subchapter 1, Section 1321, "Oil and hazardous substance liability," < http://frwebgate access.gpo gov/cgi-bin/getdoc.cgi?dbname=browse usc&docid=Cite:+33USC1321>

[68] See the National Pollution Funds Center, "Oil Pollution Act (OPA) Frequently Asked Questions," November 6, 2009, <www.uscg.mil/npfc/About NPFC/opa_faqs.asp#faq1>.

[69] See FDIC website, <www.fdic.gov/about/learn/symbol/index.html>, see also "Deposit Insurance: An Annotated Bibliography," <www.fdic.gov/deposit/deposits/international/bibliography/index.html>.

2008, this limit was temporarily raised to $250,000). Funding for the FDIC derives from fees banks are required to pay based on the volume of deposits they hold. FDIC funds are invested in U.S. Treasury securities. As of 2009, the FDIC insurance fund totaled over $17.3 billion and insured more than $4 trillion of deposits.[70] The FDIC is charged with monitoring member banks to ensure that they are meeting liquidity requirements. If a bank fails, the FDIC pays out for depositor losses, and also oversees the sale of the failed bank's assets and the settlement of its liabilities.

Another example of insurance, the Terrorism Risk Insurance Act (TRIA) of November 2002 (reauthorized in December 2006), was designed to solve a specific problem. After the events of September 11, 2001, the insurance industry was newly appreciative that terrorist attacks might occur and involve enormous potential liabilities. Thus they became reluctant to provide insurance coverage against terrorism for new commercial construction while, particularly in New York City, builders were unwilling to move forward with construction projects without such terrorism protections. Congress therefore agreed to underwrite terrorism risk insurance. Much like the Price-Anderson Act, TRIA pledged the resources of the federal government in order to encourage economic activity in an environment of pervasive risk. However, this step did not reduce those risks.

These various policy instruments all provide models for the TIH issue, and their potential applicability is evaluated below. First, however, we examine risk-reduction strategies that are applicable to TIH; these are comparable to policies such as the OSLTF and the Price-Anderson Act that impose operational requirements designed to enhance the safety of the underlying supply chain and reduce the risk of a catastrophic accident.

[70] See FDIC website, <www.fdic.gov/about/learn/symbol/index.html>

IV. Risk Reduction Strategies

Several broad areas of TIH transportation offer the potential for risk reduction, including changes in rail operations, improvements in tank car design, more effective emergency response, product substitution by TIH users, and relocation of TIH sources or users. Improvements can be achieved through a combination of voluntary initiatives by the railroads and their unions, together with government regulation. This section lays out the various options, and examines progress to date and potential for future action.

First, changes to rail operations may diminish the chances of a catastrophic accident, and may also reduce the opportunities for a terrorist attack. Rail safety improvement is an ongoing process that is in the interest of all stakeholders. Initiatives that have already been undertaken include modifications of rail equipment, such as tank car design enhancements, and development and installation of positive train control following a legislative mandate. Other risk-reduction measures might include changes to rail operations, such as rerouting, improved yard management, or repositioning the tank car within the train composition or "consist."

A second broad area for improvements is emergency response, to mitigate the effects of any incident. Better training for emergency responders that is specific to dealing with hazardous materials and TIH, appropriate equipment for such incidents, management of response infrastructure, information and training of the public and improved coordination among parties are critical, particularly in the case of an intentional or terrorist attack.

Another category of risk-reduction strategies involves product substitution and management of the supply chain (including modifying production and use locations) so as to minimize the need to transport TIH materials over long distances. This approach attacks the source of the risk directly, and would be the best long term risk reduction strategy, but could be the most difficult to achieve comprehensively because existing patterns of use and location of sources and users of TIH chemicals would be hardest to change.

Tank Car Design and Safety Improvements

One area offering clear potential for risk reduction is tank car design. Recent accidents have underlined the need to develop better safety standards for tank cars and spurred both private industry and government regulators to address the design issue. However, stakeholders in the chemical and rail industry may have conflicting interests; together with uncertainty as to regulatory roles, this creates contentious issues relating to the quantification and assignment of costs and risks borne by each player.

The modern pressurized railroad tank car is designed to transport liquids in bulk, such as petroleum products, liquid chemicals, or liquefied gases. Tank car shells made after 1989 are constructed from rolled plates of TC-128 normalized steel. The shell is surrounded by insulation and enclosed in an outer jacket of steel, which keeps the insulation in place but adds little protection. A stub sill, which is the structural member for the couplers and draft gear and is also the attachment point for the wheel sets, is attached to the underside of the tank at each end. Brakes and other features are welded to pads, which are welded to the tank shell to improve stress distribution. The average cost of a tank car in 2008 was around $120,000.[71]

As of 2006, there were 275,000 such tank cars in use in the United States, representing 17 percent of the total railcar fleet.[72] Of these, 74 percent were owned by rail car leasing companies, 26 percent by shippers, and less than 1 percent by the railroads.[73] Tank cars vary considerably in design to make them appropriate for carriage of specific chemicals; only about one-fourth of the tank car fleet is approved for use with TIH chemicals.[74]

The accident record of rail tank cars is very good overall, despite the recent TIH rail accidents described above. However, these incidents highlighted the need to strengthen TIH tank cars. The National Transportation Safety Board found that deficiencies in the breached tank cars were a major cause of the 2002 accident in Minot, ND.[75] The ruptured tank cars were constructed before the 1989 rule change that required normalized steel in tank car construction; because they were made of non-normalized steel, they were therefore less resistant to puncture than newer cars.

Many recent efforts to improve tank car design were initiated in the private sector, prompted by the desire to preempt government regulation, to gain advantage over competitors, as well as ethical consideration, public relations benefits, and a focus on enterprise risk management.

---

[71] See Comments by Olin Corporation, PHMSA Docket FRA-2006-25169, June 2, 2008, p. 1.

[72] D. Samples, "2008 and Beyond — Building for the Future," Union Tank Car Co., October 4, 2007.

[73] D. Samples, "2008 and Beyond — Building for the Future." The three largest tank-car leasing companies are the GATX Corporation, the Union Tank Car Company, and GE Rail.

[74] Patrick J. Krick, "Security, Capacity and Risk Management — The Case of TIH Products and Pressure Tank Car," 2006, (consulting company white paper), <www.thomasgroup.com/eLibrary/White-Papers/Security-Capacity-and-Risk-Management-The-Caseof-.aspx>.

[75] NTSB Report — Minot

The Association of American Railroads Tank Car Committee (AAR-TCC) began to study the design of a safer tank car following TIH accidents of 2002-2005. Its goal was to develop a TIH tank car that would reduce the conditional probability (CPR) of TIH release upon impact by 65 percent.[76] In March 2008, the AAR set new standards for shell, tank-head, and top fittings.[77] These industry rules applied a higher DOT standard to various base types of tank car used for TIH carriage.[78] However these rules were later preempted by a January 2009 federal rule, described below.

Meanwhile, shippers, carriers, rail car builders, and government joined in an effort designated the Next Generation Rail Tank Car Project (NGRTC). The project included participation by Dow Chemical, Union Pacific Railroad, and the Union Tank Car Company (UTLX), as well as the Transportation Security Administration (TSA) of the Department of Homeland Security, the Federal Railway Administration (FRA), and its Canadian counterpart, Transport Canada.[79] The goal of the project was to design a tank car that would perform five to ten times better in a standardized test that measures the energy required to cause failure in a current tank car approved for carrying chlorine.[80] The NGRTC declared the "end of [the] evolutionary path for [a] 'thicker is better' approach," and instead considered options to modify the structural design of the current tank cars to increase impact resistance or shock absorption.[81] Added head protection measures, for example, would include either stronger head shields or deformable head shields to create "crumple zones" that would absorb more impact before the impact force could reach the TIH container. The non-structural outer layer of steel could be strengthened to provide additional crash protection, with incorporation of energy-

---

[76] Conditional probability of release (CPR), the metric used by the AAR, is the estimated probability of release from a given tank car in the event of an accident.

[77] Ibid. For example, chlorine cars meeting minimum DOT specification for 105J500W cars with no head shield, head thickness of 0.787 inches, and shell thickness of 0.787 inches, would, according to the industry's new standard, have to comply with minimum specification 105J600W, with a full-height head shield and increased head and shell thickness (to 1.1360 inches and 0.9810 inches respectively) According to the AAR, the new requirements could be met using upgraded versions of the current tank cars.

[78] Association of American Railroads, "Docket No. FRA-2006-25169: Hazardous Materials: Improving the safety of railroad tank car transportation of hazardous materials: Comments of the Association of American Railroads." June 2, 2008, p. 8.

[79] See NGRTC Project, "Next Generation Rail Tank Car," presentation to Transportation Research Board (TRB), 87th Annual Meeting, January 16, 2008; and David Noland, "Safer Train Tank Car Tech Rolling Down the Line," *Popular Mechanics*, February 6, 2007.

[80] NGRTC Project, "Next Generation Rail Tank Car."

[81] NGRTC Project, "Next Generation Rail Tank Car."

absorbing layers. Within the shell, the tank support system could be modified to allow the tank to move more freely in case of impact, isolating it from crash forces. One the most promising and easiest design modifications would be improvement of fittings and valves. Reducing their profile or creating removable valves would decrease vulnerability in case of accident. The installation of real-time monitors on TIH cars to transmit information to control centers was studied, and shippers have begun to implement this measure.[82]

In August 2005, after the TIH rail accidents described above, Congress added a section of hazmat law to the SAFETEA-LU federal transportation authorization statute.[83] It required the FRA to develop and validate a predictive model for tank car accidents and to begin the rulemaking process for improved tank car standards.[84] These efforts resulted in new FRA regulations in early 2009 that raised standards for tank cars.[85]

FRA research has focused on evaluating accident survivability of tank cars through a modeling and testing process. The Volpe National Transportation Systems Center conducted a program of testing and modeling that eventually developed a concept design for a new type of tank car. The Volpe conceptual design is based on the use of sandwich panels of two sheets of steel, separated by an interior structure such as a honeycomb. Such panels can "support loads in the plane of the panel while offering effective energy-absorbing capability in the normal (out-of-plane) direction, as well as a high bending resistance."[86] Significant work remains to be done before a prototype car using this technology could be constructed.

---

[82] RFTrax of Sugarland, Texas, is developing an Asset Command Unit for the NGRTC that uses GPS to track the tank car's position and sensors to detect the level of chemical product in the tank car; it transmits this information to shippers. Dow Chemical has installed GPS tracking on its TIH tank cars.

[83] See SAFETEA-LU, "Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users," text at <frwebgate.access.gpo.gov/cgi-bin/getdoc.cgi?dbname=109_cong_bills&docid=f:h3enr.txt.pdf>.

[84] HAZMAT is addressed in Title VII of SAFETEA-LU.

[85] U.S. DoT, Pipeline and Hazardous Materials Safety Administration (PHMSA), 49 CFR Parts 171, 172, 173, 174 and 179. "Hazardous Materials: Improving the Safety of Railroad Tank Car Transportation of Hazardous Materials; Final Rule," January 13, 2009.

[86] M. Carolan, B. Talamini, and D. Tyrell, "Update on ongoing tank car crashworthiness research: predicted performance and fabrication approach," Proceedings of 2008 Joint Rail Conference, Institute of Electrical and Electronics Engineers (IEEE) and American Society of Mechanical Engineers (ASME), April 22–23, 2008, p. 2.

The DOT nevertheless drew upon the Volpe research during the regulatory process that culminated in a Final Rule published in January 2009.[87] The rule requires better puncture resistance for TIH tank cars in either the inner shell or outer jacket, installation of full head shields, and enhanced protection for valves and fittings. It also set a 50 mph speed limit for loaded TIH cars and imposed a requirement to prioritize replacement of all tank cars built from non-normalized steel. The rule specified that these standards should be considered interim tank car standards, applying to all cars built after March 16, 2009. Even if later research and testing results in different standards, the rule specified that tank cars complying with the interim standards would be continue to be acceptable for 20 years under a "grandfather" clause. These federal standards explicitly preempt the AAR standards described above.

There was a long process of dialogue and debate among stakeholders before the terms of the final rule were settled. For example, a performance standard that would have required TIH tank cars to resist shell puncture at 25 mph and tank-head puncture at 30 mph was abandoned.[88] Since this had been based on the calculation that secondary car-to-car impact speed was approximately half that of the train speed, the 50 mph limit set in the final rule was expected to be adequate instead.[89] Ultimately, the final rule based standards on a chemical industry petition that proposed a commodity-specific scale-up in tank car specifications: each commodity, ranked by degree of TIH hazard, would require the next-strongest tank car, with thicker steel.

Another important point of debate involved speed limits. The FRA had found that a "disproportionate" number of accidents occurred in non-signaled or "dark" territory. The Proposed Rule therefore required a limit of 30 mph for TIH tank cars in dark territory, unless the tank cars conformed to the new, enhanced standards. However, the railroads argued successfully for dropping this standard, arguing that it would hinder service to the non-TIH customers that comprised the vast majority of traffic.

As of mid-2009, the FRA tank car regulation had not spurred demand for new cars.[90] American Railcar Industries blamed the economic slowdown: "We haven't seen much of

---

[87] U.S. DoT, Pipeline and Hazardous Materials Safety Administration (PHMSA), 49 CFR Parts 171, 172, 173, 174 and 179. "Hazardous Materials: Improving the Safety of Railroad Tank Car Transportation of Hazardous Materials; Final Rule," January 13, 2009. Hereafter DOT Tank Car Final Rule

[88] Based on the calculation that secondary car-to-car impact speed was approximately half of the train speed, this standard had been proposed in conjunction with the 50 mph speed limit.

[89] See Discussion in DOT Tank Car Final Rule, p. 1779.

[90] Argus Rail Business, "FRA tank car replacement rules fail to spur demand," June 22, 2009.

an impact form the FRA rule. Orders are pretty soft.... With the economy slowing down, shipments have slowed down."[91]

The final rule represented an incremental approach that was more palatable to railroad and chemical industry stakeholders. The rulemaking process highlighted the difficulty of resolving the competing interests of different stakeholders. Instead, cooperative programs such as the NGRTC could provide a valuable model for performing the research necessary to allocate long-term investments towards the more radical tank car enhancements that might do more to reduce the risk of a TIH release.

TIH Train Re-routing and Re-scheduling

The potential consequences of a TIH release depend on the severity of the accident and also on the location and time of the accident. One widely-discussed risk-mitigation proposal involves re-routing trains containing TIH tank car loads, for example, by choosing a route with less population exposure.

This risk-reduction strategy came to the fore in the midst of concern over rail security after the 9/11 attacks. TIH tank cars passing through major population centers were recognized as potential chemical weapons. Proponents of mandatory rerouting of TIH products argued that diverting trains around cities would place fewer people at risk of a terrorist attack, and would also decrease risks due to accident.

On the basis of this reasoning, in February 2005 the Washington, D.C., City Council enacted an emergency measure that banned transportation of hazardous materials within a specified "Capitol Exclusion Zone" with a radius of 2.2 miles from the U.S. Capitol.[92] D.C. Councilmember Kathy Patterson argued that, given D.C.'s high profile as a target, and a lack of appropriate federal action, it was imperative for local authorities to act. In highly publicized testimony, Dr. Jay Boris of the U.S. Naval Research Laboratory suggested a potential for enormous casualty rates if TIH were released in Washington during a daytime event that had attracted huge crowds to the Mall. Under this worst case, he estimated, there could be as many as 100,000 deaths within thirty minutes of a chlorine release near the Capitol.[93] The D.C. Council asserted that the ban would not impose an unreasonable burden on the railroad. Baltimore, Cleveland, Boston and other

---

[91] Ibid.

[92] Walt Bogdanich and James Dao, "Legislators Move to Toughen Federal Rail Oversight," *New York Times*, February 2, 2005, <www.nytimes.com/2005/02/02/national/02rail.html>.

[93] Boris presentation to D.C. City Council.

cities considered implementing similar bans, but little effort was made to identify where the rerouted shipments would go instead.

CSX Transportation, Inc., owner of the rail line passing through the District, immediately filed a motion in federal court seeking suspension of the ban. CSX argued that the city's action violated the Commerce Clause of the U.S. Constitution and was preempted by existing federal law. CSX feared that if D.C.'s ban were upheld and other cities and counties followed, it would complicate railway operations and add significant extra costs especially to HAZMAT transportation.

CSX's initial challenge was at first denied in D.C. District Court in April 2005; the judge ruled that the D.C. ban did not conflict with federal law.[94] In early May 2005, however, the U.S. Court of Appeals for D.C. reversed that decision; ruling in favor of CSX, it held that an injunction to block the D.C. ban would be permitted.[95] There was public criticism of the decision on appeal, with calls for Congress to legislate mandatory HAZMAT re-routing to keep dangerous TIH chemicals away from government targets and population centers.[96]

The goal of any re-routing strategy should be to minimize both the risk and the impact of a TIH release. There are, however, many possible means to evaluate the route. Risk could be evaluated according to parameters that include least population exposed to TIH risk, shortest route by distance, shortest route by time, or safest track quality. Complicating the issue is that these criteria may be contradictory: for example, the shortest route might expose more people to a possible TIH release, or the route that puts the fewest people at risk might be a rural track of lower quality without signals, thus increasing the potential for an accident. Therefore, choice of re-routing criteria must involve careful evaluation to determine whether new routes actually represent a significant reduction of overall risk.

Rerouting is also complicated by the nature of the rail network itself, which is far less extensive than the highway network and therefore offers fewer route options.[97] Each individual rail carrier operates mostly over its own network, which is unlikely to have

---

[94] Terrence Nguyen, "Judge rules in favor of DC HAZMAT ban," *Fleetowner.Com*, April 19, 2005, <fleetowner.com/news/dc_hazmat_ban_washington_041905/index.html>.

[95] CSX Transportation, Inc. v. Williams, United States Court of Appeals, D C. Circuit, May 3, 2005, <bulk resource.org/courts.gov/c/F3/406/406.F3d.667 05-5131.html>

[96] "Washington's Deadly Bridge," *New York Times*, July 5, 2005, <www.nytimes.com/2005/07/05/opinion/05tue1.html>.

[97] Glickman, Erkut, and Zschocke, "The cost and risk impacts of rerouting railroad shipments of hazardous materials," p. 1016.

multiple efficient routing options. Cooperation with other rail companies would provide more rerouting options; however, it would also require interchanges among carriers. Interchanges involve switching, with greater risk of accidents, and they also impose administrative costs and loss of revenue for the railroad originating the shipment. In addition to the cost and complexity, and questions about which routing choice gives the greatest safety and security for the least cost, there will remain essential industries that can only be served by using track that lead through large cities.

Rail industry opponents of rerouting proposals have argued that moving TIH cars out of cities would not necessarily reduce overall risk of an accident.[98] Most tracks running through cities are of the highest quality, and are equipped with the best signaling systems. Moving TIH cars through cities often represents the most direct route, thus minimizing the distance the TIH must be shipped. The nature of the rail network makes it very difficult for most shipments to avoid cities; shifting TIH traffic to a more rural route might require carriage over less-safe track over greater distances, and for longer time in transit. Thus, seeking to decrease the likelihood of a terrorist attack by rerouting might, paradoxically, increase the likelihood that an accident might take place (although perhaps in an area where it would have consequences for fewer people). Thus whether overall risk would be reduced would depend on the relative balance between likelihood of an accident, which might be increased by rerouting, and the likelihood that a substantially smaller population would be exposed.

Several studies have attempted to assess the opportunities for improving safety by rerouting hazardous materials (HAZMAT). The Oak Ridge National Laboratory of the U.S. Department of Energy produced a framework and a Web/GIS tool for routing HAZMAT shipments.[99] This tool, designated "THREAT" (Tool for HAZMAT Rerouting Evaluation and Alternative Transportation), searches for routes to optimize specified objectives and calculates performance measures for those routes.[100] The routing engine incorporates GIS (global information system) data illustrating rail networks, HAZMAT data on commodity movement and characteristics, population data from the census, risk functions, and other parameters to generate routing solutions and route assessments.

---

[98] AAR, "Mandatory HAZMAT Rerouting," <www.aar.org/GovernmentAffairs/~/media/AAR/PositionPapers/833.ashx>.

[99] Han, L.D., S. Chin, H. Hwang, and B.E. Peterson, "A Tool for Railroad Hazmat Routing under Shipment Bans in Major Cities," Proceedings of the 85th TRB Annual Meetings CD, Paper 06-1790, Washington, DC, 2006.

[100] Han, Chin, Hwang, and Peterson, "A Tool for Railroad HAZMAT Routing."

A 2006 case study applying this tool to various scenarios demonstrated the tradeoffs involved in re-routing and the possibility of unintended consequences of mandatory re-routing.[101] For example, a "Least Population" scenario reduced the number of people at risk, but did so with a route about twice as long in distance and time. Thus, although the population exposed in case of an accident might be diminished, the probability of an accident occurring was evidently worse. Since overall risk depends on both the probability of a release and the probable consequences of a release, the effect of such a - routing strategy on overall risk may be, at best, ambiguous.

Another rerouting analysis, conducted by Glickman, Erkut, and Zschocke, concluded however that in some cases, risk could be reduced without substantially increasing route length of shipments.[102] The authors studied alternate routes for a random selection of origin-destination (O-D) pairs, and assessed the expected number of residents exposed to the impacts of a HAZMAT release from an accident.[103] Some O-D pairs, such as the Birmingham-Providence route, offered an opportunity for risk reduction without increasing route length. Others did not. On the New York-Charlotte route, for example, an alternate route resulted in a risk reduction of 91 percent, but at the cost of a 25 percent increase in distance. The results of the study suggest that rerouting opportunities may indeed exist, but must be studied on a case-by-case basis.

The railroad industry has undertaken several TIH routing initiatives. For example, specified "key trains" carrying hazardous materials must travel on routes that are inspected at least twice per year.[104] Any track used for meeting and passing "key trains" is required to be at least Class 2.[105] Railroads prefer to route trains with TIH tank cars on

---

[101] Han, Chin, Hwang, and Peterson, "A Tool for Railroad HAZMAT Routing."

[102] T. Glickman, Erkut, E., and Zschocke, M.S., "The cost and risk impacts of rerouting railroad shipments of hazardous materials." *Accident Analysis and Prevention*, Vol. 35, Issue 5, September 2007, pp. 1015-1025.

[103] Number of residents exposed was calculated as the product of the accident rate, link length, conditional release probability, impact area, and population density.

[104] AAR Circular OT-55-I. A "key train" is defined as having: "five tank car loads of Poison or Toxic Inhalation Hazard (PIH or TIH) (Hazard Zone A, B, C, or D) or anhydrous ammonia, or; 20 car loads or intermodal portable tank loads of a combination of PIH or TIH (Hazard Zone A, B, C or D), anhydrous ammonia, flammable gas, Class 1.1 or 1.2 explosives, and environmentally sensitive chemicals, or; one or more car loads of Spent Nuclear Fuel (SNF), High Level Radioactive Waste (HLRW)."

[105] The FRA classifies track based on safety in classes 1–9. The higher the class number, the higher quality the track and the faster trains are allowed to run on that track Most freight operates on class 4 track or lower; no freight operates on tracks rated higher than class 5.

higher-quality track with better signaling systems, because this reduces risk. The dominant routing priority, however, is operational efficiency, generally determined by the shortest route. Railroads may be reluctant to shift TIH traffic away from the shortest route because such changes create both operational challenges and higher costs.

New federal regulations have signaled an increased government attention to routing. In general, the DOT has opted for a flexible approach that allows railroads considerable freedom in selecting TIH shipment routes. In a rule issued November 26, 2008, DOT explicitly declined to ban TIH movement through urban areas, acknowledging that such mandatory re-routing could potentially increase risks.[106] Instead, DOT emphasized mandatory route analyses. The new rule requires rail carriers to compile annual data on movements of explosives, TIH, and radioactive materials.[107] They must then use these data in a comprehensive assessment of safety and security risks for each route on which hazardous materials are transported, as well as possible alternate routes.[108] The rule directs that railroads use 27 specified factors as the basis for their analyses.[109] These factors include volume of HAZMAT transported, trip length for route, track type, class, and maintenance schedule, single vs. double track, proximity to iconic targets, presence of passenger traffic along route, and past incidents.[110] The rule directs that for each primary route currently used, "commercially practicable" alternatives must be identified and analyzed.[111] A practicable route is defined as "one that may be utilized by the railroad within the limits of the railroad's particular operating constraints and, further, is economically viable given the economics of the commodity, route, and customer relationship."[112] If a change in route would considerably raise costs, the rail carrier is to

---

[106] DoT, PHMSA, 49 CFR Parts 172, 174 and 209, "Hazardous Materials: Enhancing Rail Transportation Safety and Security for Hazardous Materials Shipments; Railroad Safety Enforcement Procedures; Enforcement, Appeal and Hearing Procedures for Rail Routing Decisions; Final Rules." November 26, 2008. Hereafter referred to as PHMSA, Rail Routing Final Rule, November 2008.

[107] PHMSA, Rail Routing Final Rule, November 2008.

[108] Note that the regulation appears to focus more on accident risk than on the possibility of terrorism, since a targeted terrorist act would be designed to cause maximum casualties in an urban area; routing might therefore be expected to have a greater impact on reduction of risk from terrorism.

[109] These factors are specified in Appendix D to 49 CFR Part 172.

[110] Note, however, that the volume of population exposed along a route varies with time of day: at night, with a few exceptions such as nighttime athletic events, the majority of urban populations are already "sheltering in place" at nighttime, which is a common protection strategy for a public exposed to a TIH gas.

[111] PHMSA, Rail Routing Final Rule, November 2008, 72186.

[112] For definition, see Interim Final Rule of April 2008: DoT, PHMSA, 49 CFR Parts 172, 174 and 209, "Hazardous Materials: Enhancing Rail Transportation Safety and Security for Hazardous Materials

document the supporting data for such a conclusion. Carriers must consider the use of interchange arrangements. Based on the route analyses, carriers must select routes for HAZMAT that pose the least risk, balancing all relevant factors.

Chain of Custody

In a complex supply chain, TIH products are passed from producer to railroad carrier to end-user or consumer. The railroad carrier may switch the product from one train to another or to a different rail carrier (referred to as interchange). These handoffs create vulnerabilities: unattended tank cars could be attacked; accidental leaks might not be immediately detected.

Because of these potential vulnerabilities, securing the TIH chain of custody was a focus in a TSA rule on Rail Transportation Security in November 2008.[113] The new regulations ordered shippers and carriers to undertake physical inspections to check for signs of tampering and to require documentation of all transfers. In high-threat urban areas (HTUAs) designated by the TSA, delivered cars must be kept within secure areas. The regulation specified the authority of TSA officials to inspect facilities and records relevant to rail security. Railroads, shippers, and receivers must designate rail security coordinators to serve as the primary contact with TSA, to coordinate security activities, and to report any incidents or concerns. Time limits are set within which rail carriers must provide TIH tank-car locations and shipping information to TSA.

Railroad companies instituted new measures to comply with these new documentation and control requirements for TIH rail cars. For example, Union Pacific notified customers that billing information for tank cars must be in UP's system before cars could be accepted by UP employees.[114] CSX notified customers that they would be responsible for designating secure areas at their shipping and receiving facilities.[115] CSX specified that in

---

Shipments; Railroad Safety Enforcement Procedures; Interim Final Rule and Proposed Rule." April 16, 2008, p. 20760. Under the Final Rule of November 2008, route selection procedures were to be implemented by September 1, 2009, if six months of data were analyzed, or by March 31, 2010, if data for all of 2008 were analyzed.

[113] Department of Homeland Security, Transportation Security Administration, 48 CFR Parts 1520 and 1580, "Rail Transportation Security; Final Rule" November 26, 2008.

[114] Union Pacific, "Chemical Transportation Safety Update," April 1, 2008. <http://www.uprr.com/she/cts/prevent.shtml>

[115] CSX, Letter to HAZMAT Shippers and Receivers, December 19, 2008. <http.//www.csx.com/share/customers/ch/docs/TSARegsLetter-REF24822.pdf>

HTUAs, consignees must have personnel present for hand-offs and must document all transfers.

Positive Train Control

Positive Train Control (PTC) is a collection of systems designed to increase railroad safety by overriding the engineer's control of the train in dangerous situations and automatically stopping the train. The American Association of Railroads describes the purpose of PTC as "systems designed to help prevent collisions among two or more trains, to enforce speed limits and to protect employees engaged in track maintenance."[116] A PTC system uses sensors on the locomotive and along the tracks, and then makes calculations involving the train composition (or "consist") and the terrain over which the track runs to determine when and whether to stop the train.[117]

Similar collision-avoidance train protection or control systems are already in use around the world, especially in high-speed passenger operations. However, nowhere in the world is such a system in place on a network comparable in extent and complexity to the North American rail network: its freight volumes exceed those of any other rail network in the world. Recognizing the potential safety benefits, however, Class I U.S. freight railroads (the largest by operating revenues as defined by the FRA) have been developing and testing PTC prototype systems, especially since the early 1990s.[118] In the U.S. Northeast Corridor between Washington DC and Boston, Amtrak uses a version of positive train control.[119] However, the high cost of implementing such a system over the entire U.S. rail network, combined with the technical challenges, have delayed PTC implementation in the United States.

---

[116] AAR, "Positive Train Control: Frequently Asked Questions," <www.aar.org/Initiatives/PositiveTrainControl/PTC_FAQ.aspx>.

[117] Positive Train Control could be complemented by electronically-controlled pneumatic (ECP) brakes, which are simultaneously activated along the entire length of the train by an electric signal. This would allow the train to stop much faster: between 40 percent and 60 percent more quickly for a long train. ECP brake systems are also considered to be more reliable and less subject to failure. However ECP brakes are incompatible with conventional brakes; an FRA official has estimated that it would cost around $6 billion to retrofit the entire North American freight car fleet for ECP brake operations. See U.S. DOT, 49 CFR Part 232, "Electronically Controlled Pneumatic Brake Systems; Final Rule," October 16, 2008, p. 61513.

[118] Peter A. Hansen, "6 high-tech advances," *Trains,* November 2008, p. 29.

[119] See description of ACSES (Advanced Civil Speed Enforcement System), the Positive Train Control system installed on Amtrak's Northeast corridor, at <www.alstomsignalingsolutions.com/OurProducts/PositiveTrainControl/ACSES/>.

The recent catalyst for PTC was the collision of a Metrolink commuter train with a Union Pacific freight train on September 12, 2008, in Los Angeles, California, which resulted in 25 deaths and over 130 injured. The accident appears to have been caused by the Metrolink engineer's failure to respond to a stop signal, resulting in collision with the incoming freight train which had not yet entered a siding to let the commuter train pass by.[120] This accident prompted legislation that was signed into law on October 16, 2008.[121] The Rail Safety Improvement Act of 2008 (RSIA) required all Class I railroads (the largest) and all intercity passenger and commuter railroads to implement a PTC system by December 31, 2015, on main line track carrying either passengers or TIH materials.[122]

The implementation of PTC in the United States involves significant practical challenges. First, effective PTC requires interoperability among all major railroads, since locomotives from one railroad often operate over the tracks of another railroad. The four U.S. Class I freight railroads promptly agreed on interoperability standards in October 2008.[123] Second, PTC is not an "off-the-shelf system": significant components of the technology must be designed, tested, and adapted for the specific operating environments of the rail lines on which they are installed. The final major obstacle is cost, including a large investment in new technology. The FRA estimated that industry-wide costs might range from $2.3 to $5 billion,[124] with most of this cost borne by the private Class I railroads.

While PTC will not eliminate rail accidents, it should represent a safety improvement that could help reduce the risk of all rail accidents, including those involving TIH.

Hours of Service Regulations

TIH accidents at Graniteville and Macdona raised questions about the hours-of-service regulations that govern rail labor. At Graniteville, a crew running up against a time limit

---

[120] Jennifer Steinhauer and Michael Cieply, "Rail Line Says Train Ran Signal; Death Toll at 25," *New York Times*, September 13, 2008, <www.nytimes.com/2008/09/14/us/14crash.html>.

[121] Rail Safety Improvement Act of 2008 (RSIA), full text and bill summary, <www.govtrack.us/congress/bill.xpd?bill=h110-2095>.

[122] Main line track is track over which 5,000,000 gross tons or more of annual traffic is transported. These requirements are defined in the legislation and are subject to further specification by the FRA.

[123] AAR press release, "Four Biggest U.S. Railroads Committed To PTC Interoperability," <www.aar.org/Initiatives/PositiveTrainControl/PTC_Interop/PTC_Interop1.aspx>. The four largest U.S. railroads are: Union Pacific, Burlington Northern Santa Fe, Norfolk Southern Corporation, and CSX.

[124] AAR, "Positive Train Control: Frequently Asked Questions."

failed to perform its duties adequately, creating the conditions that led to the accident. At Macdona, the NTSB concluded, fatigue impaired a crew's ability to operate its train safely, and the crew missed stop signals, which led to the collision. The circumstances were very different, but both demonstrate the importance of designing hours-of-service regulations that create the right incentives for safety. Hours of service rules are the product of lengthy negotiations between rail management and labor, and are subject to stringent regulation by the government.[125]

Hours-of-service regulations were among the main focuses of the Rail Safety Improvement Act (RSIA) of 2008. According to the new requirements, an employee cannot be required to be on duty:

1. Where the employee has spent in any calendar month a total of 276 hours on duty … or in another mandatory service for the carrier;

2. for more than 12 consecutive hours; or

3. unless the employee has had at least 10 consecutive hours off duty during the previous 24 hours.[126]

An employee may not be required to remain or go on duty without specific regular periods of extended rest at his or her home terminal. The employee may not spend more than 15 hours on duty and waiting for transportation, except in case of an accident or equipment failure. Hours of service regulations are also implemented for signal employees, contractors, and subcontractors.[127]

Tank Car Position in Consist

Train cars in an accident are subjected to complex and dynamic forces, which are affected by a car's position in relation to the point of impact, collision, or derailment. It would clearly be desirable to position cargoes that have the highest potential danger at the point where crash forces are weakest, but there is no consensus over what the safest position in a train consist is for hazardous materials.

---

[125] The original Hours of Service Act was enacted by Congress in 1907 and has been modified many times.

[126] "H.R. 2095: Rail Safety Improvement Act of 2008 — Congressional Research Service Summary," <www.govtrack.us/congress/bill.xpd?bill=h110-2095&tab=summary>.

[127] Railroads and their employees are allowed to submit alternate hours-of-service regimes to the FRA for approval.

The NTSB has argued that TIH tank cars should be positioned at the rear of trains, based on a 1992 FRA report, "Hazardous Materials Car Placement in a Train Consist," which concluded that the rear quarter of the train had a lower probability of damage in an accident.[128] The NTSB accident report on Graniteville concluded that, "Had the chlorine cars been placed behind the other loaded cars in the train, the reduction in the trailing tonnage would have reduced the impact forces on the tank cars."[129]

The railroads, however, do not accept the argument that the rear quarter of the train is safer. They argue that regulations on placement of TIH cars within the consist would have the effect of increasing the amount of train handling and car coupling and decoupling, which present risk. The railroads emphasize procedures that minimize TIH tank car handling. Given the lack of agreement, there is little momentum for activity by regulators on this front.

Emergency Response

The consequences of accidents or of deliberate attacks involving shipments of TIH materials depend in part on the effectiveness of efforts by first responders such as emergency medical services (EMS), fire, police and others local officials, as well as railroad personnel on the scene. A well informed, adequately equipped, and effectively executed response can limit the scope of property damage and the loss of life. Response strategies might include containing exposure through patching, flooding the area with water, leading evacuation efforts, or encouraging shelter in place. The presence of an effective response capacity might also deter terrorist attacks, by making it clear that the amount of harm that could be achieved is limited.[130] In some instances, ineffective emergency response can actually make things worse; calling for sheltering in place or evacuation when the opposite strategy would be the best course of action can needlessly place populations at risk. Developing capacities for effective emergency response to TIH release is a form of resilience and risk mitigation that could help to reduce the overall scope of the externality associated with the transportation of TIH materials.

---

[128] R.E. Thompson, E. R. Zamejc, and D. R. Ahlbeck, *Hazardous Materials Car Placement in a Train Consist*, Vol 1. *Review and Analysis*, Report DOT/FRA/ORD/18.I (Washington, D.C : Federal Railroad Administration, U.S. DOT, 1992).

[129] NTSB Report—Graniteville

[130] Research and Special Projects Administration, Office of Hazardous Materials Safety, Department of Transportation, and John A. Volpe National Transportation System Center, *The Role of Hazardous Materials Placards in Transportation Safety and Security* (2003), p. iii.

The challenges of responding to a TIH incident have been on the public agenda since at least the early 1900s. A number of serious rail accidents involving the transportation of dangerous materials during this period spurred wide-spread concern and led the railways to create, in 1907, the bureau of explosives (BOE); federal controls were established a year later under the authority of the Interstate Commerce Commission (ICC).[131] Since the terrorist attacks of September 11, 2001, railroads, chemical manufacturers, and government renewed efforts to help ensure that local communities can quickly and effectively respond to a TIH incident. These efforts have expanded the abilities of emergency responders and helped to reduce the risk associated with the transportation of TIH materials, but there are still areas where public policy could do more to improve emergency response.

The transportation of shipments across a freight rail network comprising 140,000 miles of track creates difficult challenges for emergency response and planning.[132] TIH shipments travel across jurisdictions throughout the nation, along routes that are not usually specified ahead of time.[133] An unanticipated release could happen in many unexpected locations along the transportation route. Even communities without chemical facilities must be prepared to respond to a TIH incident. Thus, while rail security and safety is a national issue, initial response is a local activity.

The federal government, the chemical industry, and the railroads support local first responders through regulations, support for training, funding, and quick-response networks. Generally, federal law preempts local and state statutes governing the transportation of hazardous materials.[134] Federal law directs levels of training and response planning at the local and state level. It also requires clear markings on shipments of hazardous materials.[135] Federal legislation in 1986 directed the creation of local emergency planning committees (LEPCs) and state emergency planning committees (SEPCs) to develop plans and provide coordination for response to emergencies.[136]

---

[131] Transportation Research Board, *Cooperative Research for Hazardous Materials Transportation: Defining the Need, Converging on Solutions* (Washington, D.C.: National Academies Press, 2005), p. 24.

[132] Transportation Security Administration, *Freight Rail Modal Annex*, 2007, <www.tsa.gov/assets/pdf/modal_annex_freight_rail.pdf>, p. 2.

[133] Association of American Railroads, "HAZMAT Transport by Rail," 2008 p. 4.

[134] Transportation Research Board, *Cooperative Research for Hazardous Materials Transportation*, p. 34.

[135] Marking hazardous shipments could increase the vulnerability to intentional disruptions or acts of terrorism, an issue discussed below.

[136] Title III of the Superfund Amendment and Reauthorization Act of 1986 (SARA), also known as the Emergency Planning and Community Right-to-Know Act. See Linda-Jo Schierow, "The Emergency

Labor Department regulations in conjunction with professional organization guidelines spell out obligations of first responders and mandate minimum levels of training.[137] Within the Department of Labor, Occupational Safety and Health Administration (OSHA) regulations define the minimum levels of training for first responders that may deal with hazardous materials. Recently, the National Fire Protection Organization (NFPA), a professional organization representing a significant portion of the first responder community, revised its guidelines interpreting the applicability of OSHA regulations in order to incorporate HAZMAT/WMD planning.[138] This revision responded to the suggestion that current interpretations of the baseline levels of competency were set too low to address the possible threat of terrorism and did not assure adequate first response capabilities.[139] NFPA guidelines now recommend that all fire, EMS, and other individuals who may be called to respond to a toxic incident are trained at the "operations" level, as defined by OSHA regulations. Previously, NFPA guidelines recommended that first responders be trained at the more basic "awareness" level in order to satisfy OSHA regulations. This revision in the interpretation of the applicability of OSHA regulations is a potentially significant change that supports a higher level of training and readiness for all first responders.[140]

The federal government, and the chemical and railroad industries, support and provide training programs for first responders and their own personnel.[141] Examples include CHEMTREC, the Chemical Transportation Emergency Center, which is supported and founded by the American Chemistry Council; the Transportation Technology Center (TTC), which is operated by the Association of American Railroads; and TRANSCAER (Transportation Community Awareness and Emergency Response), which is supported by the chemical and transportation industries and the emergency response community.

A variety of federal grants and programs help offset some of the costs of specialized training and equipment devoted to hazardous materials. Since 1990, DOT's Hazardous

---

Planning and Community Right-to-Know Act (EPCRA): A Summary," Congressional Research Service (CRS) Report RL32683, 2007.

[137] See 29 CFR 1910.120(q)(6); National Fire Protection Association (NFPA). *NFPA 472: Standard for Competence of Responders to Hazardous Materials/Weapons of Mass Destruction Incidents*, 2008.

[138] NFPA 472.

[139] See Steven Bell, "Current Issues in Transportation of Hazardous Materials," Hearing before the U.S. House of Representatives, Subcommittee on Railroads of the Committee on Transportation and Infrastructure, June 13 2006.

[140] See Gregory Noll, "NFPA 472," *NFPA Journal*, March/April 2008.

[141] See <www.phmsa.dot.gov/HAZMAT>.

Materials Emergency Preparedness Grant Program provided $182 million in HMEP grants to states and territories for the development of response plans, training, and purchase of specialized equipment.[142] Additionally, FEMA distributed over $2. 4 billion through the Assistance to Firefighters Grant (AFG) program since the inception of the program in 2001.[143] These grants are offered annually to support firefighters and EMS first-responder activities, with highest priority on those activities that support response to chemical, biological, radiological, nuclear, and explosive (CBRNE) threats.[144] Yet despite ongoing support, as of April 2008 only 16.4 percent of U.S. fire departments had specialized HAZMAT teams.[145]

DOT regulations also support first responders. DOT regulations[146] require that shippers of hazardous materials provide accompanying information (in the form of both external placards and markings, as well as on shipping papers) about the type of material transported, the quantity, and a 24-hour emergency contact number that connects to a person informed about the hazardous material being transported and appropriate emergency response measures.[147] These regulations are critical to first responders. First responders are often initially alerted to the presence of a dangerous material through color-coded placards or other labels that are required by DOT regulations. Additionally, 24-hour hotlines operated by CHEMTREC and TRANSCAER supply first responders with emergency contact information and technical support. At the federal level, the National Response Center (NRC) coordinates between federal entities in the event of an accident involving hazardous materials and supplies support to on-site authorities.[148] The

---

[142] HMEP grants are paid for by fees collected from shippers and carriers of hazardous materials. PHMSA, Hazardous Materials Emergency Preparedness (HMEP) Grants Program Fact Sheet.

[143] DHS. "America's Firefighters to Receive $485 Million in Grants." October 6, 2006. <http://firegrantsupport.com/docs/media06_061006.pdf>.

[144] Department of Homeland Security, Notice of Guidelines, *Federal Register*, Vol 73, No. 50, March 13, 2008, p. 13555.

[145] See U.S. Fire Administration website, <www.usfa.dhs.gov/applications/census/summary.cfm#table1>. See also National Research Council, *Terrorism and the Chemical Infrastructure*, p. 53.

[146] 49 CFR 172.

[147] Transportation Research Board, *Cooperative Research for Hazardous Materials Transportation*, pp. 67–68.

[148] The National Response Center (NRC) is the federal point of contact for reporting oil, chemical, radiological, biological, and etiological discharges. The NRC coordinates response actives between multiple federal entities and on-scene authorities. <www.nrc.uscg.mil/>.

chemical industry, through CHEMNET, and many railroads also field rapid-response teams to support on-site activities by responders at the local, state, and national levels.[149]

The efforts just described largely focus on the unique demands of hazardous material incidents, but effective emergency response also requires more general health and safety capabilities. Neglecting the broader challenges facing this infrastructure while focusing narrowly on ways in which HAZMAT response is novel could hamper the ability of local officials to respond to a TIH release. In addition, there is a potential for reducing overall safety and security if steps taken to counter the threat of terrorism raise the risk of accident, or vice versa.

The threat of terrorism creates responsibilities and burdens for first responders. The re-designation of first responders at the "operations" level, for example requires a greater commitment to specialized training and equipment.[150] This creates new burdens at a time when funding for many basic fire and EMS services is lacking. Devoting resources to preparing for low-probability events such as TIH incidents and terrorism diverts resources from challenges that may be more pressing. Federal programs and industry support offset some of these costs, but significant budgetary constraints at the local level mean that preparations for unlikely scenarios may be difficult to sustain and justify when support the general operations of first responders is lacking or inadequate.[151] Without support for general operations, first responders will be under pressure to divert funds that are earmarked for specialized requirements, and to neglect those requirements. Providing general support for first responders, then, is an important component of addressing the unique challenges of transporting TIH materials.

Responding to the unexpected and fast-moving challenge of a TIH release involves special demands. A key challenge for first responders is to determine whether and how to direct nearby residents to shelter in place or to evacuate.[152] Determining which option is best requires expertise and simulation tools to synthesize a raft of data, including

---

[149] Transportation Research Board, *Cooperative Research for Hazardous Materials Transportation*, p. 69.

[150] Equipment may be relatively cheap and simple, such as a drum handling tool, or expensive and sophisticated, such as advanced robotics. USFA, *Hazardous Materials Response Technology Assessment*. HAZMAT imposes specialized response conditions; for example, sometimes response must be delayed so that environmental conditions can be assessed remotely before first responders arrive on the scene. Bell, "Current Issues in Transportation of Hazardous Materials."

[151] Budgetary constraints are a perennial challenge for local fire services, sometimes forcing cuts or reductions in basic services. USFA, "Introduction," *Funding Alternatives for Fire and Emergency Services*, 2000, <www.usfa.dhs gov/downloads/pdf/publications/fa-141.pdf>.

[152] National Institute for Chemical Studies, "Sheltering in Place as a Public Protective Action," 2001.

information about the material released, current meteorological conditions, and the topography of the exposed area. Advances in dispersion modeling, such as recent work undertaken by the U.S. Naval Research Laboratory, suggest that it may soon become possible to provide emergency responders with near-real-time predictions for the spread of a release of TIH through a complex urban environment.[153] The availability of such information could help emergency responders assess the rapidly evolving conditions of a TIH incident and advise the public accordingly. Such services might also speed up response time by providing essential meteorological data much faster.

Such technologies, to be effective, require "dual-use" tools applicable to a much broader range of circumstances, including effective public channels of communication and an extensive and continuing program of public education. Working and accessible emergency communication systems, including reverse 9-1-1 systems, sirens such as those used in tornado warning and civil defense, and the federal Emergency Alert System (EAS) are indispensable to ensuring that essential directions are received by the public. The Emergency Alert System, which relies on broadcasters and cable outlets, among others, to distribute instructions, failed during the derailment and ammonia release in Minot, ND in 2002, which hampered response efforts.[154] Developing and implementing sophisticated real-time simulation technologies is inadequate without devoting resources to maintaining other tools, such as channels of communication, and assuring that hospital staffs and facilities can handle the surge in patients and "worried well" that may result in the wake of TIH incident.[155]

The general challenges of emergency response thus intersect in many ways with the specific needs of HAZMAT response. Efforts to create an emergency response capacity for the unique features of a TIH incident also require a robust general response infrastructure.

In addition to new simulation tools, pre-notification and educational efforts directed toward at-risk populations can also reduce response times.[156] Pre-notification can reduce

---

[153] Describing recent advances in simulation technology and how it can be usefully applied to unexpected releases of TIH is Boris, "The Threat of Chemical and Biological Terrorism."

[154] Jack Shafer, "What Really Happened in Minot, N D.?" *Slate*, January 10, 2007 <www.slate.com/id/2157395/>.

[155] National Research Council, Committee on Science and Technology for Countering Terrorism, *Making the Nation Safer: The Role of Science and Technology in Countering Terrorism* (Washington, DC: National Academies Press, 2002), pp. 127-131.

[156] On the importance of pre-notification and education in the context of a large-scale release within a densely populated area, Transportation Security Administration, "Proceedings of the May 28, 2008

the lag between initial notification and response through the coordination of TIH information with local emergency services. Local emergency responders and 9-1-1 services should be knowledgeable about the frequent types and locations of TIH shipments in their community before an incident occurs.[157] They should also have quick access to specific information concerning the presence of TIH shipments within a community that can be accessed as fragmentary reports are first coming into 9-1-1 operators. Doing so will allow emergency responders to quickly identify a possible TIH incident before arriving on scene and shorten the window for identifying which TIH material has been released.[158] During a release in a densely packed area, however, those in the immediate vicinity will have to take action before professional responders arrive on the scene. Educational outreach efforts targeting communities near chemical plants and rail yards that serve as hubs for TIH material describing how to properly shelter in place can be instrumental in mitigating the damage from a release.[159]

Wide distribution of information concerning the movement of TIH materials supports safety measures that are designed to limit the number of accidents and ensure effective response. Yet there are concerns that the availability of such data potentially undermines security, by providing terrorists with information that could be used to launch an attack. The tension between safety and security is evident in recent debates concerning the appropriate identification of hazardous materials.

Placards to identify hazardous materials are communication tools that are easy to understand and are recognizable by the first responders and workers that handle over 1.2 million hazardous materials movements daily.[160] However, the same qualities that makes such placards useful — their simplicity and accessibility to observers — may also facilitate attacks, by assisting terrorists in identifying TIH tank cars.[161] DOT and DHS recently examined alternative measures, such as radio frequency identification tags (RFIT), or operational alternatives such as armed escorts. However, the high cost of new

---

Chicago-Area TIH Materials Emergency Response & Preparedness Roundtable," Version 1.1, Sept. 14, 2009.

[157] Ibid.

[158] Ibid.

[159] Ibid.

[160] DOT and Volpe Center, *The Role of Hazardous Materials Placards*, p. 8.

[161] A DOT study concluded that placards would not supply enough information to terrorists to facilitate a significant attack. Ibid. p. iii.

investments in technology and training were judged to offer only marginal benefits, and these alternatives were dismissed.[162]

Product Substitution and Supply Chain Management: "Inherently Safer Technologies"

The most desirable solution in preventing chemical releases is to reduce or eliminate the hazard where possible, not to control it. This can be achieved by modifying processes where possible to minimize the amount of hazardous material used, replace a hazardous substance with a less hazardous substitute, or minimize transportation by co-locating production and use.[163] Product substitution and supply chain reorganization address the risk associated with the use and transportation of toxic chemicals at the source. These strategies are often grouped together under the rubric of "inherently safer technologies" (ISTs).[164] However, product substitution and supply chain reorganization are contentious issues that present significant political, economic, and technical barriers to implementation.

There have been many recent calls on the federal government to support the development and adoption of ISTs. In addition to the recommendation of the National Research Council, environmental groups such as Greenpeace and the Environmental Defense Fund have publicly declared their support for an active federal role mandating the use of ISTs in certain cases.[165] Security experts note that there is a need for government to provide incentives to encourage businesses to develop and adopt ISTs that would otherwise be economically unfeasible.[166] The railroad industry supports the promotion of ISTs as a

---

162 Ibid. See also "Department of Homeland Security Announces Support for Rail HAZMAT Placards." April 8, 2005, <www.dhs.gov/xnews/releases/press_release_0655.shtm>.

163 National Research Council, *Terrorism and the Chemical Infrastructure*, p. 106.

164 "Inherently safer technologies" may include a broad range of strategies, including product substitution and supply chain redesign. Senate Bill 1602, introduced in the 107th Congress, for example, defined ISTs broadly to include processes that limit or reduce the use, storage, and transportation of toxic chemicals through process redesign and simplification, product reformulation, or input substitution

165 Rick Hind (Greenpeace), Testimony before Committee on Homeland Security, Subcommittee on Transportation Security and Infrastructure Protection, December 12, 2007. Carol Adress (Environmental Defense Fund), Testimony before Senate Committee on Homeland Security and Government Affairs, July 13, 2007.

166 Report 109-332, "Report to Accompany Chemical Facility Anti-Terrorism Act (S. 2145)," U.S. Senate Committee on Homeland Security and Governmental Affairs, 2006, p. 9.

way of solving its problems with transporting dangerous TIH materials.[167] At the Congressional level, proposed legislation would provide some support for ISTs, ranging from making their use mandatory, to requiring review of the possibilities of their use.[168] At the state and local level, a number of efforts have been undertaken to support the use of ISTs.[169]

However, the chemical industry opposes legislation that would lead to greater implementation of ISTs.[170] Chemical industry critics object to any federal role in promoting ISTs to achieve safety and security.[171] A related objection questions whether regulations should be considered within the sphere of environmental law or of national security.[172] John Chamberlin, Corporate Security Manager, Asset Protection for Shell and a representative of the American Petroleum Institute, testified that he was: "strongly oppose[d] to any environmental mandates for inherently safer technology pursued under the guise of security."[173] This argument fails to acknowledge that the government has responsibility both for national security as a military matter, and for homeland security, assuring the well-being of the public.

The success of regulatory support for "inherently safer technologies" is uncertain and remains mired in ongoing disputes between advocates and opponents of ISTs.[174] However, the argument about the merits of specific ISTs is separate from question of

---

[167] American Association of Railroads, Statement for the Record to the U S. House of Representatives Committee on Homeland Security, Subcommittee on Transportation Security and Infrastructure Protection, December 12, 2007.

[168] Senate Bill 1602, the Chemical Security Act of 2001, and Senate Bill 2486, the Chemical Safety and Security Act of 2006, both supported the adoption of ISTs.

[169] Dana Shea and Todd Tatelman, "Chemical Facility Security: Regulation and Issues for Congress," Congressional Research Service, Report RL 33847, 2008, p. 8.

[170] Jacob Schlesinger and Thaddeus Herrick, "Delayed Reaction: Chemical Manufacturers Elude Crackdown on Toxic Materials," *Wall Street Journal,* May 21, 2003; Shea and Tatelman, "Chemical Facility Security."

[171] Report 109-332, "Report to Accompany Chemical Facility Anti-Terrorism Act."

[172] Paul Rosenzweig, "The Chemical Security Act: Using Terrorism as an Excuse to Criminalize Productive Economic Activity," Heritage Foundation Executive Memorandum no. 833, September 12, 2002, <http://www.heritage.org/Research/HomelandSecurity/em833.cfm>

[173] Report 109-332, "Report to Accompany Chemical Facility Anti-Terrorism Act," p. 16.

[174] Bruce Alpert, "Chemical Security Bill Wins Nod from House: Industry May Press Battle in Senate," *The Times-Picayune,* November 7, 2009, < http://www.nola.com/news/t-p/capital/index.ssf?/base/news-7/1257576020228640.xml&coll=1>.

what kinds of policies should be established that will induce firms to use them. All things begin equal, it is usually preferable to establish incentives to develop and use ISTs rather than creating a mandate to use specific technologies, because with incentives, research investments may discover ISTs that are both more effective and lower in cost than those now in use.

Critics and proponents of federal support for ISTs agree that, at present, significant technological and economic barriers prevent the large-scale elimination of the use of toxic chemicals. In some cases, alternatives simply do not yet exist, while in other instances, the costs of substitution are judged to be prohibitive.[175] For example, there are a number of alternatives to the use of chlorine gas in water treatment, such as processes that use ultraviolet light and sodium hypochlorite. However, as the chemical industry points out, there are far fewer alternatives to the use of chlorine in the production of plastics.[176]

The cases of chlorine and ammonia illustrate the possibilities and limitations of substitution and supply chain reorganization. The two chemicals present different challenges based on the nature of the products and the industries within which each is used, the alternatives available, and the costs of conversion. The case of chlorine reveals some conditions under which substitution or changes in the supply chain are both feasible and desirable. For example, swimming pools can be equipped with chlorine generators that electrify salt into chlorine, eliminating the need for chemicals that are typically manufactured regionally from long haul shipments of chlorine gas. Although the volumes involved may be relatively small, this kind of initiative illustrates the potential for incremental steps to reduce transportation of TIH. Usage and distribution of ammonia, by contrast, illustrates some of the challenges, as detailed below.

One of the most common uses for chlorine gas has been in purification of drinking water and wastewater.[177] In comparison with other industrial processes using chlorine gas, purification offers significant scope for potential substitution. Over the past decade, some

---

[175] National Research Council, *Terrorism and the Chemical Infrastructure*, p. 7.

[176] Benjamin Brodsky, "Industrial Chemicals as Weapons: Chlorine," Nuclear Threat Initiative Issue Brief, 2007, < http://www.nti.org/e_research/e3_89 html> See, however, "Clorox to Halt Use of Chlorine at Bleach Production Sites."

[177] Since 1999, all facilities using over 2,500 lbs of chlorine are subject to the Environmental Protection Agency's Risk Management Program (RMP) guidelines. The 2002 Bioterrorism Preparedness Act imposed additional security and safety obligations on all drinking water facilities (but not wastewater), requiring that all drinking water facilities serving over 3,300 people must prepare vulnerability assessments.

water facilities have begun to employ less-toxic methods of operation.[178] Sodium hypochlorite (NaOCl, a form of liquid bleach), ultraviolet light, ozone, and bleach generated on-site are some of the alternatives to chlorine gas.[179] Since 1999, at least 114 wastewater plants and 93 drinking water facilities have adopted less acutely toxic chemicals.[180] A 2006 survey of over 200 of the nation's largest wastewater utilities, serving roughly 25 percent of the U.S. population, found that less than half currently use chlorine gas, and an additional 10 percent plan to convert to a less toxic process in the near term.[181] A survey of facilities that recently converted from chlorine to an alternative found that initial conversion costs ranged from slightly over $600,000 to $13 million, depending on what new form of disinfection is used, the size of the facility, and building costs.[182] Liquid bleach generally costs the least, in terms of conversion and annual supply costs, compared to other alternate forms of disinfection. Switching to an alternative method in some instances actually projected to be cost-neutral or even produced a net savings in the long term.[183] The regulatory and reporting costs associated with handling large amounts of chlorine gas, for example, can be eliminated by switching to an inherently safer technology. Nonetheless, over 2,800 water facilities still use quantities of toxic chemicals that require reporting under the risk-management planning requirements of the Clean Air Act.[184]

---

[178] Claudia Copeland, "Terrorism and Security Issues Facing the Water Infrastructure Sector," CRS Report RL32189, 2008, p. 5.

[179] Orum, *Preventing Toxic Terrorism*, pp. 10–11; Government Accountability Office (GAO), "Securing Wastewater Facilities: Costs of Vulnerability Assessments, Risk Management Plans, and Alternative Disinfection Methods Vary Widely," March 2007, pp. 5-6.

[180] Orum, *Preventing Toxic Terrorism*, p. 10. "Despite these improvements, approximately 1,150 wastewater facilities and 1,700 drinking water plants [still use] extremely hazardous chemicals, primarily chlorine gas." Ibid.

[181] GAO, "Securing Wastewater Facilities: Utilities Have Made Important Upgrades but Further Improvements to Key System Components May Be Limited by Costs and Other Constraints," March 2006, pp. 2-5, 15-16.

[182] GAO, "Securing Wastewater Facilities. Costs of Vulnerability Assessments, Risk Management Plans, and Alternative Disinfection Methods Vary Widely," p. 13.

[183] Ibid

[184] Copeland, "Terrorism and Security Issues Facing the Water Infrastructure Sector," p. 5. Any facility that stores over 2,500 lbs of chlorine gas must submit risk management plans to the EPA. GAO, "Securing Wastewater Facilities: Utilities Have Made Important Upgrades but Further Improvements to Key System Components May Be Limited by Costs and Other Constraints," March 2006, p. 9.

Anhydrous ammonia, which is used in fertilizer and other applications, presents a different set of challenges. Because there are many forms of fertilizer, there are numerous potential alternatives to direct application of anhydrous ammonia, including other nitrogen-based fertilizers, phosphorous-based fertilizers, and potassium-based fertilizers.

However there are numerous economic and logistical challenges to replacing anhydrous ammonia. It has a much higher nitrogen content than other fertilizers, so it is a more cost-effective option for farmers. Ammonia is also an input for other nitrogen-based fertilizers, such as nitrogen solutions or urea, as well as phosphate fertilizers. Agriculture industry advocates assert that, "the current level of crop production in the U.S. could not economically be sustained without the use of ammonia."[185] Anhydrous ammonia is the only commercial fertilizer that can be effectively applied to crops in the fall.[186] Thus, it is argued, any fertilizer substitutes for anhydrous ammonia would be required in greater volumes, at greater cost, and with a high impact to farmers. Substitution of ammonia in industrial processes would likely be even more complicated.[187]

If external costs due to transportation hazards are not incorporated into the price, the feasibility of substitution of other fertilizers for anhydrous ammonia will depend on trade-offs between the resulting safety improvements and the potential loss of convenience and additional costs of alternatives to ammonia. The two sides in the debate over the potential for substitutions for ammonia appear to be very far apart. A federal push to reduce ammonia consumption might only be successful if significant subsidies to alternative products are offered. It may be more efficient to focus efforts on extending the pipeline network and promoting pipeline transportation of ammonia in order to decrease shipments by rail and truck.

---

[185] "Statement on Behalf of Fertilizer Institute by Joe Giesler, Terra Industries, before PHMSA and FRA, Public Meeting on Safe Transportation of Hazardous Materials to Address the Safe Transportation of Hazardous Materials in Railroad Tank Cars," p. 181.

[186] "Testimony of Robert Felgenhauer and Supplemental Written Submission on behalf of the Fertilizer Institute, Before the STB, EP 677, Common Carrier Obligation of Railroads."

[187] Giesler Statement before PHMSA and FRA.

V. Policy Options and Assessment

TIH stakeholders have taken some important initiatives to reduce the risks of a breach of TIH safety or, to a lesser degree, a breach of security, and to minimize the negative impacts if a release does occur. However, the actions taken have generally been uncoordinated and have focused on objectives of specific stakeholders. Such an approach is likely to lead to suboptimal outcomes. For example, improved tank car design without product substitution might reduce the probability of a release if there is an accident or terrorist attack, but does not address the underlying dangers of shipping such hazardous materials. Similarly, creating a fund to pay for catastrophic damage due to a TIH release does nothing to improve safety and security of the TIH supply chain. Successfully tackling the TIH issue requires a more coordinated set of policies that address the volume of TIH moved, the safety and security with which they move, effective responses to a release, and mechanisms to limit or share liability where appropriate and to compensate victims when needed.

Such a comprehensive and coordinated response must take into account the following key factors:

- the risks to the public and to all elements of the supply chain from a TIH release;
- the importance of TIH products to the economy;
- the externalization of the costs of TIH risk;
- the distribution of interest and accountability among numerous industries, including rail, chemical, agricultural, and water treatment entities;
- the difficulties of quantifying a low-probability, high-consequence TIH event;
- the inestimable possibility of an accident or terrorist act releasing TIH material;
- the large number of variables in any prediction of damage;
- the large geographic area requiring protection;
- the variety of costs and benefits of substituting safer products;
- the cost and uncertainties involved in planning appropriate capabilities and emergency responses;

- the difficulty of coordinating approaches by a broad range of governmental regulators, each of whose responsibility is somewhat isolated (or "stovepiped") from the rest.

Approaches used to address other types of externalities provide some guidance; environmental externalities, in particular, have many close analogies to TIH. Legislative, regulatory, activist, and business interests have come together to craft many solutions to environmental problems that may delight few, but are acceptable to most, and taken together have had strong positive effects. They offer some lessons that are relevant for addressing TIH:

- All stakeholders need to be at the table; each must "give and get."
- Regulatory authority must be clear and, if not focused in a single organization, must be consistently coordinated.
- Economic incentives influence business and consumer decision making.
- Taxes, broadly defined include government levies or industry fees, can be an effective tool to internalize external costs into the price of goods and services.
- Markets can be effectively used to cap and trade external costs.
- Operating practices and technology can be used to minimize external costs.
- A well-designed set of actions can lead to successful outcomes for business and society.

Policy solutions should be guided by clearly stated principles to ensure that they are effective, cost-efficient, and acceptable. The guiding principles we propose are:

- Policy solutions should recognize the risk of TIH carriage as an externality, and should aim to incorporate external costs into the cost of TIH products and their transportation.
- There is no single solution; instead, a menu of policies aimed at reducing risk and consequences should be adopted, such as:
    - product substitution by chemical users,
    - relocation of production, to reduce the need for transportation and resulting exposure,

- improvements in rail safety, such as better tank car design, and
- operational changes in TIH transport, including routing and timing of shipments and other security measures.

- Unintended consequences should be part of the assessment of policies that appear to optimize the safety of the parties and the public while minimizing costs. For example, attempts to internalize the TIH externality through higher rail transportation prices could lead to the diversion of TIH transport to trucks and other modes that are actually less safe.

- To the extent practical, solutions should allow markets to allocate accountability equitably, effectively, and with incentives for all of the parties to invest in mitigation of consequences of accidents.

- The interests, financial and otherwise of all of the stakeholders and all elements of the supply chain — TIH chemical producers, railroads transporting TIH, producers of TIH tank cars, industrial consumers of TIH chemicals, and first-responder institutions — in the management and financing of externalities associated with TIH production, transport, and use must be taken into account when safety policies are made.

- Regulatory authority should be as clear and concentrated as possible to simplify policy creation and enforcement.

- Participation by the government is particularly necessary for assessment and mitigation of the risk of terrorist attack, because the consequences of a well-planned and executed attack, however improbable, could far exceed those of TIH accidents. The resulting financial burden would require a special role for government, because private insurance would be inadequate.[188]

---

[188] Mitigation of the terrorism threat has been discussed above in each of the relevant sections: rerouting shipments, avoiding large concentrations of people potentially exposed, investments in faster, technically trained and equipped response capability, and public training sufficient to save significant numbers of lives. While most of these steps are to some degree cost-justified as protections of the public from accidental releases, for such steps to be sufficiently rigorous to prevent massive loss of life from a terrorist attack would require very large government and private investments, especially since one cannot know in advance what cities might be targeted. Using $10 million per life saved as a criterion, the analysis by Barrett shows that an effective degree of mitigation from a successful terror attack would be greater than this threshold. See Barrett, "Mathematical Modeling and Decision Analysis for Terrorism Defense."

Taking these principles into account, we recommend four approaches by which Congress and federal regulators should create incentives, funding, and mandates to address the TIH challenge:

- internalizing external costs, and creating a fund for claims;
- improving supply chain operations;
- enhancing emergency response; and
- focusing regulatory authority.

We discuss each in turn in the last part of this paper.

Internalize External Costs and Create a Fund for Claims

A key obstacle to minimizing the risks of TIH products is that the external costs of risk are not included in the decision making process of the supply-chain participants. Since there are in many cases products or processes that can substitute for TIH materials, increasing the price of TIH products by incorporating the costs of risk should lead to less TIH usage. Thus, the first action recommended is that the supply chain participants should estimate the cost of risk and internalize it into the price of TIH products.[189]

For the reasons described in this paper, estimating the cost of risk is extremely challenging and potentially controversial. Nevertheless, a first approximation of the cost of risk already exists in the price of private insurance. Each supply-chain participant faces some exposure to an accidental or intentional release of TIH material. In order to protect themselves, the producers, transporters, and users may seek insurance. The cost of such insurance is high, however, because of the limited pooling opportunity for this type of risk and the potential for substantial damage payouts.[190]

---

[189] The recommendations in this section address the internalization of risks from an accidental release. A more complex analytical approach would be needed to assess the risks of a terrorist attack.

[190] Because the insurance is very costly, most participants self-insure for damages up to around $25 million and then buy high-deductible insurance coverage of approximately $1 billion. Railroads report that TIH insurance with low deductibles is very costly, and protection is not available above $1 billion. Availability of coverage has decreased over the past few years, as has the number of insurance companies willing to cover freight rail. See Testimony of James Beardsley, Managing Director, National Rail Transportation Practice, Aon Risk Services, before U.S. House of Representatives Committee on Transportation and

A first step towards reflecting these costs would be to incorporate insurance costs for the entire supply chain into the freight rates. However, this approach faces an institutional barrier, in that product-specific insurance costs cannot be included in the Surface Transportation Board (STB) tests of rate reasonableness. The STB would need to modify its current rules to facilitate implementation of this concept. Internalizing the external cost of TIH risk via this insurance model would be a market-based but indirect approach.

A more comprehensive approach would require calculation of the expected costs of risk per ton-mile of TIH moved, once all required operational improvements have been included. A potentially useful quantification methodology would center on an analysis of the probability of an accident resulting in a release, and the expected costs of such an incident. Establishing these parameters is challenging, because they are sensitive to a multitude of assumptions.

The problem could be viewed as analogous to estimating the health effects of air pollution in the 1970s. Those analyses were not analytically elegant and were highly controversial, but establishment of at least a rough estimate was essential to understanding the magnitude of the external costs, mobilizing stakeholder interest in resolving the problem, and determining the allocation of resources. The same may be true for TIH. Analysis could be sponsored by a federal agency such as the FRA or PHMSA; and sensitivity tests could be used to test assumptions and specify a range of reasonableness around the external costs. The results of such an analysis could be incorporated into the cost of TIH transportation by one of the means described above (insurance, rate calculations, etc.).

Incorporation of the risk of TIH release into transportation costs might appropriately be accompanied by creation of a liability fund to pay claims in the event costs of a release exceeded insurance coverage. Otherwise, a large accident, or multiple accidents, might bankrupt one or more supply chain participants. Following the Oil Spill Liability Trust Fund (OSLTF) model, a federally-sponsored TIH liability fund could create a pool of money for damage from releases beyond insurance coverage. The OSLTF funding mechanisms (the tax on oil, cost recovery from negligent parties, and the interest earned on the fund) could serve as a model.

In contrast to the OSLTF, which is not a no-fault model, the desirability of a no-fault insurance model for TIH should be evaluated, since the possibility and extent of damage may be affected by the actions of multiple players. From the design of the tank cars to

---

Infrastructure, Subcommittee on Railroads, "Current Issues in Rail Transportation of Hazardous Materials," June 13, 2006, p. 44.

their maintenance to the movement over the nation's rail system, the actions of each participant affect the overall integrity of the system. Attempts to assign fault for anything short of gross negligence could result in unproductive finger-pointing and litigation. In recent accidents, rail employee (human-factor) causes contributed to the accidental release of TIH, but often the railway may be sued even if fault apparently lies with the shipper's loading procedures, simply because the railroad company's pockets may be seen as deeper than those of other participants in the supply chain. Railroads are required to move TIH shipments under their common-carrier obligation and cannot decline to accept TIH risk. With all these factors in mind, the Price-Anderson Act, FDIC, and OSLTF models should be evaluated by policymakers to determine which elements of each model can be applied to the TIH supply chain to minimize risk.

Another model that might help minimize use of chlorine gas in water treatment is the "stranded asset recovery" model found in the electricity industry. Under this model, electric utilities were allowed to add a small surcharge to the electricity price they charged their customers to recapture the foregone value of assets sold below book value due to regulatory requirements. The same rationale could be used if water authorities, especially those in high-threat urban areas, are required to eliminate the use of chlorine gas. They could be allowed to recapture costs to convert to a substitute technology through a small "product substitution fee" added to water users' bills.[191]

Another possible model to encourage substitution of safer products for TIH materials is cap-and-trade. This approach could be applied to TIH transportation by awarding a fixed number of TIH permits for production, for use, and for transportation. Limiting the total quantity of TIH produced, consumed, and transported would create incentives for product substitution and relocation of production or use. Permits could be decreased over time to push for further replacement of TIH chemicals with less toxic alternatives. Cap-and-trade has not been applied to analogous situations, so significant analysis would be necessary to decide at what point in the supply chain to award allowances, and also whether allowances should be grouped, or instead separated by TIH commodity.

Whatever solution is ultimately created, internalizing costs and creating a fund for damages could lead to a price shock for TIH users, who have made investment and production decisions based on prices that did not include the external costs. Changing the economics in "mid-stream" raises equity issues, especially for users who made long-term investments in fixed assets such as water treatment plants and complex chemical

---

[191] Some may challenge such an approach as heavy-handed, but there is ample precedent for such mandates that support the safety and welfare of the public, even in the realm of rail transportation: mandated positive train control and was largely unfunded by the government.

facilities. To address this issue, transitional phase-in could spread the external costs over a number of years. The transition could be accelerated by government-offered low interest loans or tax advantages, which would be justified by the social welfare gains of reducing the volume of TIH usage. A recent precedent for similar government conversion subsidies is the federal government's funding of television converter boxes as a result of the mandated shift to digital broadcasting. Determination of the most effective approach should be made by the DOT and enacted into law by Congress.

None of these policy options are, however, sufficient to compensate for the potential worst-case consequences of a terrorist attack on a shipment of TIH through a highly populated area. For such a situation, the government's terrorism re-insurance system (TRIA, described above) is available. TRIA might also be extended to cover particularly damaging accidents, as well, since the consequences of accidents occurring at midday in a city might approach those of a terror attack. This might mitigate some of the financial pressure on of internalizing the risk of TIH accidents into product and shipping costs.

These suggestions, targeted at internalizing the TIH externality and creating a fund for TIH release-related damages, should yield three positive outcomes. The first is to reduce the volume of TIH materials used, through encouragement of product substitution and increasing the proximity of producers and users. Second, these options would enable compensation for TIH-related damage without bankrupting producers, transporters, or users. The third benefit is a transition plan that would balance equity and speed.

Improve Supply Chain Operations

While internalizing the TIH externality will encourage product substitution and shorten transportation risk through production or usage relocation, TIH shipments will undoubtedly continue. Therefore efforts to improve the quality and reliability of the TIH supply chain must continue. This paper has described an array of industry initiatives aimed at improving safety and security of TIH shipments. Many of these efforts are already in the design or implementation stage, such as tank car redesign and improvements in rail employee hours-of-service rules and better chain-of-custody procedures. When positive train control is implemented, it should also enhance the safety and security of TIH shipments.

Routing TIH shipments to minimize risk is another operational action which is being undertaken. The supply chain participants consider routing in decisions on production, transportation, and sourcing. Recent rail regulations require railways to undertake more formal assessment of routing options but, while there are some opportunities to improve safety, the tradeoffs are complex and do not yield simple solutions.[192] As the rail industry learns to optimize the tradeoffs, the desirability of implementing event-related re-routing rules should also be explored. For example, federal regulations might be instituted to limit TIH shipments from passing within a certain number of miles of an outdoor event where the expected attendance is above a certain threshold number. Such rules might substantially reduce the availability of attractive targets for terrorists hoping to use TIH against crowds as a weapon of mass destruction, and also would limit the damage resulting from any accidental release, while keeping disruption of the TIH supply chain at more manageable levels. Any such limitations should be based on rigorous risk assessment that balances safety and security with the operational impact to the supply chain.

Enhance Emergency Response and Public Information

The extent of human injury and property damage from a TIH release is directly related to the effectiveness of the emergency response. Several factors limit the ability of TIH emergency responders to mitigate losses. First, immediate and accurate information about the specific product that has been released and the conditions and circumstances of the release are essential, because TIH products with different characteristics require different actions to mitigate damage. Confusion about what product was released has, in past accidents, resulted in injury to first responders and the public. Second, a release could take place anywhere along 140,000 miles of freight rail infrastructure, and thus any and all of approximately one million first responders must have at least a rudimentary understanding in dealing with a TIH release. Third, better and more quickly available meteorological information is needed to improve public protection and mitigation measures.

The adoption of crisis management best practices into the emergency response process should provide first responders with better information for decision making, decreasing the risk of damage to themselves, the general populace, and property. Information is of limited value without local emergency response capabilities to take advantage of that information in order to contain released chemicals and protect residents. Therefore the challenge of TIH requires broad support for both the specific challenges and the more general emergency response infrastructure. Ongoing and increased support for a robust

---

[192] Glickman, Erkut, and Zschocke, "The cost and risk impacts of rerouting railroad shipments of hazardous materials."

emergency response infrastructure capable of addressing diverse public health challenges is essential to minimizing the damages associated with the transportation of TIH.

In addition to better training for first responders, public education will be needed on how to interpret and follow warnings and instructions from emergency operation centers, such as the best direction to flee a release cloud, or when and how to seek shelter in place. Education will also need to be repeated from time to time as populations move and age.

Rationalize Regulatory Framework

A broad range of federal, state, and local regulatory agencies are involved in rule making and oversight that applies to TIH. As part of the U.S. Department of Transportation, the Pipeline and Hazardous Materials Safety Administration (PHMSA) has broad responsibilities for hazardous materials regulation. The agency also provides grants to states to improve HAZMAT emergency response. Within PHMSA, the Office of HAZMAT Safety (OHM) oversees HAZMAT transportation, by issuing regulations and performing inspections of shipper and carrier facilities. Also part of the DOT, the Federal Railroad Administration (FRA) regulates rail operations and supports rail safety research.[193] The FRA has more rail inspectors in the field than any other agency. However, the Homeland Security Act of 2002 gave lead authority to the Department of Homeland Security (DHS) for "security activities in all modes of transportation"; within DHS, the Transportation Security Administration (TSA) is designated as the "lead federal entity" in transportation security matters.[194] Memoranda of Understanding between DHS and DOT are supposed to coordinate the roles of TSA, PHMSA, and FRA in transportation security, so that TSA has the lead in developing national strategy for transportation security, PHMSA has the lead on pipelines and the responsibility for "promulgating and enforcing regulations and administering a national program of safety, including security, in multimodal HAZMAT transportation," and FRA has the lead on rail safety. However, significant potential for confusion or conflicting priorities remains.

---

193 FRA, "Regulatory Overview: Safety Rulemaking. Reports, and Program Development," September 28, 2007, <www.fra.dot.gov/downloads/Safety/regulatory_overview.pdf>.

194 "Annex to the Memorandum Of Understanding between the Department of Homeland Security and the Department of Transportation Concerning TSA and PHMSA Cooperation on Pipeline and Hazardous Materials Transportation Security," <www.phmsa.dot.gov/staticfiles/PHMSA/DownloadableFiles/Annex%20to%20MOU%20between%20TSA-PHMSA.PDF>.

A key lesson from the experiences with environmental externality was that concentrating responsibility at a single federal agency, the EPA, was critical for addressing these controversial issues successfully. In the case of TIH, multiple regulatory bodies provide unique and specialized capabilities, but whether it is desirable to concentrate more authority under one agency should be evaluated. It might well improve the focus on TIH priorities and make the regulatory process more efficient. PHMSA might be well-positioned to take on the lead regulatory role for TIH, because the organization has a deep technical foundation in TIH and other hazardous materials. It also has a view of the entire supply chain, unlike other agencies such as the FRA that are more centered on one aspect of the overall TIH safety and security issue. However, these advantages would have to be weighed against PHMSA's lesser knowledge of railroad operations.

Achieving consensus on regulatory rationalization is likely to be difficult, as each regulatory agency has its own constituents and may be reluctant to relinquish responsibilities and power. The recommended action in this area is, therefore, that the Secretary of Transportation, in consultation with the DHS and the EPA, should assess the specific regulatory items that should be centralized and analyze which organization would provide the best umbrella. An optimal outcome would be a TIH regulatory body with a critical mass of technical skill and political stature to convene interested parties, make difficult decisions, and create a unified course of action. Even before this happens, however, the other recommendations made in this paper can proceed.

Conclusions and next steps

To achieve the goals outlined in these four broad areas for addressing the TIH rail transportation risk, four concrete next steps should be taken.

First, we recommend that the Secretary of Transportation, in collaboration with DHS and other relevant federal agencies, should convene a discussion among representatives of the affected parties to seek consensus on the principles to apply to policy development concerning safety and security of shipment of TIH chemicals. The most important issue is designing a claims fund, deciding how such a fund should be financed, and for what purposes its assets should be expended.

Second, this discussion should also seek a consensus on schedules and economic costs of initiatives ranging establishment of a liability or claims fund to encouragement of product substitution. The programs are proceeding and the technologies need to be encouraged. The more difficult issues involve timing for these efforts. What are realistic completion dates and priorities for deployment or adoption? How quickly should the old systems be phased out? These questions require the collaboration of the private sector with government, and involve difficult economic and risk tradeoffs.

Third, to address regulatory rationalization, the Secretary of Transportation should evaluate whether PHMSA, FRA, or another agency is best suited to take the lead in working with other agencies on redefining the roles of federal regulatory bodies to deal more effectively and efficiently with problems raised by TIH safety and security externalities.

Fourth, the Surface Transportation Board should examine how the common carriage obligations of the railroads and their rate regulation might be modified to include all the external risks as well as operating costs for incorporation in rate regulation for rail transport of TIH cargoes.

Finally, we recommend that the Department of Homeland Security, in collaboration with the Department of Transportation and other appropriate federal and state agencies initiate a focused study of specific security issues including: timing and routing of TIH shipments, preparedness of emergency management organizations and first responders, public education, and the role of intelligence and policy agencies and their sharing of information with private actors in the TIH supply chain.

There are many issues to address and challenges to overcome in addressing TIH transportation. A comprehensive supply-chain view of the safety and security externality of TIH rail transportation should make it possible to make significant progress in substantially reducing the risk of harmful TIH release.

Glossary	
AAR	Association of American Railroads
ACC	American Chemistry Council
AFG	Assistance to Firefighters Grant
BNSF	Burlington Northern and Santa Fe Railway
BOE	Bureau of Explosives
CHEMTREC	Chemical Transportation Emergency Center
CP	Canadian Pacific Railway
CPR	Conditional Probability of Release
CSX	major east coast railroad [Not an acronym]
DHS	Department of Homeland Security
DOT	Department of Transportation
EAS	Emergency Alert System
EMS	Emergency Medical Services
EPA	Environmental Protection Agency
FAST3D-CT	Three-dimensional computational fluid dynamics model for contaminant transportation
FDIC	Federal Deposit Insurance Corporation
FRA	Federal Railroad Administration
GATX	Formerly General American Transportation Company (Note: No longer its name)
HAZMAT	Hazardous Materials
HEMP	Hazardous Materials Emergency Preparedness Grant
ICC	Interstate Commerce Commission
IST	Inherently Safer Technologies
LEPC	Local Emergency Planning Committee
NFPA	National Fire Protection Association
NGRTC	Next Generation Rail Tank Car Project

NOx	Nitrous Oxide
NRC	National Response Center or National Research Council
NS	Norfolk Southern Railway
NTSB	National Transportation Safety Board
O-D	Origin-Destination
OHM	Office of HAZMAT Safety
ONR	Office of Naval Research
OSLTF (or OSL-TF)	Oil Spill Liability Trust Fund
PHMSA	Pipeline and Hazardous Materials Safety Administration
PHMSA-RSPA	Pipeline and Hazardous Materials Safety Administration, Research and Special Programs Administration
PTC	Positive Train Control
R&D	Research and Development
R/VC	Revenue to Variable Cost
RAR	Railroad Accident Report [this acronym not used in the paper]
RFIT	Radio Frequency Identification Tag
SAC	Stand Alone Cost
SAFETEA-LU	Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users
SARA	Superfund Amendment and Reauthorization Act of 1986
SEPC	State Emergency Planning Committee
SO2	Sulfur Dioxide
STB	Surface Transportation Board
TCC	Tank Car Committee
THREAT	Tool for HAZMAT Rerouting Evaluation and Alternative Transportation
TIH	Toxic Inhalation Hazards
TRANSCAER	Transportation Community Awareness and Emergency Response
TRB	Transportation Research Board

TRIA	Terrorism Risk Insurance Act of 2002
TSA	Transportation Security Administration
TTC	Transportation Technology Center
UP	Union Pacific Railroad
URCS	Uniform Rail Costing System

STB Finance Docket No. 35504

UNION PACIFIC R.R. – PETITION FOR DECLARATORY ORDER

OPENING EVIDENCE AND ARGUMENT
OF
NORFOLK SOUTHERN RAILWAY COMPANY

EXHIBIT 4

THE NEW ATLANTIS
A JOURNAL OF TECHNOLOGY & SOCIETY

The Future of Chemical Weapons

Jonathan B. Tucker

In recent years, the nuclear ambitions of Iran and North Korea, and lingering fears of bioterrorism in the wake of the 2001 anthrax letter attacks, have overshadowed concerns that rogue states and terrorist organizations could acquire and use chemical weapons (CW). Whereas biological warfare agents are living microorganisms that cause deadly infectious diseases such as anthrax, smallpox, and plague, chemical warfare agents are manmade toxic chemicals such as chlorine, phosgene, and sarin nerve gas. Today the CW threat has all but disappeared from the radar screen of senior U.S. government policymakers, the news media, and the general public. In 2008, for example, the bipartisan Commission on the Prevention of Weapons of Mass Destruction Proliferation and Terrorism, chaired by former Senators Bob Graham (D.-Fla.) and Jim Talent (R.-Mo.), excluded any discussion of chemical weapons from its report, *World at Risk*. The rationale for this omission was that an incident of chemical terrorism would resemble a hazardous-materials accident and would be far less consequential than either a nuclear or biological attack. In November 2009, the Obama administration issued a new *National Strategy for Countering Biological Threats* but made no mention of chemical weapons.

The current sense of complacency about the CW threat is partly the result of several positive developments, including the demise of the Soviet Union, which possessed the world's most threatening chemical arsenal, and the entry into force in April 1997 of the Chemical Weapons Convention (CWC), an international treaty banning the development, production, transfer, and use of chemical arms, to which all but a handful of countries adhere. Nevertheless, there are real grounds for concern about a future resurgence of the CW threat. A confluence of military, economic, and technological trends—the changing nature of warfare in the twenty-first century, the globalization of the chemical industry, and the advent of destabilizing chemical technologies—have begun to erode the normative bulwark of the CWC and could result in the emergence of new chemical threats from both state and sub-state actors. To prevent these potential risks from materializing, much needs to be done at both the national and the international levels.

Jonathan B. Tucker is a senior fellow specializing in chemical and biological weapons issues in the Washington, D.C. office of the James Martin Center for Nonproliferation Studies of the Monterey Institute of International Studies. His most recent book is War of Nerves: Chemical Warfare from World War I to Al-Qaeda *(Pantheon Books, 2006).*

A Brief History of Chemical Warfare

Chemical weapons were first used on a large scale during World War I. In late 1914, the military imperative of breaking out of the bloody stalemate of trench warfare led the Prussian chemist Fritz Haber to propose releasing clouds of chlorine gas from pressurized cylinders in order to drive the enemy from his trenches. Once Germany broke the taboo against poison warfare at Ypres in April 1915, all of the other major combatants followed suit. By the end of the war, attacks with chlorine, phosgene, mustard gas, and other toxic agents had inflicted roughly one million casualties, about 90,000 of them fatal.

Despite the negotiation in 1925 of the Geneva Protocol banning the battlefield use of chemical weapons, their development continued during the inter-war period. In 1936, Gerhard Schrader, a German industrial chemist developing pesticides at the I. G. Farben company, accidentally discovered a new family of supertoxic poisons that attack the nervous system, causing convulsions and death by respiratory paralysis. The German Army subsequently developed these compounds into what became known as the G-series nerve agents, including tabun, sarin, and soman. Fortunately, Hitler never made use of these secret weapons during World War II, in part because German intelligence concluded—incorrectly—that the Allies had discovered them independently. In the early 1950s, industrial chemists at Imperial Chemical Industries in Britain developed a new pesticide called Amiton that soon proved too toxic for agricultural use and was pulled from the market. But Amiton was transferred to the British chemical warfare establishment at Porton Down and became the first of the V-series nerve agents, which readily penetrate the skin and are lethal in minute quantities: a drop of VX weighing 10 milligrams can kill a grown man in minutes. During the Cold War, the United States and the Soviet Union produced and stockpiled tens of thousands of tons of nerve agents in a shadowy chemical arms race that paralleled the more visible nuclear competition.

Chemical weapons also proliferated to several countries in the developing world and were used on the battlefield in the Yemen Civil War (1963-67) and the Iran-Iraq War (1980-88). During the latter conflict, Saddam Hussein first ordered the use of mustard gas in 1983 to counter Iran's numerical superiority and "human-wave" infantry tactics, which were overwhelming Iraqi positions. When his chemical attacks did not provoke international condemnation, Saddam became emboldened and initiated the use of nerve agents in March 1984 during the battle of

Majnoon Island. The Iranian forces were vulnerable to chemical attack because the Basij militia had no gas masks and the Revolutionary Guards refused to shave their beards, preventing their masks from achieving an airtight seal. Towards the end of the war, Saddam Hussein used chemical weapons as an instrument of terror against the restive Kurdish population in northern Iraq. In a notorious attack on March 16-17, 1988, the Iraqi Air Force dropped bombs containing mustard gas and nerve agents on the Kurdish town of Halabja, killing an estimated 5,000 civilians, many of them women and children. Terrorist groups such as Aum Shinrikyo in Japan and al-Qaeda in Afghanistan have also attempted to acquire and use chemical weapons, so far with limited success.

Some analysts have questioned whether chemical arms meet the criteria of a "weapon of mass destruction" because large quantities of an agent like sarin would be required to cause thousands of casualties in an outdoor attack. But if the threat posed by a weapon is thought of as the product of the likelihood of its use and the scale of the potential consequences, then chemical weapons must be taken seriously. Not only are the materials, equipment, and know-how for CW agent production more accessible to states and terrorist organizations than those for nuclear or biological weapons, but under the right atmospheric and weather conditions, toxic chemicals can have devastating effects on unprotected troops or civilians.

CW Proliferation Today

Like a *chiaroscuro* painting by Rembrandt, the current status of CW proliferation is a mixture of light and shadow. On the bright side, the effective implementation of the Chemical Weapons Convention since its entry into force in 1997 has reduced the number of countries that possess chemical weapons from nearly twenty during the 1980s to a half-dozen today. To date 188 states, accounting for about 98 percent of the world's population and landmass, as well as 98 percent of the global chemical industry, have signed and ratified the CWC. This number is remarkable when one considers that the treaty has only been in force for a dozen years. Much of the credit for this achievement goes to the CWC's international secretariat, the Organization for the Prohibition of Chemical Weapons (OPCW) in The Hague, which has actively recruited new members.

The basic prohibitions of the CWC are comprehensive in that they ban the development, production, possession, transfer, and use of *all* toxic chemicals *except* for peaceful purposes and the preparation of defenses against chemical attack. This approach, known as the "general purpose criterion," ensures that the treaty cannot be overtaken by technological change: as soon as a novel CW agent is developed, it automatically falls under the purview of the CWC. For practical reasons, however, the treaty's stringent verification regime does not cover the entire universe of toxic chemicals, which is vast and continually expanding. Instead, verification is based on the finite set of chemical agents and precursors (key ingredients) that have been developed or used in the past for warfare purposes. These compounds are listed on three "schedules" in an annex to the treaty. Schedule 1 comprises known CW agents and their immediate precursors that have no utility for peaceful purposes, while Schedules 2 and 3 contain "dual-use" chemicals that can be diverted for CW agent production but also have legitimate industrial applications in small and large quantities, respectively. Together with quantitative production thresholds, the three Schedules serve as the basis for determining which chemical industry facilities in CWC member countries must be declared and opened up for routine visits by OPCW international inspection teams.

The CWC also requires the declaration of existing chemical weapons stockpiles and their destruction under strict international monitoring, as well as the dismantling or conversion to peaceful purposes of former CW production facilities. Seven parties to the treaty—Albania, India, Iraq, Libya, Russia, South Korea, and the United States—have declared chemical weapons stockpiles and proceeded to destroy them under international supervision. Three of the declared CW possessor states have already completed the destruction of their stockpiles: Albania in July 2007, South Korea in October 2008, and India in March 2009. Libya pledged to finish the job by December 31, 2010 but has encountered technical difficulties and was recently granted an extension until May 15, 2011, while Iraq has a small legacy stockpile of about 500 chemical munitions that it has yet to destroy. As of December 2009, about 56 percent of the world's declared total of 71,194 tonnes (metric tons) of CW agents had been verifiably eliminated.

The major problem facing the chemical disarmament process is that the United States and Russia, the world's two largest possessors of chemical weapons, are behind schedule in eliminating their vast toxic arsenals left over from the Cold War. As of December 2009, the United States had destroyed 66 percent of its stockpile while Russia had reached the 45 percent mark. At the current rate of destruction, the United States will have destroyed only 90 percent of its stockpile by the extended CWC deadline of April 29, 2012, and it is not expected to finish the job until 2021. Russia is also unlikely to meet the 2012 destruction deadline. Because the CWC has no provision for further extensions, the expected failure by the two largest CW possessors to eliminate their stockpiles on schedule could undermine the credibility of the chemical disarmament regime. Even so, Washington and Moscow remain committed to the goals of the CWC and have reaffirmed their intention to complete the task as soon as possible.

As membership in the CWC approaches universality, chemical weapons have lost any residual political legitimacy, even for purposes of retaliation or deterrence. Yet despite this new international norm, several countries continue secretly to possess chemical weapons and to upgrade their capabilities. At present, only eight states remain outside the CWC. Angola, Egypt, North Korea, Somalia, and Syria have neither signed nor acceded to the treaty; Israel and Burma (Myanmar) have signed but not ratified; and Taiwan would like to join but cannot because since 1971 it has not been a member of the United Nations. Four of the hold-out countries—Egypt, Israel, Syria, and North Korea—have been named in public sources as likely possessors of chemical weapons. In addition, the U.S. State Department's 2005 unclassified report on compliance with arms control agreements (the most recent available) publicly accused three CWC member states—China, Iran, and Russia—of violating their treaty obligations by retaining undeclared CW development or production facilities.

In order to address such allegations of noncompliance, the negotiators of the CWC built into the verification regime the option for any member state to request the OPCW inspectorate to conduct a short-notice challenge inspection of any suspect facility, declared or undeclared, that is located on the territory of another member state. This measure was intended as a "safety net" to capture clandestine chemical weapons development, production, or storage facilities that countries have deliberately not declared and hence are not subject to routine international inspection. Unfortunately, despite festering allegations of noncompliance, no state party to the CWC has yet requested a challenge inspection in the dozen years since the treaty entered into force. One reason for this inaction is that the CWC negotiators set a high bar for launching a challenge inspection by requiring the requesting state to provide evidence of a treaty violation. Not only is it politically risky for one member state to directly accuse another of cheating, possibly provoking a retaliatory challenge, but the failure of a challenge inspection to find "smoking-gun" evidence to substantiate the charge could end up letting the accused party off the hook, even if it is actually guilty.

The longer the CWC challenge inspection mechanism remains unused, however, the less it retains the power to deter violations. Accordingly, it would be desirable to lower the political threshold for launching a challenge inspection by using this measure to clarify ambiguities and concerns about compliance, such as whether or not a particular facility should have been declared, rather than attempting to catch a violator red-handed. Exercising the challenge-inspection option for clarification purposes would help to restore its credibility and also make it possible to work out the kinks in the process so that it does not have to be used for the first time in response to a crisis.

After most of the world's declared chemical weapons have been eliminated by the 2012 deadline, the primary focus of CWC implementation will shift from disarmament to nonproliferation, or efforts to ensure that chemical activities are conducted for non-prohibited purposes only. A key element of this task, as British CW analyst Julian Perry Robinson has pointed out, is "protecting against the malign exploitation of dual-use chemistry," meaning chemical materials, production equipment, and technologies that have both peaceful and military applications. Unfortunately, the CWC contains some major gaps with respect to verifying the nonproduction of chemical weapons at dual-use industry facilities.

First, because the three Schedules were compiled during the CWC negotiations in the 1980s and early 1990s and have not been updated since, they do not include a number of CW agents and precursors of more recent vintage. As a result, although the general purpose criterion bans the development or production of *any* chemical agent or precursor for hostile purposes, facilities that manufacture toxic chemicals not listed on the Schedules are exempt from routine inspection. The CWC does include an expedited procedure for updating the Schedules so that the verification system can keep pace with technological change, but member states have so far hesitated to use it. One reason for their reluctance is that adding new CW agents and their precursors to the Schedules would disclose sensitive information, such as the molecular structures of these compounds, that proliferators and terrorists could exploit.

Because facilities that produce unlisted CW agents and precursors are not subject to routine verification under the CWC, the only way to pursue suspected violations involving such chemicals is by requesting a challenge inspection, which has not occurred for the reasons noted above. Thus, to prevent would-be cheaters from circumventing the treaty and undermining its effectiveness, the member states must either find the political will to employ the challenge-inspection mechanism to pursue cases of alleged noncompliance or develop alternative ways of enforcing the general purpose criterion at the national and international levels.

States of CW Proliferation Concern

Although unclassified information on states of CW proliferation concern is hard to come by, U.S. government reports and other public sources have identified a number of suspects. Even as Russia destroys the vast stockpile of chemical weapons it inherited from the Soviet Union, concerns linger about Moscow's compliance with the CWC. According to Russian military chemists who defected to the West, from the 1970s through the early 1990s the Soviet Union and then Russia ran a top-secret program called Foliant that successfully developed a new generation of nerve agents known as *novichoks*, after the Russian word for "newcomer." Reportedly, these compounds are more deadly and resistant to treatment than either the G-series or the V-series nerve agents. Dr. Vil Mirzayanov, a former Soviet military chemist who worked on the Foliant program, wrote in the Summer 2009 issue of the journal *CBRNe World*, "Agent 230 [a novichok], which was adopted as a chemical weapon by the Russian Army, is 5-8 times more poisonous than VX gas. It is impossible to cure people who are exposed to it."

Some of the novichoks consist of a "binary" formulation of two precursor chemicals, which would be stored in separate compartments inside a bomb or shell. After the munition was fired and en route to the target, the two precursors would be allowed to mix together and react to form the lethal agent, which would then be released on impact. (The United States, it should be noted, produced a binary sarin artillery shell from 1987 to 1990, before the CWC was concluded.) According to Mirzayanov, the novichok binary precursors were designed to lack the telltale molecular "signatures" of nerve agents, such as a carbon-phosphorus bond. Because of their relatively low toxicity, these chemicals could be manufactured in ordinary pesticide plants, making it hard for OPCW inspectors to detect them even during a CWC challenge inspection. The State Department cited these allegations in its 2001 arms control compliance report:

> since 1992, Russian scientists familiar with Moscow's chemical warfare development program have been publicizing information on a new generation of agents, sometimes referred to as "Novichoks." These scientists report that these compounds, some of which are binary agents, were designed to circumvent the Chemical Weapons Convention and to defeat Western detection and protection measures. Furthermore, it is believed that their production can be hidden within commercial chemical plants. There is concern that the technology to produce these compounds might be acquired by other countries.

Whether the Soviet Union or Russia ever produced and stockpiled the novichok agents in significant quantities is unknown, at least from open sources. Meanwhile, technical information about these deadly compounds has gradually leaked into the public domain through the publication of unclassified books and reports, raising concern that the knowledge to produce them could spread to rogue states and terrorist organizations. Because no effective antidotes against the novichoks are available, however, synthesizing and handling even small quantities of these agents would be exceedingly dangerous.

Outside Russia, chemical weapons proliferation today is concentrated in two regions of persistent conflict and crisis, East Asia and the Middle East. According to the State Department's 2005 arms control compliance report, "China continues to conduct CW research and development that has applications for either defensive or offensive purposes. China also has the capability to quickly mobilize its chemical industry to produce a wide variety of chemical agents." North Korea, for its part, has not signed the CWC and shows little interest in doing so. According to unclassified estimates by the South Korean government, Pyongyang has a chemical weapons stockpile of between 2,500 and 5,000 tonnes of mustard, phosgene, sarin, and V-series nerve agents. In addition, the North Korean army has deployed thousands of chemical-capable artillery pieces and multiple rocket launchers within range of Seoul, which would be devastated if war were to break out on the Korean Peninsula. Another Asian country that may possess an offensive CW capability is Burma (Myanmar). The human rights group Christian Solidarity Worldwide alleged in 2005 that the Burmese government was using chemical weapons against rebel fighters from the Karen ethnic minority, although these charges have not been corroborated.

In the Middle East, Syria reportedly has an advanced chemical arsenal, including large stockpiles of sarin and VX. It has also acquired hundreds of Scud-type ballistic missiles that could deliver chemical warheads against Israeli population centers. According to published assessments, this capability serves as a relatively inexpensive "poor man's atom bomb" that provides a partial counterweight to Israel's undeclared but widely acknowledged nuclear deterrent force. Beyond this strategic role, Syria might conceivably use chemical weapons to bolster its conventional military operations in the event of a war with Israel over the Golan Heights. Given the shortcomings of the Syrian army in past engagements with the Israel Defense Forces in 1967, 1973, and 1982, a CW capability might provide Syria with a greater range of tactical options.

Iran (unlike Syria) is a party to the CWC, but the U.S. government believes that it is secretly violating its treaty commitments. In early 2008, then-Director of National Intelligence J. Michael McConnell stated in congressional testimony that Tehran "maintains dual-use facilities intended to produce CW agent in times of need and conducts research that may have offensive applications. We assess Iran maintains a capability to weaponize CW agents in a variety of delivery systems." This testimony suggests that Iran may have eliminated its active CW stockpile (first acquired during the Iran-Iraq War) and switched to a "mobilization" strategy in which it would rapidly produce chemical weapons in the early stages of a crisis or war.

Egypt also appears to have a CW capability, although details are sketchy from public sources. The country employed chemical weapons in the 1960s during its military intervention in Yemen, and it later built an indigenous nerve-agent production capability at the Abu-Zaabal Company for Pest Control Materials and Chemicals near Cairo. Egypt also transferred chemical weapons and related technology to Syria in 1973 and Iraq in the 1980s. Although Egypt has so far refused to join the CWC in order to retain some political leverage vis-à-vis Israel's nuclear weapons capability, the Egyptian CW program appears inactive and may simply consist of a legacy stockpile.

Little public information is available about Israel's CW capabilities. Tel Aviv signed the CWC in January 1993, committing politically to abide by the basic aims of the treaty, but the Israeli parliament decided in 1997 not to ratify until all of Israel's Arab neighbors agree to follow suit. The top-secret Israel Institute for Biological Research near the town of Ness Ziona is known to conduct research and development on chemical defenses, but some suspect that it does offensive work as well. In addition, there have long been unsubstantiated rumors about an Israeli chemical weapons stockpile in the Negev Desert. Despite the potential harm to Israel's chemical industry from CWC-mandated restrictions on trade in Schedule 2 chemicals with countries that refuse to join the treaty, security rather than economic concerns have dominated the Israeli debate over ratification. Military analysts such as Gerald M. Steinberg of Bar-Ilan University have argued that the tacit threat of Israeli nuclear retaliation in response to a Syrian or Iranian chemical attack would not be credible because of its lack of proportionality, while relying exclusively on retaliation with conventional weapons would not provide a sufficient deterrent. According to Steinberg, by remaining outside the CWC, Israel creates uncertainty in the minds of potential military adversaries that it may have the capability to retaliate in kind to a chemical attack, thereby bolstering deterrence.

A major stumbling block to chemical disarmament in the Middle East has been the political and strategic linkage that exists between chemical and nuclear arms. Although neither Egypt nor Syria admit possessing chemical weapons, both countries have refused to join the CWC until Israel openly acknowledges its undeclared nuclear arsenal and accedes to the Nuclear Nonproliferation Treaty as a non-nuclear-weapons state. The current deadlock over chemical disarmament in the Middle East is likely to persist unless and until the peace process eases regional tensions and addresses the core security needs on both sides of the Arab-Israeli divide.

The regional picture is not entirely bleak, however. Over the past decade, several Arab countries have broken with the hard-line states by signing and ratifying the CWC. A particularly encouraging development was the rollback of Libya's CW program in 2004. Libyan leader Muammar Khaddafi, seeking to rejoin the international community after decades of diplomatic isolation and harsh economic sanctions, agreed to renounce his country's nuclear and chemical weapons programs, including a stockpile of more than 24 tonnes of mustard gas. After acceding to the CWC, Tripoli declared a former CW production plant that had been concealed inside a pharmaceutical factory at a site called Rabta, and proposed to convert the facility to the peaceful production of drugs and vaccines for the African market. Since Libya's accession to the CWC, Iraq and Lebanon have also joined the treaty, leaving Egypt and Syria as the last remaining holdouts in the Arab world.

This brief survey makes clear that despite significant progress toward global chemical disarmament since the entry into force of the CWC in 1997, the complete abolition of this category of armament remains a distant goal. Today about a half-dozen countries, both inside and outside the treaty regime, continue to possess chemical weapons. Even so, the nature of the problem has changed. "Vertical" proliferation, or the acquisition of larger stockpiles and more advanced agents and delivery systems by existing CW possessors, has essentially replaced the earlier process of "horizontal" proliferation, or the spread of chemical arms to additional states.

The Changing Nature of Warfare

The nature of warfare in the twenty-first century is changing. Traditional set-piece battles between regular armies, as occurred during the 1991 Persian Gulf War and to a lesser extent in the 2003 Iraq War, are becoming increasingly rare. Instead, most military conflicts in the world today are civil wars, insurgencies, counterinsurgency campaigns, and low-intensity "operations other than war," such as U.N. peacekeeping and counterterrorism. This trend, combined with the ongoing implementation of the CWC and the political delegitimation of chemical warfare, make it unlikely that the large-scale battlefield use of chemical weapons will recur in the future. Nevertheless, much as "military necessity" (*Kriegsräson*) drove the resort to chemical weapons in World War I and the Iran-Iraq War, the new forms of conflict could create incentives to employ such arms. For example, insurgent groups may view poison gas as a means of asymmetric warfare against domestic or foreign armies that have vastly superior conventional military capabilities. Conversely, government forces might employ chemical weapons against rebel fighters and civilians in entrenched separatist enclaves, perhaps in a covert manner that makes such attacks difficult to confirm or attribute. Finally, because ethnic and communal wars feed on deep hatreds and are often fought in a savage manner with little regard for the laws of armed conflict, they could well outstrip the normative and legal restraints against the use of chemical arms.

Three examples of "improvised" chemical warfare in the recent past may be harbingers of the future. In June 1990, the Sri Lankan rebel group known as the Tamil Tigers fought a battle with the Sri Lankan Armed Forces (SLAF) near the town of Kiran on the island's east coast. Running low on conventional munitions, the Tigers seized cylinders of pressurized chlorine from a paper mill and released the gas upwind of a fort controlled by the SLAF. The toxic cloud injured more than sixty Sri Lankan government soldiers, enabling the rebels to overrun the fort. At the same time, some of the toxic gas drifted back into Tamil territory, angering the Tigers' constituency. In this case, the Tigers' use of a chemical weapon was opportunistic in that the chlorine was readily available and satisfied an urgent military need As terrorism analyst John Parachini has noted, however, the rebels did not make further use of chemical weapons because they feared a loss of support from the local population and the Tamil diaspora, who were essential to the group's fundraising.

A second example of improvised chemical warfare occurred during the war in the former Yugoslavia between Serbia and Croatia (1991-1995). On six occasions from 1993 to 1995, Serbian forces used rockets, bombs, artillery, machine-gun tracers, and mortars to attack the Petrochemia chemical plant, one of Europe's largest fertilizer producers, which is located less than a kilometer from the Croatian town of Kutina. Because the Petrochemia facility stored a variety of toxic substances, including anhydrous ammonia, sulfuric acid, and formaldehyde, the Croatian Ministry of Defense deployed special hazardous-materials response units and a network of mobile and tower-based chemical sensors connected to a computer with a predictive dispersion model to prevent and mitigate hazards to the civilian population. Serbian forces also attacked a Croatian chemical plant thirty kilometers from the town of Jovan, resulting in the release of 72 tons of anhydrous ammonia. Fortunately, local public-safety officers had time to evacuate the town's 32,000 residents. In a third incident, the Serbians fired mortars at the Herbos pesticide plant in the industrial center of Sisak but did not hit critical process-control or chemical storage areas. Although none of the Serbian attacks on Croatian chemical facilities resulted in a major threat to public health, subsequent U.S. computer modeling determined that if existing chemical storage containers had been breached, lethal concentrations of toxic materials would probably have spread over a wide area. Future conflicts may well involve deliberate attacks on chemical plants with the intent of harming civilian populations, a tactic that Theodore Karasik of the RAND Corporation has called toxic warfare without weapons.

The most recent example of improvised chemical attacks took place in Iraq during the first half of 2007, when Sunni insurgents affiliated with the group Al-Qaeda in Iraq (AQI) decided to augment their vehicle-borne improvised explosive devices (IEDs) with chlorine, which is widely used in Iraq for water purification. On January 28, 2007, an AQI suicide bomber in the town of Ramadi detonated a truck laden with explosives and a tank of liquid chlorine. The blast killed sixteen people outright and also vaporized the chlorine, producing a cloud of noxious gas that caused vomiting and breathing problems in dozens of Iraqi civilians downwind and terrorized the community. Over the next six months, AQI operatives detonated several more truck bombs incorporating containers of liquid chlorine. Because the explosions burned much of the agent rather than dispersing it, the chlorine gas was not concentrated enough to cause many deaths. In an effort to enhance the toxic effects of the bombs, the insurgents experimented with different proportions of chlorine and explosive before finally abandoning the effort in June 2007. Although attacks with chemical IEDs have not recurred since, their repeated use in Iraq may have crossed a psychological threshold that could make a return to such tactics more likely.

Changing Proliferation Dynamics

The chemical weapons threat is linked not only to changes in the international security environment but also to the process of economic globalization. Many developing countries have acquired the capability to manufacture their own fertilizers and pesticides, and multinational companies are building sophisticated multipurpose chemical plants in parts of the world where labor costs are low and environmental regulations are less stringent. At the same time, the burgeoning global trade in chemicals has reduced the effectiveness of traditional nonproliferation tools such as export controls. Forty-one industrialized countries (including the United States) participate in an informal forum called the Australia Group, in which they harmonize their national controls on exports of dual-use chemicals and equipment that can be used to produce CW agents. Yet companies from countries outside the Australia Group, such as China, India, and Russia, still sell controlled items to Iran and other states of proliferation concern. Corrupt middlemen have also been implicated in the illicit trafficking of CW precursors, including Frans van Anraat, a Dutch businessman; Q. C. Chen, a Chinese national; and Nahum Manbar, an Israeli citizen. Although governments are rarely complicit in illicit sales, they are often lax in enforcing national export controls.

Other CW proliferation trends are also worrisome. Several countries that possess chemical weapons programs have tried to become self-sufficient in the production of key precursor chemicals in order to reduce their dependence on foreign manufacturers and avoid cut-offs in supply. One strategy, known as "back integration," involves the domestic manufacture of CW precursors from simpler chemicals whose export is not restricted. Another means of circumventing export controls, called "secondary proliferation," entails the transfer of CW precursors, production equipment, and know-how from existing possessors to friendly states seeking chemical arms. According to a report in *Jane's Intelligence Review*, Iran helped Syria to plan, build, and manage five pilot plants for the production of CW precursors as part of a strategic cooperation agreement between the two countries. Finally, the globalization of the chemical industry has created a large pool of people with expertise in chemistry and chemical engineering who could potentially be recruited by states or non-state actors seeking to acquire a CW capability.

Impact of Emerging Technologies

At the same time that the process of economic globalization is undermining traditional nonproliferation measures such as export controls, a number of emerging chemical technologies have the potential to transform the nature of the CW threat. The pharmaceutical industry, for example, uses a technique called "combinatorial chemistry" to discover promising drug candidates. This method involves the automated mixing and matching of molecular building blocks to generate a "library" containing thousands of structurally related compounds, which are then screened for a desired pharmacological activity such as the ability to inhibit a key enzyme. Although harmful substances discovered in this manner typically have no therapeutic value and are set aside, it would be fairly easy to "mine" a combinatorial database to identify highly toxic compounds that could be developed into CW agents. According to a group of experts convened by the International Union of Pure and Applied Chemistry (IUPAC) to discuss the implications of emerging technologies for the CWC, "Some new chemicals found by database mining will have toxicity characteristics that could lead to their being considered as chemical weapon agents." Before a new toxic chemical can be turned into an effective weapon, however, it must meet a number of additional requirements, including stability in long-term storage, an appropriate degree of volatility or persistence to ensure its effective dissemination, a low-cost production method, and the availability of medical antidotes to protect the attacker's own troops.

Recent advances in chemical production technology also have implications for the future of the CW threat. Chemical plants with flexible manufacturing equipment, such as versatile batch reactors and pipes that are easily reconfigured, are capable of switching rapidly from one product to another in response to shifts in market demand. Such multipurpose chemical plants are becoming more common in the developing world, increasing the risk that they could be diverted to the illicit production of CW agents or their precursors. In addition, chemical engineering firms in Germany, China, India, Japan, and South Korea are pioneering the use of "microreactors," continuous-flow reaction vessels the size of credit cards, in place of traditional large batch reactors for the production of fine chemicals, cosmetics, and pharmaceuticals. By operating hundreds or even thousands of miniaturized reactors, heat exchangers, and mixers in parallel, it is possible to produce tons of chemicals per hour. This emerging technology offers economic, safety, and environmental benefits, including improved control of reaction parameters, higher yields with fewer unwanted byproducts, reduced energy consumption and generation of hazardous wastes, lower capital and production costs, and the ability to scale up simply by adding more units ("numbering up"). Yet chemical microdevices have a potential dark side because they are particularly well suited for the synthesis of highly toxic and reactive compounds. Moreover, by in effect shrinking a chemical plant to the size of a bedroom and minimizing the amount of heat and the volume of liquid and gaseous effluents generated by the facility, miniaturized production equipment could eliminate the traditional intelligence "signatures" associated with illicit CW agent production.

Another trend in chemical manufacturing is the growing convergence between chemical and biological production methods. By employing a set of advanced genetic engineering techniques known as synthetic biology—explored in depth in these pages in Spring 2006 ("The Promise and Perils of Synthetic Biology")—it is now possible to endow bacterial or yeast cells with the specialized biochemical machinery needed to produce complex molecules of medicinal value that are difficult and costly to extract from natural sources. For example, Jay Keasling and his colleagues at the University of California, Berkeley, have inserted "cassettes" of genes coding for complex metabolic pathways into yeast cells, enabling them to produce the immediate precursor of the anti-malarial drug artemisinin, a complex molecule that is currently extracted from the sweet wormwood plant. At the same time, the pharmaceutical and biotech industries have learned how to synthesize potent natural substances called peptides (short protein fragments) in multi-ton quantities by strictly chemical means. Although both synthetic biology and peptide synthesis offer great benefits, they could potentially be misused to produce biological toxins and other naturally occurring compounds for CW purposes. At present, the production of peptides is not subject to routine verification under the CWC, a gap that will have to be addressed in the future. Also warranting clarification is the extent to which the treaty's definition of chemical production "by synthesis" covers biotechnological methods such as metabolic engineering.

CWC Breakout Scenarios

One consequence of the spread of flexible chemical manufacturing technologies (including multipurpose plants, microdevices, and biotechnological processes) is that they could enable countries to acquire a "latent" or "virtual" capacity to produce CW agents without the need to build dedicated facilities for that purpose. Defense analyst Michael Moodie contends that a CWC member state intending to violate the treaty could carry out the research, development, and small-scale testing of a CW production line in secret and then maintain this capability in distributed form within its civilian chemical industry. In the event of a crisis or war, the country's leaders could decide to acquire an active stockpile of chemical weapons and convert one or more flexible manufacturing plants to clandestine CW agent production. The short lead-time required for start-up would limit the ability of potential adversaries to counter the threat by deploying improved chemical defenses.

This potential for rapid "breakout" from the CWC poses major challenges for the chemical disarmament regime. Not only is a standby CW production capability much harder to detect than an active stockpile or a dedicated manufacturing facility, but a dual-capable plant would violate the treaty only when it actually began to produce CW agents. Because obtaining hard evidence for a secret mobilization program would be difficult, effective concealment might be possible even in the face of fairly intrusive on-site inspections. For these reasons, a number of chemical weapons proliferators appear to be shifting to a rapid-breakout strategy. In recent years, for example, U.S. intelligence officials have asserted in congressional testimony that Iran does not have a CW stockpile but instead maintains dual-use production facilities that could manufacture chemical agents in wartime.

The problem of virtual proliferation warrants a recalibration of some of the verification measures in the CWC. In particular, there is a serious gap in coverage with respect to "other chemical production facilities" (OCPFs), a category of chemical industry plants that do not currently manufacture CW agents or precursors listed on the Schedules but are technically capable of doing so. The CWC requires that such facilities be declared if they produce more than 200 tonnes per year of "unscheduled discrete organic chemicals," yet member states are required to provide little information about such plants beyond the name and location of each site. As the chemical industry spreads around the world, economic powerhouses like China and India are building large numbers of OCPFs, of which an estimated 10 to 15 percent contain flexible manufacturing equipment that could be diverted fairly easily to CW agent production. Accordingly, the global proliferation of OCPFs poses a significant risk to the object and purpose of the CWC.

At present, only a small fraction of the roughly 4,500 declared OCPFs worldwide are selected each year for inspection by the OPCW. The site-selection algorithm is quasi-random but "weighted" to take account of the risk that a facility could be diverted to illicit production. In 2008, the OPCW international inspectorate visited 118 of the 4,478 OCPFs that were subject to inspection that year, or 2.6 percent—a fraction far from sufficient to provide confidence in CWC compliance. To help bridge this gap in the verification regime, the member states should authorize the OPCW to conduct a significantly larger number of OCPF inspections per year. The organization should also be directed to refine the site-selection algorithm so as to target inspections on the multipurpose chemical plants that pose the greatest risk of diversion for prohibited purposes. Finally, to avoid wasting scarce inspection resources on facilities that pose no risk to the CWC, the member states should voluntarily declare more detailed information about their OCPFs than the treaty requires.

Chemical Incapacitating Agents

Another issue of concern with respect to the future of the chemical disarmament regime is the fact that Russia, the United States, the Czech Republic, and possibly China are developing chemical incapacitating agents for use in counterterrorism operations, as well as hostage-rescue situations in which terrorists and innocent civilians are intermingled. Although chemical incapacitants are often termed "non-lethal agents," that term is a misnomer because such chemicals may cause death or permanent injury at high doses.

Russia has already made use of a powerful incapacitating agent, with disturbing results. On October 23, 2002, a band of Chechen separatists took about eight hundred people hostage during a performance of the popular musical *Nord-Ost* at the Dubrovka Theater in Moscow and threatened to set off explosives unless their demands were met. Russian special forces surrounded the theater, and a standoff with the rebels ensued that lasted for the next fifty-seven hours. Finally, at 5:15 a.m. on October 26, the Russian commandos pumped a vaporized narcotic drug (reportedly, a mixture of derivatives of the synthetic opiate fentanyl) into the theater's air-conditioning system and stormed the building about forty-five minutes later. The drug knocked out the female Chechens guarding the hostages, allowing the commandos to shoot them at point-blank range; the male Chechens had moved into the lobby and did not succumb to the gas as quickly, but they were killed in the ensuing fire-fight. Although all forty-one militants died, exposure to the powerful narcotic also claimed the lives of 129 of the hostages, demonstrating that its "non-lethal" character was a myth. In fact, no known chemical agent can incapacitate people quickly and without risk of death when employed under realistic field conditions in a military or law enforcement operation. Furthermore, the refusal of the Russian special forces to disclose the identity of the incapacitating agent prevented emergency medical personnel from administering antidotes in a timely manner. Even today, the exact composition of the narcotic gas remains a mystery. Despite the heavy loss of innocent life, the Russian government declared the hostage-rescue operation a success and is likely to employ chemical incapacitants again in future incidents of this type.

Surprisingly, the use of a potent chemical agent in the Dubrovka Theater incident was not considered a violation of the CWC, to which Russia is a party. Although the treaty bans the military use of toxic chemicals, including harassing agents such as tear gas, paragraph 9(d) of Article II allows member states to possess and employ toxic chemicals for "law enforcement including domestic riot control," as long as the types and quantities of such chemicals are consistent with law enforcement purposes. The negotiators of the CWC included this exemption to permit capital punishment by lethal injection (at the request of the United States), as well as domestic riot control using CS tear gas and similar agents that have temporary irritant effects on the eyes and skin. Because the law enforcement exemption in Article II.9 (d) is so vague, however, it does not explicitly rule out the use of more potent chemicals such as fentanyl, which unlike tear gas has depressant effects on the central nervous system that persist for several hours after exposure. For this reason, fentanyl-like chemicals are not considered riot-control agents but are more properly termed incapacitants, a category that is not defined in the CWC. It is also unclear whether or not the law enforcement exemption extends beyond domestic police use of toxic chemicals to cover counterterrorism operations conducted by paramilitary forces or U.N.-authorized peacekeeping missions overseas.

Given these ambiguities in the CWC, arms control advocates worry that some member states will interpret the law enforcement exemption too broadly, creating a major loophole that allows the development, production, and use of a new generation of potent incapacitating agents and specialized delivery systems, such as airburst munitions and mortars. If the acquisition of chemical weapons under the law enforcement exemption of the CWC continues unchecked, it could seriously undermine the treaty. In 2008, an IUPAC technical expert group warned,

> Activities to develop "non-lethal" weapons based on incapacitating agents would not easily be distinguishable from aspects of an offensive CW program: The agents would actually be weaponized, and the considerations with regard to the time between the discovery of a new toxic chemical that might be a candidate novel CW agent and its emergence as a CW may no longer apply.

Of particular concern is the possible development of a new generation of biochemical "calmative" agents that would act on the central nervous system in highly specific ways. Pharmaceutical companies are currently developing new therapeutic drugs modeled on natural body chemicals called "bioregulators," many of them peptides, that control vital homeostatic systems such as temperature, sleep, water balance, and blood pressure. In the brain, a large class of bioregulators act on neural circuits to modulate awareness, cognition, and mood. Based on this research, it may eventually become possible to develop modified bioregulator molecules called analogues that can cross the blood-brain barrier and induce a state of sleep, confusion, or placidity, with potential applications in law enforcement, counterterrorism, and urban warfare. Such chemicals are often referred to as "mid-spectrum agents" because they exist in a gray area between chemical and biological weapons. As Neil Davison of the British Royal Society has observed, even if future technical advances permit the development of safer incapacitants that are rarely lethal under operational conditions, the broader issue is "whether the police and militaries of the future (not to mention the criminals, terrorists, torturers, and dictators) should have access to chemical weapons to manipulate human cognition, perception, emotion, motivation, performance, and consciousness." Such agents could easily be misused for the repression of legitimate dissent, coercive interrogation, and other violations of human rights.

Ironically, even as the successful implementation of the CWC has helped to solidify a global norm against the use of chemical weapons, an entire category of toxic chemicals appears to be regaining legitimacy. To minimize the potential threat that an overly broad interpretation of the law enforcement exemption poses to the integrity of the chemical disarmament regime, there is an urgent need for greater transparency. As a first step, CWC member states should agree to declare the types and quantities of incapacitating agents they have produced and stockpiled. as the treaty already requires for riot-control agents. Restrictions on the types and quantities of incapacitating agents that may be employed for law enforcement purposes (including counterterrorism operations) should also be considered, along with rules of engagement for their use. As Julian Perry Robinson has argued, "If one form of toxicity suddenly becomes acceptable, the norm against weaponizing toxicity in all its forms, which is the norm that underpins the CWC regime, will be weakened and the floodgates perhaps opened."

Chemical Terrorism

Although the number of states that possess chemical arms has declined significantly since the entry into force of the CWC in 1997, interest in such weapons on the part of terrorist organizations has not. Chemical terrorism can be divided into three types of scenarios: (1) synthesis and delivery of military-grade agents, such as mustard and sarin; (2) deliberate release of toxic industrial gases, such as chlorine or phosgene; and (3) sabotage of a chemical plant, industrial complex, or chemical-transportation system, releasing toxic materials that harm the local population.

Fortunately, the combination of motivation and technical capability needed to carry out a successful chemical attack is rare. With respect to motivation, terrorist groups that have political objectives, such as the Irish Republican Army, generally have a strong incentive to calibrate their use of violence to avoid alienating their supporters and funders. Politically motivated groups also tend to be conservative in their choice of weapons and tactics, innovating only when forced to do so by the introduction of new countermeasures. In contrast, terrorist groups that would use chemical weapons must be willing to inflict indiscriminate casualties and to pursue risky, innovative tactics. Types of groups that fit this profile include those with a millennialist, racist, or religious ideology, such as apocalyptic cults, radical militias, and jihadist organizations. Toxic chemicals may be attractive terrorist weapons because they inspire extreme dread, enabling even small-scale attacks to have a disproportionate psychological impact. This effect is further amplified by obsessive media coverage, particularly on cable television news, deeply frightening the public and challenging the authority of political leaders.

In addition to motivation, acquiring a CW capability requires overcoming a set of challenging technical and logistical hurdles. Chemical terrorists seeking to use military-grade agents, such as sarin or VX, must acquire the equipment and know-how needed to synthesize, handle, and deliver highly toxic materials. Because of these technical difficulties, all incidents of chemical terrorism to date have been fairly crude and limited in scale and scope. The most notorious attacks were carried out by Aum Shinrikyo, a bizarre doomsday cult in Japan. In the mid-1990s, Aum sought to manufacture 70 tonnes of sarin nerve agent for attacks against the Japanese parliament and government ministries in downtown Tokyo. The cult's aims were to fulfill the apocalyptic prophecies of its leader Shoko Asahara and trigger a massive social upheaval that would topple the Japanese government, opening the way to the establishment of a theocratic state under Asahara's command. These wildly ambitious goals would have remained in the realm of fantasy except for the fact that Aum had accumulated vast wealth—estimated in the hundreds of millions of dollars—from an array of legitimate and criminal enterprises, including computer stores, vegetarian restaurants, and drug trafficking, as well as appropriating the property of affluent individuals who joined the cult.

Flush with cash, senior Aum leaders recruited synthetic organic chemists from Japanese universities and used front companies to purchase a $10 million chemical pilot plant from Switzerland and large quantities of nerve-agent precursors from foreign suppliers. Aum even procured a military helicopter from corrupt officials in Russia with the aim of spraying sarin over the intended targets, but the cult was unable to keep the aircraft in working order. Aum operatives did carry out two small-scale attacks with sarin, the first in the town of Matsumoto in June 1994 and the second on the Tokyo subway in March 1995. In both cases, the poor quality of the nerve agent and the crude means of delivery limited the number of fatalities to seven and twelve, respectively—fewer than would have resulted from a conventional high-explosive bomb—although hundreds more were injured and the attacks had a pervasive terrorizing effect.

Analysts have drawn different lessons from the Aum Shinrikyo case. Those experts who tend to play down the threat of unconventional terrorism argue that, despite Aum's strong motivation to acquire chemical weapons and its access to technical know-how and financial resources, the cult failed in its efforts to scale up the manufacture of sarin and to deliver it in a way that would cause thousands of deaths. The skeptics conclude from this evidence that even fairly sophisticated terrorist groups are incapable of carrying out mass-casualty chemical attacks. More pessimistic analysts point out that Aum had only forty-eight hours to produce the sarin used in the subway incident because the cult leaders had been tipped off to an impending police raid on their headquarters, which they sought to block with a diversionary chemical attack in downtown Tokyo. Because the nerve agent was synthesized in haste in a small laboratory, it was less than 30 percent pure, and Aum scientists also lacked the time to devise an effective delivery system, such as an aerosol sprayer. Instead, they filled dual-ply plastic bags with the dilute sarin solution, which cult operatives carried onto subway cars and punctured with sharpened umbrella tips, producing puddles of sarin that slowly evaporated. If Aum had taken more time to prepare the chemical attack, it might have been far more devastating.

Another terrorist organization that has actively pursued chemical weapons is al-Qaeda, which launched a CW development program in the late 1990s in eastern Afghanistan under the direction of a chemist named Midhat Mursi al-Sayyid Umar, better known as Abu Khabab al-Masri. A former scientist in the Egyptian chemical weapons program, al-Masri had joined Egyptian Islamic Jihad, which merged with al-Qaeda in 1998. He subsequently took charge of al-Qaeda's chemical weapons program, known as Project al-Zabadi. Working in a crude laboratory at the Darunta terrorist training camp, eight miles south of Jalalabad, al-Masri led a group that experimented with several World War I-era chemical agents, including hydrogen cyanide, chlorine, phosgene, and mustard gas. After the U.S. invasion of Afghanistan in late 2001, U.S. troops searched the Darunta camp and found training manuals detailing the synthesis of nerve agents and how to enhance conventional explosives with toxic chemicals. The following year, CNN broadcast a disturbing al-Qaeda videotape obtained in Afghanistan that showed three dogs being exposed to a toxic gas that appeared to kill them after several minutes. In July 2008, Abu Khabab al-Masri was killed in a U.S. Predator drone strike near the Pakistan-Afghan border, dealing a major setback to al-Qaeda's CW ambitions.

Despite the strong interest in acquiring chemical weapons on the part of al-Qaeda and allied groups, their technical capabilities for production and delivery have remained rudimentary. For example, in February 2003, acting on a tip provided by the CIA, the Saudi Arabian authorities arrested a jihadist cell consisting of five Arab men who were loosely affiliated with al-Qaeda. When the investigators examined the hard drive of a computer owned by one of the men, they found a data file containing plans for a home-made chemical dispersal device called a *mubtakkar* ("invention" in Arabic). This device, which could be built from readily available materials, consisted of a container about the size of a paint can that held two Mason jars filled with liquid hydrochloric acid, surrounded by crystals of potassium cyanide. A detonator and small explosive charge, activated remotely by cell phone, were designed to break open the jars and allow the acid to react with the crystals to generate hydrogen cyanide gas, which is lethal when released in an enclosed space.

The Saudi cell contacted al-Qaeda and proposed using the *mubtakkar* for a terrorist attack on the New York City subway system. Osama bin Laden's deputy Ayman al-Zawahiri personally approved the plan, and the team traveled to the United States in autumn 2002. Six weeks before the planned attack in spring 2003, however, al-Zawahiri called off the operation and ordered the Saudi cell to return home, explaining, "We have something better in mind." As former CIA Director George Tenet noted in his memoir, *At the Center of the Storm*, the subway attack was canceled because it "was not sufficiently inspiring to serve al-Qai'da's ambitions." Indeed, when CIA chemists reconstructed the chemical dispersal device from the plans in the confiscated computer file, they determined that it would not have worked effectively. The acid and the cyanide crystals would have reacted violently, causing the device to blow apart and abort the generation of the lethal gas. Moreover, although hydrogen cyanide is invisible and odorless, the device would have given off a second, more noxious gas called cyanogen chloride, irritating the victims' eyes, throats, and lungs and causing them to flee the subway in search of fresh air before the hydrogen cyanide could reach a lethal concentration.

Individual "lone wolf" terrorists with advanced training in organic chemistry or chemical engineering may also pose a threat. In August 1998, for example, the Moscow police arrested a forty-year-old chemist named Valery Borzov after he attempted to sell a vial of nitrogen mustard (a potent blister agent) to an undercover officer. Borzov had been fired from his scientific research job in 1997 and since then had made a living by synthesizing toxic chemicals in a home laboratory and selling them to the Russian mafia and other criminals for $1,500 per vial. After his arrest, he was diagnosed with schizophrenia, found mentally incompetent to stand trial, and committed to a mental hospital. Although Borzov could produce small amounts of military-grade CW agents, manufacturing them in larger quantities and devising a suitable delivery system would require far greater technical resources and know-how.

Although most terrorist groups that seek a CW capability are still fairly low on the technical learning curve, they could potentially improve their capabilities through a process of trial and error, particularly if they can recruit chemists and chemical engineers who have practical experience working in a state-level CW program. Groups that have developed toxic weapons in the past have typically enjoyed a permissive environment that provided time and space for experimentation. In the case of Aum Shinrikyo, the Japanese police did not take preemptive action against the cult despite clear indications that it was working with toxic chemicals. The reason was that Aum had been officially designated a religion, giving it special legal protections. Similarly, al-Qaeda's physical sanctuary in Taliban-controlled Afghanistan enabled the group to develop and test chemical weapons in secrecy. These cases suggest the importance of denying terrorist groups safe havens, either physical or legal.

Because the prevention of chemical terrorism cannot be guaranteed, effective response and mitigation capabilities are essential, including plans and procedures for the storage, deployment, and administration of medical antidotes and the decontamination of crowds and buildings. The narrow time window for treating exposures to nerve agents (minutes to hours) means that federal response teams would probably arrive too late and would be useful mainly for post-incident decontamination and clean-up. For this reason, state and local hazmat units must be given additional resources and training, along with frequent field exercises. First responders also need better handheld CW agent detectors, portable decontamination showers that can be operated by small crews, and decontamination solutions that are environmentally friendly and less corrosive to the skin. Finally, public-affairs specialists must communicate vital information to the public so that individuals can take steps to minimize their risk of exposure.

Toxic Industrial Chemicals

In addition to the synthesis of sarin and other military-grade CW agents, possible scenarios for chemical terrorism include the release of toxic industrial chemicals (TICs) such as chlorine, phosgene, arsine, and anhydrous ammonia. Although these chemicals are less lethal than classical warfare agents, they are far more widely available. Dozens of different TICs could potentially be used as weapons, complicating the tasks of identification and treatment, particularly if mixtures are used. Moreover, large volumes of these agents might be released, compensating for their lower toxicity.

TICs could be stolen or diverted from several types of facilities, including chemical or pharmaceutical manufacturing plants, oil and gas installations, semiconductor factories, and even large farms, which use toxic pesticides and anhydrous ammonia as a source of nitrogen fertilizer. Chlorine has myriad industrial applications, including plastics production, water purification, and sewage treatment; in 2008, the global production capacity for chlorine was 62.8 million tonnes. Because of their ubiquity, TICs are relatively easy to acquire. In 2007, for example, investigators from the New York Police Department set up a fictitious water-purification company and ordered large quantities of chlorine over the Internet.

Although the synthesis of military-grade CW agents requires considerable technical expertise, the release of TICs would demand little specialized know-how. Terrorists could steal a pressurized cylinder of toxic gas and discharge it into an enclosed space, such as a subway station or the ventilation system of an office building, or they could use a small explosive charge to punch a hole in a chemical storage tank and release a cloud of toxic agent. The potential consequences of a TIC attack are suggested by industrial accidents involving hazardous materials, which are fairly common and occasionally devastating. The most consequential hazmat incident to date occurred at a Union Carbide pesticide plant in Bhopal, India, in December 1984. Some evidence suggests that this event may have been the result of intentional sabotage. In the middle of the night, water leaked—or was deliberately fed—into a large holding tank of methyl isocyanate, triggering an explosive reaction that led to the release of forty tonnes of highly toxic vapor. The poisonous cloud drifted over a sprawling shantytown adjacent to the plant, kept close to the ground by an atmospheric inversion. Of the large number of people exposed to the chemical, about 100,000 required urgent medical treatment and some 50,000 were hospitalized. An estimated 2,500 victims died immediately and about 16,000 succumbed after a period of months or years. Today, a quarter-century later, thousands of victims of the Bhopal disaster still suffer from chronic ailments.

Even if perimeter and personnel security at chemical plants that work with TICs are bolstered significantly, elements of the transportation infrastructure (such as rail cars, tanker trucks, and barges) may still be vulnerable to attack. In 2005, for example, the derailment of a freight train near the small town of Graniteville, South Carolina, led to the discharge of perhaps as much as sixty tons of chlorine gas, killing nine people and injuring 250 others. The consequences of the deliberate release of a TIC would depend on the characteristics of the agent, the atmospheric and weather conditions, and the population density in the path of the toxic plume. According to data from the Environmental Protection Agency, about a hundred chemical plants in the United States each put one million or more people at risk.

The best defense against chemical terrorism involving TICs is to prevent it from happening in the first place by enhancing the physical security of chemical plants and the associated transportation infrastructure, reducing the quantities of toxic chemicals that are stored and handled at plant sites; and converting industrial processes to less toxic chemicals whenever possible, such as using ozone or bleach instead of chlorine for water treatment and carbonate esters in lieu of phosgene. The transport of TICs also needs to be better regulated. According to Paul Orum of the Center for American Progress, each year railcars carrying chlorine gas travel 300,000 miles throughout the United States, passing through almost all major cities and towns.

Because no strategy of prevention is foolproof, efforts to enhance chemical plant and transportation security must be backed up with capabilities for incident response and mitigation. Real-time computer modeling can predict the geographical area affected by a toxic plume so that public health officials can advise local residents to evacuate or shelter in place. Improving the ability of cities and states to mitigate the consequences of chemical terrorism involving TICs would have the secondary benefit of building capacity to handle ordinary hazmat accidents.

Conclusions and Recommendations

Despite the successful implementation of the CWC over the past dozen years, chemical weapons remain a serious threat to U.S. and international security and deserve greater attention from policymakers, the news media, and the general public. The CW threat is multifaceted, encompassing military-grade agents, novel incapacitating agents, and toxic industrial chemicals. Moreover, in a world of globalized, flexible chemical manufacturing, countries may decide to hedge their bets by acquiring a standby capability to produce CW agents in a crisis or war. Such "latent" proliferation enables states to break out of the CWC on short notice, creating serious dilemmas for the verification of compliance.

To help prevent the re-militarization of chemistry, the United States and other like-minded countries should take the following steps:

• Increase significantly the budget of the OPCW, which has remained flat at about €74.5 million for the past five consecutive years despite the growing burden of inspections.

• Provide greater political support for the OPCW action plans to achieve universal adherence to the CWC and to ensure effective national implementation of the treaty by all member states. Since the OPCW adopted the action plan on universality in 2003, thirty-three additional countries have joined the CWC.

• Revive the dormant CWC challenge inspection mechanism by using it to clarify ambiguities about compliance, such as whether a particular facility should have been declared, thereby avoiding the political risks of trying to catch suspected violators red-handed.

• Earmark additional funding to accelerate the destruction of U.S. and Russian CW stockpiles in a safe and environmentally responsible manner, so as to complete the task as close as possible to the April 2012 treaty deadline.

• Increase the total number of OCPF inspections per year, while further refining the site-selection algorithm to focus on the multipurpose chemical manufacturing facilities that pose the greatest risk to the CWC.

• Clarify the law enforcement exemption in the CWC to restrict the types and quantities of chemical agents that can be used for counter-terrorism and paramilitary operations.

• Improve the monitoring of global trade in dual-use chemical precursors and production equipment, and support cooperative multinational efforts to track and interdict illicit shipments.

• Strengthen political and economic sanctions on companies and governments that continue to supply CW precursors and production equipment to known proliferators.

• Expand domestic preparedness measures for incidents of chemical terrorism.

Despite the important strides that have been made since the end of the Cold War in reducing the threat of chemical weapons, their total abolition remains a distant goal. At the same time, the emerging political and technological challenges to the effective implementation of the CWC provide grounds for concern. To prevent the chemical disarmament regime from unraveling in the future, the United States and other responsible members of the international community must take urgent steps to strengthen the ban on this largely forgotten class of armament.

STB Finance Docket No. 35504

UNION PACIFIC R.R. – PETITION FOR DECLARATORY ORDER

OPENING EVIDENCE AND ARGUMENT
OF
NORFOLK SOUTHERN RAILWAY COMPANY

EXHIBIT 5

TOXIC WARFARE

Theodore Karasik

Prepared for the United States Air Force
Approved for public release; distribution unlimited

RAND
Project AIR FORCE

The research reported here was sponsored by the United States Air Force under Contract F49642-01-C-0003. Further information may be obtained from the Strategic Planning Division, Directorate of Plans, Hq USAF.

Library of Congress Cataloging-in-Publication Data

Karasik, Theodore William.
Toxic warfare / Theodore Karasik.
p. cm.
"MR-1572."
Includes bibliographical references.
ISBN 0-8330-3207-0
1. Poisons—War use. 2. Toxins—War use. 3. Hazardous substances—War use. 4. Biological warfare. 5 Radioactive wastes—War use. 6. Terrorism. I.Title.

UG447 .K365 2002
358'.3—dc21

2002026562

Published 2002 by RAND
1700 Main Street, P.O. Box 2138, Santa Monica, CA 90407-2138
1200 South Hayes Street, Arlington, VA 22202-5050
201 North Craig Street, Suite 202, Pittsburgh, PA 15213-1516
RAND URL: http://www.rand.org/
To order RAND documents or to obtain additional information, contact Distribution Services: Telephone: (310) 451-7002;
Fax: (310) 451-6915; Email: order@rand.org

PREFACE

Recent events suggest that "toxic warfare"—or the use of inexpensive chemicals and industrial waste in weaponry—is on the rise. Accordingly, this report offers an initial analysis of the extent of the problem by bringing together what is currently known about toxic weapon use. Both state and nonstate actors (including insurgents and terrorists) are using toxic weapons, which provide an attractive asymmetrical option because they are inexpensive, are available in large quantities, are found in urban areas, and, perhaps most significantly, are not entirely secure from theft or diversion. The substances used to make these weapons have thus far been relegated to low-priority status under international law regulating the use of chemical weapons—thereby making it easier for those interested in their use to gain access to them. This report offers historical examples, most drawn from the past decade, to illustrate where and how such weapons have been used. It also examines U.S. operations during toxic warfare and discusses current thinking in the United States about toxic weapons with respect to both military operations and homeland security.

The report should be of interest to those involved in military and civilian crisis response planning. This study was conducted as part of the Strategy and Doctrine Program of RAND's Project AIR FORCE. Comments are welcomed and may be addressed to the author or to the Program Director, Dr. Ted Harshberger. The cutoff date for this research was January 2002.

PROJECT AIR FORCE

Project AIR FORCE, a division of RAND, is the Air Force federally funded research and development center (FFRDC) for studies and analyses. It provides the Air Force with independent analyses of policy alternatives affecting the development, employment, combat readiness, and support of current and future air and space forces. Research is performed in four programs: Aerospace Force Development; Manpower, Personnel, and Training; Resource Management; and Strategy and Doctrine.

CONTENTS

TABLES

SUMMARY

In recent years, there appears to be an increased interest in weapons that incorporate chemicals and industrial wastes that are both inexpensive and relatively easy to acquire. Such "toxic weapons" provide a means for hostile state or nonstate actors to improve their capabilities within the context of asymmetrical warfare. In basic terms, toxic warfare refers to the use of chemicals or industrial waste to harm or alter the behavior of an opponent during military operations. Toxic warfare does not, however, require the use of traditional weapons; it can also involve the release of chemicals into the environment (e.g., from industrial manufacturing or waste sites). A preliminary review of incidents involving toxic weapons suggests that such weapons merit greater attention as part of military and civilian crisis response planning.

WHAT ARE TOXIC WEAPONS?

In contrast to chemical weapons, which involve the use of banned substances such as the nerve agents sarin and soman, toxic weapons are made from materials that are usually readily (and legally) available in connection with industrial operations. The most common types of hazardous materials used in toxic weapons are irritants, choking agents, flammable industrial gases, water supply contaminants, oxidizers, chemical asphyxiants, incendiary gases and liquids, industrial compounds, and organophosphate pesticides. Various forms of toxic waste (e.g., petroleum spills, smoke, refuse, sewage, and medical waste) can also be used in toxic warfare.

Abundant sources of industrial materials and waste are available for use in toxic warfare. Although large industrial facilities are an obvious source of concern, other common urban locations, such as airports, college laboratories, and even garden-supply warehouses, pose risks as well. Illegal chemical and toxic waste sites are another potentially significant source of toxic warfare materials.

Toxic warfare can be used by both state and nonstate actors to achieve a number of objectives. Toxic warfare can cause casualties among opposing militaries by incapacitating and, in some cases, killing the adversary. Toxic warfare can also halt or force delays in military logistics flows or operations and can disrupt the functioning of the urban infrastructure through contamination or corrosion. Toxic weapons can, moreover, derive power from the uncertainty that stems from their potential use. Toxic substances often represent an unknown threat, and the level of uncertainty surrounding the potential damage these substances *might* cause can increase their impact even when little or no physical harm has been done.

RECENT USE OF TOXIC WEAPONS

There have been many incidents of toxic warfare in recent years. During the Gulf War, retreating Iraqi forces intentionally caused the release of crude petroleum from field production facilities and ignited the oil to slow advancing coalition forces—the only time U.S. operations have faced a toxic attack. During the Balkan wars, Serbian forces attacked a Croatian Petrochemia facility that stored large quantities of anhydrous ammonia and a variety of other potentially hazardous chemicals. From 1993 to 1995, the facility was attacked six times with rockets, bombs, artillery, and mortars. Serbian forces also intentionally targeted a pesticide production facility at Sisak and a natural gas refinery in Ivanic. During the siege of Muslim forces in Tuzla by the Serbs, the Muslims threatened to release large quantities of chlorine gas from railroad tank cars under their control despite the large number of friendly casualties that would have resulted. Other toxic incidents have occurred in Chechnya, Sri Lanka, and the Middle East.

Some new trends in toxic warfare also seem to be emerging. For example, toxic weapons seem to be used more frequently in conjunction with increasingly complex forms of organization, training, and equipment, including that represented by Al-Qaeda and Osama bin Laden. Another trend concerns increased opportunism in the use or combination of toxic substances. Those who use toxic weapons seek to create uncertainty by exploiting whatever opportunities are available to bend the definition of chemical warfare and conventional conflict through their choice of toxic materials and tactics.

TOXIC THREATS IN EXPEDITIONARY SETTINGS

Although U.S. military forces have not yet faced repeated threats from toxic weapons, that possibility clearly exists, particularly in light of the wide availability of toxic materials. One such threat arises from toxic smoke in the field of operations, which can be used to cause confusion, impair vision, and disrupt military operations. Water supplies in areas of operations are vulnerable to both intentional and accidental contamination. Toxic waste poses another threat. The U.S. military is currently seeking to improve its ability to respond to toxic warfare by updating military field manuals and related documents to address the issue of organizing, training, and equipping for such warfare.

At the same time, however, the level of threat that toxic weapons represent remains to be determined. Should toxic warfare be considered a mere nuisance or a threat of strategic concern? Although it is impossible to know how extensively toxic weapons will be used in the future, there are several reasons for concluding that toxic warfare merits serious consideration as part of future planning strategies.

- **The United States is not immediately aware of the location of toxic threats.** In future operations, it is possible that an entire area of operations could be contaminated with toxic waste. Although the identification of specific threats is a painstaking process, U.S. forces will need to improve their knowledge of the locations of both legal and illegal sources of toxic waste.
- **At the operational level, U.S. forces currently have no tailored response to toxic warfare in doctrine.** In particular, the U.S. military will need to resolve at the doctrinal level the trade-off between force protection and mobility/agility. Put another way, to what extent does the potential for toxic warfare require that chemical kits, protective clothing, cleanup materials, and the like

be carried on operations if doing so would impede the mobility and agility of the forces?

- **The use of toxic weapons has implications for U.S. military lift and logistics.** As base security becomes more critical to operations, the vulnerability of key logistics sites has emerged as an important issue. Many sites are vulnerable to toxic attack, including ports, airfields, and related fixed sites that serve as choke points. Support staging areas as well as rail and road networks are also potential targets, as are intermediate and infrastructure logistics bases. Procedures will be needed to address these threats.
- **At the tactical level, U.S. armed forces may not be ready for toxic warfare.** The Office of the Secretary of Defense has found a number of problems associated with preparation for toxic warfare as a subset of a nuclear, biological, or chemical attack. For example, toxic vapors often hug the ground, an issue that is not addressed in some scenarios. Air Force programs also require additional policy and guidance, an integrated training and exercise program, and first-responder equipment for addressing toxic attacks.
- **Cleanup from a toxic attack may pose a difficult challenge.** The decontamination of aircraft presents an especially difficult challenge, as demonstrated by the oil-laden rain encountered by coalition forces during the Gulf War. Decontamination procedures will need to address fixed sites as well as cargo and equipment.

TOXIC THREATS IN THE UNITED STATES

Toxic warfare is a threat not just for U.S. forces engaged in military operations but also for civilians within the United States. This risk is increased by the wide availability of toxic materials throughout the United States, together with the proximity of industrial operations to large urban centers.

At the forefront of toxic warfare in the United States are the first responders, whose mission is to respond immediately in the event of a crisis or disaster. First responders include personnel from medical, law enforcement (or security), fire/rescue, hazardous material

(HAZMAT), and explosive ordnance disposal organizations. U.S. domestic responders are in the process of organizing, training, and equipping to counter potential attacks.

Other domestic capabilities, however, need to be improved as well. Currently, for example, there is no consistent approach toward burden sharing among agencies, particularly with regard to treating casualties. Internet connectivity in many hospitals remains poor, with only 25 percent of laboratories up to federal standards for access to and dissemination of information. Moreover, in the event of multiple toxic attacks, the scope of response needed could overwhelm local resources.

Military and civilian crisis response preparedness efforts must also be better coordinated. The U.S. military possesses chemical weapon prevention and cleanup expertise that is applicable to homeland security. Civilian crisis response personnel can for their part provide expertise in areas such as HAZMAT. Additional opportunities to share information and coordinate efforts need to be identified.

Finally, the risks associated with toxic warfare—both for expeditionary forces and within the United States—must be better understood. Planning for military operations and civilian crisis response requires a detailed understanding of the benefits and costs associated with various options for countering toxic weapons. While this report is meant to fill some of the gaps in understanding surrounding toxic weapons, a quantitative risk assessment should be considered as a means of providing a more thorough evaluation of the problem.

ACKNOWLEDGMENTS

The contents of this report are the result of discussions with colleagues at the Armed Forces Medical Intelligence Center, the Air Mobility Command, Lawrence Livermore National Laboratory, the Monterey Institute of International Studies, the Central Intelligence Agency, the Defense Intelligence Agency, the National Ground Intelligence Center, and the U.S. Transportation Command (TRANSCOM). RAND colleagues Ted Harshberger, Eric Larson, Derek Eaton, Jed Peters, William O'Malley, Les Dishman, Richard Bancroft, and Leroy Reyes also contributed commentary to early ideas and evolving thought as well as useful primary and secondary sources. Special thanks go to Kristin Leuschner, who edited and critiqued the original draft.

ACRONYMS

AFMIC	Armed Forces Medical Intelligence Center
APOD	Aerial port of debarkation
C^2	Command and control
C^4I	Command, control, communications, computers, and intelligence
CBRN	Chemical, biological, radiological, and nuclear
CBW	Chemical and biological weapon
CINC	Commander in chief
CONUS	Continental United States
CWC	Chemical Weapons Convention
ELN	Army of National Liberation (Colombia)
EOD	Explosive ordnance disposal
FAE	Fuel air explosive
FARC	Revolutionary Armed Forces of Colombia
FM	Field Manual
HAZMAT	Hazardous material
HQ AFCESA	Headquarters, Air Force Civil Engineer Support Agency

IO	Information operations
JP	Joint Publication
KTO	Kuwaiti theater of operations
LPG	Liquefied petroleum gas
LTTE	Liberation Tigers of Tamil Eelam
MIC	Methyl isocyanate
NBC	Nuclear, biological, and chemical
OSD	Office of the Secretary of Defense
PCB	Polychlorinated biphenyl
PKK	Kurdish Workers Party
POE	Port of embarkation
PSYOP	Psychological operations
SBCCOM	Soldier and Biological Chemical Command (U.S. Army)
TRANSCOM	Transportation Command
UNPROFOR	United Nations Protection Force
USACMLS	U.S. Army Chemical School
WMD	Weapons of mass destruction

Chapter One

INTRODUCTION

In recent years, there would appear to be an increased interest in weapons that incorporate inexpensive, relatively easy-to-acquire chemicals and industrial wastes. Such "toxic weapons" might take the form of a rocket containing insecticide or several barrels of toxic chemicals left in an adversary's path to force the diversion of troops. To date, however, instances of toxic warfare have not been subjected to extensive analysis, largely because greater interest has been manifested in more sophisticated forms of chemical warfare, including the use of weapons of mass destruction (WMD) and the development of nuclear, biological, and chemical (NBC) doctrine.[1]

A preliminary review of incidents involving toxic weapons suggests that they merit greater attention, especially because of the threat they pose within the context of asymmetrical warfare. Asymmetrical strategies focus on attacking an adversary's points of vulnerability by

[1]See Jean Pascal Zanders, "Assessing the Risk of Chemical and Biological Weapons Proliferation to Terrorists," *Nonproliferation Review*, Fall 1999, pp. 17–34; Raymond A. Zilinskas, "The Threat of Bioterrorism," Center for Nonproliferation Studies briefing, August 3, 1998, available at http://cns.miis.edu/iiop/cnsdata; Al J Venter, "Biological Warfare: The Poor Man's Atomic Bomb," *Jane's Intelligence Review*, Vol. 11, No. 3, March 1, 1999, p. 42; Malcolm Dando, "Discriminating Bio-Weapons Could Target Ethnic Groups," *International Defense Review*, Vol. 30, No. 3, March 1, 1997, p. 77; Gert G. Harigel, *Chemical and Biological Weapons: Use in Warfare, Impact on Society and Environment*, Carnegie Endowment for International Peace, available at http://www.ceip.org/files/publications/Harigelreport.asp?p=8; *Chemical Warfare. A Burning Issue—Project on Insurgency, Terrorism and Security*, available at http://paladin-san-francisco.com/llbgas03.htm; Jonathan B. Tucker (ed.), *Toxic Terror. Assessing Terrorist Use of Chemical and Biological Weapons*, Cambridge, MA: MIT Press, 2000; and Graham Spearson, "Strategic and Security Issues: Forbidden, Not Forgotten," *International Defense Review*, Vol. 30, No. 3, March 1, 1997, available at Intelink.

increasing the level of threat in areas in which that adversary is least prepared. Asymmetrical tactics seek means of catching the enemy off guard, and they do so using unexpected—as well as typically inexpensive and easily available—means of attack.

Toxic weapons provide an opportunity for hostile state or nonstate actors to increase their asymmetrical capabilities. The materials for toxic warfare are ubiquitous, particularly in industrialized nations such as the United States. The number of such attacks seems to be on the increase, and the potential exists for more frequent and more lethal uses of such weapons in the future. This risk can increase to the extent that U.S. troops are deployed to unstable, unsafe areas in which toxic materials are readily available.

This study attempts to fill some of the gaps in our understanding of toxic weapons in asymmetrical warfare. Toward this goal, it first examines the scope of the risks these weapons pose. It then describes some recent incidents involving toxic warfare and proceeds to discuss the nature of the risk both to U.S. expeditionary forces and to the U.S. homeland.

RECENT EXAMPLES OF TOXIC WARFARE

The manner in which industrial chemicals may be intentionally used as toxic weapons can be briefly illustrated through some examples drawn from the Gulf War and the Balkan conflict. In 1990, retreating Iraqi forces intentionally caused the release of crude petroleum from field production facilities and ignited the oil in efforts to slow advancing coalition forces. In the mid-1990s, the Balkan conflict involved frequent attacks on chemical production facilities. From 1993 to 1995, for example, Serbian forces launched six attacks on a Petrochemia facility near Kutina, Croatia, that stored large quantities of anhydrous ammonia as well as a variety of other potentially hazardous chemicals; these attacks involved rockets, bombs, artillery, and mortars. Serbian forces are also known to have targeted a pesticide production facility at Sisak and a natural gas refinery in Ivanic. Although none of these attempts was wholly successful, subsequent U.S. modeling efforts indicated that if the attacks had destroyed existing stored chemical containers, lethal concentrations of chemicals would likely have spread over a wide area. Toxic weapons were also used against the Serbs, such as when Muslim forces in

Tuzla threatened the use of chemicals in efforts to hold off a Serbian attack against the city. These forces vowed to release large quantities of chlorine gas from railroad tank cars if the city was assaulted—despite the large number of friendly casualties that would have resulted from such an action.

THE UBIQUITY OF RAW MATERIALS FOR TOXIC WEAPONS

Although the threat posed by toxic weaponry may in some cases be little more than a nuisance, in other cases it can have catastrophic results. Indeed, the fact that some acts of toxic warfare have been ineffective should not be used as evidence that the threat from these weapons is low, especially in light of the ubiquity of toxic substances both within the United States and worldwide. The relatively easy access to such materials, when combined with their low cost and the low security often associated with storage facilities, makes them a potentially attractive and highly available option for asymmetrical warfare. Industrialized nations are home to thousands of facilities and sites that manufacture, use, or transport toxic substances; these include oil and gas installations, extended pipelines, refineries, and chemical shipping facilities.[2] At the same time, chemicals useful for toxic warfare can be obtained almost anywhere in the world. Existing stored chemicals—including those found on military sites—can easily be made to serve as "weapons of opportunity."

The notion of opportunism is central to this discussion. A manufacturing capability is not required in order for industrial chemicals to be used as weapons. In fact, these substances need not even be shaped into anything resembling a traditional weapon in order to be effective. In some cases, toxic warfare could occur as a "side effect" of more traditional military operations, such as when damage to industrial facilities from military operations leads to a catastrophic chemical release. Indeed, the very presence of such facilities can threaten military operations in urban areas, which could be affected if, for example, an electrical power interruption or an improper facility shutdown were to cause a chemical release. Such events are common during complex emergencies, armed conflicts, and post-

[2]See "Forced to Take a Lead on Hazardous Materials," *Jane's International Police Review*, January 1, 2000, available at Intelink.

conflict reconstitution periods. The key point is that while toxic warfare is typically initiated by a deliberate act, it can also result when adversaries exploit the opportunities presented by accidental toxic releases and the ubiquity of toxic substances.

THE IMPACT OF TOXIC WEAPONS

Toxic warfare is used by state and nonstate actors to achieve military and political goals. On one level, toxic warfare can cause casualties among opposing militaries. It can incapacitate and in some cases kill the adversary, although the latter objective is not necessarily the primary motivation for its use. Toxic warfare can also halt or force delays in military logistics flows or operations. Similarly, it can disrupt the functioning of the urban infrastructure and create panic among the citizenry. Yet much of the power of toxic weapons lies in the uncertainty associated with their potential use. Toxic substances often represent an unknown threat, and the level of uncertainty surrounding the potential damage these substances *might* cause—be it to soldiers in transit, to the civilian population, or to urban infrastructure and military logistics—can increase their effect even in cases in which little or no physical harm has occurred. Thus, while more conventional types of weapons might cause greater levels of collateral damage and can be more accurately targeted, toxic weapons are useful in asymmetrical warfare precisely because they use relatively small amounts of available chemicals or industrial waste to create what seems to be—and sometimes is—a disproportionately large and potentially devastating threat.

Toxic warfare remains a possibility within the United States in large part because of the size of the U.S. industrial infrastructure, which makes greater use of toxic chemicals and produces more industrial waste than any other country in the world. The quantity of chemicals alone provides terrorists with many potential opportunities to use toxic weapons to scare, maim, and kill. The possibility of toxic warfare is especially likely during complex emergencies and conflict.

ABOUT THIS REPORT

This study provides a qualitative overview of the threat posed by toxic weapons and identifies key vulnerabilities faced by the United

States and the U.S. military, particularly the U.S. Air Force. Because the analysis is drawn entirely from unclassified sources, it cannot offer a detailed analysis of the intelligence requirements for toxic warfare. Nor does the report seek to provide a quantitative assessment of the risks associated with toxic weapons. While such an effort may prove useful and even necessary in helping the U.S. military determine how great an effort should be directed toward toxic weapons, it was beyond the scope of this study.

The remainder of the report focuses on several issues related to toxic warfare. Chapter Two explains the composition and sources of toxic weapons as well as their potential for harm. Chapter Three analyzes the use of toxic weapons by state and nonstate actors over the past decade and considers the potential for escalated use. Chapter Four focuses on the threat to U.S. forces that are engaged in expeditionary operations, particularly the U.S. Air Force. Finally, Chapter Five considers the nature of the threat to the U.S. homeland.

Chapter Two

WHAT ARE TOXIC WEAPONS?

If we are to analyze the potential threat toxic weapons pose, we must first look in more detail at the nature of toxic weapons, the sources of materials for those weapons, and the type of damage they can cause. This chapter addresses each of these issues in turn.

THE COMPONENTS OF TOXIC WARFARE

Put simply, toxic warfare refers to the use of chemicals or industrial waste to harm or alter the behavior of an opponent during military operations.[1] Toxic warfare does not require the use of weapons per se; while toxic substances may be incorporated into traditional weaponry, such warfare can also involve the release of chemicals into the environment (e.g., from industrial manufacturing or waste sites) without the use of any traditional weapons. Toxic warfare typically involves the use of inert chemicals that in some cases produce immediate, mild health effects. These conditions cannot, however, spread without direct exposure to the substances, which are relatively nonpersistent in the environment. In contrast to chemical weapons, which can involve the use of banned substances such as the nerve agents sarin and soman, toxic weapons are made from materials that are usually readily (and legally) available in connection with industrial operations.

[1] Dust agents are also part of toxic warfare in that toxic materials can absorb substances and carry the agent toward its intended target site depending on the time of day or night, the ground and air temperature, and weather patterns at the site of use.

Among the most common types of hazardous materials are the following:

- Irritants (acids, ammonia, acrylates, aldehydes, and isocyanates);
- Choking agents (chlorine, hydrogen sulfide, and phosgene);
- Flammable industrial gases (acetone, alkenes, alkyl halides, and amines);
- Water supply contaminants (aromatic hydrocarbons, benzene, etc.);
- Oxidizers capable of increasing the danger of explosions (oxygen, butadiene, and peroxides);
- Chemical asphyxiants (aniline, nitrile, and cyanide compounds);
- Incendiary gases (compressed isobutene, liquefied natural gas, and propane);
- Incendiary liquids (liquid hydrocarbons, gasoline, and diesel and jet fuel);
- Industrial compounds that act much like blister agents (dimethyl sulfate); and
- Organophosphate pesticides that can act as low-grade nerve agents.

Various forms of toxic waste (which may include petroleum spills, smoke, refuse, sewage, and medical waste) can also be used in toxic warfare. All these substances can contribute in varying degrees to a state or nonstate actor's asymmetrical capability.[2]

---

[2]Joint Publication (JP) 3-11 defines industrial chemicals as chemicals developed or manufactured in industrial operations or research by industry, government, or academia These chemicals are not primarily manufactured for the specific purpose of producing human casualties or rendering equipment, facilities, or areas dangerous for human use. Hydrogen cyanide, cyanogen chloride, phosgene, and chloropicrin are industrial chemicals that can also be military chemical agents. This term and its definition are approved for inclusion in the next edition of JP 1-02. See *Joint Doctrine for Operations in Nuclear, Biological, and Chemical (NBC) Environments*, Washington, D.C., Joint Publication 3-11, July 11, 2000.

The Chemical Weapons Convention (CWC) regulates the use of chemical substances in warfare, including more traditional chemical weapons as well as substances used to make toxic weapons. Article 2, paragraph 1, of the CWC defines "chemical weapons" as

> (a) Toxic chemicals and their precursors, except where intended for purposes not prohibited under this Convention, as long as the types and quantities are consistent with such purposes;
>
> (b) Munitions and devices, specifically designed to cause death or other harm through the toxic properties of those toxic chemicals specified in subparagraph (a), which would be released as a result of the employment of such munitions and devices; [and]
>
> (c) Any equipment specifically designed for use directly in connection with the employment of munitions and devices specified in subparagraph (b).

Many of the substances used in toxic weapons are found on Schedule 3 of the CWC.[3] While Schedule 1 of the CWC focuses on superlethal

---

[3]Schedule 1 lists three families of nerve agents: the sarin, soman, and GF family; the tabun family; and the VX family. Nerve agents are organophosphorous chemicals of very high toxicity. The first nerve agent, tabun, was discovered in 1936 during a search for better pesticides. Nerve agents act by inhibiting the enzyme acetylcholinesterase, thus preventing the enzyme from destroying the neurotransmitter acetylcholine after it has transmitted a nerve signal to a muscle. The muscle will then remain contracted—i.e., in cramp. Few or no peaceful uses have yet been identified for any members of the three listed nerve agent families.

Schedule 1 includes two families of nerve agent precursors and two individual nerve agent precursor chemicals. Mustard agents and lewisites cause wounds resembling burns and blisters. They can also cause severe damage to the eyes, respiratory system, and internal organs. Schedule 1 includes 15 agents of this type: nine sulfur mustards, three nitrogen mustards, and three lewisites. Mustard gas was discovered in 1822 and was used extensively during World War I. In the 1930s it was used against Abyssinia and China and in the 1980s against Iran. A considerable part of the present-day stockpile of chemical weapons to be destroyed under the convention consists of mustard agent in bulk form and in filled munitions.

Two toxins have been included in Schedule 1: ricin and saxitoxin. Both have been studied for possible use as chemical weapons. Ricin is a protein that is formed in the seeds of the widely cultivated castor oil plant, from which it can be extracted. It is more toxic than nerve agents on a weight basis and acts by blocking the body's synweapons that involve nerve agents and Schedule 2 includes dual-use (both industrial and military) chemicals (typically of limited use), Schedule 3 focuses on chemicals that can be legally used in industrial processes. Schedule 3 chemicals tend to be easier to obtain than those listed in Schedules 1 and 2 and can be employed for destructive purposes. Typically they have also been less widely emphasized than those found in Schedules 1 and 2.

One of the greatest threats from Schedule 3 toxins comes when substances are combined. The result can be a weapon-grade substance such as phosgene, cyanogen chloride, hydrogen cyanide, and chloropicrin. Each of these chemicals has a legitimate industrial use but also poses a threat in toxic warfare. Phosgene is a gas used as an intermediate in the preparation of many organic chemicals, including agrochemicals, and was used in chemical weapons during World War I. Inhalation can be fatal, but exposure may not be noticed immediately. Cyanogen chloride and hydrogen cyanide are both important synthetic intermediates; hydrogen cyanide has also been used as a pesticide. Both can block cell respiration, and high concentrations can be fatal within minutes. Chloropicrin is a soil sterilant, grain

---

thesis of proteins. Ricin is being studied as a possible chemotherapeutic agent for the treatment of leukemia and liver cancer. Saxitoxin is a complex organic chemical synthesized by a blue-green algae species. These algae provide food for mussels, which accumulate the toxin. The toxin acts on the nervous system. One milligram can eventually kill a human being. Higher doses may be lethal within 15 minutes. Saxitoxin is used as a biochemical research tool.

Schedule 2 agents are dual-use chemicals of limited use. There are three toxic chemicals. Amiton is an organophosphorous insecticide that was first synthesized around 1950. Today it is considered too toxic for use in agriculture. PFIB, short for perfluoroisobutylene, is a gas that is formed as a by-product during the production of some perfluorinated polymers, such as Teflon. It has no commercial application. Its toxicity is similar to that of phosgene (see below). BZ has earlier been weaponized as an incapacitating agent to be disseminated as aerosolized solid particles. It is widely used in minute quantities as a biochemical research tool and is also an intermediate in the production of a pharmaceutical. Finally, Schedule 2 includes a considerable number of precursors to nerve agents, mustard gas, lewisites, and BZ. All chemicals containing a phosphorus atom with one attached methyl, ethyl or propyl group are included (with one exception: the pesticide fonophos).

Schedule 3 includes phosgene (carbonyl dichloride), cyanogen chloride, hydrogen cyanide, and chloropicrin (trichloronitromethane). Precursors are phosphorus oxychloride, phosphorus trichloride, phosphorus pentachloride, trimethyl phosphite, triethyl phosphite, dimethyl phosphite, diethyl phosphite, sulfur monochloride, sulfur dichloride, thionyl chloride, ethyldiethanolamine, methyldiethanolamine, and triethanolamine.

disinfectant, and synthetic intermediate. Exposure can cause severe irritation and lacrimation.

Although Schedule 3 chemicals are not considered nerve agents either by international law or by chemical treaty, Schedule 3 includes seven nerve agent precursors. Examples include phosphorus oxychloride and phosphorus trichloride, which have extensive applications in the chemical industry, including insecticide production and chlorination. Three sulfur mustard and three nitrogen mustard precursors are listed on Schedule 3, including triethanolamine, which has several uses ranging from the production of surface-active chemicals to use as a solvent. Sulfur monochloride serves as a chlorinating agent in the production of dyes and pesticides and is also used for cold vulcanization of rubber and as a polymerization catalyst for vegetable oils.

As these examples suggest, toxic weapons can have lethal potential—although, as will be shown later, they need not be lethal in order to be effective.

SOURCES OF TOXIC SUBSTANCES

One of the most important features of toxic weapons is the ready availability of the substances used to create them. There are abundant sources of industrial materials and waste for use in toxic warfare. In fact, chemical waste is likely to be found in some form and quantity at any industrial site. Unprocessed laboratory solvents, for example, pose a risk of toxic exposure, especially if they enter into the water supply. The risk of toxic exposure is significant because chemical production sources and stockpiles are frequently stored in drums and tanks located near inhabited areas. Industrial chemicals that are released as vapors can pose an additional risk because they tend to remain concentrated in locations downwind from the release point and can accumulate in low-lying areas such as valleys, ravines, and man-made underground structures. Table 2.1 lists the major industrial sources of chemical toxins.

While large industrial facilities are obviously sources of major concern for toxic weaponry, other common urban locations pose risks as well. Urban areas that contain toxic materials include airports, col-

Table 2.1

Potential Sources of Chemical Toxins for State and Nonstate Use

Paint formulation and organic chemical producers
Production of pesticides and wood preservatives
Manufacturing plants and smelting industries
Agricultural fumigants, industrial wastes, and pharmaceutical wastes
Lead, mercury, and cadmium-nickel battery manufacture
Textile mills, cosmetics manufacturing, dyeing and tanning industries
Petroleum refining

SOURCE: George A. Alexander, "Ecoterrorism and Nontraditional Military Threats," *Military Medicine*, Vol. 165, No. 1, January 2000, p. 3.

lege laboratories, and even garden-supply warehouses.[4] The most common risks are associated with gases, especially the irritants chlorine, sulfur dioxide, ammonia, and hydrogen chloride. Table 2.2 shows the most common locations and sources of toxic materials in urban areas.

Another potentially major source of materials for toxic warfare lies in the illegal chemical and toxic waste sites—both industrial and medical—that can be found throughout North America, Europe, the Middle East, and likely East Asia. Millions of tons of toxic waste are transported each year by both organized and nonorganized criminal networks into poorer, urbanized centers in areas of conflict and crisis.[5] Because criminals seek to avoid waste disposal fees, they typically select remote areas to deposit their illegal toxic shipments, thereby making it easy for these materials to be diverted by state or nonstate actors for other uses—including military tactics and operations.[6] Increasingly, these wastes are being transported to

[4]Annual waste production is discussed in Gert G. Harigel, *The Concept of Weapons of Mass Destruction: Chemical and Biological Weapons, Use in Warfare, Impact on Society and Environment*, presented at the Conference on Biosecurity and Bioterrorism, Istituto Diplomatico "Mario Toscano," Rome, Italy, September 18–19, 2000, p. 10.

[5]See John Dean, "Organized Crime Versus the Environment," *Jane's International Police Review*, January 1, 2000, available at Intelink; and Christoph Hilz, *The International Toxic Waste Trade*, New York: Van Nostrand Reinhold, 1992.

[6]See "Forced to Take a Lead on Hazardous Materials," January 1, 2000, Mark Galeotti, "Crimes of the New Millennium," *Jane's Intelligence Review*, August 1, 2000, available

Table 2.2

Locations of Toxic Materials in Urban Areas Available to State and Nonstate Actors

Location	Toxic Materials
Airports	Aviation gasoline, jet fuel
Farm and garden-supply warehouses	Pesticides
Barge terminals	Bulk petroleum and chemicals
College laboratories	Organic chemicals, radioactive material
Electronics manufacturers	Arsine, arsenic trichloride
Food processing and storage areas	Ammonia
Glass and mirror plants	Fluorine, hydrofluoric acid
Pipelines and propane storage tanks	Ammonia, methane, and propane
Plastic manufacturers	Isocyanates, cyanide compounds
Landscaping businesses	Ricin
Medical facilities	Radioactive isotopes, mercury, waste
Inorganic chemical plants	Chlorine
Hard rock ore mines	Potassium and sodium cyanide
Pesticide plants	Organophosphate pesticides
Petroleum storage tanks	Gasoline, diesel fuel
Photographic supply distributors	Cyanides, heavy metals
Rail and trucking lines, chemical manufacturing plants	Anhydrous ammonia; sulfuric, phosphoric, and hydrochloric acids; flammable liquids; chlorine; peroxides; and other industrial gases
Power stations and transformers	Polychlorinated biphenyls (PCBs)

SOURCE: *The Infantryman's Guide to Modern Urban Combat*, Field Manual (FM) 90-10-1, Q-2 (coordinating draft), July 1, 2000 (hereafter referred to as FM 90-10-1).

unstable areas. In Somalia and in the Levant, for example, illegal toxic waste transfers measuring in the hundreds of tons occur alongside military operations.[7] Eventually the two may intersect, creating a toxic combat environment that affects the U.S. Air Force and other U.S. services.

at Intelink; and Mark Galeotti, "The New World of Organized Crime," *Jane's Intelligence Review*, September 1, 2000, available at Intelink

[7]The Israeli transfer to Jordan involved 500 tons of toxic material. See Ghassan Joha, "Israel's Bid to Dump Toxic Waste in Jordan Foiled," *The Star*, November 30, 2000, accessed from FBIS-IAP-20001130000091. For more on illegal toxic dumping, see Svend Soyland, *Criminal Organizations and Crimes Against the Environment: A Desktop Study*, Turin, Italy: United National Interregional Crime and Justice Research Institute, June 2000.

THE IMPACT OF TOXIC WARFARE

There are three broad categories of effects associated with toxic warfare: health hazards, damage to or contamination of military or civilian infrastructure, and psychological effects resulting from the actual or threatened use of toxic substances.

In assessing the potential human health hazards or risks from exposure to toxic weapons, we must consider the form of the substance released (solid, liquid, or gas) as well as its innate toxicity and the nature of the exposure (e.g., how much of the chemical was released and whether the person was exposed through inhalation, ingestion, etc.).[8] For humans, the most extreme health effects typically occur as a result of exposure to gases. The irritants chlorine, sulfur dioxide, and hydrogen chloride all have relatively high toxicity when inhaled. In addition, combustibles such as the polymer intermediate vinyl acetate present extreme fire hazards. In the 1970s, the latter compound was responsible for a large, potentially dangerous vapor release in a major metropolitan area; the explosion involved a 30,000-gallon-capacity tank as well as 21 other tanks with chemical substances. The greatest threat to people comes from off-gases, which form from the oxidation of modern plastics and their monomers. Vinyl chloride, carbon monoxide, and hydrogen cyanide, for example, contribute to making phosgene upon burning. As many as half of the deaths attributed to smoke inhalation are actually due to poisonous off-gases released during fires.

The lethality of off-gases was apparent in the 1984 disaster in Bhopal, India, in which a disgruntled employee mixed water into methyl isocyanate (MIC), a chemical intermediate used in the synthesis of carbamate pesticide (sevin). The local inhabitants who gathered around the plant to watch the disaster unfold inhaled the deadly gases released from the mixture of water and MIC and were among the first of more than 3800 fatalities. Although most carbamate pesticides manufactured in Western countries today do not call for large vol-

[8]D. J Rodier and M. G. Zeeman, "Ecological Risk Assessment," in L. G. Cockerham and B. S. Shane, *Basic Environmental Toxicology*, Boca Raton, FL: CRC Press, 1994, pp. 581–604; E. B. Overton, W. D. Sharpe, and P. Roberts, "Toxicity of Petroleum" in *Basic Environmental Toxicology*, pp. 133–156; and P. A. Reinhardt and J. G. Gordon, *Infectious and Medical Waste Management*, Chelsea, MI: Lewis Publishers, 1991.

umes of MIC on-site, MIC is typically transported to the sites during the production process. In addition, other chemicals that are typically kept on-site at Western industrial facilities (e.g., ammonia and phosgene) could potentially result in a catastrophic release of a magnitude similar to that of the Bhopal incident.[9] The impact of such catastrophic releases could involve thousands of individuals, resulting in health effects ranging from minor lung and skin irritation to death.

In addition to causing health effects, toxic substances can be used by state and nonstate actors against civilian and military symbols and infrastructure. Toxic warfare can render infrastructure targets unfit for occupation or use by humans and can also damage structures through corrosion. State and nonstate actors can use toxic warfare against civilian and military building and facilities, population centers, command-and-control (C^2) facilities, and logistical lines. Civilian targets include national monuments, public gathering places, conveyances, and energy and water facilities. Military targets include fixed formations such as bases or troop emplacements and mobile targets such as convoys, columns, and shipping. When used against military targets, toxic weapons can interrupt operations by forcing an opponent to change planning and deployment options on short notice. Other civilian and military targets include military bases, airfields, government and civilian buildings, oil and gas pipelines, pumping stations, refineries, and water supplies as well as transportation infrastructure such as highways and bridges.[10]

Toxic weapons also have the potential for use in psychological operations. The presence of toxic materials or even the possibility of their intended use can result in avoidance, uncertainty, fear, panic, and a host of other reactions in the population—even when the actual physical damage stemming from their use is limited. The extent

[9]Derived from interviews with Monterey Institute of International Studies researcher Eric Croddy, 2000–2001

[10]Water supplies provide an interesting example of the confusion that can result from understanding the difference between a biological and toxic attack. Although the commanders in chief (CINCs) treat water security with stringent security measures, an outright attack is difficult to assess, treat, and counter. See Al J. Venter, "Poisoned Chalice Poses Problems: The Terrorist Threat to the World's Water," *International Defense Review*, Vol. 32, No. 1, January 1, 1999, p. 57.

of psychological effects from toxic warfare is to a large extent unknown, and the unclassified sources reviewed for this report do not provide sufficient evidence to warrant many conclusions in this area. Given the potential for toxic weapons to cause serious harm, however, it is likely that even less toxic substances could be perceived as posing a potentially lethal danger—particularly when the composition of the substances used in such weapons is not known, as is often the case. It is likely that the uncertainty surrounding the use of many toxic weapons will play to the advantage of those who use them.

Such uncertainties are in fact a key feature of toxic weapons and constitute one of the reasons it is difficult to plan a response to their use. An individual act of toxic warfare could be lethal or could be a mere nuisance. Yet the extent of a toxic weapon's impact cannot always be known immediately or even for some time after an attack. For example, there is no question that a weapon incorporating medical waste would have a much smaller relative impact (e.g., five cases of HIV or hepatitis B or C) than a toxic release that killed thousands. Yet the extent of the harm caused by the biohazardous materials might not be immediately apparent, and if the number of cases of infected people gradually increased, fear and panic could spread among the populace. The impact of the weapon using medical waste would still not approach that of the toxic release. Nonetheless, the uncertainty surrounding the biohazardous weapon's effect could serve to enhance that effect and produce a significant result given the materials used.

In the next chapter, we will look at some examples of how toxic weapons have been used by both state and nonstate actors.

Chapter Three

RECENT USE OF AND THINKING ABOUT TOXIC WEAPONS

As discussed in the previous chapters, toxic weapons offer a number of advantages to state and nonstate actors who seek to advance their military and political objectives. Industrial chemicals and chemical waste are both plentiful, providing a low-cost and easily assembled option that can be deployed through a variety of means—including air delivery (missiles and rockets), land delivery (cars, trucks, or containers in legal or illegal transit or at a stationary location), or sea delivery (barges and small craft). Toxic weapons can cause physical harm to humans and can damage and contaminate infrastructure. They can also create temporary panic or chaos, thereby exerting an asymmetrical effect on information and psychological operations (IO/PSYOP). The advantages of toxic weapons are offset somewhat by the uncertainty surrounding their effects; these weapons are often difficult to target, and their physical impacts can be inconsistent. Such uncertainties, however, can make them the weapons of choice for insurgents, terrorists, and rogue nations looking mostly for tactical and/or psychological advantage.

This chapter provides an overview of recent incidents involving toxic weapon use, focusing on two especially prominent types of toxic warfare: poisonings and the use of chemicals and smoke. It ends with a discussion of notable developments in toxic warfare, including the use of toxic weapons within more sophisticated terrorist networks; a growing opportunism concerning the materials used to make toxic weapons; and an apparent increase in interest in using such weapons.

A caveat to the reader is in order, however. The goal of this chapter is to offer a relatively broad view of the range of possibilities associated with toxic weapons. This discussion is meant as a qualitative overview and does not purport to offer a quantitative analysis of the risks associated with particular kinds of toxic weapons or the consequences of specific attacks. It is hoped that the current discussion can help identify areas requiring further quantitative analysis.

POISONING WITH CHEMICALS, SEWAGE, AND PESTICIDES

Many recent incidents of toxic warfare have involved poisoning with chemicals, sewage, or pesticides. All these substances can be used to interfere with military operations, disrupt the functioning of civilian infrastructure, cause physical harm, and instill fear among the general populace.[1]

Episodes of poisoning have a long history in toxic warfare. In 1986, the Liberation Tigers of Tamil Eelam (LTTE) poisoned tea with potassium cyanide in an effort to cripple the Sri Lankan tea export industry.[2] In December 1989, during civil unrest in Romania in conjunction with the collapse of the Ceaucescu government, the water supply for the city of Sibiu was poisoned with an organophosphate by Romanian nationalists.[3] In March 1992, water tanks at a

---

[1]Water poisonings can occur, but only under the right conditions. Chlorine residuals and actual consumption of water nowadays limit toxic effectiveness and the utility of the fluoroacetates. According to Siegfried Franke, in terms of poisonings, some substances work well in waterworks, food supplies, and crops The prerequisite for these applications is great resistance to hydrolysis or to the formation of equally poisonous products of hydrolysis. Sarin dissolves in water to an unlimited extent and hydrolyzes very slowly, and the same is true of the organic compounds of fluorine, which have been suggested for sabotage and diversion work. Other poisons or chemical warfare agents dissolve in water only to a limited extent, but their solubility and resistance to hydrolysis suffice to achieve effective contaminations. See Siegfried Franke, *Manual of Military Chemistry*, Vol. 1., Berlin: Deutscher Militarverlag, 1967, pp. 30 and 139. See also William H. Monday, *Thinking the Unthinkable: Attacking Fresh Water Supplies*, master's thesis, Naval Postgraduate School, Monterey, CA, AD-B241, December 1998.

[2]See Abraham D. Sofaer, George D. Wilson, and Sidney D. Dell, *The New Terror: Facing the Threat of Biological and Chemical Weapons*, Stanford, CA: Hoover Institution, 1999, p. 82.

[3]See "A History of Biological and Chemical Threats to Water Supply," *International Defense Review*, Vol. 32, No. 1, January 1, 1999, p. 58.

Turkish army base outside Istanbul were poisoned with potassium cyanide; suspicion was aroused when two empty 25-kg boxes were found next to the water tanks and a layer of foam was seen on the water. An investigation concluded that the Kurdish Workers Party (PKK) had launched the attack.[4] In 1994, during heavy fighting on the Thai-Cambodian border near Pailin, more than a dozen Khmer Royal Armed Forces combatants died after having consumed water from streams and ponds poisoned by opposing Khmer Rouge forces.[5] In 2000, Chechen rebels attempted to poison Russian soldiers with an unidentified toxic substance found in wine delivered to the soldiers by Chechen civilians.[6]

The Israeli-Palestinian Conflict

The Israeli-Palestinian conflict has involved the use of pesticides, other chemicals, and sewage in toxic weapons. In October 1997, Israeli counterterrorism official Meir Dagan stated that he was afraid that toxic weapons were about to be used in the Israeli-Palestinian conflict.[7] During the same month, Israeli settlers from Gosh Etzion sprayed a chemical on Arab grape farms in the Ertas and Khader villages south of Bethlehem, ruining hundreds of grapevines and as many as 17,000 metric tons of grapes.[8] On June 19, 1999, Hamas announced plans to poison water supplies is Israel with "chemical sub-

---

[4]The amount in question would not have caused death. See "Turks Report Attempt to Poison Air Force Unit," Reuters, March 28, 1992, as quoted in Monday, *Thinking the Unthinkable*, December 1998, p 137.

[5]See "A History of Biological and Chemical Threats to Water Supply," January 1, 1999. Although the number of deaths caused by poisoning was much smaller than that caused by land mines in the region, the use of poison was nonetheless an effective terror weapon.

[6]See Jason Pate, Gary Ackerman, and Kimberly McCloud, *2000 WMD Terrorism Chronology: Incidents Involving Sub-National Actors and Chemical, Biological, Radiological, or Nuclear Materials*, Monterey, CA: Center for Nonproliferation Studies, available at http://cns miis.edu/pubs/reports/cbrn2k.htm.

[7]See Yigal Sarna and Anat Tal-Shir, "Most of All He Likes to Disguise Himself and Operate in Enemy Territory," *Yediot Aharonot*, October 24, 1997, pp. 16–19, accessed from FBIS-FTS-19971102000227.

[8]See Shabatai Zvi, "Israeli Settlers Destroy 17,000 Tons of Grapes," *Al-Ayyam*, October 23, 1997, available at http://www.hebron.com/article04-10-23-97.html

stances."[9] In November 1999, Israeli forces arrested an unidentified Hamas leader who had charts, tables, and specific instructions for mixing toxic substances into usable weapons. The materials were all obtained locally and were easy to disguise.[10]

In 2000, both Hezbollah and Hamas used insecticide in rockets or threatened to burn Israeli factories where industrial wastes were stored, creating clouds of toxic vapors.[11] In February 2000, Turkish authorities seized eight units of an unknown toxic substance during a weapons raid of Hezbollah facilities in Gazientep.[12] In June 2000, Palestinian news sources reported that Israeli settlers from the Efrat settlement on the West Bank had deliberately released sewer water into agricultural fields maintained by Palestinian settlers in the village of Khadder, near Bethlehem. According to local farmers, the release of the wastewater was part of an "annual tradition" designed to force Palestinian farmers off of their land.[13] In September 2001, Israelis used chemical fertilizer in a mass poisoning of 145 sheep and goats in the West Bank.[14]

Pesticides or other chemicals are also suspected to have been used as part of an attack by Palestinian suicide bombers in December 2001. Hazardous materials were found in a device detonated by the attackers, creating what officials believed was a crude attempt to make a

---

[9]See Gavin Cameron, Jason Pate, Diana McCauley, and Lindsay DeFazio, *1999 WMD Terrorism Chronology: Incidents Involving Sub-National Actors and Chemical, Biological, Radiological, and Nuclear Materials*, Monterey, CA: Center for Nonproliferation Studies, Vol. 7, No. 2, Summer 2000, available at http://cns.miis.edu/pubs/npr/vol07/72/wmdchr72.htm.

[10]"Hot Mish'al," Channel 2 Television Network, November 8, 1999, accessed from FBIS-FTS-19991109000932.

[11]See Paul Bedard, "Danger Zone," *U.S. News & World Report*, March 6, 2000, p. 10.

[12]See Pate, et al., *2000 WMD Terrorism Chronology*.

[13]See "Settlers Pump Sewerage Water into Palestinian Groves," Palestine Information Network, June 21, 2000, available at http://www palestine-info.net/daily_news/prev_editions/2000/June2000/21June.htm#9.

[14]See Tracy Wilkinson, "Microcosm of the Mideast Conflict in a Dead Flock," *Los Angeles Times*, September 1, 2001, p A3, and Stefan H. Leader, "The Rise of Terrorism," *Security Management*, April 2001. The conclusion was reached after investigators found a large amount of cyanide along with manuals in the bombers' residences.

chemical weapon. One of the bombs used in the attacks on Jerusalem appears to have been immersed in some kind of chemical. An Israeli official noted that Palestinian bombers had apparently experimented with their explosive devices in order to "maximize the effect" by spreading hazardous materials in the vicinity of the blast.

CHEMICALS, GASES, AND SMOKE

Chemicals, gases, and smoke can be used as part of traditional weaponry such as bombs and rockets or as weapons in themselves—as, for example, when industrial facilities are attacked to cause a chemical release. Several such uses are examined in this section.

Bosnia

In the first week of August 1993, Bosnian Muslim forces used chlorine in 120mm shells on three occasions against Bosnian Serb forces. A few shells were fired at each decisive point of the battle either to facilitate a Muslim breakthrough or to stall the Serbs' advance. United Nations Protection Force (UNPROFOR) observers described the weapons as "crude, almost like home-made stuff with a radius of only 20 meters." The order to use chlorine for defense purposes came from Andjelko Makar, Chief of Staff of the Second Corps of the Bosnia-Herzegovina Army based in Tuzla.[15]

Croatia

Serbian forces have frequently used toxic weapons, both as traditional weapons and through attacks on industrial facilities. As described in the introduction to this report, Serbian forces in Croatia used rockets, bombs, artillery, machine gun tracers, and mortars on six occasions between 1993 and 1995 to attack the Petrochemia plant, which produced fertilizer, carbon black, and light-fraction petroleum products. Hazardous substances at the plant included ammonia; sulfur (which poses a hydrogen sulfide inhalation hazard

---

[15]See Yossef Bodansky, "Bosnian Muslim Forces' First Combat Use of Chemical Weapons," *Defense and Foreign Affairs Strategic Policy*, August 31, 1993, p. 16

in the event of a fire); nitric, sulfuric, and phosphoric acids; heavy oil; and formaldehyde.[16]

Other chemical plants were attacked in the Croatian war. Serbian forces used rockets containing cluster bombs on a natural gas refinery in eastern Slavonia where ethane, propane, and butane were stored. Serbian forces also struck a chemical plant near the town of Jovan, releasing 72 tons of anhydrous ammonia and forcing the evacuation of 32,000 residents. Mortar attacks were launched on the Herbos pesticide plant located in Croatia's industrial center at Sisak. In addition, Serbian forces attacked large fuel storage tanks along the highway from Belgrade to the outskirts of Zagreb and started large fires at Osijek, Sisak, and Karlovak.[17] The refinery at Sisak, which produced liquefied petroleum gas (LPG), fuels, petroleum coke, and solvents, was hit particularly hard. Thousands of Serbian artillery rounds hit 38 storage tanks, destroying all of them. U.S. modeling efforts indicate that had the attacks destroyed existing stored chemical containers, lethal concentrations of chemicals would have covered a wide area.

Toxic warfare was also used against the Serbs. Muslim forces in Tuzla threatened chemical use in order to hold off a Serbian attack against the city, vowing to release large quantities of chlorine gas from railroad tank cars if the city was assaulted—despite the large number of friendly casualties that would have resulted from such an action.[18]

Sri Lanka

During the 1990s, the LTTE used chemical waste to attack industrial facilities on several occasions as a means of creating confusion at strategic points. In November 1995, LTTE forces launched a gas attack on Sri Lankan troops in a bid to lift a siege on the rebel bastion of Jaffna, sparking heavy battles that left 84 dead on both sides. The

---

[16]See FM 90-10-1, Q-8–Q-9. Refineries are usually designed so that two fires can be controlled and suppressed at one time, but at this refinery firefighters had to fight as many as five major fires simultaneously.

[17]Ibid.

[18]Ibid.

toxic attack was the first since 1990, when the LTTE fired chlorine gas cylinders into a besieged military camp near Batticaloa on the east coast.[19] In 2001, Tamil rebels attacked the Bandaranaike International Airport and military base with mortars. The first wave of attacks, launched at 3:30 a.m., targeted industrial and fuel facilities at the airport to create a fire and smoke diversion, while a second wave of mortars was aimed at both commercial and military aircraft. The resulting damage claimed 12 aircraft, costing millions of dollars, and closed the airport for a day.[20]

Chechnya and Russia

In Chechnya, both Chechens and Russians have accused each other of ammonia and chlorine attacks. In 1995, a Chechen soldier described a Russian weapon that released an unknown toxic chemical:

> But one day an aircraft appeared and dropped a strange bomb. That is, it fell very strangely, rather slowly, flipping over and over the whole time. It detonated at a height of 120 meters above the ground and lots and lots of these little petals came out. They came whirling slowly down. At first we thought they were mines you know, the kind you scatter and if you step on them they blow off your foot. But then, after a while, they began to explode spontaneously. Not very loudly, but there were bangs throughout the forest. I went up and picked up one of these things. It went off in my hand. In the middle, between two petals, was a kind of capsule, about as big as a vial of brilliant green antiseptic. Some sort of liquid splashed out onto my clothing and a bit landed on my hand. I threw my jacket out, but later on there was a burning sensation on my hand, although I had immediately washed off the liquid with water. The smell was so bad it was impossible to breathe. It was disgusting. And there seemed to be a bit of a

[19] See Agence France-Presse, November 25, 1995, accessed from FBIS-FTS-19951125000450.

[20] See "Tamil Rebels Raid Sri Lankan Airport," *Washington Post*, July 25, 2001, p. 14.

> smell of garlic. Then, a couple of days later, the leaves began to fall from the trees.[21]

This incident is particularly interesting because of the delivery system used, which was similar to a fuel-air explosive. However, the weapon was used to deliver not a mainstream chemical agent but some type of toxic substance or waste. Clearly, the Russians were modifying existing weaponry.[22] The incident also suggests something of the psychological uncertainty surrounding toxic warfare. The soldier recognizes that something toxic has landed on his clothing but doesn't know what it is. He also reports a feeling of revulsion at the substance's odor and has difficulty breathing as a result.

In both 1999 and 2000, Chechen rebels launched toxic attacks involving chemical and petroleum waste. On December 10, 1999, Chechens detonated previously prepared containers of chlorine and ammonia. As part of a battle with federal forces, they also ignited five oil wells, which burned up to 200 tons of oil per day.[23] The resulting smoke degraded the Russians' ability to observe the Chechens' actions and hence their ability to conduct military operations. In January 2000, Chechen forces tried to slow a federal force's offensive by blowing up 60-ton-capacity barrels in 111 rail cars loaded with chlorine solution and petroleum and emitting clouds of toxic gases.[24]

---

[21]See Alexander Mnatsakanyan, "Were Chemical Weapons Used in Chechnya?" *Izvestia*, August 24, 1995, pp. 1–2, accessed from FBIS-FTS-19970502001427.

[22]Based on interviews with Eric Croddy from the Monterey Institute of International Studies and with analysts at the Armed Forces Medical Intelligence Center (AFMIC), July 2001.

[23]See "Grozny Gas Cloud Blown in Wrong Direction," Russian Public Television First Channel Network, December 29, 1999, accessed from FBIS-FTS-19991229001437; and "Five Oil Wells Still Ablaze in Chechnya," RIA, November 30, 1999, accessed from FBIS-FTS-19991201000318.

[24]See "Toxic Cloud in Chechnya: Rebels Detonate Chlorine Tank," RIA, December 10, 1999, accessed from FBIS-FTS-1999121000813; Pate et al., *2000 WMD Terrorism Chronology*; Mikhail Supotnitskii, "The Second Coming of Chlorine," *Nezavisimoye voyennoe obozrenie*, No. 1, January 2000, p. 4, accessed from FBIS-CEP-20000127000079; and Yevgenii V. Antonov, "Threat of Terrorist Attack Using Weapons of Mass Destruction from Chechnya," *Yadernyy kontrol*, No 2, March–April 2001, pp. 55–70, accessed from FBIS-CEP-20010610000001.

Russia began to take the toxic threat seriously by sending NBC troops to the area and issuing gas masks and other protective measures for soldiers.[25] Military intelligence reported that mines, barrels, cisterns, and canisters filled with chlorine, ammonia, liquid nitrogen, and low-level radioactive waste stolen from medical and research waste disposal facilities[26] near Grozny had been placed at the intersections of major streets.[27] It is not entirely clear what Chechen rebels hoped to achieve through this particular combination of chemicals. In March 2000, Russian raids on Chechen positions in Grozny found ten tons of chlorine in preparation for deployment.[28]

Another example of the psychological impact of toxic weapons occurred in 2001, when rumors spread throughout Russia and the Persian Gulf of a Chechen plan to use chemicals. A Chechen chemist by the name of "Chitigov" (who was linked to the Chechen Arab warlord Khattab), together with "renowned chemist al-Khazur" from the United Arab Emirates, was reported to be trying to invent a chemical bomb in field conditions. The bomb was to be constructed from materials easily obtained from glass factories.[29] Rumors such

---

[25]See Andrei Korbut, "Chechnya: The Ecological Threat Is Growing," *Nezavisimoye voyennoye obozrenie*, No. 176, January 28, 2000, available at http://nvo.ng.ru/wars/2000-01-28/2_ecohazard.html. See also Olga Oliker, *Russia's Chechen Wars 1994–2000: Lessons from Urban Combat*, MR-1289-A, Santa Monica: RAND, 2001.

[26]Medical waste as a potential toxic weapon also needs to be defined more clearly. In terms of biological sources, thousands of hospitals around the world produce millions of tons of infectious and medical waste every day. Clinics, colleges and universities, diagnostic laboratories, pharmaceutical companies, mortuary facilities, and doctors' offices also generate waste. Biological toxins can include human blood and blood products, cultures and stocks of infectious agents, pathological wastes, contaminated wastes from patient care, discarded biological materials, contaminated animal carcasses, body parts, bedding, and contaminated equipment. In addition, the disposal of infectious and medical waste is a problem because of its potential to transmit disease. Because commercial services for infectious and medical waste disposal are either poor or nonexistent in most areas of the world, these wastes may constitute a serious health hazard for military forces. The primary hazard is that these wastes remain infectious for years if left untreated

[27]See Korbut, "Chechnya The Ecological Threat Is Growing," January 28, 2000 See also Oliker, *Russia's Chechen Wars 1994–2000*, 2001.

[28]See "Snipers, Small Rebel Groups Remain in Grozny," ITAR-TASS, March 12, 2000, accessed from FBIS-CEP-20000312000074.

[29]See Timofey Borisov, "Smear a Grenade with Glue and Rain Down Hell," *Rossiyskaya gazeta*, August 30, 2001, as cited in "Paper Profiles Chechen Manufacturer

as this suggest the potential psychological impact of toxic weapons, which are made to seem more powerful than they really are. In the past, Chechens have used information operations to exaggerate their chemical and biological weapon (CBW) capabilities.

TRENDS IN TOXIC WARFARE: ESCALATION OF USE, INCREASED SOPHISTICATION, EXOTIC COMBINATIONS

Al-Qaeda and Osama bin Laden

The experience of Al-Qaeda and Osama bin Laden points to the dangerous combination of easy-to-obtain toxic weaponry and sophisticated terrorist networks. Toxic weapons seem to be used to an increasing extent in conjunction with more complex forms of organization, training, and equipment. Ever since the 1993 World Trade Center car bombings, when Al-Qaeda used cyanide in a bungled attempt to cause a toxic attack as well, Al-Qaeda has shown an interest in toxic warfare.[30] Al-Qaeda has experimented with cyanide gas in Derunta, Afghanistan.[31] Another bin Laden cell in Africa planned a cyanide attack in Europe.[32] After the September 11 terrorist attacks on the United States, U.S. Attorney General John Ashcroft told the Senate Judiciary Committee that several individuals linked to the hijackers had fraudulently obtained or attempted to obtain hazardous material transportation licenses.[33] While Al-Qaeda has a number of options available to it, toxic warfare may certainly be one of them.

---

of Toxic Weapons," accessed from FBIS-CEP-20010830000180 The same recipes are found in Osama bin Laden's training manual.

[30]See Craig Pyes and William C. Rempel, "Poison Gas Plot Alleged in Europe," *Los Angeles Times*, November 12, 2001, p. 10.

[31]See James Risen and Judith Miller, "Al Qaeda Sites Show Skills in Chemicals," *New York Times*, November 11, 2001, p. B1. See also Rory McCarthy, "Inside Bin Laden's Chemical Bunker," *The Guardian*, November 17, 2001; Keith B. Richburg, "Bin Laden and Bombs," *Washington Post*, November 22, 2001, p. A1; and Tom Walker, "Al-Qaeda's Secrets: Bin Laden's Camps Reveal Chemical Weapon Ambition," *Sunday Times* (UK), November 25, 2001.

[32]See Pyes and Rempel, "Poison Gas Plot Alleged in Europe," November 12, 2001, pp. 1 and 10

[33]See "FBI Starts Nationwide Records Check on HAZMAT Truckers," CNN Online, September 26, 2001, available at http://www.cnn.com.

The ELN and FARC

While the combination of toxic warfare with increasingly sophisticated terrorist networks represents one trend, increased opportunism in the use or combination of toxic substances represents another. In March 1998, for example, the ELN (the Army of National Liberation) mortar attacks outside Cucuta, Colombia, included two explosive charges at a checkpoint, killing Colombian soldier Alberto Moreno Vesga. According to a medical report, the ELN used "fecal material in the explosive devices, causing a high level of contamination in the wounds. Soldier Moreno died from wounds suffered on the arms, [and] legs, and a severe [sepsis] as a result of the fecal substances placed in the aforementioned explosives." A stream of toxic attacks has subsequently occurred. In late 2000, the ELN attacked the police department in Cajibio with sulfuric acid and ammonia. In March 2001, FARC (the Revolutionary Armed Forces of Colombia) attacked the police station in Puerto Lieras with pipe bombs that were loaded with glue, sulfuric acid, gasoline, tar, and feces.[34] In September 2001, FARC attacked the Huila police department with unidentified pulmonary agents thought to be chlorine.

LTTE Sea and Land Attacks

The Tamil Sea Tigers (LTTE)[35] have used smoke and vapors both to create casualties and to cause deception, sometimes through elaborately staged or sophisticated means. In September 2001, the Tamil Sea Tigers attacked Bandaranaike Airport, destroying half of the Sri Lankan air fleet and causing millions of dollars of damage. Included was an attack on the airport's fuel depot that was aimed at spreading smoke and vapors.[36] The attack was intended to produce—and indeed resulted in—a spectacular mess that destroyed the fuel depot while also causing confusion and eventual military operations. One month later, in October 2001, a suicide squad from the LTTE sea

[34]See "FARC Allegedly Using Acid, Tar, Feces to Make Bombs," *El Tiempo*, September 6, 2001, accessed from FBIS-LAP-20010906000034.

[35]The Tamil Sea Tigers is the oceangoing version of the Tamil Tigers.

[36]See Rohan Gunaratna, "Intelligence Failures Exposed by Tamil Tigers Airport Attack," *Jane's Intelligence Review*, September 2001, pp. 14–17.

forces attacked the MV Silk Pride at sundown as the ship approached the Haffna peninsula. The oil tanker, carrying 225 tons of low-sulfur diesel, 160 tones of kerosene oil, and 275 tons of auto diesel, caught on fire.[37] LTTE fighters later participated in yet another toxic attack in an effort to interrupt Sri Lanka's economy.[38]

RAISING THE LEVEL OF VIOLENCE?

This review of incidents involving toxic warfare suggests that interest in the use of such weapons may well be on the rise. Recent raids on Al-Qaeda cells both in Europe and in Afghanistan have uncovered manuals clearly illustrating that Al-Qaeda terrorists were thinking, among other things, about deploying toxic weapons. Those who use toxic weapons are also taking whatever opportunities become available to bend the definition of chemical warfare and conventional conflict through their choice of toxic materials and tactics. By breaking down the barriers concerning the types of materials that are used in attacks, terrorists and insurgents are looking to increase their opportunities to catch the adversary off guard and create uncertainty. These asymmetrical warfare options are by design far from those described by chemical warfare treaties and international warfare regulations. Terrorists are also incorporating toxic weapons into more complex preparation and planning strategies.

Taken together, these developments suggest that nonstate actors may be attempting to increase their military prowess through the use of toxic weapons. What this could mean for the United States and the U.S. Air Force will be the subject of the next two chapters.

---

[37]See "Further on Tamil Tigers Attacking Oil Tanker in Sri Lanka," Agence France-Presse, October 30, 2001, accessed from FBIS-SAP-20011030000111.

[38]See "Guerrilla Suicide Boat Hits Sri Lankan Oil Tanker," Reuters, October 30, 2001.

Chapter Four

TOXIC THREATS IN EXPEDITIONARY SETTINGS

U.S. forces have faced the specter of toxic attacks for some time. Typically, these attacks have been considered within the context of operations against countries such as North Korea and the former Soviet Union, and the primary weapons of concern have been militarized chemical and biological agents. However, the United States has given scant consideration to the use of more expedient toxic agents or to the damage that something short of chemical and biological warfare agents could cause.

Although U.S. operations have not yet faced repeated threats from toxic weapons,[1] that possibility clearly exists, particularly in light of the wide availability of toxic materials. Water supplies in areas of operations are vulnerable to intentional and accidental contamination. Toxic waste poses yet another threat, especially because an increasing number of U.S. operations are being conducted in urban industrial areas with decaying and wrecked chemical infrastructures.

U.S. forces frequently operate in environments in which there are toxic materials, particularly industrial chemicals. A number of these chemicals have the potential to interfere with U.S. operations in a significant manner across the range of military operations. Most toxic weapons can be released as vapors—which, as noted earlier, tend to remain concentrated downwind from the release point, in

[1]Previous studies of airfield intrusions and attacks show that quick attacks were the most successful. See David A. Shlapak and Alan Vick, "*Check Six Begins on the Ground*". *Responding to the Evolving Ground Threat to U.S. Air Force Bases*, MR-606-AF, Santa Monica: RAND, 1995; and Alan Vick, *Snakes in the Eagle's Nest: A History of Ground Attacks on Air Bases*, MR-553-AF, Santa Monica: RAND, 1995

natural low-lying areas such as valleys, ravines, or man-made structures; or in any area with low air circulation. Explosions can create and spread liquid hazards, and vapors may condense to liquids in cold air.[2]

The U.S. military is currently seeking to improve its capabilities in responding to a range of possible terrorist threats, and toxic warfare is one such threat. Many U.S. military field manuals and related documents are in the process of being updated, and organizing, training, and equipping for toxic warfare are among the issues being addressed.[3]

This chapter focuses on risk and planning issues for U.S. forces engaged in expeditionary settings. We first examine the risks from toxic warfare for such operations. We then look at the current state of knowledge regarding such threats and identify gaps that need to be filled.

U.S. OPERATIONS AND TOXIC WARFARE IN THE 1990S

Although the United States has had limited experience with toxic warfare, a review of past incidents involving toxic threats can point to some areas of potential vulnerability. One threat arises from toxic smoke in the field of operations.

The threat from toxic smoke is greatest for ground forces deployed to unstable areas, which today include Afghanistan, Pakistan, Uzbekistan, and Kyrgyzstan. Operation Desert Storm provides an example of the confusion and damage that can result from toxic

---

[2]Four industry-standard dispersion models measure the spread of toxic materials: AFTOX, DEGADIS, INPUFF, and SLAB. See Breeze Software and Services, *Breeze Haz Materials*, available at http://www.breeze-software.com/content/haz/.

[3]The Chemical Corps Doctrine and Development Division of the U.S. Army Chemical School (USACMLS) conducted a study on lapses in doctrine regarding toxic warfare. They deemed that JP 1.02 (Joint Warfare of the Armed Forces of the United States), FM 101-5-1 (Operational Terms and Graphics), FM 3-100 (Chemical Operations Principles and Fundamentals), FM 3-3 (Chemical and Biological Contamination Avoidance), FM 3-11 (Flame, Riot Control Agents and Herbicide Operations), FM 3-18 (Special NBC Reconnaissance), and FM 34-54 (Battlefield Technical Intelligence) all need to be rewritten. See *USACMLS Doctrine Changes*, available at http://www.wood.army.mil/cmdoc/doctrine%20changes.pdf.

smoke, which can be used to impair vision and disrupt military operations. From January 25 to 27, 1991, Iraqi troops created a massive oil spill off Kuwait that ignited more than 700 Kuwaiti oil fields, sending smoke throughout the area of operations. In response, U.S. F-111Fs launched GBU-15 guided bombs that managed to destroy oil manifolds connecting storage tanks to the terminal. While this action drastically cut the flow of oil, oil fires continued to release large quantities of poisonous gases. In addition, some wells failed to ignite, forming vast pools of raw crude that covered hundreds of acres and created potential firetraps. So great was the smoke from burning oil wells that visibility was severely limited for coalition air forces in the Kuwaiti theater of operations (KTO). For fliers, the smoke created abrupt and repeated transitions from clear skies to instrument flying conditions. The weather also added to the problem, with black-spattering, oil-laden rain clogging engines in the air and on the ground.[4]

U.S. armed forces are also subject to contaminated supplies. Contamination can result from poor security on the part of outside suppliers as well as from the presence of toxic waste in and around the area of operations. One example of the risk of water contamination arose during Operation Just Cause. When U.S. forces landed in Somalia, the first priority for allied commanders was to supply fresh water to their forces on the ground. A plant located in Saudi Arabia had initially been commissioned to deliver thousands of pallets of bottled water at a cost of millions of dollars. Upon their delivery to Somalia, however, some of the bottles were found by U.S. Army chemists to be contaminated with fecal matter, and the entire lot was dumped. Until alternative sources of water could be found, most

---

[4]See Federation of American Scientists, *Reaching Globally, Reaching Powerfully: The United States Air Force in the Gulf War—A Report—September 1991*, available at http://www.fas.org/man/dod-101/ops/docs/desstorm.htm; Federation of American Scientists, *Chapter VI—The Air Campaign*, available at http://www.fas.org/irp/imint/docs/cpgw6/cpgw_ch6_execute.htm; and U.S. General Accounting Office, *Operation Desert Storm: Evaluation of the Air Campaign*, Washington, D.C., GAO/NSIAD-97-134, June 1997, p. 5, Appendix IV:3 The Armed Forces Medical Intelligence Center stated that the detonation of the oil wells was intended to create flame barriers and to give off hydrogen sulfide gas contained in oil diverted from deep, high-pressure wells. If the petroleum is ignited in the presence of large quantities of natural gas, the effects would be similar to a fuel air explosive (FAE). See Federation of American Scientists, *AFMIC Weekly Wire 48-90*, available at http://www.fas.org/irp/gulf/cia/970129/970110_WW48090_90_0001.html

U.N. contingents had to make do with Kenyan boxed water that was deemed clean. French forces had water flown in daily from Europe, which needed to be well guarded at French bunkers.[5]

U.S. THINKING ABOUT TOXIC THREATS

Throughout the 1990s, the growing awareness of the threat posed by NBC weapons provided a foundation for learning more about the phenomenon. Toxic weapons using industrial chemicals are relatively easy to produce, as there is no need to synthesize, process, improvise agent delivery devices, or conduct testing. Little or no specialized knowledge of the manufacturing process is required. Toxic substances such as chlorine, phosgene, and hydrogen cyanide can easily be acquired and adapted.[6] For those seeking to use toxic weapons, the biggest threat is to avoid detection by authorities. Yet the wide availability of the substances used to make toxic weapons makes detection difficult.

An example of more formal U.S. thinking about potential toxic threats can be found in the 1997 *Assessment of the Impact of Chemical and Biological Weapons on Joint Operations in 2010*. This study examined, among other threats from chemical warfare, the potential for toxic weapons to disrupt U.S. military operations. The study identified local and asymmetrical attacks as the most likely threats to U.S. forces.[7] More specifically, the report examined a scenario in which a "blue team" uses chemical agents thinly to avoid lethal levels, which allows the force to impede U.S. military operations while complicating detection and cleanup. This report provides an idea of broad U.S. thinking about chemical weapons, al-

---

[5]See Venter, "Poisoned Chalice Poses Problems," January 1, 1999.

[6]See U.S. General Accounting Office, *Statement of Henry L. Hinton, Jr., Assistant Comptroller General, National Security and International Affairs Division, Testimony Before the Subcommittee on National Security, Veterans Affairs, and International Relations, Committee on Government Reform, House of Representatives, Combating Terrorism: Observations on the Threat of Chemical and Biological Terrorism*, Washington, D.C, GAO/T-NSIAD-00-50, October 20, 1999.

[7]See U.S. General Accounting Office, *Report to Congressional Requesters, Chemical Weapons: DOD Does Not Have a Strategy to Address Low-Level Exposures*, Washington, D.C., GAO/NSIAD-98-228, September 1998.

though it does not offer a separate assessment of the response needed for toxic weapons.

In 1998, the Office of the Secretary of Defense (OSD) assessed the potential for a chemical attack to cause significant delays in the deployment of forces and to impair mission success. Although this OSD report did not specifically address toxic threats to the forces, it did examine the impact of a chemical or biological attack on an installation serving as a power projection site (i.e., one that our forces would use as a launching point in a time of crisis), using Fort Bragg and Pope Air Force Base (both located in Fayetteville, North Carolina) as its focus. The Pope/Bragg study concluded that chemical/biological attacks would significantly delay deploying forces and had the potential to impair the mission achievement of those forces. It further suggested that many of the vulnerabilities observed could be minimized through a preparedness program consisting of planning, training, exercises, and equipment. In consonance with this conclusion, the study recommended that DoD establish a program of installation preparedness to enhance awareness, plans, and preparations for the possibility of chemical or biological attacks at key force projection sites. This need formed the basis of the Pope/Bragg pilot.[8]

The U.S. Army Soldier and Biological Chemical Command (SBCCOM) has also developed a preparedness program for addressing issues relating to WMD. This program, which is directed toward U.S. military installations and has been successfully piloted at Fort Bragg and Pope Air Force Base, is based on the Army's experience in the Nunn-Lugar-Domenici Domestic Preparedness Program and on its participation in the Pope/Bragg study. The program's objective was to validate an approach toward preparing key military installations to respond to asymmetrical attacks involving WMD. Accordingly, it consisted of planning, training, exercises, and other technical assistance. The program targeted installation commanders and their staffs, installation emergency responders (fire, HAZMAT, and law enforcement/security personnel as well as health care

---

[8]See Paul Wolfowitz, Deputy Secretary of Defense, letter to the Honorable Bob Stump, Chairman, Committee on Armed Services, U S House of Representatives, Washington, D.C., April 25, 2001.

providers), and their counterparts in the local, state, federal, and host-nation communities. [9] The pilot programs succeeded in reducing delays in deployment by 45 percent on average and had a positive impact on the installation's other operations.[10]

Other work remains to be done to ensure that military doctrine adequately addresses the issue of toxic warfare. In conjunction with SBCCOM preparations, the Chemical Corps Doctrine and Development Division of the U.S. Army Chemical School found that several field manuals—JP 1.02, FM 101-5-1, FM 3-100, FM 3-3, FM 3-11, FM 3-18, and FM 34-54—need to be rewritten to reflect the potential for toxic warfare. The school argued that doctrine should be based on the description found in the *Assessment of the Impact of Chemical and Biological Weapons on Joint Operations in 2010.* Combined with the evidence that nonstate actors had been increasingly thinking about toxic warfare, FM 3-100 now pinpoints the need to identify toxic waste sites. [11]

REMAINING ISSUES FOR EXPEDITIONARY OPERATIONS

The level of threat represented by toxic weapons remains to be determined. Should toxic warfare be considered a nuisance or a threat of strategic concern? Although it is impossible to know how extensively toxic weapons will be used in the future, the experience of toxic warfare to date and the kinds of urban operations in which the United States will likely be involved suggest that toxic warfare merits serious consideration as part of future planning strategies. There are several reasons for this conclusion:

- **The United States is not immediately aware of the location of toxic threats.** Overall, the U.S. military is actively aware of the potential for toxic threats, but the identification of specific threats is a painstaking process. In future operations, it is possible that an entire area of operations could be contaminated

---

[9] Ibid.

[10] Ibid.

[11] Ibid. Discussions with AFMIC analysts, 2000–2001.

with toxic waste.[12] Therefore, as the war on terrorism continues, U.S. forces will need to improve their knowledge of the locations of both legal and illegal sources of toxic waste as part of their intelligence assessments and contingencies.[13]

- **At the operational level, U.S. forces currently have no tailored response to toxic warfare in doctrine.** As the U.S. military develops a response to toxic warfare, it will need to provide a doctrinal response to resolve the trade-off between force protection and mobility/agility. One response to the potential for toxic warfare could be to bring chemical kits, protective clothing, cleanup materials, and the like, on every operation. Doing so, however, would impede the mobility and agility of the forces.

  Emergency response exercises and training should also be expanded to incorporate all the elements that could be involved in responding to a toxic attack. Air Force first responders currently exercise with their civilian counterparts on an annual basis, using the Disaster Response Force infrastructure to vary the types of NBC attack to include nuclear/radiological, biological, chemical, incendiary, and explosive materials.[14] The Air Force is investigating the possible use of the SBCCOM Program and services provided by the University of Texas A&M Emergency Responder Training Program. Three interactive training CD-ROMs for the emergency response to terrorism have been published by Headquarters, Air Force Civil Engineer Support Agency (HQ AFCESA) and distributed to all Air Force installations.[15]

- **The use of toxic weapons has implications for U.S. military lift and logistics.** As base security becomes more critical to operations, the vulnerability of key logistics sites has emerged as an

---

[12]Interview with a U.S Navy SEAL, 2001, who asked not to be identified. According to the interviewee, each operation is conducted in failed states filled with toxic waste, sewage, and radioactive waste.

[13]The author participated in the planning process by contributing to classified AFMIC products on toxic warfare and their presence in the Afghan theater.

[14]See Wolfowitz, letter to the Honorable Bob Stump, April 25, 2001

[15]Ibid

important issue.[16] Many sites are vulnerable to toxic attack, including ports, airfields, and related fixed sites that serve as choke points. Ports of embarkation (POEs) and en route facilities may be targeted in order to disrupt or inhibit U.S. military deployment both within and outside the threatened theater. For some large-scale operations, the en route structure is limited and may be a particularly lucrative target. Fixed sites are high-value targets for adversary toxic attack. Combat forces are vulnerable both during entry operations and during movement to areas of military operations. Support staging areas as well as rail and road networks are also potential targets, as are intermediate and infrastructure logistics bases. Aerial ports of debarkation (APODs) are vulnerable as well.

The APOD provides an example of how the U.S. Air Force can incorporate the possibility of toxic warfare into its planning. Because each APOD is unique, the size and operational flexibility of any particular site will affect the commander's options for preventing toxic contamination. To minimize the potential for aircraft to be exposed to toxic threats during ground operations, APOD plans need to include expedited offload procedures within the toxic threat area (e.g., engines running, no crew changes or refueling). It must also be recognized that in the event of contamination, some aircraft will not be able to land at or depart from certain areas of an aerial port regardless of its level of toxic preparedness. Instead, contaminated aircraft will need to be thoroughly decontaminated—a rigorous process if high-tech planes with advanced polymers are damaged or destroyed.[17]

- **At the tactical level, U.S. armed forces may not be ready for toxic warfare.** OSD has found a number of problems with preparation for toxic warfare as a subset of an NBC attack. Toxic waste vapors often hug the ground, an issue that is not addressed in some scenarios. On November 15 2001, the Air Force Deputy Chief of Staff/Installations and Logistics issued

[16]See David A. Fulghum, "Terrorism Makes Base Protection Critical," *Aviation Week & Space Technology*, June 18, 2001, p 196.

[17]See U.S. Air Force, *Civil Engineer Emergency Response Operations*, Air Force Manual 32-4004, December 1, 1995, pp. 70–80.

direction and guidance to all Major Commands on installation actions required for preparation of response to terrorist attacks with weapons of mass destruction. The document directed installations to plan, equip, train, and exercise installation emergency reponse capability for terrorist WMD events. Air Force publications to support this policy are in progress.

The Air Force is coordinating several documents to provide needed planning, organization, equipage, training, and exercise/evaluation program policy guidance for commanders and first responders. The planned policy guidance documents implemented Air Force Doctrine Document 2-1.8, *Counter Nuclear, Biological and Chemical Operation*. Other documents include Air Force Policy Directive 10-25, *Full Spectrum Threat Response*; Air Force Instruction 10-2501, *Full Spectrum Threat Response Planning and Operations*; Air Force Handbook 10-2502, *WMD Threat Planning and Response*; and Air Force Instruction 10-2601, *Counter NBC Operations*. The Air Force has developed its Baseline Equipment Data Assessment List in the event of a toxic or NBC attack. [18] Additional training is being developed.

- **Cleanup from a toxic attack may pose a difficult challenge.** Contaminated aircraft pose an especially difficult decontamination challenge, as demonstrated by the oil-laden rain that coalition forces confronted during the Gulf War. Fixed-site decontamination techniques typically focus on fixed facilities and mission support areas such as command, control, communications, computers, and intelligence (C^4I) facilities, supply depots, aerial and sea ports, medical facilities, and maintenance sites. However, cargo may require extensive decontamination measures, specialized and highly sensitive monitoring equipment, and extended weathering or destruction. It is therefore possible that equipment decontamination may have to be delayed until after conflict termination.[19]

In sum, the U.S. military is aware of the threat of toxic warfare, and some progress is being made to raise awareness through U.S. strat-

---

[18] Ibid

[19] FM 90-10-1, Appendix A.

egy and doctrine. However, more work remains to be done in identifying and locating toxic threats, developing operational and tactical responses to toxic warfare, expanding training for responding to toxic attacks, and devising adequate cleanup procedures. The United States must also address the threat of toxic weapons within the homeland, as will be discussed in the next chapter.

Chapter Five

TOXIC THREATS IN THE UNITED STATES

Toxic warfare is a threat not just for U.S. forces engaged in military operations but also for civilians within the United States. The risk is increased by the wide availability of toxic materials throughout the United States, together with the proximity of industrial operations to urban centers. In fact, the combination of large population centers and multiple toxic material sources poses a range of threats that need not involve warfare; accidents, incompetence, or employee malevolence could all produce a toxic incident with significant implications for civilian populations. Yet the potential for terrorists to use toxic weapons as part of a deliberate attack adds another dimension to this threat.

This chapter focuses on some of the issues relating to toxic threats in the United States and assesses the potential for an effective response in the event of a disaster. It also offers recommendations for civilian-military planning.

AREAS OF VULNERABILITY

U.S. officials have been thinking about toxic warfare attacks on U.S. territory for some time. Prior to the 1996 Atlantic Olympics, for example, federal authorities considered potential threats from improvised chemical devices such as the use of high explosives by terrorists to puncture a train car loaded with chlorine gas. Since 1996, the

United States has routinely taken active measures to prepare for special events.[1]

Awareness has also increased with respect to the potential for toxic attacks involving hazardous materials. Since 1999, the Gilmore Commission has discussed the use of hazardous materials as toxic weapons. Commission members have investigated prevention, preparedness, mitigation, and response for HAZMAT scenarios and incidents in CONUS as well as chemical, biological, radioactive, and nuclear (CBRN), agroterror, and cyber threats.[2]

One issue of great concern remains the potential vulnerability of chemical and industrial facilities within the United States. Although available unclassified sources do not provide sufficient information from which to draw conclusions about the frequency of past attacks that have been planned or executed against industrial facilities, we can get an idea of the potential vulnerability of many such facilities from a recent example involving Greenpeace activists and a Dow Chemical plant near Baton Rouge, Louisiana. In February 2001, Greenpeace activists concerned about security problems in the chemical industry sought to underscore their point by scaling the fence of the plant, and they succeeded in gaining access to the control panel that regulates potentially dangerous discharges into the Mississippi River.[3] The activists' objective was not to release toxic materials into the river but rather to prove that Dow's security procedures were lacking. If terrorists had gained similar access, however, the results could have been devastating. At the plant, industrial chemicals such as chlorine, sulfuric acid, and hydrochloric acid could potentially provide terrorists with the materials necessary to create powerful toxic weapons. A 1999 study by the federal Agency for Toxic Substances and Disease Registry referred to these chemi-

---

[1]See Jonathan Tucker, "National Health and Medical Services Response to Incidents of Chemical and Biological Terrorism" *JAMA*, Vol. 278, August 6, 1997, pp 362–368, available at http://jama ama-assn.org/issues/v278n5/ffull/jpp71006.html.

[2]See the materials under the Advisory Panel to Assess Domestic Response Capabilities for Terrorism Involving Weapons of Mass Destruction at http://www rand org/nsrd/terrpanel/.

[3]See Eric Pianin, "Toxic Chemicals' Security Worries Officials," *Washington Post*, November 12, 2001, p. A14.

cals as "effective and readily accessible materials to develop improvised explosives, incendiaries and poisons."[4]

The seriousness of the problem is directly related to the large number of sites in the United States containing chemicals capable of causing harm. Indeed, many of the chemicals used or produced in plants throughout the country have the potential to match or exceed the 1984 disaster in Bhopal, India. This risk is compounded by the frequent movement of these chemicals, typically by rail, through densely populated areas such as Baltimore and Washington.

The toxic threat within the United States is not limited to civilians. An attack could potentially affect or be directed toward one or more of the many military installations located here. Attacks on critical installations or embarkation points could delay, prevent, or degrade U.S. military operations for homeland protection or overseas deployment.

STEPS FOR PROTECTING THE UNITED STATES FROM AND RESPONDING TO TOXIC WARFARE

How well are industrial facilities protected against the possibility of a toxic attack? In the aftermath of September 11, some U.S. industries have increased the precautions taken to protect their facilities. The chemical industry, for example, issued stringent new site security guidelines, and officials say they are in daily contact with the FBI and other federal authorities to prepare for a direct threat against a chemical plant.[5] Protective measures have also been temporarily increased to provide safeguards for industrial facilities and operations as well as to forestall the potential for retaliation during U.S. military operations. For example, immediately after the United States began bombing Afghanistan on October 7, 2001, the U.S. railroad industry imposed a 72-hour moratorium on carrying toxic or dangerous chemicals. These shipments were resumed, however, after the chemical industry argued that chlorine was essential to the continued operation of sewage treatment plants and that there was no evidence such shipments were being targeted by terrorists.

---

[4]Ibid.

[5]Ibid.

The threat from toxic releases remains large. According to "worst-case" scenarios that companies are required by law to file with the Environmental Protection Agency, a single accident at any of the nearly 50 chemical plants operating between Baton Rouge and New Orleans could potentially put at risk 10,000 to one million people.[6] Environmental and hazardous chemical experts say that serious security problems also persist to varying degrees at chemical manufacturing centers in Texas, New Jersey, Delaware, Philadelphia, and Baltimore.[7] The Dow Chemical plant targeted by Greenpeace reported as its potential "worst case" the release of 800,000 pounds of hydrogen chloride, a suffocating gas that would threaten 370,000 people.

At the forefront of toxic warfare in the United States are the first responders—those individuals who are part of any "organization responsible for responding to an incident involving a weapon of mass destruction."[8] First responders include personnel from medical, law enforcement (or security), fire/rescue, HAZMAT, and explosive ordnance disposal (EOD) organizations. First responders receive extensive training and participate in frequent exercises. Yet while such training is likely to provide the basis for an effective initial response to a toxic attack, other crisis response capabilities need to be improved as well.

ISSUES TO BE ADDRESSED

Despite the solid preparedness of first responders, other aspects of the U.S. crisis response network are lacking. Currently, for example, there is no consistent approach toward burden sharing among agencies, particularly with regard to treating casualties. Internet connectivity in many hospitals remains poor, with only 25 percent of laboratories up to federal standards for access and dissemination of information. Moreover, in the event of multiple toxic attacks, the scope of response needed could overwhelm local resources. Most U.S. hospitals are unprepared to deal with the casualties they would

[6]This scenario provides an estimate of the radius of a dangerous cloud of escaping gas and how many people could potentially be affected.

[7]See Pianin, "Toxic Chemicals' Security Worries Officials," November 12, 2001.

[8]Defense Authorization Act for FY 2001, in Section 1031.

see in the wake of a terrorist attack with toxic weapons, and hospitals have been slow to train staff and to equip facilities owing to a lack of funds.[9]

Military and civilian crisis response preparedness efforts must also be better coordinated. An opportunity exists for improved synergy between military preparedness and civilian expertise in areas such as HAZMAT. Civilian preparations for toxic threat have increased since September 11, and civilian organizations are improving their knowledge of the nature of the threat and the needed response. Additional organizing, training, and equipping are being provided at the state level. The U.S. military possesses chemical weapon prevention and cleanup expertise that is applicable to homeland security. Civilian organizations and first responders can benefit from working closely with the military in preparing to respond to toxic threats. The military can for its part expand its efforts to coordinate with civilian organizations in the event of a toxic attack. Such information-sharing and coordination efforts will be necessary to preparing an effective response to the threat of toxic weapons, particularly at a time when so many demands are being placed on the resources of civilian and military personnel involved in crisis response.

FINAL THOUGHTS

Toxic warfare has been a reality for some time. Unfortunately, the continued use of small-scale toxic weapons as well as the persistent threat thereof signals that state and nonstate actors alike recognize that they are in possession of a potent new weapon. Foreign adversaries, including both state and insurgent/terrorist interests, increasingly see toxic warfare as a viable weapon for achieving their military and political goals.

U.S. understanding of this threat, while slow to mature, has improved, particularly for current counterterrorism operations. In

---

[9]See Daniel J. DeNoon, "Hospitals Not Ready for Terrorist Attacks," WebMD Medical News, January 26, 2000, available at http://www.webmd.com. Hospitals have three ranked priorities in the event of a HAZMAT incident The primary duty is to protect current patients, staff, and the facility itself. The secondary duty is to give the best treatment possible to contaminated patients presenting for care. The final concern is to protect the environment outside the facility.

addition, the U.S. military is improving its ability to prevent and respond to toxic warfare. This report has provided a preliminary examination of an increased interest in asymmetrical toxic warfare among state and nonstate actors. U.S. forces—especially the U.S. Air Force—must continue to think about the problem and take appropriate steps for responding to it.

The risks associated with toxic warfare need to be better understood. Planning for military operations and civilian crisis response requires a detailed understanding of the benefits and costs associated with various options for countering toxic weapons. Military personnel and civilian officials are currently planning for a wide range of threats, all of which are competing for a limited pool of resources. While this research has aimed to show that toxic warfare merits greater attention, it has not attempted to quantify the risk by calculating the frequency of toxic attacks in relation to other kinds of risks or by assessing the full consequences of these weapons' use. A quantitative risk assessment should be considered as a means of providing a more thorough evaluation of the problem.

BIBLIOGRAPHY

Agence France-Presse, November 25, 1995, accessed from FBIS-FTS-19951125000450.

"A History of Biological and Chemical Threats to Water Supply," *International Defense Review*, Vol. 32, No. 1, January 1, 1999, p. 58.

Alexander, George A., "Ecoterrorism and Nontraditional Military Threats," *Military Medicine*, Vol. 165, No. 1, January 2000, p. 3.

Antonov, Yevgenii V., "Threat of Terrorist Attack Using Weapons of Mass Destruction from Chechnya," *Yadernyy kontrol*, No. 2, March–April 2001, pp. 55–70, accessed from FBIS-CEP-20010610000001.

Bedard, Paul, "Danger Zone," *U.S. News & World Report*, March 6, 2000, p. 10.

Bodansky, Yossef, "Bosnian Muslim Forces' First Combat Use of Chemical Weapons," *Defense and Foreign Affairs Strategic Policy*, August 31, 1993, p. 16.

Borisov, Timofey, "Smear a Grenade with Glue and Rain Down Hell," *Rossiyskaya gazeta*, August 30, 2001, as cited in "Paper Profiles Chechen Manufacturer of Toxic Weapons," accessed from FBIS-CEP-20010830000180.

Breeze Software and Services, *Breeze Haz Materials*, available at http://www.breeze-software.com/content/haz/.

Cameron, Gavin, Jason Pate, Diana McCauley, and Lindsay DeFazio, *1999 WMD Terrorism Chronology: Incidents Involving Sub-National Actors and Chemical, Biological, Radiological, and Nuclear Materials*, Monterey, CA: Center for Nonproliferation Studies, Vol. 7, No. 2, Summer 2000, available at http://cns.miis.edu/pubs/npr/vol07/72/wmdchr72.htm.

Chemical Warfare: A Burning Issue—Project on Insurgency, Terrorism and Security, available at http://paladin-san-francisco.com/libgas03.htm.

Cockerham, L. G., and B. S. Shane, *Basic Environmental Toxicology*, Boca Raton, FL: CRC Press, 1994.

Dando, Malcolm, "Discriminating Bio-Weapons Could Target Ethnic Groups," *International Defense Review*, Vol. 30, No. 3, March 1, 1997, p. 77.

Dean, John, "Organized Crime Versus the Environment," *Jane's International Police Review*, January 1, 2000, available at Intelink.

DeNoon, Daniel J., "Hospitals Not Ready for Terrorist Attacks," WebMD Medical News, January 26, 2000, available at http://www.webmd.com.

"FARC Allegedly Using Acid, Tar, Feces to Make Bombs," *El Tiempo*, September 6, 2001, accessed from FBIS-LAP-20010906000034.

"FBI Starts Nationwide Records Check on HAZMAT Truckers," CNN Online, September 26, 2001, available at http://www.cnn.com.

Federation of American Scientists, *AFMIC Weekly Wire 48-90* (U), available at http://www.fas.org/irp/gulf/cia/970129/970110_WW48090_90_0001.html.

Federation of American Scientists, *Chapter VI—The Air Campaign*, available at http://www.fas.org/irp/imint/docs/cpgw6/cpgw_ch6_execute.htm.

Federation of American Scientists, *Reaching Globally, Reaching Powerfully: The United States Air Force in the Gulf War—A Report—September 1991*, available at http://www.fas.org/man/dod-101/ops/docs/desstorm.htm.

"Five Oil Wells Still Ablaze in Chechnya," RIA, November 30, 1999, accessed from FBIS-FTS-19991201000318.

"Forced to Take a Lead on Hazardous Materials," *Jane's International Police Review*, January 1, 2000, available at Intelink.

Franke, Siegfried, *Manual of Military Chemistry*, Vol. 1, Berlin: Deutscher Militärverlag, 1967.

Fulghum, David A., "Terrorism Makes Base Protection Critical," *Aviation Week & Space Technology*, June 18, 2001, p. 196.

"Further on Tamil Tigers Attacking Oil Tanker in Sri Lanka," *Agence France-Presse*, October 30, 2001, accessed from FBIS-SAP-20011030000111.

Galeotti, Mark, "Crimes of the New Millennium," *Jane's Intelligence Review*, August 1, 2000, available at Intelink.

Galeotti, Mark, "The New World of Organized Crime," *Jane's Intelligence Review*, September 1, 2000, available at Intelink.

"Grozny Gas Cloud Blown in Wrong Direction," Russian Public Television First Channel Network, December 29, 1999, accessed from FBIS-FTS-19991229001437.

"Guerrilla Suicide Boat Hits Sri Lankan Oil Tanker," Reuters, October 30, 2001.

Gunaratna, Rohan, "Intelligence Failures Exposed by Tamil Tigers Airport Attack," *Jane's Intelligence Review*, September 2001, pp. 14–17.

Hallmark, Brian, et al., *NBC at the NTC: Distraction or Necessity?* internal paper, Santa Monica: RAND, 2002.

Harigel, Gert G., *Chemical and Biological Weapons: Use in Warfare, Impact on Society and Environment*, Carnegie Endowment for International Peace, available at http://www.ceip.org/files/publications/Harigelreport.asp?p=8.

Harigel, Gert G., *The Concept of Weapons of Mass Destruction: Chemical and Biological Weapons, Use in Warfare, Impact on Society and Environment*, presented at the Conference on

Biosecurity and Bioterrorism, Istituto Diplomatico "Mario Toscano," Rome, Italy, September 18–19, 2000.

Hilz, Christoph, *The International Toxic Waste Trade*, New York: Van Nostrand Reinhold, 1992.

"Hot Mish'al," Channel 2 Television Network, November 8, 1999, accessed from FBIS-FTS-19991109000932.

Joha, Ghassan, "Israel's Bid to Dump Toxic Waste in Jordan Foiled," *The Star*, November 30, 2000, accessed from FBIS-IAP-20001130000091.

Joint Doctrine for Operations in Nuclear, Biological, and Chemical (NBC) Environments, Washington, D.C., Joint Publication 3-11, July 11, 2000.

Korbut, Andrei, "Chechnya: The Ecological Threat Is Growing," *Nezavisimoye voyennoye obozrenie*, No. 176, January 28, 2000, available at http://nvo.ng.ru/wars/2000=01=28/2_ecohazard.html.

Leader, Stefan H., "The Rise of Terrorism," *Security Management*, April 1997.

McCarthy, Rory, "Inside Bin Laden's Chemical Bunker," *The Guardian*, November 17, 2001.

Mnatsakanyan, Alexander, "Were Chemical Weapons Used in Chechnya?" *Izvestia*, August 24, 1995, pp. 1–2, accessed from FBIS-FTS-19970502001427.

Monday, William H., *Thinking the Unthinkable: Attacking Fresh Water Supplies*, master's thesis, Naval Postgraduate School, Monterey, CA, AD-B241, December 1998.

Oliker, Olga, *Russia's Chechen Wars 1994–2000: Lessons from Urban Combat*, MR-1289-A, Santa Monica: RAND, 2001.

Overton, E. B., W. D. Sharpe, and P. Roberts, "Toxicity of Petroleum," in L. G. Cockerham and B. S. Shane, *Basic Environmental Toxicology*, Boca Raton, FL: CRC Press, 1994, pp. 133–156.

Pate, Jason, Gary Ackerman, and Kimberly McCloud, *2000 WMD Terrorism Chronology: Incidents Involving Sub-National Actors and Chemical, Biological, Radiological, or Nuclear Materials*, Monterey, CA: Center for Nonproliferation Studies, available at http://cns.miis.edu/pubs/reports/cbrn2k.htm.

Pianin, Eric, "Toxic Chemicals' Security Worries Officials," *Washington Post*, November 12, 2001, p. A14.

Pyes, Craig, and William C. Rempel, "Poison Gas Plot Alleged in Europe," *Los Angeles Times*, November 12, 2001, p. 10.

Reinhardt, P. A., and J. G. Gordon, *Infectious and Medical Waste Management*, Chelsea, MI: Lewis Publishers, 1991.

Richburg, Keith B., "Bin Laden, Bombs and Buddhas; Documents Left in Kabul Detail Foreigners' Roles," *Washington Post*, November 22, 2001, pp. A1, A35.

Risen, James, and Judith Miller, "Al Qaeda Sites Show Skills in Chemicals," *New York Times*, November 11, 2001, p. B1.

Rodier, D. J., and M. G. Zeeman, "Ecological Risk Assessment," in L. G. Cockerham and B. S. Shane, *Basic Environmental Toxicology*, Boca Raton, FL: CRC Press, 1994, pp. 581–604.

Sarna, Yigal, and Anat Tal-Shir, "Most of All He Likes to Disguise Himself and Operate in Enemy Territory," *Yediot Aharonot*, October 24, 1997, pp. 16–19, accessed from FBIS-FTS-19971102000227.

"Settlers Pump Sewerage Water into Palestinian Groves," Palestine Information Network, June 21, 2000, available at http://www.palestine-info.net/daily_news/prev_editions/2000/June2000/21June.htm#9.

Shlapak, David A., and Alan Vick, *"Check Six Begins on the Ground": Responding to the Evolving Ground Threat to U.S. Air Force Bases*, MR-606-AF, Santa Monica: RAND, 1995.

"Snipers, Small Rebel Groups Remain in Grozny," ITAR-TASS, March 12, 2000, accessed from FBIS-CEP-20000312000074.

Sofaer, Abraham D., George D. Wilson, and Sidney D. Dell, *The New Terror: Facing the Threat of Biological and Chemical Weapons*, Stanford, CA: Hoover Institution, 1999.

Soyland, Svend, *Criminal Organizations and Crimes Against the Environment: A Desktop Study*, Turin, Italy: United National Interregional Crime and Justice Research Institute, June 2000.

Spearson, Graham, "Strategic and Security Issues: Forbidden, Not Forgotten," *International Defense Review*, Vol. 30, No. 3, March 1, 1997, available at Intelink.

Supotnitskii, Mikhail, "The Second Coming of Chlorine," *Nezavisimoye voyennoe obozrenie*, No. 1, January 2000, p. 4, accessed from FBIS-CEP-20000127000079.

"Tamil Rebels Raid Sri Lankan Airport," *Washington Post*, July 25, 2001, p. 14.

"Toxic Cloud in Chechnya: Rebels Detonate Chlorine Tank," RIA, December 10, 1999, accessed from FBIS-FTS-1999121000813.

TRANSCOM J5 and AMC officials, personal interviews, July and August 2001.

Tucker, Jonathan, "National Health and Medical Services Response to Incidents of Chemical and Biological Terrorism" *JAMA*, Vol. 278, August 6, 1997, pp. 362–368, available at http://jama.ama-assn.org/issues/v278n5/ffull/jpp71006.html.

Tucker, Jonathan B. (ed.), *Toxic Terror: Assessing Terrorist Use of Chemical and Biological Weapons*, Cambridge, MA: MIT Press, 2000.

"Turks Report Attempt to Poison Air Force Unit, Reuters, March 28, 1992, as quoted in William H. Monday, *Thinking the Unthinkable: Attacking Fresh Water Supplies*, master's thesis, Naval Postgraduate School, Monterey, CA, AD-B241, December 1998, p. 137.

U.S. Air Force, *Civil Engineer Emergency Response Operations*, Air Force Manual 32-4004, December 1, 1995.

U.S. General Accounting Office, *Operation Desert Storm: Evaluation of the Air Campaign*, Washington, D.C., GAO/NSIAD-97-134, June 1997.

U.S. General Accounting Office, *Report to Congressional Requesters, Chemical Weapons: DOD Does Not Have a Strategy to Address Low-Level Exposures*, Washington, D.C., GAO/NSIAD-98-228, September 1998.

U.S. General Accounting Office, *Statement of Henry L. Hinton, Jr., Assistant Comptroller General, National Security and International Affairs Division, Testimony Before the Subcommittee on National Security, Veterans Affairs, and International Relations, Committee on Government Reform, House of Representatives, Combating Terrorism: Observations on the Threat of Chemical and Biological Terrorism*, Washington, D.C., GAO/T-NSIAD-00-50, October 20, 1999.

U.S. General Accounting Office, *Statement of Mark E. Gebicke, Director, Military Operations and Capabilities Issues, National Security and International Affairs Division, Testimony Before the Committee on Veterans' Affairs, U.S. Senate, Chemical and Biological Defense: Observations on DOD's Plans to Protect U.S. Forces*, Washington, D.C., GAO/T-NSIAD-98-83, 1998.

Venter, Al J., "Biological Warfare: The Poor Man's Atomic Bomb," *Jane's Intelligence Review*, Vol. 11, No. 3, March 1, 1999, p. 42.

Venter, Al J., "Poisoned Chalice Poses Problems: The Terrorist Threat to the World's Water," *International Defense Review*, Vol. 32, No. 1, January 1, 1999, p. 57.

Vick, Alan, *Snakes in the Eagle's Nest: A History of Ground Attacks on Air Bases*, MR-553-AF, Santa Monica: RAND, 1995.

Walker, Tom, "Al-Qaeda's Secrets: Bin Laden's Camps Reveal Chemical Weapon Ambition," *Sunday Times* (UK), November 25, 2001.

Wilkinson, Tracy, "Microcosm of the Mideast Conflict in a Dead Flock," *Los Angeles Times*, September 1, 2001, p. A3.

Wolfowitz, Paul, Deputy Secretary of Defense, letter to the Honorable Bob Stump, Chairman, Committee on Armed Services, U.S. House of Representatives, Washington, D.C., April 25, 2001.

Zanders, Jean Pascal, "Assessing the Risk of Chemical and Biological Weapons Proliferation to Terrorists," *Nonproliferation Review*, Fall 1999, pp. 17–34.

Zilinskas, Raymond A., "The Threat of Bioterrorism," Center for Nonproliferation Studies briefing, August 3, 1998, available at http://cns.miis.edu/iiop/cnsdata.

Zvi, Shabatai, "Israeli Settlers Destroy 17,000 Tons of Grapes," *Al-Ayyam*, October 23, 1997, available at http://www.hebron.com/article04-10-23-97.html.

STB Finance Docket No. 35504

UNION PACIFIC R.R. – PETITION FOR DECLARATORY ORDER

OPENING EVIDENCE AND ARGUMENT
OF
NORFOLK SOUTHERN RAILWAY COMPANY

EXHIBIT 6

BBC NEWS

'Chlorine bomb' hits Iraq village

At least 32 people have been killed and 50 injured in a suspected chlorine bomb in Iraq's Diyala province, police say.

The attack happened in an open-air market in the village of Abu Sayda at about 2000 (1600 GMT) on Tuesday.

A police spokesman in the provincial capital Baquba said doctors at a local hospital believed the nature of victims' burns suggested poison gas.

Use of chlorine bombs has become more common since the start of the year, says a BBC correspondent in Baghdad.

Last month a bomb using chlorine and high explosive killed 35 people in Ramadi, west of the capital.

Chlorine - widely used as a cleaner and purifier in areas of poor water sanitation - is easy to obtain in Iraq.

Chlorine gas burns the skin on contact and can be fatal after a few breaths.

In February the United States military reported finding a bomb factory near Falluja, where chlorine car bombs were being constructed.

Diyala province - with its mixed Shia and Sunni Muslim population - has been the scene of frequent violence of a sectarian nature as well as attacks by anti-US insurgents.

Story from BBC NEWS:
http://news.bbc.co.uk/go/pr/fr/-/2/hi/middle_east/6660585.stm

Published: 2007/05/16 11:56:46 GMT

STB Finance Docket No. 35504

UNION PACIFIC R.R. – PETITION FOR DECLARATORY ORDER

OPENING EVIDENCE AND ARGUMENT
OF
NORFOLK SOUTHERN RAILWAY COMPANY

EXHIBIT 7

ASSOCIATION OF
AMERICAN RAILROADS

Law Department
Louis P. Warchot
Senior Vice President-Law
and General Counsel

July 10, 2008

Honorable Anne Quinlan
Acting Secretary
Surface Transportation Board
395 E St., S.W.
Washington, DC 20423

Re: STB Ex Parte No. 677 (Sub-No. 1) – Common Carrier Obligation of Railroads – Transportation of Hazardous Materials

Dear Secretary Quinlan:

Pursuant to the Notice of the Board served June 4, 2008 (and supplemental procedural orders served June 19, and June 23, 2008), attached is the Written Testimony of the Association of American Railroads for filing in the above proceeding.

Respectfully submitted,

Louis P. Warchot
Attorney for the Association of
American Railroads

BEFORE THE

SURFACE TRANSPORTATION BOARD

STB EX Parte No. 677 (Sub-No. 1)

COMMON CARRIER OBLIGATION OF RAILROADS---TRANSPORTATION OF HAZARDOUS MATERIALS

WRITTEN TESTIMONY OF

THE

ASSOCIATION OF AMERICAN RAILROADS

Of Counsel:

Paul Guthrie
Paul R. Hitchcock
Theodore K. Kalick
Jill Mulligan
Robert T. Opal
David C. Reeves
John M. Scheib
Peter J. Shudtz
Greg E. Summy
Richard E. Weicher

Louis P. Warchot
Association of American Railroads
50 F Street, N.W.
Washington, D.C. 20001
(202) 639-2502

Kenneth P. Kolson
10209 Summit Avenue
Kensington, M.D. 20895

Counsel for the Association of American Railroads

Dated: July 10, 2008

TABLE OF CONTENTS

BEFORE THE
SURFACE TRANSPORTATION BOARD

STB EX Parte No. 677 (Sub-No. 1)

COMMON CARRIER OBLIGATION OF RAILROADS---TRANSPORTATION OF HAZARDOUS MATERIALS

WRITTEN TESTIMONY OF
THE
ASSOCIATION OF AMERICAN RAILROADS

I. Introduction

By Notice served June 4, 2008 (and supplemental procedural order served June 19, 2008), the Surface Transportation Board ("Board") scheduled a public hearing for July 22, 2008 on the common carrier obligation of railroads with respect to the transportation of hazardous materials. The Association of American Railroads ("AAR"), whose members account for 75 percent of U.S. freight rail mileage, 92 percent of employees, and 95 percent of revenues, intends to testify at the hearing and hereby submits this written testimony as directed by the Board in its Notice.

The Board's Notice is an outcome of testimony provided by railroad industry and shipper community participants at the Board's April 24-25, 2008 public hearing in Ex Parte No. 677, Common Carrier Obligation of Railroads. The transportation of toxic inhalation hazard ("TIH") materials was one of the specific items on the Board's agenda in that proceeding and was the subject of significant discussion at the hearing. As a principal focus of its testimony, the railroad industry, through the AAR and other railroad witnesses, noted that although rail is the safest mode of transportation for many hazardous materials, including TIH materials, the transportation of TIH materials as currently mandated under the railroads' common carrier obligation subjects the railroads to significant risks and raises the specter of "bet the company" exposure in case of the release of such materials.

In response to the Board's institution of this proceeding and the specific inquiries set forth in its Notice, the AAR presents the testimony below which addresses the scope of the railroads' common carrier obligation regarding TIH materials, the current untenable situation facing the railroads with respect to the transport of such materials, and proposals for Board action to address the current situation consistent with the common carrier obligation. Although the Board's Notice references hazardous materials generally, including TIH materials, the AAR's testimony will focus on TIH materials because of the extraordinary risk and exposure imposed upon the railroad industry due to the unique characteristics of such materials.[1]

II. AAR Position on TIH Materials Transport

At the outset, the AAR wishes to make clear that it is not seeking at this juncture for the railroad industry to be relieved of its common carrier obligation to transport TIH materials. It is, however, asking the Board to issue a policy statement that will provide guidance as to what that obligation requires and permits. As the Board has long recognized, the railroads' common carrier obligation is not absolute. The Board has discretion in interpreting that obligation, and, as in all other matters before it, its discretion should be informed by the public interest.

[1] A description of the commodities that the railroads consider to be TIH materials is set forth in Attachment 1.

The AAR recognizes that rail transportation is the safest and most secure mode of transporting TIH materials generally and that many such materials currently play an important role in the national economy. The issue, from the railroad industry's perspective, is that if there is a public interest need for the railroads to be compelled to carry TIH materials, there is a corresponding public interest need for the industry to be able to take into account and protect itself against the increased risk and potentially ruinous liability exposure associated with transporting TIH. Such exposure could jeopardize not only the financial condition of individual carriers but also the financial health of the industry itself with attendant adverse effects on the ability of the railroad network to provide efficient and responsive rail services to the public in general. Accordingly, in this proceeding the industry does not seek relief from its current common carrier obligation to transport TIH materials, but instead asks that the Board: (1) recognize and approve the right of a rail carrier (if it chooses to do so) to establish, as conditions of transport, liability-sharing arrangements with shippers and find that such conditions are reasonable service terms for rail common carrier transportation of TIH materials; (2) consider the extraordinary costs of TIH materials transport in Board proceedings; and (3) support long-term policy solutions to address the open ended risk and exposure associated with TIH materials transport.

Specifically, the AAR first proposes that the Board issue a formal policy statement based on the record in these proceedings making clear that a railroad, if it chooses to do so, may establish common carrier service terms that: (1) require the shipper of TIH materials to indemnify the carrier for the full amount of any liability or exposure resulting from a release of TIH materials above a threshold level that would be the greater of the amount of insurance that the railroad carries for such an incident or, for Class I railroads, $500 million[2]; and (2) require the shipper to obtain insurance or other forms of assurance to support such indemnification at levels depending upon the circumstances of the TIH materials transportation (including the size and financial ability of the shipper).

The AAR's proposal is predicated on the premise that rail carriers would continue to assume liability for the risk of transporting TIH materials at the primary level and accept the normal risks of rail operations and accidents associated with the transport of any commodity. Rail carriers would, however, be provided assurance by the Board that they may require shippers to share the extraordinary risks presented by a potential release of the extra-hazardous TIH materials they have chosen to ship. Consistent with the common carrier obligation requirement to "provide service on reasonable request," the rights of rail carriers to "establish reasonable...rules and practices," and the public interest, both the carrier and the shipper would share the extraordinary liability risk of TIH transport. This shared liability would not only provide protection for the rail network against catastrophic exposure, but also act as an incentive for all stakeholders to seek to further reduce the risks associated with TIH material transport through operational changes in their respective industries and/or legislative action.

Second, the AAR proposes that the extraordinary cost of TIH materials transport resulting from the actions that railroads take to address and mitigate the specific dangers associated with the commodities themselves be recognized by the Board in STB proceedings. There are unique and significantly greater risks associated with TIH materials transport than with other commodities and the railroads must take unique and extraordinary measures in response to

[2] Minimum threshold levels of less then $500 million would be established for Class II and Class III railroads. Also, this proposal assumes that at least $500 million of insurance for TIH materials transport is commercially available for Class I carriers. If the insurance market changes, appropriate relief would be sought from the Board to address that circumstance.

those risks. The Board should allow the costs of those measures to be considered in rate reasonableness and any other relevant STB proceedings.

Third, while the first two AAR proposals would result in mitigating the significant risks, costs and potential liability for the railroads in transporting TIH materials, there remains the potential for catastrophic accidents and ruinous exposure as long as such commodities are transported at all. Thus, long-term solutions must also be sought to address more completely the ultimate concern that a single accident could not only be financially ruinous for a rail carrier but also have significant adverse consequences for public safety. As long as it is in the public interest to require railroads to transport TIH materials, public policy should favor appropriate protection for rail carriers against the risk associated with TIH materials and for the public to share or limit that risk. Accordingly, the Board should assist in identifying and lend its support to policy initiatives that would address the overall health and financial risks to the railroads and the public resulting from the release of TIH materials in transport.

III. The Common Carrier Obligation Does Not Preclude Railroads From Establishing Reasonable Conditions on TIH Materials Transport

As explained below, the AAR's proposals, and specifically the proposal to allow rail carriers to establish risk sharing terms with TIH shippers, are necessary under the current circumstances facing TIH materials transport and is consistent with Court, Board and Interstate Commerce Commission ("ICC") case law defining a reasonable practice under the common carrier obligation.

A. General Common Carrier Obligation of Rail Carriers

As the Board indicated in its Notice in this proceeding, the common carrier obligation derives from 49 USC § 11101(a), which requires that a carrier provide "transportation or service upon reasonable request." However, the common carrier obligation is not absolute and service requests must be reasonable. *See e.g.*, G.S. Roofing Prods. Co. v. STB, 143 F.3d 387, 391 (8^{th} Cir. 1998).

In assessing what constitutes a reasonable request, there are two avenues of inquiry. The first is whether the "request" for service is reasonable. As noted in Consolidated Rail Corp. v. ICC, 646 F.2d 642, 647 (D.C.Cir. 1981), "[l]ong ago the Supreme Court made it clear that '[no] party has the right to insist upon a wasteful or excessive service for which the consumer must ultimately pay.'" The second is the reasonableness of the carrier's response to the request for service. A carrier is only required to take reasonable steps to provide adequate service under the circumstances and may "establish reasonable ...rules and practices in matters related to that transportation or service." 49 U.S.C. 10702; *see, e.g.*, Granite State Concrete Co., v. STB, 417 F.3d 85, 92-94 (1^{st} Cir. 2005) ("Granite"); see also Chicago & Northwestern Transp. Co. v. Kalo Brick & Tile Co., 450 U.S. 311, 325 (1981)).

The obligations of a carrier to "provide service on reasonable request" pursuant to section 11101(a), and to "establish reasonable...rules and practices" pursuant to section 10702, are not statutorily defined. As noted in Granite, 417 F.3d at 92-94: "The two statutory provisions ... do not provide precise definitions for the operative standards: section 11101 does not define what would constitute adequate service on reasonable request, and section 10702 does not define what would be reasonable rules and practices." The Granite court (at 92) further ruled that under the statutory scheme of the ICC Termination Act of 1995 ("ICCTA") the definition and scope of these terms are to be determined by the Board on a case-by-case basis in light of all the relevant facts and circumstance. See also National Grain & Feed Ass'n v. United States, 5 F.3d 306, 310

(8th Cir. 1993); Decatur County Comm'rs v. STB, 308 F.3d 710, 716 (7th Cir. 2002); GS Roofing Prods. Co. v STB, 143 F.3d 387, 392 (8th Cir. 1998).

The Board's broad discretion to determine the scope of the rail common carrier obligation under 49 U.S.C.11101(a) is in no manner nullified or circumscribed by the existence of safety – or security – regulations issued by the Department of Transportation ("DOT") pertaining to the commodity or service at issue. Simply because DOT regulations may set standards for the way a specific hazardous material may be packaged or transported by rail, that does not modify or define the common carrier obligation of rail carriers to transport the materials.

As specifically recognized by the courts and the Board's predecessor agency (the ICC), DOT safety regulations govern only safety issues (and similarly security regulations govern security issues). Only the Board has jurisdiction under the ICCTA to determine the scope of the common carrier obligation (*i.e.*, what constitutes a "reasonable request" for service under 49 U.S.C. 11101(a) or a "reasonable rule or practice" under 49 U.S.C. 10702), and only the Board has jurisdiction to rule on economic issues pertaining to the rail transportation of hazardous materials, including with respect to insurance and liability issues. See, e.g., Akron, C. & Y. Ry. v ICC, 611 F2d 1162, 1170 (6th Cir. 1979) ("Akron") ("questions of safety [regarding rail transport of nuclear materials] are also questions of risk and liability. A question of possible liability for damage resulting from carriage of a commodity is therefore within the Commission's jurisdiction as the regulator of the economics of interstate rail transport"); see also Delta Airlines v. CAB, 543 F2d 247, 259-260, 267 (D.C. Cir. 1976) ("Delta Airlines"); Radioactive Materials, Missouri-Kansas-Texas R.R., 357 ICC 458, 463-64 (1977) ("MKT")

Thus, the Board can assess the risks of transport of a commodity in determining the reasonableness of a request for such transportation and the reasonableness of conditions placed upon common carriage transport in response to the request.

B. Common Carrier Obligation of Railroads in the Context of TIH Materials

The scope of the common carrier obligation of railroads to transport hazardous materials was the subject of a series of ICC cases originating in the late 1970's (the Akron and MKT cases). In those cases, the ICC examined the specific facts and circumstances relating to the carriers' efforts to "flag out" from or otherwise condition their common carrier obligations to transport the radioactive materials (spent nuclear fuel and radioactive waste) and, based on the record at that time, did not approve the carriers' request.

The only case of which the AAR is aware involving agency consideration of the rail common carrier obligation to transport TIH materials is Classification Ratings of Chemicals, Conrail, 3 ICC 2d 331 (1986) ("Conrail"). In that case, Conrail attempted to "flag out" from its common carrier obligation to transport TIH because the product was highly lethal (referencing the chemical disaster in Bhopal, India in 1984).[3] In its "flag out," however, Conrail noted that it might be willing to provide the transportation as a contract carrier where it could more closely supervise and set terms for shipment handling, insurance and allocation of risk. See Conrail, at 337.

---

[3] In the Bhopal accident, a lethal gas (methyl isocyanate) leaked from a Union Carbide India Limited (UCIL) pesticide plant in Bhopal, India. At least 3,800 people died and several thousand other individuals experienced permanent or partial disabilities. In 1989 the Supreme Court of India directed a final settlement of the Bhopal litigation in the amount of $470 million. See Union Carbide Corporation statement on its website (www. Bhopal.com (2007). The $470 million settlement amount did not include extensive environmental clean-up costs. (The damage claims would potentially have been orders of magnitudes higher had the catastrophic disaster occurred in the U.S.)

In evaluating Conrail's attempt to limit its common carrier obligation to transport the TIH materials at issue, the ICC referenced its findings in the Akron and MKT cases and summarized them as follows:

> "[W]hen a flag-out for the transportation of nuclear materials is involved, the Commission has relied on the extensive safety regulation by both DOT and [Nuclear Regulatory Commission] and the limitation on a carrier's liability under the Price-Anderson Act, and concluded 'a railroad may not renege on its common carrier commitment to transport radioactive materials on the ground they are too hazardous, if, in fact, the minimum safety requirements of DOT and NRC are satisfied.'"

Id at 335 (quoting from DOE v Baltimore & O.R. Co., 364 ICC 951, 959 (1981)).

However, in the Conrail case, the ICC found that the hazardous materials case before it was different from the nuclear waste cases. "Nuclear materials are extensively regulated by both DOT and NRC, and carrier liability is limited by Federal law (the Price-Anderson Act). Only DOT regulates transportation safety of hazardous chemicals. Moreover, there are no limitations on carrier liability for the transportation of such commodities." Conrail at 336. As further noted by the ICC: "[T]he Commission has discretion to determine if there may be limitations on a carrier's tariff publication/common carrier obligation [regarding transport of ultra-hazardous materials].... This determination will include an analysis of the hazard posed by the involved commodity, the need for stricter safety standards [than DOT's safety regulations], and financial evidence including insurance costs and the extent of carrier liability." Conrail at 337.

The ICC ultimately denied Conrail's "flag out" attempt, but did so because it found that Conrail had failed to meet its evidentiary burden. In that regard, the ICC stated: "Conrail has presented no meaningful evidence on why it cannot accomplish what it seeks to do in a published tariff. It has not shown that it could not use the tariff (through publication of various rules) to limit liability or to gain greater control over when commodities are tendered and how they are handled." Conrail at 337.

Consistent with the holding in the Conrail case, the Board can help delineate the appropriate limitations or conditions on a carrier's common carrier obligation, including with respect to the transportation of TIH materials. In the Conrail context, the ICC focused, in part, on an analysis of the hazard and the extent of carrier liability. That should be the same focus for the Board in this proceeding taking into account the current environment in which there is a greater risk of potentially catastrophic liability related to the rail transportation of TIH materials than in Conrail and growing opportunities to avoid such transport.

In this regard, the AAR does not dispute that the movement of TIH materials is governed by an extensive set of DOT regulations and Transportation Security Administration ("TSA") requirements that are intended to minimize the hazards of transporting TIH materials by rail. However, DOT regulations and TSA requirements, while adding to the costs of TIH materials transport, do not provide a clear legal shield for the railroads from potentially enormous exposure should there occur a catastrophic incident involving release of TIH materials. Moreover, the extent of potential carrier liability far exceeds the levels of commercial insurance carriers can practicably obtain.

Unlike in Conrail, the railroad industry is not seeking to "flag out" from its common carrier obligation to transport TIH materials. Instead the industry seeks to act upon the ICC's specific rulings in Conrail that a carrier may seek to address its higher costs and potentially enormous liability exposure for a TIH "chemical disaster" arising from the transportation of these materials through reasonable service rules governing common carrier service. Accordingly, the AAR, consistent with the Conrail decision, seeks a formal policy statement by the Board that a carrier may include specific terms in its common carrier service offerings involving TIH materials that address the immediate and significant concerns regarding carrier liability exposure and that such offerings do not constitute unreasonable practices and are not unreasonable responses to requests for TIH materials transport.

C. Reasonable Practices of Railroads in the Context of TIH Materials Transport

Conditions on TIH materials transport in the present environment would not only be consistent with the railroads' common carrier obligation, but would also be reasonable practices under 49 U.S.C. 10702. What is a "reasonable practice" is dependent upon the circumstances with the appropriate question being "whether actions taken by [the carrier] are unreasonable." Granite State, 417 F3d at 92.[4]

The touchstone of a reasonable practice is a finding by the Board that a specific carrier rule or practice is predicated upon a legitimate and urgent carrier concern and represents "a reasonable accommodation between the [carrier's]... concerns and the petitioners' service needs." See Granite at 92-93. In the present context, the overriding risk, exposure, and safety concerns serve as an appropriate basis for a finding that a rail carrier imposing liability-sharing and indemnity requirements as a condition of rail common carrier transportation of TIH materials would be a reasonable means of mitigating railroad exposure consistent with the public interest.

IV. It is Reasonable for the Railroads to Require the Sharing of Risk and Liability for TIH Materials Transportation With Shippers

As noted above, the AAR's proposed policy statement would make it clear that if a carrier chooses to do so, it may establish liability sharing and indemnity arrangements for shippers of TIH materials as a condition of common carrier service. For the reasons explained

[4] It should also be noted that "the burden has consistently been placed on complainants to prove the merits of an unreasonable practice claim." N. Am. Freight Car Ass'n v. BNSF Ry., STB Docket No. 42060 (Sub-No.1), 2007 WL 20123 (served Jan. 26, 2007), Slip Op. at 5, *affirmed*, North America Freight Car Ass'n v. STB, __F.3d__, 2008 WL 2491983 (D.C.Cir. June 24, 2008).

below, there are compelling grounds at this time for the Board to clarify that carriers may impose such conditions.

A. The liability exposure to the railroads in transporting TIH materials are significant and are based upon the unique characteristics of TIH materials

Railroads typically transport approximately 100,000 carloads of TIH each year; and the railroads are proud of their hazmat safety record. In 2006 (the most recent year for which data are available), 99.996 percent of rail hazmat shipments reached their final destination without a release caused by an accident.

That record is the result of a concerted effort by the industry to ensure the safety of extra-hazardous materials. For example, railroads participate in DOT rulemakings on TIH safety and security issues; participate in industry committees that establish new standards for tank cars carrying TIH; help communities develop and evaluate emergency response plans; train or assist with the training of tens of thousands of emergency responders each year; provide emergency responders with critical information to help mitigate hazmat incidents; and use special operating procedures on trains carrying TIH in accordance with DOT handling and routing regulations.

Despite the railroads' overall favorable safety record, however, the current environment for the rail transportation of TIH materials is untenable. Accidents can, and unfortunately even though the odds are extremely minimal, will occur, even when the railroads are not at fault. Therefore, every time a railroad moves one of these shipments, it faces potentially ruinous liability.

Moreover, railroads face these huge risks for a tiny fraction of their business. Shipments of TIH constitute only about 0.3 percent of all rail carloads. The revenue that highly-hazardous materials generate does not come close to covering the potential liability to railroads associated with transporting this traffic.

The fact that the commodities move in accordance with Department of Transportation-approved safety regulations does not eliminate the problem or the concern. Given the level and complexity of railroad operations—the railroad "factory floor" is outdoors and more than 140,000 miles long—it is unrealistic to expect that no rail accidents will occur, especially when the railroads can do everything right and a third party can cause an accident (*e.g.*, automobiles running into sides of moving trains). Natural causes such as rains and flooding provide examples of the types of TIH release incidents that could occur even where the railroad is not at fault. In one instance, flash flooding washed out ballast underlying an industry track on the Union Pacific in a heavily populated area. Loaded chlorine cars were on the track at the time. Fortunately, no incident occurred because the cars remained on the track even though the support under the rail was washed away. Had the cars fallen off the track, they would have struck an exposed fuel transmission pipeline. In another instance, earlier this year, a tornado derailed a loaded chlorine car near Chicago, fortunately without a release of the commodity.

As noted above, while accidents involving highly-hazardous materials on railroads are exceedingly rare, railroads could be subjected to multi-billion dollar claims, even for accidents where the railroads do nothing wrong, because of the unusual characteristics of the TIH commodities themselves. Unfortunately, the potential enormous liability of the railroad industry for damage claims arising from accidental TIH releases is starkly demonstrated by actual examples of three tragic accidents involving TIH over the last few years. These examples also clearly demonstrate that it is the inherent nature of the materials themselves that create the potential for enormous carrier liability claims.

In its recent Notice of Proposed Rulemaking, Hazardous Materials; Improving the Safety of Railroad Tank Car Transportation, 73 FR 17818 (April 1, 2008), DOT examined in detail the

National Transportation Safety Board's (NTSB) findings regarding three recent accidents involving PIH (Poison Inhalation Hazard)/TIH releases[5] from tank cars, which occurred between 2002 and 2005, in Minot, ND, Macdona, TX and Graniteville, SC. The NSTB's findings as reported by DOT are summarized as follows:

1. Minot, ND – The accident occurred at approximately 1:30 am on Jan 18, 2002 near Minot and resulted in the derailment of 31 cars of a 112-car train. Eleven of the 31 derailed cars were pressurized tank cars transporting anhydrous ammonia. Five of the tank cars ruptured and instantaneously released their contents. Approximately 146,000 gallons of anhydrous ammonia were released from those five cars. As a result, a toxic vapor plume covered the derailment site and the surrounding area. The plume rose approximately 300 feet and gradually expanded five miles downwind of the accident site. The remaining six cars also suffered from shell impacts and gradually released 74,000 gallons of anhydrous ammonia. One resident was fatally injured and 333 people suffered other injuries. NTSB credited the emergency response effort (the Fire Department ordered residents in the area to shelter-in-place) with the relatively low number of injuries (333 injuries in 11,600 persons affected). An industry source estimates the total losses from the accident as approximately $125 million.[6] (73 FR at 17826)

2. Macdona, TX- The accident occurred at approximately 5:00 am on June 28, 2004 and resulted in derailment of four locomotives and 36 cars belonging to two trains that collided. One of the derailed cars was a tank car transporting chlorine. The car was punctured and instantaneously released approximately 9,400 gallons of chlorine, and a toxic vapor plume engulfed the accident area to a radius of approximately 700 feet before drifting away from the site. The vapor cloud drifted with the wind and traveled toward several residential areas within the city of San Antonio. Sea-World, a large commercial entertainment venue, was about 10 miles northwest of Macdona in the path of the chlorine vapor cloud. Thirty-three persons were injured, three fatally. (73 FR at 17827-28.)

3. Graniteville, SC- The accident occurred at approximately 2:30 am on January 6, 2005 when a freight train struck a train on a rail spur leading to the Avondale Mills textile manufacturing facility. The collision resulted in the derailment of three locomotives and 17 cars, including three pressurized tank cars transporting chlorine. One of the tank cars was punctured and instantaneously released approximately 9,220 gallons of chlorine, creating a toxic vapor plume that engulfed the surrounding area. As a result of the chlorine release, 5,400 people within a 1- mile radius of the derailment site were evacuated for several days. Nine persons were fatally injured and 554 sustained other injuries. The NTSB noted that despite an effective emergency response, the eight civilian

---

[5] The terms PIH and TIH as used by DOT are synonymous (see 73 FR 20752, 20757 (April 16, 2008) (DOT interim final routing regulations regarding hazardous materials)).
[6] See Chicago SouthShore & South Bend R.R. ("Chicago SouthShore") April 17, 2006 written testimony in Ex Parte No. 677 at 8.

fatalities were determined to have died from asphyxia that occurred within minutes of exposure to the chlorine gas. Avondale Mills reported that it was unable to recover financially from the accident and closed its 10 mills in SC and GA. (73 FR at 17827-28) (On April 7, 2008, NS also reached a confidential settlement with Avondale Mills (which alone asserted claims against NS for $420 million). Publicly available information indicates that claims of all parties affected by the Graniteville accident will exceed $500 million, not including extensive environmental remediation costs.)[7]

In its April 1, 2008 NPRM, DOT also included a "what if" analysis regarding the three accidents. As found by DOT:

> "Each of the three accidents discussed...above share certain similarities that effectively minimized the catastrophic results of the accidents. Each accident occurred in a relatively rural area, thereby limiting the population exposed to the hazardous materials release. Each accident occurred during the early morning hours, while most of the surrounding populations were in their homes and not in the immediate accident vicinity. The meteorological conditions at the time of each accident effectively limited the speed at which the resulting toxic plumes expanded and the distance over which the plumes expanded. Had any of the accidents occurred in a more densely populated area or later in the day, it is likely that many more people would have been exposed to the toxic plumes. Had the meteorological conditions at the time of any of the accidents been different (e.g., wind speed or direction, temperature, barometric pressure, or humidity) it is possible that the plumes could have expanded more than what actually occurred, again, exposing many more people to the toxic chemicals...." (73 FR at 17829)

As is evident from the DOT analysis, an accident involving the transportation of TIH is of a far different nature and magnitude than a normal railroad accident involving a derailment or collision resulting in spillage or release of lading, and the difference is predicated solely on the nature of the TIH lading itself. A train accident involving the spillage or release of coal, corn oil, or some other non-TIH material will likely be limited to a confined area near the accident site and cause a relatively localized amount of personal injury or property damage, no matter how severe the accident or how it occurred. As the three accidents discussed by DOT demonstrate, however, a TIH accident resulting in a release is not localized and has the potential to cause extensive death, injury and property damage miles away from the accident site.

[7] See April 7, 2008 news release on NS website. See also, Associated Press, Meg Kinnard, SC Firm, Railroad Settle Suit Over Spill, April 7, 2008.

A TIH release is also not readily—if at all-- containable, no matter how rapidly an emergency response team may respond (or is able to respond due to the toxic nature of the release). The speed, path and destructive power of an accidental TIH release are based on the vagaries of wind, weather, time, geography, and population density of the surrounding areas. Should an accident occur within or near a densely populated area, or should there be a popular public attraction within a few miles of the site in the path of a toxic TIH plume (e.g., a Sea World as in the Macdona, TX accident) an accident resulting in a TIH release under unfavorable meteorological conditions has the potential to be truly catastrophic (on a scale even exceeding Bhopal) and result in billions of dollars in personal injury and property damage claims.

As an illustrative example, as noted in the April 17, 2008 written testimony of Chicago SouthShore in Ex Parte No. 677 (at 10), if an incident similar to the three accidents examined by DOT were to occur in a major city like Chicago with a population of approximately three million (and an estimated 12,750.3 people per square mile), "the results would be horrific." As noted by Chicago SouthShore (in summarizing an economic analyst's report):

> "A recent study conducted by Risk Management Solutions, entitled *Catastrophe, Injury & Insurance: The Impact of Catastrophes on Workers Compensation, Life and Health Insurance* (2004) (the "RMS Study"), concluded that a rush hour rail accident in Chicago involving a chlorine release from a single car could result in 10,000 fatalities, 32,600 other casualties and more than $7 billion in claims. RMS Study at 54-59. If such an incident involved the release of TIH from multiple cars, the losses would be considerably higher."

It should also be noted that rail transportation of TIH is far riskier now than at the time of the Conrail case (1986). There are terrorism concerns that did not previously exist and that severely affect the risk profile of TIH materials transportation. Indeed, potential terrorist attacks on rail transportation of TIH materials are one of the principal focus points of the DOT's April

16, 2008 final interim rule pertaining to safety and security for hazardous materials shipments.[8] As noted by DOT (73 FR at 20752):

> "The same characteristics of hazardous materials that cause concern in the event of an accidental release also make them attractive targets for terrorism or sabotage. Hazardous materials in transportation are frequently transported in substantial quantities and are potentially vulnerable to sabotage or misuse. Such materials are already mobile and are frequently transported in proximity to large population centers. Further, security of hazardous materials in the transportation environment poses unique challenges as compared to security at fixed facilities...."

The terrorism risk presented by TIH materials is also the focus point of TSA proposed rules regarding rail transportation security.[9] As noted by TSA: "[TIH materials] present a significant rail transportation security risk and an attractive target for terrorists because of the potential for them to use these materials as weapons of mass effect." 71 FR at 76861.

Unfortunately, although a rail carrier may exercise the utmost diligence under its own safety and security procedures and in accordance with new and proposed federal requirements (as further discussed in Section V below), there simply is no guarantee that a successful terrorist attack resulting in a release of TIH materials cannot occur at some location on a carrier's extensive rail network and cause catastrophic damage. Similarly, there is no guarantee that a rail carrier would not be the subject of potential liability claims in the event of a successful terrorist attack resulting in a release of TIH materials based on assertions, however unfounded, that the carrier was somehow remiss in its safety or security responsibilities.

---

[8] Docket No. PHMSA-RSPA-2004-18730, Hazardous Materials: Enhancing Rail Transportation Safety and Security for Hazardous Materials Shipments, 73 FR 20752 (April 16, 2008).

[9] TSA NPRM (71 Fed. Reg. 76852 (Dec. 21, 2006).

Not only are there new terrorism concerns, there is also far more traffic and congestion on the rail network that could potentially increase the risk of accident.[10] There are also multitudinous new population and commercial centers that were formerly rural, increasing the potential for enormous liability claims for personal injury and property damage should a TIH release occur on what previously was an isolated portion of the rail network.

The legal landscape is also perilous, with potentially enormous jury awards predicated on a "deep pockets" approach. Railroads do not own tank cars holding TIH materials, do not load the tank cars, are not responsible for maintenance of the tank cars, and cannot ensure by inspection against leakage of the tank cars. Yet, if a tank car transporting TIH materials were to develop a leak and result in a release of TIH materials causing personal injury or property damage, there is little doubt that there would be claims filed against the carrier and the outcome in the litigation process would by no means be a certainty. Under our jury system, it is a fact of life that a carrier can be exposed to, and be found responsible for, enormous damage claims even where they were not at fault.

On the basis of the uniquely dangerous characteristics of TIH materials and the significant risk and exposure to the railroads in transporting such commodities, the AAR believes it is not a "reasonable" request for a shipper to ask the railroads to transport TIH materials at this

---

[10] As the National Surface Transportation Policy and Revenue Study Commission recently noted, "Congestion [is affecting] every mode of surface transportation for ever-lengthening periods each day, as a result of the mismatch between demand and supply of limited capacity." (Report of the National Surface Transportation Policy and Revenue Study Commission, Volume 1, p. 4.) The magnitude of the looming freight rail capacity issue was also borne out by a recent study by Cambridge Systematics, a prominent economic and transportation consulting firm. The purpose of the study, which focused on 52,000 miles of primary rail corridors, was to estimate the cost of the expansion in capacity necessary for U.S. freight railroads to handle the 88 percent increase in freight rail traffic forecast by the DOT for 2035. The study found that if rail capacity needs are not properly addressed, by 2035 some 16,000 miles of primary rail corridors — nearly one-third of the 52,000 miles covered in the study — will be so congested that a comprehensive service breakdown environment on the railroads affected would exist. Because the rail system is so interconnected, this outcome would mean that the entire U.S. freight rail system would, in effect, be disabled.

time without agreeing, if so requested, to share with the shippers the significant exposure resulting from such transport.

B. The Proposed Policy Statement Clarifying That Rail Carriers May Impose Conditions on the Transportation of TIH Materials is Consistent with the Public Interest

Railroads do not produce TIH materials, do not use TIH materials, do not own the tank cars used to transport TIH materials, and do not make the decisions on where TIH materials will be transported. Yet, under their current common carrier obligation, railroads are the only participants in the production, distribution and consumption chain for TIH materials that are required to handle these commodities. Indeed, even among transportation companies, railroads are the only entities required to handle TIH materials – no one requires motor carriers, barge or vessel operators or air transporters to handle this traffic.

An interpretation of the railroads' common carrier obligation where the enormous, uninsurable liability risk arising out of the distribution of TIH materials is placed upon the rail carriers instead of shared with the manufacturers and users of TIH materials would represent a seriously misguided public policy. Doing so would provide little or no incentive to manufacturers and users of TIH materials to develop and substitute safer products or to limit the public's exposure to TIH materials transportation movements to the minimum extent possible.

Today there are many substitute products for TIH materials (including, for example, substitutes for chlorine and anhydrous ammonia). Although the existence of these substitute products may not currently eliminate the need for TIH materials for some commercial and agricultural uses, there should be strong incentives in place for manufacturers and users to replace, where feasible, TIH materials and other highly-hazardous materials with less hazardous substitutes and new technologies. As the National Research Council (part of the National

Academy of Sciences) has noted, "the most desirable solution to preventing chemical releases is to reduce or eliminate the hazard where possible, not control it." (Terrorism and the Chemical Infrastructure: Protecting People and Reducing Vulnerabilities, National Research Council – Board on Chemical Sciences and Technology, May 2006, p. 106). This can be achieved by "modifying processes where possible to minimize the amount of hazardous material used" and "[replacing] a hazardous substance with a less hazardous substitute." Id. In a similar vein, in a January 2006 report, the Government Accountability Office ("GAO") recommended that the Department of Homeland Security ("DHS") "work with EPA to study the advantages and disadvantages of substituting safer chemicals and processes at some chemical facilities." [Homeland *Security: DHS is Taking Steps to Enhance Security at Chemical Facilities, but Additional Authority* is *Needed*, GAO, Jan. 2006, p.7.] And the Center for American Progress ("CAP") in an April 2007 report[11], notes that "the only way to truly protect communities is to get unnecessary toxic cargoes off the tracks." (CAP report at 1).

There are many real-world examples to make the case for using safer chemicals. According to the CAP, some 25 water utilities no longer receive chlorine gas by rail, and now use safer and more secure treatments like liquid bleach or ultraviolet light. "As a result," noted the CAP report, "more than 26 million people no longer live within range of a chlorine gas release from these facilities, and additional millions are no longer in danger from rail shipments to these facilities." (CAP report at 8.) One facility referenced in the CAP report was the Blue Plains wastewater treatment facility, just a few miles from the U.S. Capitol. The facility used chlorine to disinfect water until shortly after 9/11 when the facility switched to sodium hypochlorite, a safer alternative. (CAP report at 13) Also, a March 2007 GAO report (at p. 14, Table 1) lists 23 large wastewater treatment facilities located throughout the country that have

[11] Attached as Attachment 2.

recently converted or plan to convert from chlorine gas to a safer alternative. (GAO, *Securing Wastewater Facilities: Costs of Vulnerability Assessments, Risk Management Plans, and Alternative Disinfection Methods Vary Widely,* March 2007.)[12] Railroads recognize that the use of TIH materials cannot be immediately halted. However, over the medium to long-term, using safer chemicals would go a long way in reducing hazmat risks.

As noted above, current policies relating to the rail transportation of TIH materials, however, do not provide appropriate incentives for reducing or eliminating unnecessary shipments of TIH. A more appropriate public policy would be one that encourages the entities who are making the decisions to produce, ship and use TIH materials to find product alternatives to TIH materials wherever possible. However, where product alternatives are not possible, public policy should also strongly discourage unnecessary shipment of TIH materials. This traffic should not be moving long distances across the country to further the commercial interests of producers or receivers when closer sources of supply are available. The current system works contrary to these goals. Far from discouraging unnecessary use or shipment of TIH materials, the current system will continue to encourage these activities by insulating TIH materials producers and receivers from the risks of their commercial decisions by allowing them to shift those risks to the railroads, which cannot refuse to handle the shipments under their current common carrier obligation.

The AAR's proposal is predicated on the premise that these problems can largely be addressed if rail carriers remain liable for the normal risks of rail operations and accidents associated with the transportation of hazardous materials other than TIH materials plus the primary risk of transporting TIH materials up to specific insurable limits. A rail carrier would be

[12] Attached as Attachment 3.

permitted, however, to require shippers to bear the extraordinary risks presented by a potential release of the extra-hazardous TIH materials they have chosen to ship by rail.

The AAR's proposal involves a reasonable and fair sharing of the risks. Where there is unknowable and unlimited liability exposure resulting from the inherent nature of the commodity itself, the risk inherent to that commodity is appropriately placed on the manufacturer/shipper of the dangerous commodity who is the main economic beneficiary of its manufacture and transportation. The railroads would still have the same strong incentives to operate safely, but they would no longer face the unwarranted and unreasonable levels of risk and exposure that give rise to the legitimate concerns discussed in these comments.

Moreover, the AAR believes that a clear interpretation of the common carrier obligation to permit liability sharing as proposed by the AAR would create an incentive for all the stakeholders, (*i.e.*, manufacturers, users, and railroads) to work together to find means to eliminate such exposure through the use of alternate products, changes in manufacturing locations, or legislative or policy initiatives such as discussed in Section VI below.

C. The Board Can Confirm that the Railroads Can Condition TIH Materials Transport Through the Issuance of a Policy Statement

The AAR, based upon the record at this hearing, submits that the Board should issue a general policy statement to the effect that:

> It would not be an unreasonable practice for a rail carrier, under the provisions of 49 U.S.C. 11101(a) and 49 U.S.C. 10702, to require (if it elected to), as a condition of providing common carrier transportation services, that a TIH materials shipper indemnify and hold harmless the railroad against liability arising from a release of such materials in excess of (1) the maximum amount of insurance that the railroad carries for TIH transport or (2) $500 million for Class I railroads, whichever is greater; and to provide reasonable assurances in the form of insurance or other means to support such indemnity.[13]

[13] As noted above, separate minimum thresholds would be established for Class II and Class III railroads.

Because individual circumstances may vary, a carrier should also be allowed to establish conditions of transport setting lower thresholds of carrier liability (and, accordingly, higher levels of liability sharing with the shipper). Those conditions could be assessed by the Board on a case by case basis; however, if the carrier established conditions accepting liability at or above the specified threshold level that would be a "safe harbor" and such conditions would not be unreasonable. In addition, this proposal assumes that insurance is commercially available at the minimum threshold levels. If the insurance market changes and that is no longer the case, appropriate relief would be sought from the Board.

The Board has the authority to issue such a general policy statement, based on its findings at this hearing, under the provisions of the Administrative Procedure Act, 5 U.S.C. 553 (b) (APA) and the Board's corresponding procedural rules. 49 C.F.R. 1110.3. Those provisions provide that a "general statement of policy...may be issued as final without notice or other public rulemaking proceedings."

Such a general policy statement would note the Board's intent with respect to determining the scope of the railroads' common carrier obligation to transport TIH materials and would serve to advise the public prospectively as to how the Board proposed to exercise its considerable discretion in future cases. See, e.g., Iowa Power & Light Co. v Burlington N. Inc., 647 F2d 796, 811 (8th Cir. 1981) ("Iowa Power") As further explained in Pacific Gas & Elec. Co. v FPC, 506 F2d 33, 38 (D.C. Cir. 1974):

> "As an informational device, the general statement of policy serves several beneficial functions. By providing a formal method by which an agency can express its views, the general statement of policy encourages public dissemination of the agency's policies prior to their actual application in particular situations. Thus the agency's initial views do not remain secret but are disclosed well in advance of their actual application. Additionally, the publication of a general statement of policy facilitates long range planning within the regulated industry and promotes uniformity in areas of national concern."

The AAR would also note that Board issuance of a general statement of policy in this proceeding based on the results of its Ex Parte No. 677 (Sub-No. 1) public hearing would be comparable in effect to the Board's handling of the fuel surcharge issue. In Ex Parte No. 661, Rail Fuel Surcharges, the Board, based on rail shipper concerns that "recent fuel surcharges collected by railroads are designed to recover amounts over and above increased fuel costs," conducted a public hearing on the issue. (See March 14, 2006 Notice of Public Hearing.) Following the hearing, the Board sought additional comment on certain proposals. However, based on the testimony at the hearing, the Board also issued a general policy statement admonishing the railroads to immediately halt the challenged practice. (See August 3, 2006 Notice at 4.)

V. The Unique Costs of TIH Materials Transportation Must be Recognized in Board Proceedings

In its Notice the Board requested comment on "whether there are unique costs associated with the transportation of hazardous materials, and if so, how railroads cover those costs."

Not only are railroads currently faced with potentially enormous liability for the transportation of TIH, they also bear the burden of a multitude of unique costs associated with TIH that they are currently precluded under STB rules from identifying in rate proceedings. See Simplified Standards for Rail Rate Cases, STB Ex Parte No. 646 (Sub-No.1) (STB served Sept. 5, 2007) ("Simplified Standards"). Those unique costs include costs of maintaining insurance that covers the higher risks associated with TIH materials transport and costs of compliance with safety and security operating procedures that each railroad has in place due to the enhanced risks associated with the commodities. These operating procedures result not only in capital and operating expenditures directly related to the activity, but also increased capital and operating costs over the rail network (*e.g.*, reducing speed for a TIH materials train on a otherwise congested line slows the other trains on the line). A summary of recommended operating practices adopted by the rail industry through the AAR with respect to the transportation of hazardous materials is attached as Attachment 4. Also included in Attachment 4 is a brief description of the security initiatives that the industry has undertaken that relate to TIH materials transport.

Additional costs also result from special carrier operating procedures and risk assessments that are required to meet federal requirements for the security, handling and movement of TIH materials. Examples of these special procedures, which arise from DOT regulations, pending rulemakings, and TSA requirements are outlined below and are set forth in more detail in Attachment 5:

> •Under current DOT rules, railroads must adopt security plans for TIH materials, including analyses of safety and security risks. See 49 CFR 172.800, 172.802, 172.820. Under DOT interim final rules,[14] rail carriers must perform comprehensive safety and security risk assessments on existing hazmat routes and all "practicable alternative routes over which the carrier has authority to operate" and choose the route "presenting the fewest overall safety and security risks." with attendant operational changes.
>
> •Under proposed DOT rules applicable to TIH tank car specifications,[15] a maximum allowable operating speed of 30 mph would apply in non-signal territory to TIH tank cars not meeting the proposed TIH tank car specification; a maximum operating speed of 50 mph would apply to all TIH tank car movements. (Proposed 49 CFR 174.86)
>
> •Under proposed TSA regulations,[16] a railroad must have a security coordinator; procedures to determine the location and shipping information for each TIH rail car under its physical custody and to be able to provide TSA with such information within one hour of request. There are also stringent requirements on transfers of cars containing TIH materials between interchanging railroads and between railroads and shippers or receivers. These include requirements that cars being transferred within a High Threat

[14] Docket No. PHMSA-RSPA-2004-18730, Hazardous Materials: Enhancing Rail Transportation Safety and Security for Hazardous Materials Shipments, 73 FR 20752 (April 16, 2008).

[15] (DOT NPRM) Docket No. FRA-2006-25169, Hazardous Materials: Improving the Safety of Railroad Tank Car Transportation of Hazardous Materials (73 FR 17818, 17862 (April 1, 2008).

[16] TSA NPRM (71 Fed. Reg. 76852, 882-884 (Dec. 21, 2006)

Urban Areas ("HTUA"), or which may subsequently enter an HTUA, may not be left unattended at any time during the transfer of custody. (Proposed 49 CFR 1580.101; 1580.103; 1580.105; 1580.107)

•Under other TSA initiatives, railroads have undertaken security measures resulting from HTUA vulnerability assessments including installation of lights, fences, intrusion detection devices, smart cameras, special positioning of TIH cars when stationary in HTUAs, movement of TIH car interchange points to locations outside HTUAs and reduction in TIH dwell time. (See *e.g.*, Attachment 5.)

Under the Board's current rules governing small shipper cases (under which all or most TIH materials rate proceedings are likely to be decided) these unique costs are not allowed to be allocated directly to TIH material shippers. Use of movement-specific TIH materials costs are not permitted in small-shipper maximum rate proceedings; only system-wide URCS costs are permitted to be used for maximum reasonable rate determinations. See Simplified Standards slip op. at 58.

AAR submits that the Board's current rules governing small-shipper rate cases, as applicable to TIH materials movements, currently operate (and will increasingly operate) to unfairly prevent carriers from recovering the unique costs attributable to TIH materials movements in the rates that carriers are permitted to charge TIH materials shippers. Instead, the current rules, which are predicated on system-average costs, spread these costs over the entire shipper community to the extent possible. The current rules accordingly prevent rail carriers from reflecting the unique costs of TIH materials transportation from TIH material shippers in maximum rate cases while requiring the entire shipping community (to the extent the railroads are able to allocate these costs across their entire traffic base) to cross-subsidize TIH material shippers. This is unfair to both rail carriers and to the rail shipper community as a whole.

VI. Legislative and Policy Approaches, Such as Price Anderson Act Type Legislation, Should be Explored as a Long-Term Solution, But Should Not be a Substitute for Immediate Board Action

In its Notice, the Board requested comment on "potential policy solutions to the liability issue, including solutions modeled on the Price Anderson Act." The Board also requested comment "on the appropriate role of the Board in developing such a policy solution."

The Board clearly has the authority to lend support to and advocate a legislative/policy solution along the lines of a Price Anderson Act or other approach. The common carrier liability issue is an economic issue directly within the Board's jurisdiction (see Conrail) and the financial soundness of the railroad industry is a central tenet of Rail Transportation Policy. (*e.g.*, 49 U.S.C. 10101(3), (4), (5) and (8)). The Board has appropriate authority to propose legislation and comment on legislation in areas of agency concern. However, the Board's authority should be exercised in this context taking into account two fundamental considerations.

First, it should be understood that a legislative/policy approach would not be a substitute for a Board policy statement at this time clarifying the rail common carrier obligation as proposed in Section IV above. The enormous potential liability associated with the transportation of TIH materials is a matter of immediate urgency to the industry. The AAR's request for a clarification concerning the reasonableness of liability sharing/indemnity under the railroads' common carrier obligation is a necessary and reasonable means of addressing the currently untenable situation as promptly as possible. A legislative/policy initiative is, by its nature, an uncertain and long-term process. Accordingly, the AAR views any legislative/policy approach as complementary, but not as a substitute for its proposal in these comments.

Secondly, any long-term legislative/policy approach needs to identify and focus on the appropriate objective. A Price Anderson Act type legislative approach would have as an objective overall limitations on liability for the transport of TIH materials. The Price-Anderson Act limits the liability of a company from an incident involving the release of nuclear material, including in transportation, and provides for a fund to which all nuclear power plant licensees contribute when an incident occurs to cover any damages in excess of required insurance levels. Under a similar type of proposal for TIH materials, railroads, TIH materials shippers, and tank car owners, lessors, and manufacturers would be required to maintain insurance and be liable for a defined amount of damages arising from a release of TIH materials. Any damages above that defined amount would be paid from a fund to which shippers of these materials would contribute on a pre- and post-incident basis up to a statutory maximum payment per incident. In this context, following the Price Anderson Act approach, the railroads would be treated as "contractors" with more limited liability than the shippers who, as discussed above, have the option whether to make and use TIH materials, and gain profit from doing so.[17]

Although Price Anderson Act type legislation would be similar, in many respects, to the AAR's proposal in Section IV, a legislative enactment would provide a greater degree of certainty as to the rights and obligations of the carriers and shippers. It would also provide for the sharing of risk and exposure relating to TIH materials transport over a broader group to include the public at large, because such type of legislation would be premised on the public need for the use – and, accordingly, the transport – of TIH materials and the corresponding public recognition that there should be limitations and sharing of the liability involved in TIH materials transport.[18]

---

[17] The AAR has, in concert with the American Short Line and Regional Railroad Association, developed proposed legislation as generally described above.

[18] Also, there may be other means to effect liability limitations. For example, Congress could create a statutory liability cap for the railroads similar to the one that applies to passenger operations The railroads' total liability for all claims, including punitive damages, from a single accident — regardless of fault — is capped at $200 million. 49 U.S.C. 28103.

While the policy goal of sharing and/or limiting liability for the transportation of TIH materials is desirable based upon the fundamental premise that such transport is necessary, legislation in furtherance of such a goal would not necessarily improve public safety. If the ultimate goal is improving safety, another legislative policy option – which is not mutually exclusive – would also be to explore legislative incentives to eliminate the transport of TIH materials over the long-term through product substitution, co-location, or other means. The Board should encourage the exploration of all types of long-term legislative/policy solutions to the present untenable situation and should take action to incent carriers and shippers to achieve consensus on any such policy solutions.

VII. Conclusion

The rail industry currently faces an untenable situation regarding the transport of TIH materials. While the amount of TIH materials transported by rail is minimal, the transportation of such materials exposes railroads to significantly higher costs and potentially ruinous liability due to the extraordinarily dangerous characteristics of the commodities themselves. Nonetheless, as a result of their common carrier obligation, the railroads must transport the TIH materials and be subject to the attendant costs, risks, and exposure.

The AAR, at this time, does not seek for the railroads to be relieved of their common carrier obligation to transport TIH materials. However, if there is a public interest need for TIH materials to be transported, there is a corresponding public interest need for the railroads to be protected against the higher costs and potentially ruinous exposure uniquely associated with TIH transport.

With respect to costs, the Board should take action to recognize in STB proceedings the extraordinary costs to the railroads involved with TIH materials transport that must be incurred to address and mitigate the dangers associated with the commodities.

The Board should also take action to incent and support legislative/policy approaches that would address both the liability and safety concerns associated with the movement of TIH materials. However, legislative initiatives, by their nature, are uncertain and long-term processes. The significant risks and exposure to which the railroads are subject are concerns that need to be immediately addressed.

Accordingly, the Board should issue a policy statement based on the record in this proceeding that a railroad, if it chooses to do so, may establish common carrier service terms that: (1) require the shipper of TIH materials to indemnify the carrier for the full amount of any liability or exposure resulting from a release of TIH materials above a threshold level that would be the greater of the amount of insurance that the railroad carries for such an incident or, for Class I railroads, $500 million; and (2) require the shipper to obtain insurance or other forms of assurance to support such indemnification at levels depending upon the circumstances of the TIH materials transportation.

ATTACHMENT 1

Attachment 1
Toxic-by-Inhalation (TIH) Materials Currently Transported By Rail *

DOT Proper Shipping Name	UN/NA# **
NON-FLAMMABLE GASES, HAZARD CLASS 2.2	
Ammonia, Anhydrous	UN 1005
Ammonia, Solution	UN 3318
POISON GASES, HAZARD CLASS 2.3	
Ammonia, Anhydrous	UN 1005
Ammonia, Solution	UN 3318
Arsine	UN 2188
Boron Trichloride	UN 1741
Boron Trifluoride	UN 1008
Bromine Chloride	UN 2901
Carbon Monoxide and Hydrogen mixture, Compressed	UN 2600
Carbon Monoxide, Compressed	UN 1016
Carbon Monoxide, refrigerated liquid	NA 9202
Carbonyl Fluoride	UN 2417
Carbonyl Sulfide	UN 2204
Chlorine	UN 1017
Chlorine Pentafluoride	UN 2548
Chlorine Trifluoride	UN 1749
Chloropicrin and Methyl Bromide mixtures	UN 1581
Chloropicrin and Methyl Chloride mixtures	UN 1582
Coal Gas, Compressed	UN 1023
Compressed Gas, toxic, corrosive, n.o.s.	UN 3304
Compressed Gas, toxic, flammable, corrosive, n.o.s.	UN 3305
Compressed Gas, toxic, flammable, n.o.s.	UN 1953
Compressed Gas, toxic, n.o.s.	UN 1955
Compressed Gas, toxic, oxidizing, corrosive, n.o.s.	UN 3306
Compressed gas, toxic, oxidizing, n.o.s.	UN 3303
Compressed gas, toxic, oxidizing, n.o.s.	UN 3306
Cyanogen	UN 1026
Cyanogen Chloride, Stabilized	UN 1589
Diborane	UN 1911
Dichlorosilane	UN 2189
Dinitrogen Tetroxide	UN 1067
Ethylene Oxide and Carbon Dioxide mixture	UN 3300
Ethylene Oxide or Ethylene Oxide with Nitrogen	UN 1040
Fluorine, Compressed	UN 1045

* Compiled from AAR Circular OT-55-I (July 17, 2006), as amended by AAR CPC Circular 1182 (Sept. 21, 2007). The OT-55 list of TIH materials transported by rail is periodically revised. A complete DOT list of TIH materials (including TIH materials not currently transported by rail) is found at 49 C.F.R. § 172.101. The AAR's proposal is all inclusive and embraces all TIH materials listed at 49 C.F.R. § 172 101.
** UN identification numbers for international and domestic transportation; NA numbers for domestic transportation and transportation to Canada only. See 49 C.F.R. §172.101 (c).

Gas Identification set	NA 9035
Gas sample, non-pressurized, toxic, n.o.s.	UN 3169
Gas sample, non-pressurized, toxic, flammable, n.o.s.	UN 3168
Germane	UN 2192
Hexaethyl tetraphosphate and compressed gas mixtures	UN 1612
Hexafluoroacetone	UN 2420
Hydrogen Bromide, anhydrous	UN 1048
Hydrogen Chloride, anhydrous	UN 1050
Hydrogen Chloride, refrigerated liquid	UN 2186
Hydrogen Iodide, anhydrous	UN 2197
Hydrogen Selenide, anhydrous	UN 2202
Hydrogen Sulfide	UN 1053
Insecticide gases, toxic, flammable, n.o.s.	UN 3355
Insecticide gases, toxic, n.o.s.	UN 1967
Liquefied gas, toxic, corrosive, n.o.s.	UN 3308
Liquefied gas, toxic, flammable, corrosive, n.o.s.	UN 3309
Liquefied gas, toxic, flammable, n.o.s.	UN 3160
Liquefied gas, toxic, n.o.s.	UN 3162
Liquefied gas, toxic, oxidizing, corrosive, n.o.s.	UN 3310
Liquefied gas, toxic, oxidizing, n.o.s.	UN 3307
Methyl Bromide	UN 1062
Methyl Mercaptan	UN 1064
Methylchlorosilane	UN 2534
Nitric oxide and nitrogen dioxide mixtures or Nitric oxide and dinitrogen tetroxide mixtures	UN 1975
Nitric Oxide, Compressed	UN 1660
Nitrogen Trioxide	UN 2421
Nitrosyl Chloride	UN 1069
Oil Gas, Compressed	UN 1071
Organic phosphate, mixed with compressed gas or Organic phosphate compound, mixed with compressed gas or Organic phosphorus compound, mixed with compressed gas	NA 1955
Oxygen Difluoride, Compressed	UN 2190
Parathion and Compressed gas mixture	NA 1967
Perchloryl Fluoride	UN 3083
Phosgene	UN 1076
Phosphine	UN 2199
Phosphorus Pentafluoride	UN 2198
Selenium Hexafluoride	UN 2194
Silicon Tetrafluoride	UN 1859
Stibine	UN 2676
Sulfur Dioxide	UN 1079
Sulfur Tetrafluoride	UN 2418
Sulfuryl Fluoride	UN 2191
Tellurium Hexafluoride	UN 2195
Trifluoroacetyl Chloride	UN 3057

Trifluorochloroethylene, Stabilized	UN 1082
Tungsten Hexafluoride	UN 2196
FLAMMABLE LIQUIDS, HAZARD CLASS 3	
Ethyl Isocyanate	UN 2481
Isobutyl Isocyanate	UN 2486
Isopropyl Isocyanate	UN 2483
Methacrylonitrile, Stabilized	UN 3079
Methoxymethyl Isocyanate	UN 2605
SPONTANEOUSLY COMBUSTIBLE, HAZARD CLASS 4.2	
Pentaborane	UN 1380
OXIDIZERS, HAZARD CLASS 5.1	
Bromine Pentafluoride	UN 1745
Bromine Trifluoride	UN 1746
Tetranitromethane	UN 1510
POISONS, HAZARD CLASS 6.1	
2-Chloroethanal	UN 2232
2-Methyl-2-Heptanethiol	UN 3023
3, 5-Dichloro-2, 4, 6-Trifluoropyridine	NA 9264
Acetone Cyanohydrin, Stabilized	UN 1541
Acrolein, Stabilized	UN 1092
Allyl Alcohol	UN 1098
Allyl Chloroformate	UN 1722
Allylamine	UN 2334
Arsenic Trichloride	UN 1560
Bromoacetone	UN 1569
Chloroacetone, Stabilized	UN 1695
Chloroacetonitrile	UN 2668
Chloroacetyl Chloride	UN 1752
Chloropicrin	UN 1580
Chloropivaloyl Chloride	NA 9263
Crotonalydehyde, Stabilized	UN 1143
Cyclohexyl Isocyanate	UN 2488
Diketene, Stabilized	UN 2521
Dimethyl Sulfate	UN 1595
Dimethylhydrazine, Symmetrical	UN 2382
Dimethylhydrazine, Unsymmetrical	UN 1163
Ethyl Chloroformate	UN 1182
Ethyl Phosphonothioic Dichloride, Anhydrous	NA 2927
Ethyl Phosphonous Dichloride, Anhydrous pyrophoric liquid	NA 2845
Ethyl Phosphorodichloridate	NA 2927
Ethyldichloroarsine	UN 1892
Ethylene Chlorohydrin	UN 1135
Ethylene Dibromide	UN 1605

Ethyleneimine, Stabilized	UN 1185
Hexachlorocyclopentadiene	UN 2646
Hydrocyanic acid, aqueous solutions or Hydrogen cyanide, aqueous solutions	UN 1613
Hydrogen Cyanide, solution in alcohol	UN 3294
Hydrogen Cyanide, stabilized	UN 1051
Iron Pentacarbonyl	UN 1994
Isobutyl Chloroformate	NA 2742
Isopropyl Chloroformate	UN 2407
Methanesulfonyl Chloride	UN 3246
Methyl Bromide and Ethylene dibromide mixtures, liquid	UN 1647
Methyl Chloroformate	UN 1238
Methyl Chloromethyl Ether	UN 1239
Methyl Iodide	UN 2644
Methyl Isocyanate	UN 2480
Methyl Isothiocyanate	UN 2477
Methyl Orthosilicate	UN 2606
Methyl Phosphonic Dichloride	NA 9206
Methyl Phosphonous Dichloride, pyrophoric liquid	NA 2845
Methyl Vinyl Ketone, Stabilized	UN 1251
Methyldichloroarsine	NA 1556
Methylhydrazine	UN 1244
n-Butyl Chloroformate	UN 2743
n-Butyl Isocyanate	UN 2485
Nickel Carbonyl	UN 1259
n-Propyl Chloroformate	UN 2740
n-Propyl Isocyanate	UN 2482
Perchloromethyl Mercaptan	UN 1670
Phenyl Isocyanate	UN 2487
Phenyl Mercaptan	UN 2337
Phenylcarbylamine Chloride	UN 1672
Phosphorus Trichloride	UN 1809
sec-Butyl Chloroformate	NA 2742
tert-Butyl Isocyanate	UN 2484
Thiophosgene	UN 2474
Toxic by Inhalation liquid, corrosive, n.o.s.	UN 3390
Toxic by Inhalation liquid, corrosive, n.o.s.	UN 3389
Toxic by Inhalation liquid, flammable, n.o.s.	UN 3384
Toxic by Inhalation liquid, flammable, n.o.s.	UN 3383
Toxic by Inhalation liquid, n.o.s.	UN 3382
Toxic by Inhalation liquid, n.o.s.	UN 3381
Toxic by Inhalation liquid, oxidizing, n.o.s.	UN 3388
Toxic by Inhalation liquid, oxidizing, n.o.s.	UN 3387
Toxic by Inhalation liquid, water-reactive, n.o.s.	UN 3386
Toxic by Inhalation liquid, water-reactive, n.o.s.	UN 3385
Trimethoxysilane	NA 9269

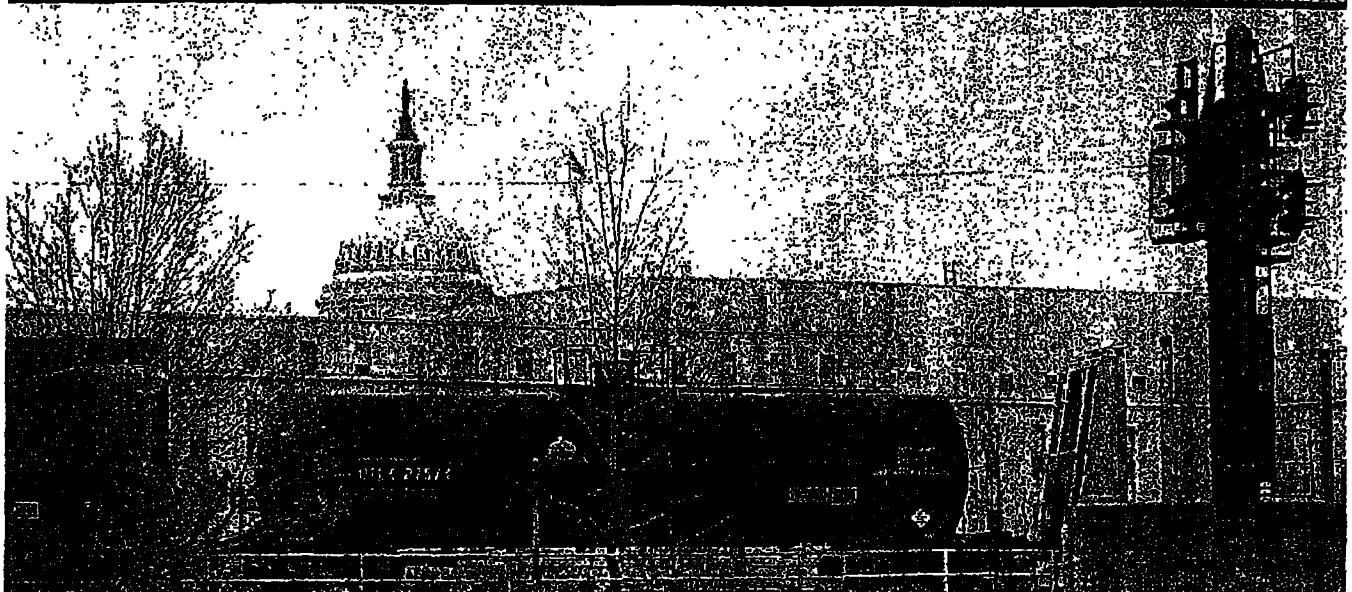
Trimethylacetyl Chloride	UN 2438
Waste Allyl Alcohol	UN 1098
Waste Hexachlorocyclopentadiene	UN 2646
Waste Toxic Liquid, corrosive, inorganic, n.o.s.	UN 3289
CORROSIVES, HAZARD CLASS 8	
Boron Tribromide	UN 2692
Bromine or Bromine Solutions	UN 1744
Bromine Solutions	UN 1744
Chlorosulfonic Acid	UN 1754
Ethyl Chlorothioformate	UN 2826
Hydrogen Fluoride, Anhydrous	UN 1052
Nitric Acid, red fuming	UN 2032
Phosphorus Oxychloride	UN 1810
Sulfur Trioxide, Stabilized	UN 1829
Sulfuric acid, fuming	UN 1831
Sulfuryl Chloride	UN 1834
Titanium Tetrachloride	UN 1838
Trichloroacetyl Chloride	UN 2442
Waste Sulfuric acid, fuming	UN 1831

ATTACHMENT 2

Attachment 2

Center for American Progress

Toxic Trains and the Terrorist Threat



How Washington Can Cut Chlorine Gas Off the Rails and Out of American Communities

Paul Orum

Progressive Ideas for a Strong, Just, and Free America

TOXIC TRAINS AND THE TERRORIST THREAT

How Water Utilities Can Get Chlorine Gas Off the Rails and Out of American Communities

By Paul Orum

Reece Rushing, Project Manager
Director of Regulatory and Information Policy,
Center for American Progress

April 2007

Contents/*April* 2007

Executive Summary

Each year, thousands of tons of highly toxic chlorine gas travel by rail in the United States to drinking water and wastewater treatment facilities and other industries. These massive railcars traverse some 300,000 miles of freight railways, passing through almost all major American cities and towns. A rupture of one of these railcars could release a dense, lethal plume for miles downwind, potentially killing or injuring thousands of people.

The Department of Homeland Security and numerous security experts have repeatedly warned that terrorists could use industrial chemicals as improvised weapons of mass destruction—and indeed, terrorists recently attacked and blew up several trucks carrying chlorine in Iraq. In this respect, railcars of chlorine gas represent a distinct national security vulnerability. Yet Congress and the Bush administration have not acted to eliminate unnecessary uses of chlorine gas railcars even where undeniably affordable and practical alternatives exist.

To examine this vulnerability and encourage action, the Center for American Progress surveyed water utilities that still receive chlorine gas by rail, as well as utilities that since 1999 have eliminated chlorine railcars by switching to a less hazardous disinfectant. Our major findings are shown in the box on page 3.

Just 37 drinking water and wastewater treatment facilities still receive chlorine gas by rail. More than 25 million Americans live in harm's way near these facilities,[1] while millions more live in cities and towns along the rail delivery routes.

The good news is this vulnerability can be removed. Since 1999, some 25 water utilities that formerly received chlorine gas by rail have switched to safer and more secure water treatment options, such as liquid bleach or ultraviolet light. These alternative treatment options eliminate the danger of a catastrophic toxic gas cloud. As a result, more than 26 million Americans who live near these facilities are safer and more secure.

These conversions also remove the threat to communities along rail delivery routes. Railroads, by their nature, are wide open and largely insecure, providing easy access to railcars—as evidenced by the graffiti that frequently marks them (see photo on page 15). This makes it practically impossible to provide security commensurate with the risk presented by railcars of chlorine gas.

The only way to truly protect communities is to get unnecessary toxic cargoes off the tracks. Converting to safer alternatives for water treatment does that.

There continues to be some progress in this direction. At least six water utilities that now use chlorine-gas railcars are in the process of converting operations. Nonetheless, many others contacted by this survey have no plans to change.

Cost was a frequently cited reason for not converting. But the survey found such conversions are affordable even at large facilities, costing no more than $1.50 per person served each year—or the price of a bag of potato chips—and often much less. Put another way, a single day's expenditures on the war in Iraq could cover construction costs of converting the remaining U.S. water utilities off chlorine gas railcars. Cost is not a sufficient justification to continue to jeopardize American communities with massive railcars of chlorine gas

State and local governments may provide incentives for water utilities to switch from chlorine gas. But communities along the rails have little or no local control over toxic trains that pass by homes, workplaces, and schools. The plant conversions identified in this report are positive, but without a national strategy, these communities will be much less secure than they should be.

Washington, D.C., for example, quickly converted its sewage treatment plant from chlorine gas railcars to liquid bleach in the aftermath of the Sept. 11, 2001, terrorist attacks. But hazardous chemicals, including chlorine gas, are still being transported by rail through the District just a few city blocks from the U.S. Capitol building—an intended target on 9/11.

In response, the city government sought to reroute toxic trains around the city. The Bush administration, however, has backed a lawsuit to block local control, arguing that local governments lack legal authority to protect citizens by rerouting trains.

The story is the same in other cities that have converted water utilities from chlorine-gas railcars, such as Cleveland and Indianapolis. Despite converting, these cities are still at risk from chlorine-gas railcars headed to other cities that have not converted, such as Minneapolis and Nashville.

A comprehensive solution can only come from the federal level. In fact, judges in the ongoing litigation over rerouting in Washington, D.C., have encouraged the Bush administration to develop a national strategy to address the security and safety dangers involved in the manufacture, use, and transportation of chlorine gas and other hazardous chemicals. Unfortunately, the administration and Congress have largely ignored this advice.

After years of inaction, and under growing public pressure, temporary and cosmetic chemical security legislation was enacted in October 2006 requiring the Department of Homeland Security to promulgate chemical-plant security regulations by April 4, 2007. But the legislation exempts water utilities, does not address transportation security concerns, and neglects safer and more secure technologies. Thus, among other shortcomings, DHS's new regulations will do nothing to address the risk posed to tens of millions of Americans by unnecessary rail shipments of chlorine gas to water utilities.

To address this danger and other chemical hazards, Congress must create meaningful national incentives. Among other actions, federal security standards should:

- Require chemical facilities to review and use available, cost-effective technologies that significantly reduce or eliminate serious emergency chemical release hazards;
- Target assistance to help water utilities convert from chlorine gas, including facilities that discontinued chlorine gas after Sept. 11, 2001;
- Give the Department of Homeland Security full authority to safeguard chemical infrastructure and the public, with appropriate roles for other governmental agencies; and
- Require chemical facilities to account for transportation risks—including the possibility of a catastrophic chemical release—in developing security assessments and plans.

Taking these actions would remove unnecessary toxic cargoes from the nation's railways and communities. The danger is immense and the solutions are clear. What we need now is action.

Major Findings

The Center for American Progress surveyed [illegible] water facilities that receive chlorine gas by rail or once [illegible] received [illegible] chlorine gas. All these facilities treat an average of five billion gallons of drinking water and four billion gallons of wastewater each day and serve more than 42 million people in [illegible] states and the District of Columbia. The survey identified facilities that have eliminated chlorine gas railcars but also found others that have no plans to do so. Major survey findings include:

- **Only 24 drinking water and 13 wastewater facilities still use *rail shipments* of chlorine gas.** These facilities are found in California, Florida, Kansas, Kentucky, Louisiana, Michigan, Minnesota, Missouri, Nebraska, South Carolina, Tennessee, Texas, Utah, and Virginia. These facilities endanger more than 25 million Americans who live nearby and millions more near railways that deliver the chlorine gas.
- **At least six drinking water and 19 wastewater facilities have eliminated *rail shipments* of chlorine gas since 1999 by switching to a less hazardous disinfectant.** These facilities are found in California, the District of Columbia, Florida, Georgia, Indiana, Kentucky, Louisiana, Maryland, Michigan, Minnesota, New Jersey, New York, Ohio, Oregon, Pennsylvania, and Washington. Some 26 million people in nearby communities and millions more along rail delivery routes are no longer threatened by chlorine gas from these facilities. Additional water utilities eliminated chlorine gas rail shipments prior to 1999 [1]
- Of facilities that still receive *rail shipments* of chlorine gas, at least four drinking water and two wastewater plants have definite plans to convert from chlorine gas to a safer, more secure disinfectant. These facilities are found in Colorado, Florida, Kentucky, Louisiana, South Carolina, and Virginia. By converting, they will remove the threat to more than five million people living nearby and millions more along their rail delivery routes. Several more such facilities are planning to convert within a few years, and others are evaluating alternatives.
- **Chlorine gas rail shipments travel long distances through populated areas.** Some 16 chlorine production sites sell chlorine by rail to the merchant market. The profusion of freight rail lines precludes identifying specific routes between producers and water utilities. The locations of producers and chlorine-gas-using water utilities, however, make clear that rail shipments often cover hundreds or even thousands of miles.
- **General cost estimates provided by 20 water facilities indicate that switching from chlorine gas to a safer, more secure disinfectant is affordable.** Conversions at these facilities cost no more than \$1.50 per person served each year—or the price of a bag of potato chips—and often cost much less. A single day's expenditures on the war in Iraq could easily have paid to convert these 20 facilities off chlorine gas.

Dangerous State of Play

Chemical Railcars Pose Serious Hazards

Exposure to chlorine gas can severely burn the eyes, skin, and lungs, and can be fatal. When released from a railcar, compressed chlorine expands rapidly into a ground-hugging poison gas cloud. A single ruptured railcar of chlorine gas can release a dense, lethal plume from 14 miles to 25 miles downwind in worst-case conditions.[5] In large urban areas, thousands of people could be killed or seriously injured in these conditions.

The Department of Homeland Security estimates that a major chlorine railcar spill could kill 17,500 people.[6] A Naval research lab likewise found that such a spill could quickly cause 100,000 serious injuries or deaths under a scenario involving large holiday crowds.[7]

This risk is especially worrisome given the vulnerability of railcars. A RAND Corp. database of worldwide terrorist incidents recorded over 250 attacks against rail targets from 1995 to 2005.[8] Insurgents in Iraq have recently targeted trucks carrying chlorine gas with several deliberate attacks.[9]

The graffiti on many railcars attests to their vulnerability. A survey of rail workers reported widespread lax security at rail yards.[10] Investigative news reports repeatedly show easy access to chemical facilities and rail cargoes.[11] A *Pittsburgh Tribune* reporter recently found so little security he could leave his business card on dozens of railcars and locations.[12]

Railcars may travel or sit near schools, hospitals, homes, and downtowns with only nominal security, if any. The railroad carrier may simply park the chlorine railcar outside the water utility fence on an unpredictable schedule, leaving it for the facility to retrieve. Rail security regulations are minimal, yet because federal rules preempt state and local requirements, chemical railcars passing through communities are largely exempt from local control.

Major chlorine rail spills are infrequent but can be deadly. Chlorine rail spills killed eight people in Youngstown, Fla., in 1978; 17 people in Montanas, Mexico in 1981; three people near San Antonio, Texas in 2004; and nine people in Graniteville, S.C., in 2005. Since 1990, the National Response Center has recorded over 160 mostly-minor spill reports involving railroads and chlorine, or more than one every six weeks.[13]

Such spills reveal the overall vulnerability of the system. But a calculated terrorist rupture of a single chlorine-gas-filled railcar could have far worse consequences, potentially poisoning an entire community.

New Interim Chemical Security Rules Won't Fix the Problem

Many federal agencies and others have warned that terrorists could use chemical facilities as pre-positioned weapons of mass destruction.[14] Yet there are almost no federal chemical security requirements. Congress enacted temporary legislation in October 2006 that requires the Department of Homeland Security to promulgate interim, stopgap chemical security requirements by April 4, 2007.[15]

But this new law is seen as an incomplete measure that will ultimately be replaced by comprehensive legislation. It has significant shortcomings that leave millions of Americans vulnerable. In particular, the new regulations:

"We are happy not to have the chlorine gas there. In the end it was a no-brainer to switch."

Bill McKeon, Chief-Wastewater, Philadelphia Water Department, Philadelphia, Pa.

- Exempt drinking water and wastewater plants and other types of facilities;
- Do not require facilities to address the dangers, security costs, and potential liabilities of transporting extremely hazardous materials to or from their facilities; and
- Ignore cost-effective safer technologies that are the most effective way to reduce the attractiveness of chemical facilities as terrorist targets.

These regulations are too focused on physical security at facilities and do not do enough to emphasize supply chain security. Better fencing, lighting, and access controls are important, but insufficient—particularly if the delivery of hazardous materials to or from a facility travels by rail through a major urban center.

In 2006, the Transportation Security Administration released draft voluntary action items for securing rail transportation of toxic inhalation materials such as chlorine gas. Yet the voluntary recommendations lack enforcement, are vague on key elements (such as protecting railcars in transit), and are silent on feasible opportunities to take hazardous cargoes off the rails.

The Bioterrorism Act of 2002 provided substantial federal funding to drinking water facilities to conduct vulnerability assessments, but did not require these facilities to reduce any hazards or otherwise improve security. Similarly, there are no significant federal security standards for wastewater plants.

Homeland Security Presidential Directive 7 designated the U.S. Environmental Protection Agency as the lead agency to oversee security at drinking water and wastewater facilities.[17] The EPA could require preventive security at water utilities under the general duty clause of the Clean Air Act. The Bush administration, however, blocked a specific proposal developed by EPA and the then Office of Homeland Security (now DHS) to use this authority to establish federal chemical security standards.[18]

Less Hazardous Alternatives Are Available

In 2006 the National Research Council reported that "the most desirable solution to preventing chemical releases is to reduce or eliminate the hazard where possible," including by modifying processes or replacing hazardous materials with less hazardous substitutes.[19] Two years ago, the Center for American Progress recommended an action plan for safeguarding hazardous chemical facilities using these techniques,[20] and one year ago released survey findings that documented some 284 facilities across diverse industries that had switched to less acutely hazardous options.[21]

The Association of American Railroads supports development of less hazardous products and technologies as substitutes for highly hazardous materials. In congressional testimony, the association explained that chlorine gas and other "toxic inhalation hazard," or TIH, chemicals comprise just 0.3 percent of all rail shipments, but railroads face potentially ruinous liability from hauling these chemicals (which they are required to carry). For this reason, the railroads "strongly support efforts aimed at finding and utilizing 'inherently safer technologies' as substitutes for hazardous materials, especially TIH" that are shipped by rail.[22]

Roughly two-thirds of large U.S. wastewater utilities already use a disinfectant chemical other than chlorine gas, or plan to stop using chlorine gas.[23] At least 160 large U.S. public drinking water systems already use liquid bleach.[24] In last year's survey, the Center for American Progress identified more than 200 drinking water or wastewater facilities that had eliminated chlorine gas since 1999—a sample of similar changes at many water utilities nationwide.[25] Most of these water facilities switched to liquid bleach, while others use ultraviolet light.

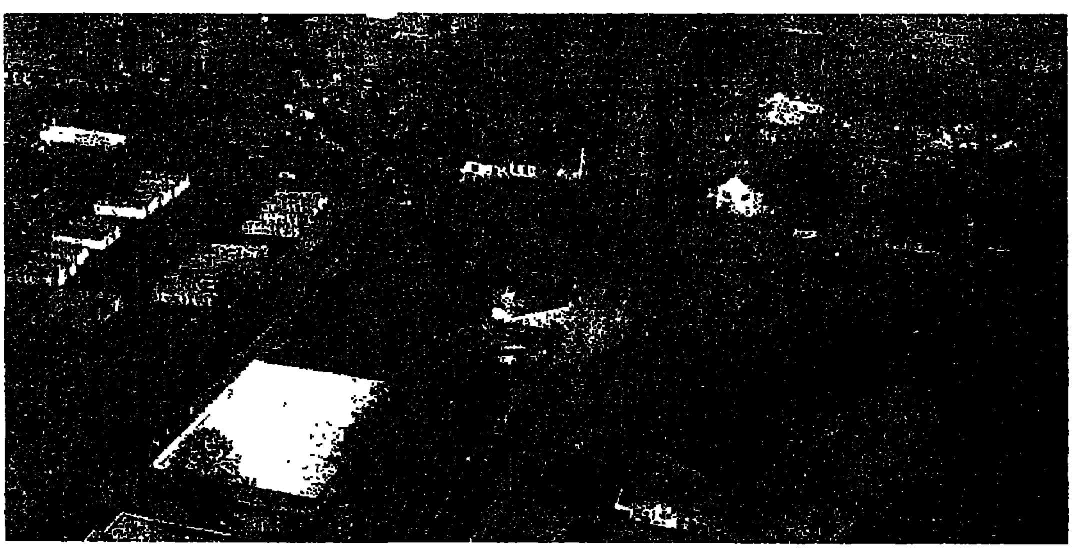
Last year's report noted that approximately 1,700 drinking water plants and 1,150 wastewater facilities report extremely hazardous substances, primarily chlorine gas, under EPA's Risk Management Planning program. This year's survey report focuses on just those water utilities that recently have received chlorine gas by rail.

Utilities that eliminate chlorine gas may replace other hazardous chemicals. Some wastewater facilities remove chlorine from effluent by using anhydrous sulfur dioxide, a dangerous toxic gas. These facilities frequently replace anhydrous sulfur dioxide with less hazardous sodium bisulfite. Similarly, some drinking water facilities replace anhydrous ammonia, a toxic gas, with aqueous ammonia, a less hazardous alternative.

Replacement Chemicals Can Be More Safely Produced

Water utilities can buy concentrated bleach in bulk as sodium hypochlorite, or generate dilute bleach on-site from salt and electricity. Recent high prices for chlorine make on-site generation increasingly attractive even for larger water utilities. Several facilities surveyed in this report are considering or adopting on-site bleach, while others are considering or adopting ultraviolet light. Both options eliminate bulk transportation of extremely hazardous substances and greatly reduce overall transportation needs

In our survey for this report, we found many utilities that eliminated chlorine gas now buy bulk sodium hypochlorite bleach. One argument against converting water utilities to bleach is that it simply shifts the danger to bleach manufacturing facilities,



A freight train derailed on Jan 6, 2005, in Graniteville, S.C., rupturing a railcar of chlorine gas. The leaking gas visible in the photo above killed nine people, sent 500 to the hospital with breathing problems, and caused more than 5,000 to evacuate for several days. (U.S. EPA) which typically make hypochlorite from bulk rail shipments of chlorine gas. Producers, however, can manufacture hypochlorite using "just-in-time" technology, in which chlorine gas is created and promptly used only in small amounts, eliminating the danger of a catastrophic gas release.

This process is used in Asia, Australia, Europe, and a few U.S. locations.[26] Further industrial-scale production is under development in the United States.[27] Currently, some 94 manufacturers across the country produce sodium hypochlorite for use in industrial or household products.[28] Full conversion to producing hypochlorite without bulk chlorine gas would eliminate thousands of rail shipments each year and take millions of Americans out of harms way.

"We are very glad the chlorine gas is gone. It's an achievement. It used to be our number one employee concern."

Ray Flasco, Water Supply Division Manager, Akron Water Supply Plant, Kent, Ohio

Producing hypochlorite bleach from bulk chlorine gas is currently marginally cheaper than using safer and more secure methods—but only insofar as companies do not pay the full costs of security and liability insurance for a potential catastrophic chlorine release. Requiring producers that use bulk chlorine gas to internalize these costs would immediately make large-scale production using safer and more secure methods cost-competitive.

Major Survey Findings

Few Water Utilities Still Use Chlorine Gas Railcars

Only 24 drinking water and 13 wastewater facilities still use *rail shipments* of chlorine gas. Yet because of these few facilities, thousands of tons of deadly chlorine gas pass through major American cities Some 25 million Americans live within range of a worst-case toxic gas release around these facilities, and millions more live along rail delivery routes. Among these 37 facilities are:

- St. Paul Regional Water Services-McCarron, Maplewood, Minn., 1.3 million people at risk
- Kansas City, Missouri Water Treatment Plant, 720,000 people at risk
- Omohundro Water Treatment Plant, Nashville, Tenn., 973,663 people at risk
- East Bank Wastewater Treatment Plant, New Orleans, La., 726,185 people at risk*
- Central Regional Wastewater System, Grand Prairie (Dallas), Texas, 3.9 million people at risk

For a complete list see Appendix A on page 16 and the map on page 11.

Many Water Utilities Have Switched to Safer, More Secure Alternatives

At least six drinking water and 19 wastewater facilities have eliminated *rail shipments* of chlorine gas by switching to a less hazardous disinfectant since 1999. As a result, more than 26 million people no longer live within range of a chlorine gas release from these facilities, and additional millions are no longer in danger from rail shipments to these facilities. Among these 25 facilities are.

- Wyandotte Wastewater Treatment Facility, Wyandotte, Mich , 1.1 million people no longer at risk
- Baldwin Water Treatment Plant. Cleveland, Ohio. 1.4 million people no longer at risk

* Population before hurricane Katrina Facility intends to convert to liquid bleach but lacks dedicated funding amid extensive post Katrina needs

- Metropolitan Wastewater Treatment Plant, St. Paul, Minn., 520,000 people no longer at risk
- Joint Water Pollution Control Plant, Carson, Calif. (Los Angeles County), 210,000 people no longer at risk
- White River Water Treatment Plant, Indianapolis, Ind., 968,579 people no longer at risk

For a complete list see Appendix B on page 18 and the map on page 11. Additional water utilities eliminated chlorine gas rail shipments prior to 1999.[29]

Some Additional Water Utilities Are Eliminating Chlorine Gas

Of the 37 water facilities that still use chlorine railcars, at least four drinking water and two wastewater plants are currently converting to a safer, more secure disinfectant with at least partial construction planned by 2008. Completing these conversions will cut chemical hazards for five million people who live nearby and many others along freight railways. Facilities with well-developed plans to convert include:

- Metro Wastewater Reclamation District, Denver, Colo., 925,000 people at risk
- City of Richmond Water Purification Plant, Richmond, Va., 704,630 people at risk
- Carrollton Water Purification Plant, New Orleans, La., 892,320 people at risk**

Several other facilities may convert within a few years, and others are evaluating alternatives. Two other facilities (in Stockton and San Jose, Calif.) occasionally use liquid bleach as an available backup, but are evaluating more serviceable long-term solutions such as ultraviolet light.

** Population before hurricane Katrina

Chlorine Gas Railcars Travel Over Long Distances

Each year, approximately 45,000 shipments of chlorine gas travel by rail in the United States. These shipments may travel over more than 300,000 miles of freight railways across the country.[30] Rail lines pass through almost all major American cities and towns.

The 16 chlorine production sites listed in Appendix C reportedly sell chlorine by rail to water utilities through the merchant market. Usually, a distributor company moves the chlorine gas from the original manufacturer to the water utility. These rail shipments may travel long distances—hundreds or even thousands of miles—passing through densely populated cities and towns. There is no legal requirement to use the closest supplier or the safest route.

The large water utilities covered by this report account for only a small portion of the chlorine on the rails—but are by their nature located in or near large cities or towns. Producers also ship to chlorine packaging locations and sodium hypochlorite bleach production facilities. Additional destinations include PVC plastics producers, some paper mills, and chemical manufacturers. Roughly two-thirds of chlorine is never shipped, but rather is used on-site in chemical manufacturing or is moved by pipeline to nearby facilities. For this very reason, chemical manufacturers may co-locate to avoid shipping chlorine gas.[31]

The profusion of freight rail lines precludes identifying specific routes between producers and water utilities. However, the map on page 11 illustrates the long distances that rail shipments must travel between manufacturers and the few water utilities that still receive chlorine gas by rail.

"As a plant operator it's a weight off your shoulders if you don't have that risk of chlorine gas."

Nick Frankos, Plant Manager, Back River Wastewater Plant, Baltimore, Md.

Utilities Cited a Number of Reasons for Switching

Personnel at water facilities that eliminated chlorine gas were generally relieved to be rid of it and considered the change an achievement. Reasons and advantages for switching included: improving safety and security, meeting discharge requirements; reducing liability exposure; cutting costs of preventive maintenance, training, emergency planning, and regulatory compliance: mitigating on-site security costs associated with chlorine gas; and previous experience with chlorine leaks.

"Maintenance cost... priceless! No special training or emergency repair kits to keep on hand. We do all our repairs in-house where chlorine required an outside contractor. The Fire Department loves us. No more emergency drills and training."

John Garvin, Operation and Maintenance Manager, Regional Water Resource Agency, Owensboro, Ky.

Most surveyed facilities that have not converted are evaluating disinfectant options. These facilities cited as potential obstacles: costs of capital and replacement chemicals; the large size of the utility and needed chemical volumes; storage space and shelf life of liquid bleach; requirements to maintain backup disinfection capability and the need for reliable information on alternatives.

Some facilities also noted investments in chlorine-gas security, such as containment buildings, sensors, and scrubbers. Such sunk costs may create a disincentive to further change yet do nothing to protect incoming rail shipments.

Conversion Costs Are Manageable

Twenty facilities provided general information on the construction and operating costs of converting off chlorine gas railcars. Switching these facilities to a safer, more secure disinfectant is affordable, costing no more than $1.50 per year per person served—the price of a bag of potato chips—even without accounting for important cost savings. Many facilities are spending well less than that amount. Examples are described in the box on pages 12–13.

Cost figures varied widely depending on facilities' specific circumstances and the information available to respondents. Some facilities, for example, needed to upgrade aging infrastructure; others did not. While many respondents were able to estimate construction and chemical costs, most found it difficult to compile information on *avoided* costs from readily available sources. Some facilities, however, identified important savings in preventive maintenance, emergency planning, employee training, regulatory compliance, future site security, or other factors.

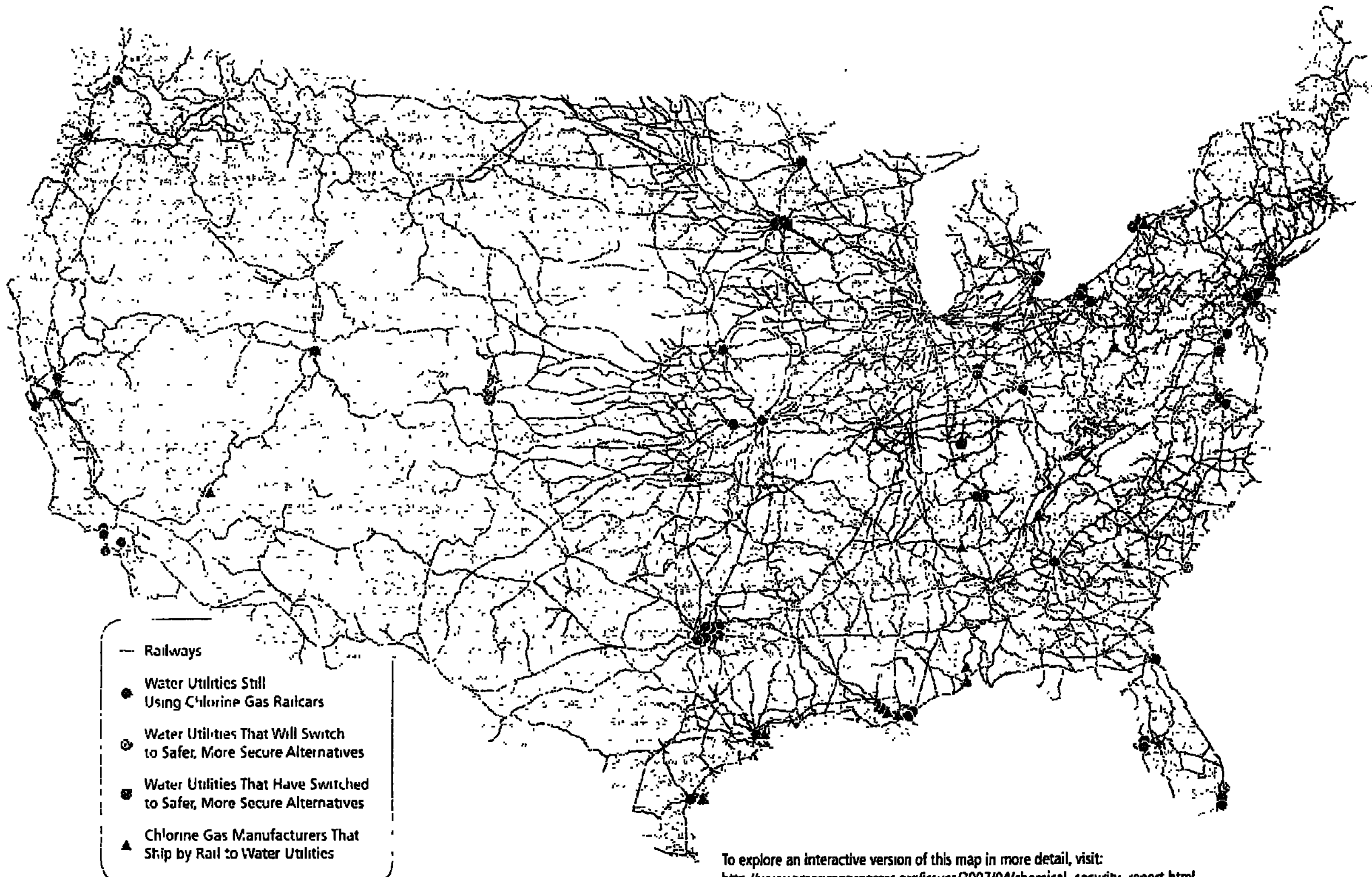
Facilities using chlorine gas face new demands to upgrade physical security to protect against a possible terrorist attack. Current practices include at best such meager physical security measures as better fences, vehicle gates, lights, employee identification, and cameras. Some facilities may also have enclosures and gas scrubbers that attempt to contain an emergency release. Converting from chlorine gas mitigates these costs while providing superior protection to employees and surrounding populations.

After all, there is little reason to believe that current security practices would be able to withstand a well-executed attack by an armed intruder. Nor does enhanced physical security do anything to protect railcars in transit to the facility.

The Government Accountability Office is currently conducting a review of costs associated with conversion of water utilities to less hazardous chemicals. This GAO report is expected in spring 2007.

Unnecessary Rail Shipments of Chlorine Gas Endanger Millions

Shown are 37 water utilities that still receive chlorine gas by rail. Distributors ship railcars of chlorine gas from 16 manufacturers to these utilities—frequently over long distances and through densely populated areas. Also shown are 25 water utilities that since 1999 have eliminated railcar shipments of chlorine gas by converting to safer, more secure alternatives for water treatment. Millions of people along railroads are no longer endangered by chlorine gas shipments to these utilities. Of utilities that still receive chlorine gas by rail, at least six more have firm plans to convert from chlorine gas within two years.



To explore an interactive version of this map in more detail, visit:
http://www.americanprogress.org/issues/2007/04/chemical_security_report.html

Conversion Costs at Specific Facilities

These 25 water facilities [illegible] chlorine gas railcars [illegible] effective alternatives [illegible] reasonable cost [illegible] [illegible] impact of all these conversions [illegible]

- **The Metropolitan Wastewater Treatment Plant in St. Paul, Minn.**, switched from chlorine gas railcars to liquid bleach in late 2005. [illegible] plant required upgrades that were projected to cost about the same whether staying with chlorine gas or switching to liquid bleach. Actual construction cost $7.8 million, and chemical costs increased $85,000 per year. Annual operating costs [illegible] preventive maintenance, energy, and emergency preparedness decreased about $65,000, while in-plant security [illegible] decreased an estimated $35,000. The entire metropolitan wastewater system serves about 2.4 million people; annual conversion costs, including otherwise necessary construction, are about 20 cents per person served.

- **The Columbia Boulevard Wastewater Treatment Plant in Portland, Ore.**, switched from chlorine gas railcars to liquid bleach in 2005. Construction cost $4.4 million, and increased chemical costs are more than offset by operating savings anticipated from reduced need for maintenance, electric power, training, labor, and emergency planning. The facility serves some 550,000 people, who will benefit from the offset of operating costs in the long term.

- **The Akron Water Supply Plant in Kent, Ohio**, switched from chlorine gas railcars to liquid bleach in 2004. Construction cost about $1.1 million (or one-fourth the cost of a new chemical building) and operating costs increased about $65,000 per year, primarily to cover chemicals. The facility, however, avoided over $1.2 million in construction costs by eliminating chlorine gas. By switching, the facility avoided constructing a containment building to enclose railcars ($308,000), installing an emergency gas scrubber ($598,000), and upgrading certain process equipment such as a chlorine gas evaporator ($369,000). Even without considering avoided costs, the facility's 280,000 customers pay only approximately 50 cents more each year.

- **The Edward P. Decher Secondary Wastewater Plant in Elizabeth, N.J.**, switched from chlorine gas to liquid bleach in [illegible]. Construction upgrades cost $750,000 and chemical costs increased $29,000 from 2002 to 2004, while maintenance and training costs decreased an estimated $70,000 per year. The facility serves about 500,000 people; annual conversion costs are about [illegible] per person served.

- **The South Treatment Plant in Renton, Wash.**, switched from chlorine gas to liquid bleach in 2003. Construction cost $2.4 million, and chemical costs increased about $350,000 per year. The entire wastewater system serves about 1.4 million people; without accounting for any operating savings, annual conversion costs are less than 40 cents per person served.

- **The Western Lake Superior Sanitary District in Duluth, Minn.**, switched from chlorine gas to liquid bleach in 2006. Construction cost $1.6 million. Operating costs initially remained about the same, with increased chemical costs offset by decreased demurrage charges that resulted from keeping a chlorine railcar on-site. A newly revised discharge permit will likely lengthen the disinfection season and increase chemical costs in the future. The facility serves 110,000 people; annual conversion costs are thus far about a dollar per person served.

- **Crescent Hill Water Treatment Plant in Louisville, Ky.**, is building an on-site generating facility for bleach disinfectant at an estimated capital cost of roughly $10 million. Accounting for depreciation, the facility estimates the cost of switching over from chlorine gas at about $500,000 annually. The entire water system serves about 850,000 people, estimated annual conversion costs are about 60 cents per person served.

- **The City of Richmond Water Purification Plant in Richmond, Va.**, is switching from chlorine gas railcars to liquid bleach in early 2007. Construction cost $11 million for a new building, about one-third directly linked to storage of liquid bleach. Chemical costs are anticipated to increase $450,000 per year. The facility serves about 500,000 people;

[illegible]

- **Blue Plains Sewage Treatment Plant in Washington, D.C.,** switched from chlorine gas railcars to liquid bleach immediately after September 11, 2001. According to the plant's chief engineer at the time, the change adds about 25 cents per month to the average household customer's utility bill.

- **The Nottingham and Baldwin drinking water treatment plants in Cleveland, Ohio** completed conversion from chlorine gas to liquid bleach in [illegible] and 2005, respectively. Construction cost an estimated $2,475,000 for both plants, and chemical costs increased about $208,000 per year. The Cleveland division of water serves some [illegible] million people; without taking into account any operating savings, annual conversion costs are less than 25 cents per person served.

- **The Buckman Water Reclamation Facility in Jacksonville, Fla.,** switched from chlorine gas railcars to ultraviolet light in 2001. Construction cost $6 million, including about $1 million for unrelated upgrades. Electricity costs increased about $950,000 per year over the previous cost of chlorine gas, but only if not considering recent dramatic chlorine price increases. The entire wastewater system serves about 575,000 people; annual conversion costs are about 80 cents per person served.

- **The Wyandotte Wastewater Treatment Facility in Wyandotte, Mich.,** switched from chlorine gas railcars to ultraviolet light in 2000. Construction cost $8 million, and operating costs increased from about $320,000 to $350,000 each year. The wastewater system serves about 415,000 people; annual conversion costs are about $1.30 per person served.

- **The Mill Creek Wastewater Treatment Plant in Cincinnati, Ohio,** switched from chlorine gas railcars to liquid bleach in 2001. Constructing a temporary conversion cost less than $40,000; planned permanent construction is projected to cost less than $3 million. Chemical costs increased about $290,000 per year. The entire metropolitan sewer district serves about 800,000 people; without

[illegible] and not accounting for any operating savings, annual conversion costs are about [illegible] per person served.

- **The City of Philadelphia** converted its Northeast, Southeast and Southwest water pollution control plants from chlorine gas to liquid bleach. Capital costs of conversion were [illegible] million for all three plants, and chemical costs increased about $275,000 per year. After converting to liquid bleach, the facilities jointly save roughly $75,000 each year in reduced labor and risk management planning costs. The entire wastewater system serves about 2.2 million people; annual conversion costs are about [illegible] cents per person served.

- **Samuel S. Baxter Water Treatment Plant in Philadelphia, Pa.,** converted to liquid bleach in 2005. Construction costs were about $2 million, and chemical costs increased about $670,000 in 2006. Estimated savings on labor and emergency planning are at least $75,000 per year. The entire drinking water system serves about 1.5 million people; annual conversion costs are less than 50 cents per person served.

- **The Middlesex County Utilities Authority wastewater plant in Sayreville, N.J.,** switched from chlorine gas railcars to liquid bleach in 2001. Construction cost $1.3 million, and chemical costs increased from 2002 to 2006 about $1.5 million, as chlorine prices more than tripled. The wastewater system serves some 800,000 people. Discounting two-thirds of increased chemical costs for price change, and not accounting for any operating savings, annual conversion costs are still less than a dollar per person served

- **The Back River Wastewater Treatment Facility in Baltimore, Md.,** switched from chlorine gas railcars to liquid bleach in 2004. Construction cost $2.6 million, and chemical costs increased from 2003 to 2008 about $2.4 million, during which time chlorine prices more than doubled. For this and other reasons the facility is planning further conversion to generating bleach on-site. The entire wastewater system serves 1.3 million people. Discounting one-half of increased chemical costs for price change, and not accounting for any operating savings, annual conversion costs are still less than a dollar per person served

Conclusion and Recommendations

More than five years after 9/11 and despite many credible warnings, the U.S. government has yet to enact policies that seriously reduce unnecessary chemical hazards. The Center for American Progress surveyed water utilities that still use chlorine gas railcars to examine systematic shortcomings in current federal chemical security policies, and to encourage Congress to enact policies that swiftly and efficiently remove unnecessary chemical hazards.

The survey shows that many large water utilities have converted from chlorine gas railcars to safer and more secure alternatives. These conversions remove terrorist targets at the facilities and on the rails, and make millions of Americans safer and more secure. Facility operators are relieved when the gas is gone and often proud of helping to bring about the change.

The roughly three dozen water utilities that still receive chlorine gas railcars can also convert to safer alternatives, but many are not acting. At the same time, recently enacted interim chemical security legislation exempts water utilities, neglects transportation hazards, and ignores safer technologies. Millions of Americans remain unnecessarily at risk from a catastrophic chemical release.

To address this threat, Congress, the administration, and industry must make chemical security an urgent national priority, with the goal of transitioning to safer, more secure technologies. Specifically:

- Water utilities that still use railcars of chlorine gas or anhydrous sulfur dioxide should shift to safer and more secure treatment alternatives.

- Congress should require chemical facilities to review and use available, cost-effective technologies that significantly reduce or eliminate serious emergency chemical release hazards.

- Congress should target grants, loans, and other incentives to help water utilities convert from chlorine gas, including facilities that discontinued chlorine gas after September 11, 2001. Such assistance should not cover containment buildings and other physical security measures that are inherently incapable of protecting chlorine gas railcars at water utilities and in transit.

- The Department of Homeland Security should go back to Congress for full authority to safeguard chemical infrastructure and the public, with appropriate roles for other governmental agencies.

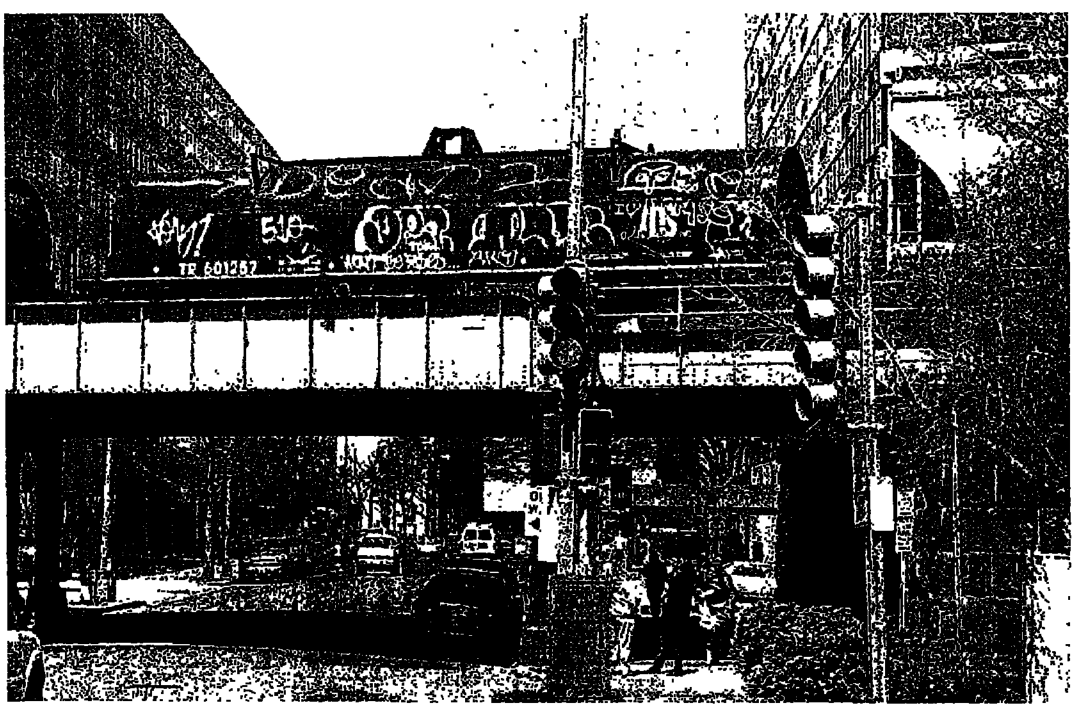
- Congress should require chemical facilities to account for transportation risks—including the possibility of a catastrophic chemical release—in developing security alternatives, assessments, and plans.

- Congress should require chemical facilities to involve appropriate employees when developing security alternatives, assessments, and plans.

- The Department of Homeland Security should develop methodologies to account for the impact of safer, more secure technologies on facility security, including the costs, avoided costs, and feasibility of alternatives.

- Manufacturers of liquid bleach should adopt production methods that do not require bulk transportation or storage of chlorine gas. Congress should require these facilities to carry sufficient liability insurance to cover a catastrophic chemical release.

These policy recommendations are reasonable and obtainable. They would impose only insignificant burdens on consumers, while delivering measurable improvements in safety and security. Indeed, many water utilities have already abandoned chlorine gas at affordable cost with effective results. Congress and the Department of Homeland Security have the responsibility to compel the swift conversion of the remaining water utilities that still receive chlorine gas by rail. The reasons to do so are self-evident in this report. Congress and DHS need only act.



A graffiti-covered rail tanker passes within blocks of the National Mall in Washington, D.C. (Jim Dougherty/Sierra Club)

Appendix A

WATER UTILITIES USING CHLORINE GAS RAILCARS

FACILITY NAME	CITY	STATE	FACILITY TYPE	APPROXIMATE FACILITY SIZE (MILLION GALLONS PER DAY (MGD))	CONVERSION STATUS	VULNERABILITY ZONE POPULATION*
Joseph Jensen Filtration Plant	Granada Hills	CA	Drinking water plant	750 MGD	Evaluating alternatives; no active plans to convert	1,700,000
F.E. Weymouth Water Treatment Plant	La Verne	CA	Drinking water plant	520 MGD	Evaluating alternatives; no active plans to convert	304,873
Los Angeles Aqueduct Filtration Plant	Sylmar	CA	Drinking water plant	600 MGD	Have looked at alternatives; no change forecast	290,000
Sacramento Regional Wastewater Treatment Plant	Elk Grove	CA	Wastewater plant	165 MGD	No apparent plans to convert	18,000
San Jose/Santa Clara Water Pollution Control Plant	San Jose	CA	Wastewater plant	115 MGD	Evaluating alternatives including ultraviolet light, liquid bleach is available backup	245,000
City of Stockton Tertiary Treatment Plant	Stockton	CA	Wastewater plant	35 MGD	Occasionally using liquid bleach as backup; considering other alternatives including ultraviolet light	430,200
Metro Wastewater Reclamation District	Denver	CO	Wastewater plant	160 MGD	Switching to liquid bleach by end of 2007	925,000
Fiveash Water Treatment Plant	Fort Lauderdale	FL	Drinking water plant	70 MGD	Switching to generating bleach on-site or other alternative by about 2008	1,526,000
John E. Preston Water Treatment Plant	Hialeah	FL	Drinking water plant	86 MGD	Developing plans to convert, possibly to on-site bleach; conversion likely within a few years	1,893,169
Alexander Orr Water Treatment Plant	Miami	FL	Drinking water plant	175 MGD	Developing plans to convert, possibly to on-site bleach; conversion likely within a few years	1,643,691
Hillsborough River Water Treatment Plant-Tampa, FL	Tampa	FL	Drinking water plant	85 MGD	Alternatives under consideration; conversion not imminent or planned	508,760
City of Tampa Howard F. Curren AWTP	Tampa	FL	Wastewater plant	96 MGD	Has studied feasibility; no specific plans to convert	1,042,000
Topeka Water Treatment Plant	Topeka	KS	Drinking water plant	22 MGD	No plans to convert	173,925
Crescent Hill Water Treatment Plant	Louisville	KY	Drinking water plant	100 MGD	Switching to generating bleach on-site by about 2008-2009	675,100
Carrollton Water Purification Plant	New Orleans	LA	Drinking water plant	120 MGD	Switching to liquid bleach, likely in 2007	892,320
East Bank Wastewater Treatment Plant	New Orleans	LA	Wastewater plant	108 MGD (pre-Katrina)	Planning to convert eventually; timeline uncertain given major capital needs post-Katrina	726,185
Detroit WWTP Chlorination/Dechlorination Facility	Detroit	MI	Wastewater plant	700 MGD	No plans to convert	2,100,000

* Vulnerability zone figures, submitted by facilities to EPA, indicate residential populations within range of a worst case toxic chemical release. These figures are not forecasts of potential casualties.
** This figure most likely significantly understates the facility's vulnerability zone population.

Appendix A, continued

WATER UTILITIES USING CHLORINE GAS RAILCARS, CONTINUED

FACILITY NAME	CITY	STATE	FACILITY TYPE	APPROXIMATE FACILITY SIZE—MILLION GALLONS PER DAY (MGD)	CONVERSION STATUS	VULNERABILITY ZONE POPULATION*
St Paul Regional Water Services-McCarron	Maplewood	MN	Drinking water plant	50 MGD	No plans to convert	1,300,000
Fridley Filter Plant	Minneapolis	MN	Drinking water plant	85 MGD	No plans to convert	337,000
Kansas City, Missouri Water Treatment Plant	Kansas City	MO	Drinking water plant	115 MGD	No plans to convert	720,000
Florence Water Treatment Plant	Omaha	NE	Drinking water plant	64 MGD	No plans to convert	390,000
North Charleston Sewer District WWTP Herbert Site	Charleston	SC	Wastewater plant	17 MGD	Switching to ultraviolet light, expected completion about summer 2007	365,213
Omohundro Water Treatment Plant	Nashville	TN	Drinking water plant	90 MGD	Evaluating options; no finalized plan to convert	973,663
Central Wastewater Treatment Plant	Nashville	TN	Wastewater plant	288 MGD	Evaluating options; no finalized plan to convert	965,468
O.N. Stevens Water Treatment Plant	Corpus Christi	TX	Drinking water plant	80 MGD	No plans to convert	360,000
Elm Fork Water Treatment Plant	Carrollton	TX	Drinking water plant	330 MGD	Evaluating alternatives; no specific plan to convert	790,000
Bachman Water Treatment Plant	Dallas	TX	Drinking water plant	150 MGD	Evaluating alternatives; no specific plan to convert	2,000,000
Eastside Water Treatment Plant	Sunnyvale	TX	Drinking water plant	440 MGD	Evaluating alternatives, no specific plan to convert	1,800,000
NTMWD Regional Water Treatment Plant	Wylie	TX	Drinking water plant	265 MGD	No plans to convert; evaluating options	[illegible],137,517
Central Wastewater Treatment Plant	Dallas	TX	Wastewater plant	120 MGD	No plans to convert; preliminary cost analysis of alternatives	930,000
Central Regional Wastewater System	Grand Prairie	TX	Wastewater plant	150 MGD	No plans to convert	3,931,692
Rolling Hills Water Treatment Plant	Fort Worth	TX	Drinking water plant	100 MGD	Under review, investigating on-site generation of bleach	428,447
East Water Purification Plant	Houston	TX	Drinking water plant	225 MGD	No plans to convert; alternatives evaluation ongoing	1,300,000
Central Valley Water Reclamation Facility	Salt Lake City	UT	Wastewater plant	56 MGD	Evaluating options as part of facility upgrade	1,334,000
Hopewell Water Treatment Plant	Hopewell	VA	Drinking water plant	10 MGD	Currently under review; no apparent plans to convert	91,000
City of Richmond Water Purification Plant	Richmond	VA	Drinking water plant	132 MGD	Switching to liquid bleach; completing conversion early 2007	704,630
City of Richmond Wastewater Treatment Plant	Richmond	VA	Wastewater plant	60 MGD	Evaluating and testing alternatives; no clear timeline to convert	722,769

* Vulnerability zone figures, submitted by facilities to EPA, indicate residential populations within range of a worst case toxic chemical release. These figures are not forecasts of potential casualties.

Appendix B

WATER UTILITIES NO LONGER USING CHLORINE GAS RAILCARS*

FACILITY NAME	CITY	STATE	FACILITY TYPE	APPROXIMATE FACILITY SIZE MILLION GALLONS PER DAY (MGD)	CONVERSION STATUS	CONVERSION YEAR	FORMER VULNERABILITY ZONE POPULATION**
Joint Water Pollution Control Plant	Carson	CA	Wastewater plant	330 MGD	Switched to liquid bleach	2004	210,000
Blue Plains Wastewater Treatment Plant	Washington	DC	Wastewater plant	370 MGD	Switched to liquid bleach	2001	1,700,000
Buckman Water Reclamation Facility	Jacksonville	FL	Wastewater plant	41 MGD	Switched to ultraviolet light	2001	360,000
R. M. Clayton WRC	Atlanta	GA	Wastewater plant	80 MGD	Switched to ultraviolet light	2000	1,151,993
Fall Creek Water Treatment Plant	Indianapolis	IN	Drinking water plant	20 MGD	Switched to liquid bleach	2000	771,633
White River Water Treatment Plant	Indianapolis	IN	Drinking water plant	70 MGD	Switched to liquid bleach	2003	968,579
Water Pollution Control Plant	Fort Wayne	IN	Wastewater plant	50 MGD	Switched to liquid bleach	2006	330,000
Waste Water Treatment Plant West	Owensboro	KY	Wastewater plant	8 MGD	Switched to liquid bleach	2001	90,000
Jefferson Parish East Bank WWTP	Harahan	LA	Wastewater plant	40 MGD (pre-Katrina)	Switched to liquid bleach	2003	790,000
Back River Wastewater Treatment Facility	Baltimore	MD	Wastewater plant	150 MGD	Switched to liquid bleach	2004	1,470,000
Wyandotte Wastewater Treatment Facility	Wyandotte	MI	Wastewater plant	45 MGD	Switched to ultraviolet light	2000	1,100,000
Metropolitan Wastewater Treatment Plant	St. Paul	MN	Wastewater plant	222 MGD	Switched to liquid bleach	2005	520,000
Western Lake Superior Sanitary District	Duluth	MN	Wastewater plant	43 MGD	Switched to liquid bleach	2006	128,293
Middlesex County Utilities Authority	Sayreville	NJ	Wastewater plant	120 MGD	Switched to liquid bleach	2001	10,740,000
Edward P. Decher Secondary Wastewater Trmt Plant	Elizabeth	NJ	Wastewater plant	65 MGD	Switched to liquid bleach	2003	50,000
City of Niagara Falls Wastewater Treatment Plant	Niagara Falls	NY	Wastewater plant	32 MGD	Switched to liquid bleach	2003	1,100,000
Mill Creek WWTP	Cincinnati	OH	Wastewater plant	130 MGD	Switched to liquid bleach	2001	860,000
Nottingham Water Treatment Plant	Cleveland	OH	Drinking water plant	70 MGD	Switched to liquid bleach	2002	1,100,000
Baldwin Water Treatment Plant	Cleveland	OH	Drinking water plant	60 MGD	Switched to liquid bleach	2005	1,400,000
Akron Water Supply Plant	Kent	OH	Drinking water plant	38 MGD	Switched to liquid bleach	2004	411,356
Columbia Boulevard Wastewater Treatment Plant	Portland	OR	Wastewater plant	70 MGD	Switched to liquid bleach	2005	157,500
Southeast Water Pollution Control Plant	Philadelphia	PA	Wastewater plant	90 MGD	Switched to liquid bleach	2002	1,182,741
Northeast Water Pollution Control Plant	Philadelphia	PA	Wastewater plant	190 MGD	Switched to liquid bleach	2003	1,575,971
Samuel S. Baxter Water Treatment Plant	Philadelphia	PA	Drinking water plant	165 MGD	Switched to liquid bleach	2005	787,271
South Treatment Plant	Renton	WA	Wastewater plant	80 MGD	Switched to liquid bleach	2003	650,000

* Facility converted since 1999 and fully eliminated chlorine gas

** Vulnerability zone figures, submitted by facilities to EPA, indicate residential populations within range of a worst case toxic chemical release. These figures are not forecasts of potential casualties.

Appendix C

PRODUCERS OF CHLORINE GAS SHIPPED BY RAIL TO WATER UTILITIES

FACILITY NAME	CITY	STATE	ACTIVITY TYPE	VULNERABILITY ZONE POPULATION*
Olin Corp. McIntosh, Alabama Plant	McIntosh	AL	Chlorine producer	42,750
Occidental Chemical Corporation, Mobile Plant	Mobile	AL	Chlorine producer	334,000
Occidental Chemical Corp., Muscle Shoals Facility	Muscle Shoals	AL	Chlorine producer	115,282
Olin Corporation Augusta, Georgia Plant	Augusta	GA	Chlorine producer	440,000
Occidental Chemical (formerly Vulcan Chemicals)	Wichita	KS	Chlorine producer	500,831
Occidental Chemical Corporation Convent Plant	Convent	LA	Chlorine producer	250,000
Occidental Chemical (formerly Vulcan Chemicals)	Geismar	LA	Chlorine producer	490,000
Occidental Chemical Taft Plant	Hahnville	LA	Chlorine producer	830,000
Pioneer Americas LLC	St. Gabriel	LA	Chlorine producer	408,000
Pioneer Americas LLC	Henderson	NV	Chlorine producer	1,100,000
Olin Corporation-Niagara Falls, New York Plant	Niagara Falls	NY	Chlorine producer	998,200
Occidental Chemical Corporation-Niagara Plant	Niagara Falls	NY	Chlorine producer	1,100,000
Olin Chlor-Alkali, Charleston Plant	Charleston	TN	Chlorine producer	258,000
Occidental Chemical Corporation Ingleside Plant	Gregory	TX	Chlorine producer	362,031
Oxy Vinyls, LP-Battleground Chlor-Alkali Plant	La Porte	TX	Chlorine producer	2,300,000
PPG Industries, Inc.-Natrium	New Martinsville	WV	Chlorine producer	97,585

* Vulnerability zone figures, submitted by facilities to EPA, indicate residential populations within range of a worst-case toxic chemical release. These figures are not forecasts of potential casualties

Appendix D: Methodology

After the Center for American Progress released survey findings last year that documented 284 facilities in diverse industries that have switched to less acutely hazardous chemicals or processes, we decided to conduct a follow-up survey of water utilities that receive rail shipments of chlorine gas. We undertook this survey for four primary reasons. First, 90-ton railcars of chlorine gas pose a distinct danger of a major chemical release. Second, large water utilities are typically located near major cities and thus endanger large numbers of people. Third, rail shipments of chlorine gas travel many miles through populated areas, putting even more people at risk. And finally, there are clear, readily available alternatives to chlorine gas, which means this vulnerability can be quickly addressed.

This survey shows where progress has been made, drawing attention to successful, cost-effective plant conversions, and where we still have security vulnerabilities, giving particular attention to rail vulnerabilities, which are too frequently left out of the chemical-security conversation.

The survey included drinking water or wastewater facilities that reported railcar amounts of chlorine gas under EPA's Risk Management Planning, or RMP, program at some time since the program began in June 1999. Several water utilities that discontinued chlorine gas railcars prior to 1999 were also surveyed. The survey consisted of telephone interviews and in some cases follow-up email communication.

For water utilities that still report chlorine gas in railcar amounts, the survey used unstructured questions about the facility's timeline and plans, if any, to convert to a safer and more secure disinfectant, as well as about facility size, population served, and potential obstacles to conversion. For facilities that had already switched or where conversion is underway, the survey also covered conversion costs. In some cases facility size and population figures are from facility Websites or EPA's Clean Watersheds Needs Survey.[34]

This survey report uses publicly available rail maps and population density figures to illustrate transportation concerns in shipping chlorine gas from manufacturing sites through distributors to water utilities. Chlorine production sites were identified through industry publications and EPA regulatory analysis documents covering the chlorine industry.[35] Given the complexity and variability of suppliers and railways, the survey report does not link suppliers, distributors, and water utilities over specific rail routes.

Acknowledgments

Paul Orum wrote this survey report and interviewed personnel at the facilities it covers. Mr. Orum previously authored "Preventing Toxic Terrorism: How Some Chemical Facilities are Removing Danger to American Communities," published by the Center for American Progress in April 2006. He is the former director of the Working Group on Community Right-to-Know and currently works as an independent consultant on chemical safety and security issues.

Reece Rushing, director of regulatory and information policy at the Center for American Progress, provided editorial oversight and assisted in preparing the report. P.J. Crowley, senior fellow and director of national defense and homeland security at the Center for American Progress, also provided input and guidance on the report.

The photo on the cover is courtesy of Jim Dougherty/Sierra Club. The author and the Center for American Progress also thank Carol Andress of Environmental Defense for providing helpful comments, and greatly appreciate the cooperation of survey respondents at water utilities across the country.

Endnotes

1 Summary population at risk figures used in this report factor in overlapping vulnerability zones

2 Summary water treatment figures used in this report factor in overlapping service areas.

3 The survey did not attempt to identify facilities that converted from chlorine gas railcars to a less hazardous disinfectant prior to 1999, but noted several wastewater facilities that had done so—the Southwest Wastewater plant in Philadelphia, Pa., and the Southerly and Westerly plants in Cleveland, Ohio. In addition, the Dalecarlia water plant in Washington, D C. eliminated chlorine gas railcars in the 1980s and is planning long term conversion to a less hazardous disinfectant The survey identified three additional facilities that eliminated rail shipments of chlorine gas since 1999, but that still use smaller containers while planning long-term conversion to a safer and more secure disinfectant—the 23rd Avenue wastewater plant in Phoenix, Ariz , and the Crown water plant and Morgan water plant in Cleveland, Ohio Other water utilities in Wheeling, W.V , Erie, Pa , and St. Louis, Mo , eliminated chlorine railcars since 1999, but have no current plans to fully convert to a less hazardous disinfectant

4 Two additional wastewater facilities, in San Jose and Stockton Calif , occasionally use less hazardous liquid bleach as a backup disinfectant

5 These dispersion distances are found in RMP*Comp, developed by the Computer Aided Management of Emergency Operations (CAMEO) team of the National Oceanic and Atmospheric Administration and the U S Environmental Protection Agency The Chlorine Institute, Pamphlet 74, "Estimating the Area Affected by a Chlorine Release" (1998) states that a chlorine gas plume from a railcar can remain at 14 8 miles "immediately dangerous to life or health " This is the level from which a healthy person must escape within 30 minutes or risk irreversible harm or death

6 Homeland Security Council and Department of Homeland Security, National Planning Scenario 8: Chemical Attack—Chlorine Tank Explosion (2005)

7 U S Naval Research Laboratory, Testimony of Dr. Jay Boris before the City Council of the District of Columbia, October 6, 2003

8 U S Government Accountability Office, GAO 05-851, Passenger Rail Security: Enhanced Federal Leadership Needed to Prioritize and Guide Security Efforts (September 2005)

9 "Militants Using Chemical Bombs in Iraq," *The New York Times*, February 21, 2007

10 International Brotherhood of Teamsters High Alert, Workers Warn of Security Gaps on Nation's Railroads (Fall 2005)

11 Working Group on Community Right-to-Know, Chemical Plant Security Breaches in the News (February 2007)

12 "Terror on the Tracks," *Pittsburgh Tribune* January 14, 2007

13 The National Response Center is the federal point of contact for reporting oil and chemical spills NRC does not verify spill reports, which may range from very small to large

14 These entities include the Department of Homeland Security, Department of Justice, Government Accountability Office, Environmental Protection Agency, Agency for Toxic Substances and Disease Registry, Army Surgeon General, and Naval Research Laboratory Brookings Institution, Rand Corporation, PACE International Union, Center for Strategic and International Studies, and numerous investigative news reports

15 Department of Homeland Security Appropriations Act, 2007, Section 550.

16 Transportation Security Administration, Recommended Security Action Items for the Rail Transportation of Toxic Inhalation Hazard Materials (March 30, 2006).

17 Homeland Security Presidential Directive/HSPD 7, Critical Infrastructure Identification, Prioritization, and Protection (December 17 2003)

18 "Philip Perry and the Politics of Chemical Security " Art Levine, *Washington Monthly*, March 2007

19 National Research Council National Academy of Sciences, Terrorism and the Chemical Infrastructure Protecting People and Reducing Vulnerabilities (May 2006)

20 Linda Greer for the Center for American Progress New Strategies to Protect America Securing Our Nations Chemical Facilities (April 6, 2005)

21 Paul Orum for the Center for American Progress, Preventing Toxic Terrorism: How Some Chemical Facilities are Removing Danger to American Communities (April 24, 2006).

22 Edward R. Hamberger, Association of American Railroads, Statement before the U.S. House of Representatives Committee on Transportation and Infrastructure, Subcommittee on Railroads (June 13, 2006).

23 U.S. Government Accountability Office, GAO-06-390, Securing Wastewater Facilities: Utilities Have Made Important Upgrades but Further Improvements to Key System Components May be Limited by Costs and Other Constraints (March 2006)

24 Reported disinfection treatments for public water systems serving more than 100,000 people. U.S. Environmental Protection Agency, Safe Drinking Water Information System (January 2007).

25 Paul Orum for the Center for American Progress, Preventing Toxic Terrorism: How Some Chemical Facilities are Removing Danger to American Communities (April 24, 2006).

26 U.S. producers that can manufacture industrial sodium hypochlorite without bulk transportation or storage of chlorine gas include Odyssey Manufacturing (Tampa, Fla.), BleachTech (Seville, Ohio) and Kuehne Chemical (Delaware City, Del.). A leading manufacturer of equipment to produce sodium hypochlorite without bulk chlorine gas is Powell Fabrication and Manufacturing, marketed as UniChlor Technology.

27 KIK Custom Products, letter to the Honorable Ed Markey, Member of Congress (July 26, 2006)

28 Chlorine Institute, Pamphlet 10, North American Chlor-Alkali Industry Plants and Production Data Report 2005 (August 2006).

29 The survey did not attempt to identify facilities that converted prior to 1999, but noted three additional wastewater facilities that had done so. These facilities are the Southwest Wastewater plant in Philadelphia, Pa., and the Southerly and Westerly plants in Cleveland, Ohio. In addition, the Dalecarlia water plant in Washington, D.C. eliminated chlorine gas railcars in the 1980s and is planning long-term conversion to a less hazardous disinfectant.

30 Bill Johnstone for the Center for American Progress, New Strategies to Protect America: Terrorism and Mass Transit After London and Madrid (August 10, 2005).

31 "Akzo Takes Chlorine off the Rails; Relocating Output Addresses Transportation Concerns," Ian Young, *Chemical Week*, November 22, 2006

32 Conversion cost information was not available or incomplete from other facilities covered by the survey

33 Environmental Defense, Eliminating Hometown Hazards (2003).

34 Population served and facility flow information from EPA's Clean Watersheds Needs Survey is found at http://cfpub.epa.gov/cwns/population.cfm

35 U.S. Environmental Protection Agency, Economic Analysis of Air Pollution Regulations: Chlorine Industry (August 2000), and Chlorine Institute, Pamphlet 10, North American Chlor-Alkali Industry Plants and Production Data Report 2005 (August 2006)

Center for American Progress

ABOUT THE CENTER FOR AMERICAN PROGRESS

The Center for American Progress is a nonpartisan research and educational institute dedicated to promoting a strong, just and free America that ensures opportunity for all. We believe that Americans are bound together by a common commitment to these values and we aspire to ensure that our national policies reflect these values. We work to find progressive and pragmatic solutions to significant domestic and international problems and develop policy proposals that foster a government that is "of the people, by the people, and for the people."

Center for American Progress
1333 H Street, NW, 10th Floor
Washington, DC 20005
Tel: 202.682.1611 • Fax: 202.682.1867
www.americanprogress.org

ATTACHMENT 3

Attachment 3

United States Government Accountability Office

GAO

Report to the Chairman, Committee on Environment and Public Works, U.S. Senate

March 2007

SECURING WASTEWATER FACILITIES

Costs of Vulnerability Assessments, Risk Management Plans, and Alternative Disinfection Methods Vary Widely

GAO

Accountability * Integrity * Reliability

GAO-07-480

GAO
Accountability · Integrity · Reliability

Highlights

Highlights of GAO-07-480, a report to the Chairman, Committee on Environment and Public Works, U.S. Senate

March 2007

SECURING WASTEWATER FACILITIES

Costs of Vulnerability Assessments, Risk Management Plans, and Alternative Disinfection Methods Vary Widely

Why GAO Did This Study

Wastewater facilities provide the essential service of collecting and treating wastewater, and discharging treated effluent into receiving waters. Since September 11, 2001, the nation's water infrastructure has received greater attention, including the risk of terrorist attacks at wastewater facilities that store hazardous chlorine gas for disinfection.

In 2006, GAO reported that many large wastewater facilities have responded to this risk by voluntarily conducting vulnerability assessments and converting from chlorine gas to other disinfection methods. The Clean Air Act requires all wastewater facilities that use threshold quantities of chlorine gas to prepare and implement risk management plans to prevent accidental releases and reduce the severity of any releases.

In this study, GAO was asked to provide information on (1) the range of costs large wastewater treatment facilities incurred in preparing vulnerability assessments and risk management plans, and (2) the costs large wastewater treatment facilities incurred in converting from chlorine gas to alternative disinfection processes. To answer these questions, GAO conducted structured telephone interviews with a number of facilities surveyed for the 2006 report. The Environmental Protection Agency (EPA) agreed with the report and provided several technical changes and clarifications.

www.gao.gov/cgi-bin/getrpt?GAO-07-480

To view the full product, including the scope and methodology, click on the link above. For more information, contact John Stephenson at (202) 512-3841 or stephensonj@gao.gov

What GAO Found

Among the large wastewater facilities GAO examined, the costs reported to prepare vulnerability assessments ranged from $1,000 to $175,000, while costs to prepare risk management plans ranged from less than $1,000 to over $31,000. Whether the documents were prepared in-house or contracted to third parties such as engineering firms was a factor in cost differences. Despite higher costs, some facilities preferred to use contractors due to their expertise and independence. According to one wastewater security official, these attributes can give contractor findings and recommendations greater credibility with utility governing boards that determine spending priorities. One facility that used a contractor to complete a vulnerability assessment in 2002 did so because, at the time, vulnerability assessment software and training were not widely available. Since that time, EPA has increased funding for the development and dissemination of risk assessment software and related training. Overall, cost estimates for vulnerability assessments and risk management plans did not relate to facility size, as measured by millions of gallons of wastewater treated per day.

For the large wastewater facilities GAO examined, reports of actual and projected capital costs to convert from chlorine gas to alternative disinfection methods range from about $650,000 to just over $13 million. Most facilities converted, or planned to convert, to delivered sodium hypochlorite (essentially a concentrated form of household bleach shipped in bulk to the facility). Managers of these facilities told GAO they considered other options, but chose delivered sodium hypochlorite because its capital conversion costs were lower than those associated with other alternatives, such as generating sodium hypochlorite on-site or using ultraviolet light. Overall, the primary factors associated with facilities' conversion costs included the type of alternative disinfection method chosen and the size of the facility. Other cost factors facility managers cited included (1) whether existing buildings and related infrastructure could be used in the conversion, (2) labor and building supply costs, which varied considerably among locations, (3) the cost of sodium hypochlorite relative to chlorine gas, and (4) the extent to which training, labor, and regulatory compliance costs were reduced for utilities that no longer had to rely on chlorine gas.

Contents

Abbreviations

AWWARF	American Water Works Association Research Foundation
DHS	Department of Homeland Security
EPA	Environmental Protection Agency
NACWA	National Association of Clean Water Agencies
OSHA	Occupational Safety and Health Administration
POTW	publicly owned treatment works
RAM-W	Risk Assessment Methodology for Water Utilities
VSAT	Vulnerability Self Assessment Tool
WEF	Water Environment Federation

GAO

Accountability * Integrity * Reliability

United States Government Accountability Office
Washington, DC 20548

March 30, 2007

The Honorable Barbara Boxer
Chairman
Committee on Environment and Public Works
United States Senate

Dear Madam Chairman:

Wastewater facilities in the United States provide essential services to residential, commercial, and industrial users by collecting and treating wastewater and discharging treated effluent into receiving waters. The Centers for Disease Control and Prevention cited sewage disposal and water treatment as important contributors to the control of infectious diseases, which it considers 1 of the 10 greatest achievements in public health of the 20th century. Wastewater disinfection, a key component of the wastewater treatment process, reduces the risk that disease will be transmitted through wastewater effluents. Historically, chlorination has been the most commonly used method of wastewater disinfection because it destroys a variety of pathogens and microorganisms.

Since the events of September 11, 2001, the security of the nation's water infrastructure against terrorist threats has received greater attention, including the potential for terrorist attacks at wastewater facilities that store large amounts of chlorine gas. If released, chlorine gas may threaten utility employees and the public near the affected facilities. The gas can be deadly if inhaled and, at lower doses, can burn the eyes and skin and inflame the lungs. In a 2004 report, the White House Homeland Security Council determined that a terrorist attack on an urban chemical facility that resulted in the rupture of a chlorine gas rail car could kill up to 17,500 individuals and hospitalize as many as 100,000.

While federal law does not require wastewater systems to take security measures to protect specifically against a terrorist attack, it does require certain wastewater facilities to take security precautions that could mitigate the consequences of such an attack. For example, the Clean Air Act[1] requires wastewater facilities that use threshold quantities of certain

[1]Pub. L. No. 101-549 (1990).

hazardous substances, such as chlorine gas, to prepare and implement a risk management plan designed to prevent accidental releases of regulated substances and reduce the severity of those releases that do occur.[2]

As we reported in March 2006,[3] many of the nation's large wastewater facilities have improved security since September 11, 2001. For instance, a substantial number of facilities reported improving security fences, increasing security lighting, and implementing improved employee and visitor identification systems, among other security enhancements. In addition, though not required, many large wastewater facilities reported that they conducted vulnerability assessments[4] to identify risks to key process components such as the use, storage, and handling of chlorine gas. Finally, many facilities reported that they recently stopped or plan to stop using chlorine gas in favor of alternate disinfection methods. Commonly used alternatives include sodium hypochlorite, essentially a concentrated form of household bleach, and ultraviolet light, which breaks down disease-causing microorganisms.

For wastewater facility managers, the costs of preparing vulnerability assessments and risk management plans and converting to alternate disinfection methods must compete for available resources with other infrastructure needs. For instance, in 2003, in its most recent Clean Water Needs Survey, the Environmental Protection Agency (EPA) estimated that, nationwide, wastewater systems faced $181.2 billion in costs to upgrade treatment systems and sewer lines, reduce the incidences of combined sewer overflows, which result in the discharge of untreated wastewater into receiving waters, and meet other pollution control requirements. Major U.S. cities, including Washington, D.C., and Cincinnati, Ohio, are facing costs between $1 billion and $2 billion to implement necessary capital improvements.

[2]EPA requires that any facility storing at least 2,500 pounds of chlorine gas submit a risk management plan.

[3]GAO, *Securing Wastewater Facilities: Utilities Have Made Important Upgrades but Further Improvements to Key System Components May Be Limited by Costs and Other Constraints*, GAO-06-390 (Washington, D.C.: Mar. 31, 2006).

[4]According to the Environmental Protection Agency (EPA), vulnerability assessments performed by water sector utilities address not only utility vulnerabilities, but also utility threats and consequences.

This report provides information on (1) the range of costs large wastewater treatment facilities incurred in preparing vulnerability assessments and risk management plans, and (2) the costs large wastewater treatment facilities incurred in converting from chlorine gas to alternative disinfection processes.

To identify the costs of preparing vulnerability assessments and risk management plans, we conducted structured telephone interviews with a select sample of large wastewater facilities identified as having completed these assessments in our March 2006 report.[5] Our March report identified 106 large facilities that prepared vulnerability assessments or had one underway and 85 facilities that were required to prepare risk management plans because they currently used chlorine gas as a disinfectant. From this universe, we chose a nonprobability sample of facilities based largely on geographic representation and size.[6]

To identify the costs incurred by wastewater treatment facilities in converting from gaseous chlorine to alternative disinfection processes, we conducted structured telephone interviews with most of the 38 large facilities identified in the March report as having converted recently from chlorine gas or indicating that they planned to do so. We also conducted site visits with some of the facilities. Where available, we gathered documentation, such as capital plans, from these facilities in order to document conversion costs. We supplemented the cost information we gathered at individual wastewater facilities with information obtained at EPA, the Department of Homeland Security (DHS), and nongovernmental organizations. Reported costs for preparing vulnerability assessments, risk management plans, and conversion from gaseous chlorine include both actual and estimated costs. For estimated costs, we asked facility managers to explain how they arrived at these estimates. Reported costs were not adjusted for inflation. We determined that reported cost data were sufficiently reliable to provide useful information about the costs for preparing vulnerability assessments, risk management plans, and conversion from gaseous chlorine and the factors that affect these costs We conducted our work between August 2006 and March 2007 in

[5]We defined large wastewater facilities as those publicly owned treatment works (POTW) that serve residential populations of 100,000 or greater

[6]Results from nonprobability samples cannot be used to make inferences about a population, because in a nonprobability sample some elements of the population being studied have no chance or an unknown chance of being selected as part of the sample.

accordance with generally accepted government auditing standards. A more detailed discussion of our scope and methodology is included in appendix I.

Results in Brief

The expenses large wastewater facilities reported to prepare vulnerability assessments and risk management plans varied widely among the facilities we interviewed, costing less than $1,000 in some cases to $175,000 in others. The cost differences were related to whether the documents were prepared in-house or contracted to third parties such as engineering firms. Despite higher costs, some facilities preferred to use contractors due to their expertise and independence. According to one wastewater security official, these attributes can give contractor findings and recommendations greater credibility with utility governing boards that determine spending priorities. Overall, cost estimates of the facilities we interviewed did not relate to facility size, as measured by millions of gallons of wastewater treated per day.

Large wastewater facilities that converted or plan to convert from chlorine gas disinfection to alternative disinfection processes also report widely varying costs, ranging from about $650,000 to just over $13 million. Key factors associated with these costs included the type of alternative disinfection method chosen and the size of the facility. The majority of the facilities we examined converted or plan to convert to sodium hypochlorite (either delivered in bulk to the facility or generated on-site), which has lower capital costs than converting to ultraviolet light. For example, managers of a treatment facility in Virginia told us they spent about $1.2 million in 2004 converting to bulk sodium hypochlorite disinfection, while managers of a comparably sized facility in Maryland told us they plan to spend an estimated $4 million converting to ultraviolet light disinfection by the end of this year. Managers of the Maryland facility indicated that one reason they chose the more expensive ultraviolet treatment option over bulk deliveries of sodium hypochlorite was to reduce risk to local traffic that could result from additional deliveries to the plant. In addition, using ultraviolet light eliminates the need for wastewater treatment plants to handle and store significant amounts of hazardous or corrosive chemicals. Other than the disinfection method and facility size, key cost factors wastewater facilities cited included
(1) whether existing buildings could be used in the conversion,
(2) building costs, which varied considerably from location to location,
(3) the higher cost of sodium hypochlorite relative to chlorine gas, and
(4) the extent to which training, labor, and regulatory compliance costs were lower at plants that no longer had to rely on chlorine gas.

Background

A majority of the nation's wastewater is treated by publicly owned treatment works that serve a variety of customers, including private homes, businesses, hospitals, and industry. These publicly owned treatment works are regulated by the Clean Water Act. Wastewater treatment includes a collection system (the underground network of sewers) and a treatment facility. Wastewater enters the treatment facility through the collection system, where it undergoes an initial stage called primary treatment, during which screens remove coarse solids, and grit chambers and sedimentation tanks allow solids to gradually sink. Next, wastewater enters secondary treatment, where bacteria consume most of the organic matter in the wastewater. After these processes, wastewater is disinfected to eliminate remaining pathogens and other harmful microorganisms.

Wastewater facilities typically use both chemical and physical disinfection methods, including the following:

- *Chlorine gas.* Injecting chlorine gas into a waste stream has been the traditional method of disinfecting wastewater. Chlorine gas is a powerful oxidizing agent, is relatively inexpensive, and can be stored for an extended period of time as a liquefied gas under high pressure Also, the residual chlorine that remains in the wastewater effluent can prolong disinfection after initial treatment. However, chlorine gas is extremely volatile and hazardous, and it requires specific precautions for its safe transport, storage, and use. Because it is stored and transported as a liquefied gas under pressure, if accidentally released, chlorine gas can quickly turn into a potentially lethal gas. EPA requires, among other things, that any facility storing at least 2,500 pounds of chlorine gas prepare a risk management plan that lays out accident prevention and emergency response activities. At certain concentrations, the residual chlorine that remains in wastewater effluent is toxic to aquatic life, so wastewater facilities that use chlorine compounds may also need to dechlorinate the treatment stream before discharging it to receiving waters.[7] Chlorine can also oxidize certain types of organic matter in wastewater, creating hazardous chemical byproducts, such as trihalomethanes. Our March 2006 report found that many large wastewater facilities have discontinued, or are planning to discontinue using chlorine gas as a disinfectant in favor of alternative disinfection methods such as sodium

[7]Sulfur dioxide, often used for dechlorination by wastewater facilities, is also covered by risk management plan rules when used or stored in threshold amounts

hypochlorite delivered in bulk to the facility. Of the 206 large wastewater facilities responding to our survey, only 85 facilities indicated they currently use chlorine gas, and 20 of these facilities plan to switch from the gas to another disinfectant.

- *Sodium hypochlorite.* Injecting sodium hypochlorite—essentially a concentrated form of household bleach—into a waste stream is another chlorination method of disinfecting wastewater. Sodium hypochlorite is safer than chlorine gas because, if spilled, it remains liquid and can be contained and recovered. For this reason, it is not subject to EPA's risk management planning requirements. However, sodium hypochlorite is more expensive than chlorine gas, and it degrades quickly if it is exposed to sunlight or is not kept at proper temperatures. For this reason, properly storing delivered sodium hypochlorite in the concentration necessary to disinfect wastewater may require an on-site building with environmental controls. Sodium hypochlorite can also be generated on-site at a wastewater facility using an "electrochlorination system" that produces sodium hypochlorite through an electrical reaction with high-purity salt and softened water. Facilities choosing this method of disinfection reduce chemical costs, but face increased electrical costs from the generation equipment. Because it is a chlorine compound, wastewater facilities using sodium hypochlorite must also be concerned with residual chlorine and hazardous chemical byproducts, such as trihalomethanes.

- *Ultraviolet light.* This disinfection method uses ultraviolet lamps to break down disease-causing microorganisms in wastewater. Wastewater passes through an open channel with lamps submerged below the water level. The lamps transfer electromagnetic energy to an organism's genetic material destroying the ability of its cells to reproduce. Because ultraviolet light is a physical process rather than a chemical disinfectant, it eliminates the need to generate, handle, transport, or store hazardous and corrosive chemicals. In addition, there are no harmful residual effects to humans or aquatic life. However, ultraviolet light disinfection may not be effective given the turbidity of some wastewater streams. Wastewater facilities using ultraviolet instead of chlorine gas or delivered sodium hypochlorite for disinfection will face additional costs to maintain lamps and increased electrical costs.

- *Ozone.* This disinfection method feeds ozone generated on-site from oxygen exposed to a high-voltage current into a contact chamber containing wastewater. According to EPA, ozone is very effective at destroying viruses and bacteria, but it is the least used disinfection method in the United States largely because of its high capital and maintenance costs compared to available alternatives.

According to EPA, vulnerability assessments help water systems evaluate susceptibility to potential threats such as vandalism or terrorism and identify corrective actions that can reduce or mitigate the risk of serious consequences. The Public Health Security and Bioterrorism Preparedness and Response Act of 2002 (the Bioterrorism Act)[8] required drinking water utilities serving populations greater than 3,300 to complete vulnerability assessments by June 2004.[9] Wastewater facilities are not required by law to complete vulnerability assessments. Congress has considered bills that would have encouraged or required wastewater treatment plants to assess vulnerabilities, but no such requirement has become law.

In our March 2006 report on wastewater facility security efforts, we found that many large wastewater facilities have either completed a vulnerability assessment or had one underway. Of the 206 large wastewater facilities that responded to our survey, 106 facilities—or 51 percent—reported that they had completed a vulnerability assessment or were currently conducting one. Several other facilities indicated they had conducted or planned to conduct other types of security assessments. Facilities cited several reasons for completing a vulnerability assessment or some other type of security assessment, but most—roughly 77 percent—reported doing so on their own initiative. Many facilities indicated they were combined systems—facilities that manage both drinking water and wastewater treatment. As such, 37 percent of facilities reported that they did some type of security assessment in conjunction with the required assessment for their drinking water facility.

The Clean Air Act requires wastewater facilities that use or store more than 2,500 pounds of chlorine gas to submit to EPA a risk management plan that lays out accident prevention and emergency response activities.

[8]Pub. L. No. 107-188 (2002).

[9]The Bioterrorism Act required the assessments to include, but not be limited to, a review of six components: (1) pipes and constructed conveyances; (2) physical barriers; (3) water collection, pretreatment, treatment, storage, and distribution facilities; (4) electronic, computer, or other automated systems that are utilized by the water system; (5) the use, storage, or handling of various chemicals; and (6) the operation and maintenance of such systems. The act further required systems to prepare or revise an emergency response plan incorporating the results of the vulnerability assessment within 6 months after completing the assessment.

Under this act, EPA requires that about 15,000 facilities—including chemical, water, energy, and other sector facilities—that produce, use, or store more than threshold amounts of chemicals posing the greatest risk to human health and the environment take a number of steps to prevent and prepare for an accidental chemical release. EPA regulations implementing the Clean Air Act require that the owners and operators of chemical facilities include a facility hazard assessment, an accident prevention program, and an emergency response program as part of their risk management plans. The regulations required that a summary of each facility's risk management plan be submitted to EPA by June 21, 1999. The plans are to be revised and resubmitted to EPA at least every 5 years, and EPA is to review them and require revisions, if necessary.

Costs of Preparing Vulnerability Assessments and Risk Management Plans among Large Wastewater Facilities Vary Widely

Although accurate information on the costs of vulnerability assessments and risk management plans is limited, available estimates suggest that their costs vary considerably. A factor contributing to the cost differential was whether they were contracted to third parties (such as engineering consulting firms) or prepared in-house with existing staff. Despite higher costs, some facilities preferred using contractors because their expertise and independence lent credibility to their assessments, which may be useful in obtaining support for security-related upgrades. Costs generally did not relate to facility size, as measured by million of gallons of wastewater treated per day.[10]

Vulnerability Assessment Costs Depend Primarily on Whether a Contractor Is Used

The reported cost of preparing vulnerability assessments at the 20 large wastewater facilities where we interviewed officials ranged from $1,000 to $175,000. Whether the assessment was done in-house with existing staff or contracted to a third party was a factor contributing to the cost differences. Officials from several facilities told us they used contractors to complete vulnerability assessments in 2002. For example, staff at the Denver Metro Wastewater Reclamation District reported that a contractor completed a vulnerability assessment in November 2002 for its Central Treatment Plant, which treats 130 million gallons of wastewater per day, at

[10]In our structured interviews we asked facility managers to provide estimates of their treatment facility's "existing flow" in millions of gallons per day. "Existing flow" refers to the calculated average flow for a recent 12-month period, as defined by EPA in its Clean Water Needs Survey, and is a common measure of treatment facility size. When we note how many gallons per day a facility treats, we are referring to its reported "existing flow."

an estimated cost of $175,000. Of this cost, $100,000 was for the contractor, and $75,000 was estimated for in-house staff time.

Other large wastewater facilities that reported completing vulnerability assessments in 2002 were part of combined systems that provide both drinking water and wastewater services. These systemwide vulnerability assessments were done before the 2002 Bioterrorism Act required drinking water utilities serving populations greater than 3,300 to complete vulnerability assessments by June 2004. The combined systems that conducted systemwide vulnerability assessments include the following:

- *San Antonio Water System (San Antonio, Texas)*. According to system staff, a contractor completed a systemwide vulnerability assessment for all its drinking water, wastewater, and related infrastructure in August 2002 for $112,000. Staff did not provide an estimate of in-house costs related to the assessment, but prorated the wastewater treatment plants costs related to this contract at $37,000: $25,000 for its Dos Rios plant, which treats 70 million gallons per day; $5,000 each for its Leon Creek and Salado Creek plants, which treat 33 million gallons per day; and $2,000 for its Medio Creek plant, which treats 5 million gallons per day.

- *The Phoenix Water Services Department (Phoenix, Arizona)*. According to department staff, a contractor completed a systemwide vulnerability assessment for its five drinking water plants, three wastewater plants, and related infrastructure in November 2002 for $479,725. Staff did not provide an estimate of in-house cost related to the assessment, but estimated the contract costs related to its largest wastewater treatment plant, the 91st Avenue Sewage Treatment Plant, which treats 140 million gallons per day, to be $100,000.

- *Fort Worth Water Department (Fort Worth, Texas)*. According to department staff, a contractor completed a systemwide vulnerability assessment for its four drinking water plants and one wastewater treatment plant in December 2002 at a cost of $292,300. Staff did not provide an estimate of in-house cost related to the assessment, but estimated the contract costs related to its Village Creek Wastewater Treatment Plant, which treats 96 million gallons per day, at $73,075.

Wastewater facility managers cited several reasons for using contractors to complete vulnerability assessments. Staff with the Phoenix Water Services Department told us they used contractors for their vulnerability assessment because a citywide policy required that contract services be used whenever possible. Staff at other wastewater facilities told us that, despite the higher costs, they preferred to use contractors because of their expertise. According to a wastewater security official, contractor expertise and independence can give contractor findings and recommendations greater credibility with utility governing boards that determine spending priorities.

One manager told us that he used a contractor for a 2002 vulnerability assessment because risk management software and tools were not yet available. After the events of September 11, 2001, EPA provided funding to the Association of Metropolitan Sewerage Agencies[11] to develop software, called the Vulnerability Self Assessment Tool (VSAT), for water utilities to use to develop vulnerability assessments. According to a Water Environment Federation (WEF) official, VSAT became available in June 2002. This official also said that EPA provided funding to WEF to provide training workshops to wastewater utilities on how to use VSAT to conduct vulnerability assessments beginning October 2002.[12]

According to interviews with wastewater facility managers, large wastewater facilities that prepared vulnerability assessments in-house with existing staff reported lower costs for preparing the document. These include the following:

- *City of Ventura Public Works Department (Ventura, California).* According to facility staff, in-house staff completed a vulnerability assessment in March 2003 for the Ventura Water Reclamation Facility, which treats 9 million gallons per day, at a cost of roughly $1,000 in staff time. Facility staff participated in VSAT training sponsored by EPA and completed the assessment using this tool.

[11]Now the National Association of Clean Water Agencies (NACWA).

[12]Prior to September 11, 2001, EPA worked to develop and disseminate risk assessment methodologies for water utilities. In 2000, EPA funded an initiative with the American Water Works Association Research Foundation (AWWARF) and the Sandia National Laboratories to apply risk assessment methodologies developed by the laboratories to water utilities. The methodology, called the Risk Assessment Methodology for Water Utilities (RAM-W), was designed to assist large water utilities and security professionals in assessing the risks from malevolent threats. Through an interagency agreement with EPA, Sandia National Laboratories provided training to selected firms in the RAM-W methodology so that these firms could then provide training and technical assistance to water utilities.

- *City of Fort Wayne Utilities Division (Fort Wayne, Indiana).* According to facility staff, in-house staff completed a vulnerability assessment in November 2005 for the Fort Wayne Water Pollution Control Plant, which treats 43 million gallons per day, at undetermined staff time. Facility staff participated in VSAT training and updated a previous risk assessment prepared for the facility by a contractor in 2000 at a contracted cost of $10,000.

- *City of Eugene Wastewater Division (Eugene, Oregon).* According to facility staff, in-house staff completed a vulnerability assessment in October 2005 for the Eugene/Springfield Regional Water Pollution Control Facility, which treats 38 million gallons per day, for about $2,000 in staff time.

- *City of Cedar Rapids Department of Water Pollution Control (Cedar Rapids, Iowa).* According to facility staff, in-house staff completed a vulnerability assessment in January 2007 for the Cedar Rapids Wastewater Treatment Plant, which treats 35 million gallons per day, for about $5,000 in staff time.

- *Detroit Water and Sewerage Department (Detroit, Michigan).* According to department staff, in-house staff completed a vulnerability assessment in January 2005 for the Detroit Wastewater Treatment Plant, which treats 700 million gallons per day, for about $20,000 in staff time.

Risk Management Plan Costs Also Influenced by Use of Contractors

Costs to prepare risk management plans ranged from less than $1,000 for facilities that completed the plan in-house to over $31,000 for facilities that used contractors. Costs to update risk management plans were generally less, ranging from less than $1,000 to $20,000 depending upon whether facilities used in-house staff or contractors.

Costs were generally higher at facilities that used contractors. These include the following:

- *The Phoenix Water Services Department (Phoenix, Arizona).* According to department staff, a contractor completed risk management plans for all the system's drinking and wastewater facilities in 1999 for $230,086. Costs for the 91st Avenue Sewage Treatment Plant were prorated at $28,761. Department staff said a contractor updated the 91st Avenue plant's risk management plan in 2004 for $20,000.

- *Fort Worth Water Department (Fort Worth, Texas).* According to department staff, a contractor completed risk management plans for all of the department's drinking water and wastewater facilities in 1999 for $124,718. Costs related to the Village Creek Wastewater Treatment Plant's risk management plan were prorated at $31,100. Department staff reported that the contractor later updated these risk management plans for $18,040 in 2004, $4,510 of which was for the Village Creek plant.

- *City of Fort Wayne Utilities Division (Fort Wayne, Indiana).* According to facility staff, a contractor completed a risk management plan in 2001 for the Fort Wayne Water Pollution Control Plant for $16,000. Facility staff reported a contractor updated the plan in 2005 for $6,000.

- *South Central Regional Wastewater Treatment and Disposal Board (Delray Beach, Florida).* According to facility staff, a contractor completed a risk management plan in 1999 for the South Central Regional Wastewater Treatment and Disposal Plant, which treats 18 million gallons per day, for $10,000. Facility staff reported a contractor updated it in 2006 for $2,000.

- *City of Portland Bureau of Environmental Services (Portland, Oregon).* According to bureau staff, a contractor completed a risk management plan in 1999 for its Columbia Boulevard Wastewater Treatment Plant, which treats 143 million gallons per day, for $30,000. Bureau staff reported they updated the plan using in-house staff in 2004 for $10,000 in staff time.

Other large wastewater facilities that prepared risk management plans in-house with existing staff reported lower costs for preparing the documents. These include the following:

- *San Antonio Water System (San Antonio, Texas).* According to system staff, in-house staff completed a risk management plan in 1999 for the Dos Rios Wastewater Treatment Plant for between $5,000 and $10,000 in staff time. In-house staff updated the plan in 2004 for less than $1,000 in staff time.

- *City of Cedar Rapids Department of Water Pollution Control (Cedar Rapids, Iowa).* According to facility staff, in-house staff completed a risk management plan in January 2000 for the Cedar Rapids Wastewater Treatment Plant for $5,000 in staff time. In-house staff updated the plan in 2004 for about $250 in staff time.

- *Denver Metro Wastewater Reclamation District (Denver, Colorado).* According to district staff, in-house staff completed a risk management plan in 1999 for $10,000 in staff time. In-house staff updated the plan in 2006 for about $1,000 in staff time.

- *City of Savannah Water and Sewer Bureau (Savannah, Georgia).* According to facility staff, in-house staff completed a risk management plan in 1999 for the President Street Water Pollution Control Plant, which treats 17 million gallons per day, at a cost of only $150 in staff time. In-house staff updated the plan in 2006 for about $130 in staff time.

Costs of Converting to Alternative Disinfection Methods at Large Wastewater Facilities Depend on the Method Used and Other Factors

Large wastewater facilities that convert from chlorine gas disinfection to alternative disinfection processes incur widely varying capital costs, which generally depend on the alternative treatment chosen and facility size. Other factors that affect capital costs include the characteristics of individual facilities, such as whether existing structures can be used, and local factors, such as building costs. Alternative disinfection processes may also pose higher annual operating costs than chlorine gas. However, these costs may be offset, at least somewhat, by savings in training and labor costs, and regulatory burdens associated with the handling of chlorine gas. Some facilities even reported or projected net annual cost savings related to wastewater disinfection.

Disinfection Method Chosen, Facility Size and Characteristics, and Other Factors Determine Capital Conversion Costs

The 23 large wastewater facilities that we interviewed reported capital costs for chlorine conversion ranging from $646,922 to just over $13 million. Table 1 identifies the 23 large wastewater facilities that recently converted or plan to convert from chlorine gas to another disinfection method and their reported and planned capital conversion cost.

Table 1: Reported and Planned Disinfection Conversion Costs for Large Wastewater Treatment Facilities

Facility name	Facility location	Conversion year	Facility size (in millions of gallons treated per day)[a]	Disinfection method	Reported or planned conversion cost[b] (in dollars)
Facilities that have completed conversion from chlorine gas					
Chambers Creek	University Place, Wash.	2002	19	Ultraviolet light	$3,900,608
Blue Plains	Washington, D.C.	2003	307	Sodium hypochlorite	12,980,726
Northeast	Philadelphia, Pa.	2003	190	Sodium hypochlorite	2,600,000
Back River	Baltimore, Md.	2004	150	Sodium hypochlorite	3,300,000
Essex and Union	Elizabeth, N.J.	2004	65	Sodium hypochlorite	775,000
Chesapeake-Elizabeth	Virginia Beach, Va.	2004	21	Sodium hypochlorite	1,225,000
Nansemond	Suffolk, Va.	2004	17	Sodium hypochlorite	1,650,740
Columbia Boulevard	Portland, Ore.	2005	143	Sodium hypochlorite	4,660,490
Valley Creek	Bessemer, Ala.	2005	46	Ultraviolet light	3,561,272
Dry Creek	Fort Wright, Ky.	2005	36	Sodium hypochlorite	646,922
Southern Regional	Boynton Beach, Fla.	2005	22	Sodium hypochlorite[c]	2,592,800
Burbank	Burbank, Calif.	2005	9	Sodium hypochlorite	2,500,000
Southeast	Philadelphia, Pa.	2006	90	Sodium hypochlorite	1,920,000
Papillon	Omaha, Neb.	2006	62	Sodium hypochlorite	3,000,000
Facilities that plan to convert from chlorine gas					
Metro Central	Denver, Colo.	2007	130	Sodium hypochlorite	13,135,000
Fort Wayne	Fort Wayne, Ind.	2007	43	Sodium hypochlorite	1,791,417
Everett	Everett, Wash.	2007	18	Sodium hypochlorite	2,562,460
South Central	Delray Beach, Fla.	2007	18	Sodium hypochlorite[c]	2,454,700
Mill Creek	Cincinnati, Ohio	2008	120	Sodium hypochlorite	3,085,000
Western Branch	Laurel, Md.	2008	20	Ultraviolet light	4,000,000
South Treatment Plant	Renton, Wash.	2009	75	Sodium hypochlorite	2,575,000
Hartford	Hartford, Conn.	2009	51	Ultraviolet light	10,892,000
Eugene-Springfield	Eugene, Ore.	2009	38	Sodium hypochlorite	4,498,000

Source: GAO.

[a]Plant size figures are figures for existing flow (a measure of average daily flow) reported by wastewater facilities in our survey.

[b]Conversion costs were not adjusted for inflation. Figures do not reflect changes in annual costs, but are reported costs for construction, labor, and materials related to the disinfection conversion. Reported conversion costs include actual costs and estimates from facility managers. As such, these cost figures do not represent the present value of the life-cycle cost of conversion. Conversion costs include reported temporary and permanent conversion costs.

[c]These facilities will generate sodium hypochlorite on-site. All other facilities listed as converted or planning to convert to sodium hypochlorite are having the chemical delivered in bulk to the facility.

As shown in the table, 17 of the 23 facilities converted or plan to convert to sodium hypochlorite delivered in bulk to the facility. Officials with several of these facilities told us they considered ultraviolet disinfection, but chose delivered sodium hypochlorite because of its lower capital conversion costs. The remainder converted or plan to convert to sodium hypochlorite generated on-site or ultraviolet light. None of the facilities we contacted adopted ozone.

Interview responses indicate that several factors affect the cost of conversion; among these are disinfection method chosen, facility size, key facility characteristics such as available buildings, and whether the conversion was permanent or temporary, as follows.

Disinfection Method

Generally, conversion to delivered sodium hypochlorite has the lowest capital costs, followed by sodium hypochlorite generated on-site, and followed again by ultraviolet light.[13] This observation is supported by cost estimates in the Chlorine Gas Decision Tool, a software program released by DHS in March 2006. The decision tool was designed to provide water and wastewater utilities with the means to conduct assessments of alternatives to chlorine gas disinfection. DHS cautions that the final costs of the disinfection systems will depend on project design details, actual labor and material costs, competitive market conditions, actual site conditions, final project scope, implementation schedule, continuity of personnel and engineering, and other variable factors.[14] With these caveats, the decision tool estimates that for a wastewater facility with an average disinfection flow of 10 million gallons per day and a peak disinfection flow of 20 million gallons per day, capital costs for conversion to delivered sodium hypochlorite would amount to $533,000, on-site generation of sodium hypochlorite would total $1,238,000, and ultraviolet disinfection would reach $1,526,000.[15]

[13]Conversion to disinfection methods such as ozone and ultrafiltration can have higher capital costs than ultraviolet light.

[14]The decision tool provides cost estimates for disinfection conversion alternatives where there is limited site-specific engineering data. DHS notes that cost estimates were based on cost curves that were developed from a combination of the actual construction costs of different-sized disinfection systems and cost estimates based on conceptual designs.

[15]DHS notes that it is normally expected that an estimate of this type would be accurate within +50 percent to -30 percent.

Our interviews with wastewater facilities provide specific examples of conversion costs. For example, managers of the Chesapeake-Elizabeth Treatment Plant, which treats 21 million gallons per day and serves customers in Virginia Beach, Virginia, reported spending an estimated $1,225,000 in 2004 converting to bulk sodium hypochlorite disinfection. Managers of the comparably sized Western Branch Wastewater Treatment Plant, which treats 20 million gallons per day and serves customers in Laurel, Maryland, estimated that they will spend $4 million converting to ultraviolet light disinfection by January 1, 2008. Managers of the Western Branch plant indicated that one reason they chose the more expensive ultraviolet treatment option over bulk deliveries of sodium hypochlorite was to avoid the risk to local traffic that could result from additional deliveries to the plant. Plant managers indicated that because sodium hypochlorite degrades more quickly than chlorine gas, truck deliveries would increase under a disinfection system using sodium hypochlorite. They also noted that ultraviolet light disinfection would eliminate the need for the facility to handle and store significant amounts of hazardous and corrosive chemicals.

Facility Size

In addition to disinfection method chosen, facility size can also influence capital conversion costs. In general, larger facilities spend more converting to alternative disinfection methods. For example, because larger facilities process a greater flow of wastewater, converting to delivered sodium hypochlorite would require a larger sodium hypochlorite storage building or buildings relative to a smaller facility. It may also require additional pumps, instrumentation, and piping to deliver treatment chemicals to a greater number of contact tanks. Importantly, the largest facilities also tend to serve high-cost urban areas, and their conversion costs reflect the higher costs for construction materials and contract labor in these markets.

For example, the Blue Plains Wastewater Treatment Plant, which treats 307 million gallons per day and serves over 2 million customers in the Washington, D.C., metropolitan area, converted from chlorine gas to delivered sodium hypochlorite in 2003 at a cost of almost $13 million. According to facility managers, the facility temporarily converted from chlorine gas to delivered sodium hypochlorite in April 2002 at a cost of $500,000, primarily for storage tanks, pumps, piping, and related instrumentation. It completed the permanent conversion in October 2003 at an added cost of about $12.5 million, which included the purchase of additional storage tanks, related pumps, piping and instrumentation, and the construction of storage facilities for sodium hypochlorite and sodium bisulfate (used for dechlorination).

Other Key Facility Characteristics

In addition to facility size, other physical characteristics related to individual facilities also play a large role in conversion costs. For instance, the availability of usable buildings on facility grounds will determine whether a facility needs to construct, expand, or update a building to properly house sodium hypochlorite and its associated metering equipment. In addition, the distance between the storage building and treatment tanks will determine the amount of piping needed to deliver stored sodium hypochlorite to the treatment tanks. An example comes from the Hampton Roads Sanitation District which provides wastewater treatment to approximately 1.6 million people in 17 cities and counties in southeast Virginia, including the cities of Newport News, Norfolk, Suffolk, Virginia Beach, and Williamsburg. In 2004, the sanitation district converted from chlorine gas to bulk sodium hypochlorite disinfection at two of its plants—the Nansemond Treatment Plant, which treats 17 million gallons per day for the city of Suffolk, and the previously mentioned Chesapeake-Elizabeth plant, which treats 21 million gallons per day. The Nansemond plant conversion cost an estimated $1.65 million, while the slightly larger Chesapeake-Elizabeth plant conversion cost about $1.2 million. Costs were higher at the Nansemond plant because a building needed to be constructed for sodium hypochlorite storage, while the Chesapeake-Elizabeth plant had an existing building that only needed to be upgraded to properly store the chemical.

Federal discharge permit requirements related to individual treatment facilities can also influence conversion costs. Certain wastewater facilities may be allowed higher chlorine residuals in treated effluent because they discharge into less sensitive waters. Often, these facilities do not have to dechlorinate wastewater, saving the facility the cost of dechlorination chemicals, equipment, and storage. For example, the Philadelphia-area Southeast and Northeast Wastewater Treatment Plants, which treat 90 and 190 million gallons per day, respectively, need only to chlorinate water prior to discharging into the Delaware River. Both plants were converted to delivered sodium hypochlorite—the Southeast plant in 2006 at an estimated cost of $1.9 million and the Northeast plant in 2003 at an estimated cost of $2.6 million. In contrast, the Baltimore-area Back River Wastewater Treatment Plant, which treats 150 million gallons per day and discharges into the ecologically sensitive Chesapeake Bay, must chlorinate and dechlorinate its wastewater before discharge. This facility converted to delivered sodium hypochlorite in 2004 at a reported cost of $3.3 million.

Temporary Conversions

Finally, some facilities have reduced conversion costs in the short term through temporary conversions. For example, the Metropolitan Sewer District of Greater Cincinnati decided to convert its Mill Creek Wastewater

Treatment Plant, which treats 120 million gallons per day, from chlorine gas to sodium hypochlorite disinfection soon after September 11, 2001. According to the plant manager, by mid-October 2001, the facility had begun disinfecting with sodium hypochlorite by hooking up a rented sodium hypochlorite trailer to its disinfection system at a cost of $25,000. By May 2002, the facility had completed an interim conversion to sodium hypochlorite by purchasing and installing two 8,000 gallon outdoor storage tanks for sodium hypochlorite at a cost of $60,000. According to the plant manager, this interim disinfection system is still in use today, though the plant intends to permanently convert to delivered sodium hypochlorite in 2008 or 2009 at an estimated cost of $3 million. The plant manager said the permanent conversion would include an unloading station for sodium hypochlorite deliveries and a new storage building for the chemical and related instrumentation. The plant manager said the new storage building was needed to reduce the decay of stored sodium hypochlorite. The plant manager added that the storage building and additional piping would improve plant safety because it would allow for central storage and delivery of sodium hypochlorite. Currently, sodium hypochlorite deliveries are made at several plant locations for odor control which, according to the plant manager, increase the odds the chemical may be mishandled and accidentally mixed with other reactant chemicals used at the plant, such as ammonia.

Similarly, the Eastern Water Reclamation Facility, which treats 16 million gallons per day and provides service to Orange County, Florida, converted from chlorine gas to sodium hypochlorite disinfection at a cost of $60,000 in November 2001 through the addition of outdoor storage tanks and related pumps. According to the plant manager, the facility may consider additional changes in the future, such as permanent sodium hypochlorite storage or on-site generation.

Changes in Annual Costs Vary Widely, with Some Facilities Reporting Savings

Changes in annual costs related to disinfection treatment conversions were hard to measure due to lack of data. Many facilities we interviewed were unable to provide complete information on annual costs related to disinfection before and after converting from chlorine gas. Available data show that annual chemical costs related to disinfection increased for facilities that converted to delivered sodium hypochlorite, because sodium hypochlorite costs more than chlorine gas.[16] Available data also show that electrical costs related to disinfection increased for facilities that converted to on-site generation of sodium hypochlorite or ultraviolet light treatment, however these facilities also saw large reductions in chemical costs. Available data also show that increases in annual costs related to disinfection were offset somewhat by savings in training and regulatory requirements, as several facilities that converted reported a reduced need for staff time devoted to complying with the EPA risk management planning that was required when the plant used chlorine gas.

A few facilities were even able to report or project annual savings due to the disinfection conversion. For example, the wastewater treatment manager of the Columbia Boulevard Treatment Plant, which treats 143 million gallons per day and provides wastewater service to Portland, Oregon, estimated that annual costs related to disinfection fell by over $100,000 after the plant completed a 2005 conversion from chlorine gas to delivered sodium hypochlorite disinfection.[17] According to the wastewater treatment manager, increases in disinfection chemical costs for the plant were more than offset by reductions in electrical, labor, and training costs. Electrical power costs fell because the plant no longer had to power chlorine gas evaporators, which heat and help convert the pressurized liquid into gas before it is injected into the waste stream. In contrast, sodium hypochlorite is fed into the waste stream via less energy-intensive pumps. Labor and training costs also fell because the plant no longer had to meet the Occupational Safety and Health Administration's (OSHA) Process Safety Management of Highly Hazardous Chemicals standard,[18] and risk management and emergency response planning costs associated with the use of chlorine gas were eliminated.

[16]In addition, sodium bisulfate, the dechlorination chemical often used with sodium hypochlorite, costs more than sulfur dioxide, the dechlorination chemical often used with chlorine gas

[17]According to the wastewater treatment manager, annual costs related to disinfection fell from $411,531 for the operating year covering July 1, 2004, to June 30, 2005, to $302,998 for the operating year covering July 1, 2005, to June 30, 2006. The wastewater treatment manager reported the plant's annual operations and maintenance budget at $12.4 million for the most recently completed operating year.

[18]OSHA's Process Safety Management of Highly Hazardous Chemicals standard (29 CFR 1910.119) contains requirements for the management of hazards associated with processes using highly hazardous chemicals.

In another example, the South Central Regional Wastewater Treatment and Disposal Plant, which treats 18 million gallons per day for customers in the cities of Delray Beach and Boynton Beach, Florida, predicts that it too will achieve annual savings once it converts from chlorine gas to sodium hypochlorite generated on-site, which it anticipates completing in September 2007. According to the Executive Director of the South Central Regional Wastewater Treatment and Disposal Board, potential disruptions of sodium hypochlorite delivery during hurricane seasons motivated them to begin generating their disinfection chemicals on-site. The plant's most recent fiscal year operating and maintenance budget for disinfection is estimated to be roughly $307,000 for chlorine gas and associated costs including equipment and maintenance, labor, and risk management planning. Postconversion annual operating and maintenance costs for disinfection are estimated to fall to $205,000 in the 2008 calendar year, primarily due to the suspension of chlorine gas purchases.

Agency Comments and Our Evaluation

We provided a draft of this report to EPA for review and comment. In its letter, reproduced in appendix II, EPA concurred with the results of the report. EPA's Water Security Division in the Office of Ground Water and Drinking Water provided technical comments and clarifications that were incorporated, as appropriate.

As agreed with your office, unless you publicly release the contents of this report earlier, we plan no further distribution until 30 days from the report date. At that time, we will send copies of this report to the appropriate congressional committees; interested Members of Congress; the Administrator, EPA; and other interested parties. We will also make copies available to others on request. In addition, the report will be available at no charge on the GAO Web site at http://www.gao.gov.

Should you or your staff need further information, please contact me at (202) 512-3841 or stephensonj@gao.gov. Contact points for our Offices of Congressional Relations and Public Affairs may be found on the last page of this report. GAO staff who made major contributions to this report are listed in appendix III.

Sincerely yours,

John B. Stephenson
Director, Natural Resources
and Environment

Appendix I: Scope and Methodology

To identify the costs of preparing vulnerability assessments and risk management plans, we conducted structured telephone interviews with a select sample of large wastewater facilities identified as having completed these documents in our March 2006 report.[1] Our March report identified 106 large facilities that reported they had prepared vulnerability assessments or had one underway, and 85 facilities that were required to prepare risk management plans because they currently used chlorine gas as a disinfectant. From these two groups, we identified 47 facilities that reported that they had prepared vulnerability assessments and currently use chlorine. Of this universe, we chose a nonprobability sample of 25 facilities to assure geographic dispersion and adequate variation in size, since these factors were likely to influence their costs.[2] We completed structured interviews with 20 of the remaining 25 facilities. We sent an interview schedule in advance of each of the interviews. We completed the structured interviews between November 2006 and February 2007. Reported costs included both actual and estimated costs. For estimated costs, we asked facility managers to explain how they arrived at these estimates. Reported costs were not adjusted for inflation.

To identify the costs incurred by wastewater facilities in converting from gaseous chlorine to an alternative disinfection process, we conducted structured telephone interviews with a nonprobability sample of 26 of the 38 large facilities identified in the March report as having recently converted or planning to convert from chlorine gas to an alternative disinfection process. We sent an interview schedule in advance of each of the interviews. We completed the structured interviews between October 2006 and February 2007. Reported costs included both actual and estimated costs. For estimated costs, we asked facility managers to explain how they arrived at these estimates. Reported costs were not adjusted for inflation. We also conducted site visits with some of the facilities. Where available, we gathered documentation, such as capital plans, from these facilities in order to document conversion costs. We supplemented the cost information we gathered at individual wastewater

[1]GAO, *Securing Wastewater Facilities: Utilities Have Made Important Upgrades but Further Improvements to Key System Components May Be Limited by Costs and Other Constraints*, GAO-06-390 (Washington, D.C.: Mar. 31, 2006). We defined large wastewater facilities as those publicly owned treatment works (POTW) that serve residential populations of 100,000 or greater.

[2]Results from nonprobability samples cannot be used to make inferences about a population, because in a nonprobability sample some elements of the population being studied have no chance or an unknown chance of being selected as part of the sample.

facilities with information obtained at the Environmental Protection Agency, the Department of Homeland Security, nongovernmental organizations, and industry representatives. We determined that reported cost data were sufficiently reliable to provide useful information about the costs for preparing vulnerability assessments, risk management plans, and conversions from gaseous chlorine and the factors that affect these costs.

We conducted our work between August 2006 and March 2007 in accordance with generally accepted government auditing standards.

Appendix II: Comments from the Environmental Protection Agency

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

MAR 20 2007

OFFICE OF WATER

Mr. John B Stephenson
Director, Natural Resources and the Environment
Government Accountability Office
Washington, DC 20548

Dear Mr Stephenson

Thank you for the opportunity to review the draft Government Accountability Office (GAO) Report *Securing Wastewater Facilities Costs of Vulnerability Assessments, Risk Management Plans, and Alternative Disinfection Methods Vary Widely*. We appreciate the information in the report. This draft report is useful, well thought out, and demonstrates a well conceived and executed project Our review did not identify any issues of concern for the Agency and my staff has provided GAO with technical comments on the draft under a separate cover

We all rely on clean, safe, and secure water. Therefore, from a public health and economic perspective, it is critical that we protect our nation's wastewater infrastructure Although there are no federal statutory requirements for wastewater utilities to conduct risk assessments, the Environmental Protection Agency (EPA) continues to develop tools and provide training to assist those water sector utilities that choose to perform these assessments on a voluntary basis As your report notes, many wastewater utilities have elected to conduct these assessments or are planning to do so in the future.

The Agency is also interested in working with the water sector to identify disinfectants that are appropriate for their needs to meet water quality standards and to protect human health and the environment. Although the conversion from gaseous chlorine to an alternate disinfectant would eliminate the impacts of a hazardous gaseous chemical release, it is important to recognize that water sector utility owners and operators need to make the choice of disinfectant that is best for their utility. Therefore, many water sector utilities may continue to use chlorine gas as a disinfectant

I appreciated the opportunity to coordinate with your staff on this project Should you need additional information or have further questions, please contact me or Cynthia C. Dougherty, Director of the Office of Ground Water and Drinking Water at (202) 564 3750.

Sincerely,

Benjamin H Grumbles
Assistant Administrator

Appendix III: GAO Contact and Staff Acknowledgments

GAO Contact

John B. Stephenson, (202) 512-3841 or stephensonj@gao.gov

Acknowledgments

In addition to the contact named above, Jenny Chanley, Steve Elstein, Nicole Harris, Greg Marchand, Tim Minelli, Alison O'Neill, Daniel Semick, and Monica Wolford made key contributions to this report.

GAO's Mission

The Government Accountability Office, the audit, evaluation and investigative arm of Congress, exists to support Congress in meeting its constitutional responsibilities and to help improve the performance and accountability of the federal government for the American people. GAO examines the use of public funds; evaluates federal programs and policies; and provides analyses, recommendations, and other assistance to help Congress make informed oversight, policy, and funding decisions. GAO's commitment to good government is reflected in its core values of accountability, integrity, and reliability.

Obtaining Copies of GAO Reports and Testimony

The fastest and easiest way to obtain copies of GAO documents at no cost is through GAO's Web site (www.gao.gov). Each weekday, GAO posts newly released reports, testimony, and correspondence on its Web site. To have GAO e-mail you a list of newly posted products every afternoon, go to www.gao.gov and select "Subscribe to Updates."

Order by Mail or Phone

The first copy of each printed report is free. Additional copies are $2 each. A check or money order should be made out to the Superintendent of Documents. GAO also accepts VISA and Mastercard. Orders for 100 or more copies mailed to a single address are discounted 25 percent. Orders should be sent to:

U.S. Government Accountability Office
441 G Street NW, Room LM
Washington, D.C. 20548

To order by Phone: Voice: (202) 512-6000
TDD: (202) 512-2537
Fax: (202) 512-6061

To Report Fraud, Waste, and Abuse in Federal Programs

Contact:

Web site: www.gao.gov/fraudnet/fraudnet.htm
E-mail: fraudnet@gao.gov
Automated answering system: (800) 424-5454 or (202) 512-7470

Congressional Relations

Gloria Jarmon, Managing Director, JarmonG@gao.gov (202) 512-4400
U.S. Government Accountability Office, 441 G Street NW, Room 7125
Washington, D.C. 20548

Public Affairs

Paul Anderson, Managing Director, AndersonP1@gao.gov (202) 512-4800
U.S. Government Accountability Office, 441 G Street NW, Room 7149
Washington, D.C. 20548

PRINTED ON RECYCLED PAPER

ATTACHMENT 4

Attachment 4
Railroad Industry Recommended Operating Practice and Security Initiatives

1. OT-55 (Recommended Railroad Operating Practices for Transportation of Hazardous Materials)

AAR's member railroads have adopted operating restrictions for the transportation of TIH and other highly hazardous materials, embodied in Circular OT-55. OT-55 provides that a train transporting five or more tank cars containing highly-hazardous materials will:

- be operated at a maximum operating speed of 50 mph;
- hold the main track at meeting or passing points if the siding does not meet FRA Class 2 standards, when practicable;
- transport only cars equipped with roller bearings; and
- when a bearing defect in a car is reported by a wayside detector and a visual inspection fails to confirm a defect, the train will proceed at a maximum speed of 30 mph until it passes over the next wayside detector (or reaches a terminal) and if the next detector also reports a defect, the car will be set out from the train.

In addition, for routes with high volumes of highly-hazardous materials:

- wayside bearing defect detectors will be spaced no more than 40 miles apart;
- main track will be inspected by rail defect detection and track geometry inspection cars at least twice annually (sidings will be inspected at least once annually); and
- track used for meeting and passing trains transporting five or more TIH materials must be Class 2 or higher (if a track of a lesser class must be used in an emergency, one of the trains must stop).

OT-55 contains other restrictions on TIH transportation as well:

- loaded TIH cars cut off in motion must be handled in cuts of no more than two cars and cars that will be cut off in motion and coupled to a loaded TIH car must be handled in cuts of no more than two cars;
- for new facilities, the loading and unloading of TIH materials and the storing of TIH materials in tanks must take place at least 100 feet from mainline class 2 track or higher, and loaded TIH tank cars must be stored at least 50 feet from mainline class 2 track or higher.

2. AAR terrorism risk analysis and Security Management Plan

In response to the terrorist attacks of September 11, 2001, the railroad industry created critical action teams to perform risk assessments regarding the transportation of hazardous materials (with emphasis on TIH materials). Their work culminated in 53 permanent security countermeasures.

In addition, the industry prepared a Security Management Plan with four threat-based Alert Levels. Railroads implement specific security actions as the alert level changes. Many security actions relate directly to the transportation of TIH materials. The Security Plan is regularly exercised, reevaluated, and updated.

To monitor threat and warning information, the railroads created the Railway Alert Network (RAN), a 24x7 secure facility that operates at the Secret level. The industry also established the Surface Transportation Information Sharing and Analysis Center (ST-ISAC) to operate as a backup capability for the RAN and to monitor cyber security threats. The ST-ISAC operates 24x7 at the Top Secret Level. The railroad industry is in constant communication with government intelligence agencies to monitor threat and warning information.

3. Industry research efforts relating to TIH materials transportation

The railroad industry has also devoted considerable resources in research efforts to enhance the security of tank cars transporting TIH materials. The industry is examining with DOT/TSA technology that would enable a tank car to self-seal in the event the car is penetrated by ammunition; that would make tank cars more resistant to penetration; and that would sense a release of TIH.

ATTACHMENT 5

Attachment 5
DOT and TSA Initiatives Related to TIH Materials Transport

I. DOT/Pipeline and Hazardous Materials Safety Administration (PHMSA) requirements for TIH materials safety and security plans, 49 C.F.R. § 172.820 (interim rule) [73 FR 20752 (April 16, 2008)]

1. Rail carriers transporting TIH materials must compile information and data on the commodities transported, including the routes over which these commodities are transported.
2. Rail carriers transporting TIH materials must use the data they compile (including relevant information from state officials) regarding security risks to high-consequence targets along or in proximity to a route to analyze the safety and security risks for each route used and practicable alternative routes to the route used.
3. Using these analyses, rail carriers must select the route posing the least overall safety and security risk for the TIH materials (taking into account twenty-seven relevant factors).
4. The railroads must compile the data for TIH materials movements and conduct the route analyses on an annual basis.
5. Rail carriers must institute measures to prevent unauthorized access to TIH materials during storage and mitigate storage risks to population centers.
6. Rail carriers transporting TIH materials must notify consignees of any significant unplanned delays affecting the delivery of the TIH material.
7. Rail carriers must work with shippers and consignees to minimize the time a rail car containing TIH material is placed on track awaiting pick-up, delivery, or transfer.
8. Rail carriers must conduct security visual inspections at ground level of rail cars containing TIH to check for signs of tampering or the introduction of an improvised explosive device (IED).

II. PHMSA speed limit requirements for TIH transportation, proposed 49 C.F.R. § 174.826 [73 Fed. Reg. 17818 (April 1, 2008)]

PHMSA has proposed two speed limit requirements for TIH rail transportation as part of its proposal to require upgraded TIH materials tank car specifications:

1. Trains transporting TIH materials would be subject to a 50 mph limit (current railroad industry practice only limits trains transporting five or more tank cars containing TIH materials to 50 mph).
2. Trains transporting TIH materials in tank cars that do not meet the upgraded specifications would be subject to a 30 mph restriction in non-signaled territory.

III. Transportation Security Administration (TSA) Rail Transportation Security Regulations (proposed 49 C.F.R. Part 1580) [71 FR 76852 (December 21, 2006)]

TSA's proposed rules would impose various security requirements upon rail carriers transporting TIH materials:

1. Rail Security Coordinator. A carrier must designate a rail security coordinator (RSC) and at least one alternate RSC to be available to TSA on a twenty-four hour, seven day per week basis to serve as primary contact for receipt of intelligence information and other security-related activities. Proposed 1580.101
2. Reporting. A carrier must immediately report incidents, potential threats, and significant security concerns to TSA. Proposed 1580.105
3. Location and Shipping Information. A carrier must provide to TSA, upon request, the location and shipping information of rail cars within its physical custody or control that contain TIH materials. The information must be provided to TSA no later than one hour after receiving the request. Proposed 1580.103
4. Chain of Custody and Control. A carrier must provide for a secure chain of custody and control of rail cars containing TIH materials. The carrier must document the transfer of custody of a rail car containing TIH from a shipper regardless of whether the carrier is physically accepting the rail car at a shipper facility located outside or inside an HTUA. The carrier must also perform a physical security inspection on the car to ensure that no one has tampered with it or otherwise compromised its security. With respect to transfers within an HTUA, each delivering carrier transferring physical custody of a rail car containing TIH to a receiving carrier must ensure that the receiving carrier takes physical possession of the rail car before the delivering carrier leaves the interchange point. Both carriers must ensure that the rail car is attended at all times during the physical transfer of custody. The same requirements would apply whenever a carrier transfers or receives a rail car containing TIH if the rail car may subsequently enter an HTUA. Proposed 1580.107

IV. TSA Security Action Items

TSA (on June 23, 2006) issued twenty-four "Recommended Security Action Items for the Rail Transportation of Toxic Inhalation Hazard Materials" which require carriers to:

1. Designate an individual with overall responsibility for hazardous materials transportation security planning, training, and implementation (including with respect to company-designated critical infrastructure).
2. Conduct exercises, at least annually, to verify the effectiveness of security plan(s).
3. Develop and conduct an internal or external company audit program to independently verify that the security plan is being effectively implemented.
4. Identify and annually review company-designated critical infrastructure.
5. Maintain a communications network to receive timely government notices of current threat conditions and available intelligence information and adjust security measures as necessary.
6. Establish liaison and regular communication with federal, state, and local law enforcement, emergency responders, security agencies, and industry partners.

7. Establish liaison and collaboration with other railroad security offices to promote information sharing and security enhancements.
8. Reinforce security awareness and operational security concepts to all employees.
9. Reinforce the need for employees to immediately report to the proper authorities all suspicious persons, activities, or objects encountered.
10. Have contingency plans in place to supplement company security personnel to protect company-designated critical infrastructure as threat conditions warrant.
11. Restrict access to information controlled by the railroad that it determines to be sensitive, in particular information about hazardous materials shipments and security measures.
12. Make available emergency response planning materials, and work with local communities to facilitate their training and preparation to respond to an emergency or security incident.
13. Work with the federal, state, local, and tribal governments to identify through risk assessments those locations where security risks are the highest and implement protective measures at these locations.
14. Focus proactive community safety and security outreach and trespasser abatement programs in areas adjacent to company-designated critical infrastructure
15. To the extent feasible and practicable, utilize photo identification procedures for company-designated critical infrastructure. Establish procedures for background checks and safety and security training for contractor employees.
16. To the extent feasible and practicable, and as threat conditions warrant, restrict the access of contractors and visitors at non-public areas of company-designated critical infrastructure and monitor the activities of visitors in or around such infrastructure.
17. Establish employee identification measures for all employees and conduct spot checks as threat conditions warrant.
18. Implement measures to deter unauthorized entry and increase the probability of detection at company-designated critical infrastructure as threat conditions warrant.
19. Utilize interlocking signals and/or operating rules to prevent trains from occupying moveable bridges until they are locked in place.
20. Maintain systems to locate rail cars transporting TIH materials in a timely manner and provide information on the location of rail cars carrying TIH materials to DHS and DOT as requested.
21. During required on-ground safety inspections of cars containing TIH materials, inspect for any apparent signs of tampering, sabotage, attached explosives, and other items. Train employees to recognize suspicious activity and report security concerns found during inspections.
22. Provide local authorities with information on the hazardous materials transported through their communities consistent with AAR Circular OT-55.
23. Consider alternative routes when they are economically practicable and result in reduced overall safety and security risks. Work with the DHS and DOT in developing better software tools to analyze routes.

24. In rail yards, to the extent feasible, place cars containing TIH materials where the most practical protection can be provided against tampering and outside interference in accordance with the AAR Security Management Plan.

TSA also issued three supplemental security action items on November 21, 2006 which require that:

1. Rail carriers with operations in High Threat Urban Areas (HTUA) must develop site-specific security plans that address the security of TIH material in loaded rail cars ("TIH cars") within HTUA. The site-security plan must address the following objectives:

    - Reduce the number of hours TIH cars are held in yards, terminals, and on railroad-controlled leased track in HTUA.
    - Minimize the occurrence of unattended TIH cars in HTUA.
    - Reduce potential exposure to surrounding people, property and environment in HTUA with special emphasis on reducing potential exposure to hospitals, high-occupancy buildings, schools, and public venues.
    - Reduce the occurrence of standing TIH trains in HTUA.
    - Provide procedures for the protection or surveillance of unattended TIH trains in HTUA
    - Ensure compliance with CFR 49 Part 174.14 (48 hour rule).[1]
    - Develop site-specific procedures for the positive and secure handoff of TIH cars at points of origin, destination, and interchange in HTUA.

2. Rail carriers will not operate trains carrying TIH within a specified distance of public venues with National Special Security Events in progress and as requested by the appropriate agency responsible for overall event security coordination.

3. Rail carriers will, in the security planning process, identify and select areas throughout the carrier's system where cars containing TIH can be moved and held when threat conditions warrant.

(The railroads have taken specific actions and otherwise modified their operating procedures in compliance with the TSA security action items. For example, the railroads have reported and reduced dwell time for TIH materials in HTUA; have changed operating procedures so that when TIH materials are held during transportation, they are placed away from public facilities, such as hospitals and schools, and placed in active yards rather than on "unattended" tracks; have moved interchange locations away from HTUA; have installed lights, fences, intrusion detection systems, and cameras; and have developed site-specific security plans.)

[1] 49 C.F.R. 174.14 provides that:
(a) A carrier must forward each shipment of hazardous materials promptly and within 48 hours (Saturdays, Sundays, and holidays excluded), after acceptance at the originating point or receipt at any yard, transfer station, or interchange point, except that where biweekly or weekly service only is performed, a shipment of hazardous materials must be forwarded on the first available train.

STB Finance Docket No. 35504

UNION PACIFIC R.R. – PETITION FOR DECLARATORY ORDER

OPENING EVIDENCE AND ARGUMENT
OF
NORFOLK SOUTHERN RAILWAY COMPANY

EXHIBIT 8

THOMPSON HINE ATLANTA CINCINNATI CLEVELAND COLUMBUS DAYTON NEW YORK WASHINGTON, DC

January 13, 2012

By Hand Delivery

Cynthia Brown
Chief, Section of Administration
Office of Proceedings
Surface Transportation Board
395 E Street, SW
Washington, D.C. 204231

231682

RE: STB Finance Docket No. 35517; *CF Industries, Inc. v. Indiana & Ohio Railway, Point Comfort and Northern Railway, and The Michigan Shore Railroad—Petition For Declaratory Order*

Dear Ms. Brown:

Enclosed for filing in the above-captioned case please find an original and ten (10) copies of the Highly Confidential and Public version of the Opening Evidence and Argument on Behalf of American Chemistry Council, Arkema, Inc., The Chlorine Institute, Inc., The Fertilizer Institute and PPG Industries, Inc.

Also included are three (3) CD's each of the Highly Confidential and Public versions of the attached documents.

Enclosed are additional copies of the pleadings for stamp and return. Kindly date-stamp the additional copies for return to this office by messenger.

If you have any questions, please do not hesitate to contact the undersigned.

Sincerely,

Jeffrey O. Moreno

ENTERED
Office of Proceedings
JAN 13 2012
Part of
Public Record

Enclosures

THOMPSON HINE LLP
ATTORNEYS AT LAW
1920 N Street, N.W.
Washington, D.C. 20036-1600
www.ThompsonHine.com
Phone 202.331.8800
Fax 202.331.8330

PUBLIC VERSION

JAN 13 2012

BEFORE THE
SURFACE TRANSPORTATION BOARD

Finance Docket No. 35517

CF INDUSTRIES, INC. v. INDIANA & OHIO RAILWAY, POINT COMFORT AND NORTHERN RAILWAY, AND THE MICHIGAN SHORE RAILROAD— PETITION FOR DECLARATORY ORDER

OPENING EVIDENCE AND ARGUMENT ON BEHALF OF AMERICAN CHEMISTRY COUNCIL, ARKEMA, INC. THE CHLORINE INSTITUTE, INC., THE FERTILIZER INSTITUTE AND PPG INDUSTRIES, INC.

I. PRELIMINARY STATEMENT

The American Chemistry Council ("ACC"); Arkema, Inc. ("Arkema"); the Chlorine Institute, Inc. ("CI"); The Fertilizer Institute ("TFI"); and PPG Industries, Inc. ("PPG"), hereinafter collectively ("Complainants"),[1] hereby present their collective evidence in the first stage of this proceeding. This evidence consists of: (1) the depositions of RailAmerica employees, James Shefelbine and Harry Shugart, together with those documents submitted to Complainants by RailAmerica in response to discovery that have been attached to those depositions as exhibits; and (2) the Verified Statement of Frank Reiner, the President of CI. The foregoing documents are attached hereto as Attachments A, B and C, respectively. Since the entire discovery record has been designated by RailAmerica as Highly Confidential pursuant to the Protective Order in this proceeding, Attachments A and B will be referred to in this document only in general terms.

---

[1] Inasmuch as the identified parties are Complainants in Docket NOR 42129, they are referred to here as Complainants for ease of reference.

As of the date of preparation of this filing, seven operating subsidiaries of the railroad holding company RailAmerica have adopted virtually identical tariff language that requires the movement of toxic-inhalation-hazard ("TIH") materials by rail to occur in Special Train Service ("STS").[2] The key element of this tariff requires that all TIH materials move in dedicated trains of no more than three cars that are accompanied at all times by a RailAmerica employee. Although RailAmerica contends that STS enhances the safety and security of TIH transportation, it has not conducted a single analysis to demonstrate that STS provides any such enhancements over the existing comprehensive federal safety and security regulations for TIH transportation or the degree of such enhancements. RailAmerica seeks to justify STS on varying grounds.

On the one hand, RailAmerica states that its subsidiaries such as Alabama Gulf Coast Railway ("AGR") are really not doing anything other than what is mandated by the Federal Railroad Administration ("FRA") regulations already in place.[3] Alternatively, RailAmerica argues that STS is necessary to provide additional safety and presumably security over and above those protections imposed under the pervasive and comprehensive regulations of the U.S. Department of Transportation ("DOT") and the Transportation Security Administration ("TSA"). This alternative claim is made without the slightest demonstration of the need for such "additional" measures, the cost of such measures, or the benefits flowing from such measures.

---

[2] RailAmerica has persistently attempted to describe this requirement as "priority train service," in a transparent attempt to distinguish its tariff from past STS tariffs that have been found unreasonable. Whatever the label, the required service is an unreasonable practice.

[3] See the Response to Complainants' Supplemental Information in Response to the Board's Order of September 30, 20011, at pp. 17-8 and attached Verified Statement of James Shefelbine filed October 31, 2011 by SGR and RailAmerica in Docket No. 42129.

Even assuming, *arguendo*, that the STS charges can be justified on a cost basis, the STS program itself must be held unlawful. It is well established that no carrier "has a right to insist upon a wasteful or excessive service for which the consumer must ultimately pay." *Atchison Railway Co. v. United States,* 232 U.S. 199, 217 (1914), quoted with approval in *Consolidated Rail Corp. v. I.C.C.* 646 F.2d 642, 647 (D.C. Cir, 1981). The internal documents of RailAmerica and its subsidiaries reflect a complete absence of any analysis by any qualified person(s) regarding the costs or benefits of the STS program. At most, the RailAmerica STS program was the result of the "brainstorming" of seven RailAmerica employees following the non-specific orders of the RailAmerica President to make things safer. No objective or quantifiable criteria were employed to attain these non-specific goals and no objective or quantifiable benefits were ascertained or even sought to be ascertained in the process. In short, the STS program was developed on a whim and implemented with a clear view towards how much additional revenue and profit could be obtained for RailAmerica.[4] Such costly and unnecessary services that are sought to be mandated without any justification therefore are plainly contrary to the established law of the Board and its predecessor.

The charges for STS service are as high as $15,000 per car for movements of as little as 22 miles. RailAmerica internal documents clearly reveal that the extraordinarily high STS charges are based upon a surcharge formula that greatly overstates RailAmerica subsidiary railroad costs while asserting to customers that the charges are necessary to offset those costs. In short, the RailAmerica documents, as well as the deposition testimony of its officials, demonstrate that the STS charges are a subterfuge for a scheme

[4] In Shefelbine Deposition Exhibit 2 at p. 19, RailAmerica calculates the substantial profits to be generated under the STS program even using unrealistically low STS surcharges and limited numbers of cars.

designed and implemented to greatly inflate RailAmerica profits under the guise of improved safety measures. Such fraudulent misrepresentations have long been held by the Board and its predecessor to constitute unreasonable practices prohibited by 49 U.S.C. § 10702.

Finally, the regulations governing the rail transportation of TIH commodities are comprehensive and have been developed over a nearly 100 year period. The safety regulations developed and implemented by the DOT and the security regulations of the TSA have been fully vetted, reviewed and subjected to public scrutiny. While these regulations continue to evolve with the advent of new technology, and are almost constantly the subject of procedures of the Tank Car Committee of the American Association of Railroads ("AARTCC") and the DOT and TSA, RailAmerica has never sought to present suggestions for modifications of tank car designs or of railroad operating procedures with respect to TIH materials.

The reason for RailAmerica's failure to seek regulatory intervention for its perceived safety and security improvements is obvious; none would be imposed or even permitted by the respective Federal agencies charged by Congress with regulating TIH transportation. Those agencies, DOT and TSA, have undertaken exhaustive and comprehensive evaluations of tank car design and operating parameters that RailAmerica's ad hoc "team" did not consider or even pretend to understand. These evaluations, submitted for public comment and review, are required not only to establish safe and secure operating designs and procedures, but to conduct cost/benefit analyses as well.

RailAmerica claims to justify its STS on the basis of "simple physics." Although simple, their analysis is not accurate. As is shown by the Verified Statement of Frank Reiner, the President of the Chlorine Institute, and a long-time tank car building engineer, no catastrophic release of chlorine or any other TIH material from a properly designed and constructed rail tank car subject to both the requirements of the DOT and the AAR Interchange Rules, has ever occurred absent some fundamental failure of the railroad moving the tank car to observe basic safety procedures, certainly not including STS. As a result, the elements of STS that RailAmerica would unilaterally impose on TIH shippers have been considered and rejected by the responsible Federal agencies.

The observations of the Court in *Consolidated Rail Corp. v. I.C.C.* 646 F.2d 642, 652 (D.C. Cir. 1981), with respect to STS requirements for nuclear waste, apply with equal force to RailAmerica's STS requirement for TIH materials:

> [RailAmerica has] had and continue[s] to have, ample opportunity to petition both the [TSA] and DOT for review of their respective regulations in this area. Any evidence indicating that significant safety [or security] benefits could be achieved by STS may be considered by DOT and [TSA] pursuant to the procedures each agency has established permitting petitions to issue, amend, or rescind transportation safety [or security] regulations.

The only difference between the nuclear waste STS requirement 30 years ago and the TIH STS requirement today is the fact that TIH transportation has had a much longer history and is much better understood than nuclear waste transportation was in the 1970s. If RailAmerica truly believes that some supplemental train service is required for TIH materials, the path for it to follow is clearly outlined by the Federal agencies with comprehensive regulatory jurisdiction. The refusal of DOT and TSA to adopt STS requirements for TIH movements is conclusive evidence in this proceeding that the STS requirement is unreasonable, because RailAmerica has not even attempted to demonstrate that STS is not a wasteful or excessive service for which shippers must pay.

II. SUMMARY OF THE EVIDENCE

The evidence presented by Complainants demonstrates three fundamental and indisputable facts: (1) prior to designing and implementing the Special Train Services that are the subject of this proceeding, RailAmerica conducted no analysis of any kind to determine what, if any, benefits would result from the STS program, and, in fact, had no capability to even engage is such an analysis; (2) the only cost analysis performed by RailAmerica was an analysis as to how much additional revenue and additional profit would inure to the benefit of RailAmerica as a result of STS; and (3) rail tank cars approved by the Department of Transportation, and operated under regulations promulgated by both the safety and security regulators of the Departments of Transportation and Homeland Security, are extremely robust, and when operated according to existing regulations have no record of ever suffering a catastrophic release of TIH material. In short, there is no basis whatever for the extremely onerous and costly burdens imposed by STS.

A. RailAmerica Discovery

In his deposition, the leader of the RailAmerica team designated by the RailAmerica President and Chief Executive Officer to put a team together and make "safety" recommendations to RailAmerica subsidiary carriers testified that a team of seven people, with no special safety or security experience, and without the benefit of any outside consultants or experts, essentially stitched together out of whole cloth the STS program.[5] This team operated without any written instructions or protocols and had no expertise in tank car survivability or the probability of a release from a TIH tank car in the event of a derailment. Their proposal made no effort to analyze the costs versus the benefits of the STS program. Rather, every iteration of the proposal from start to finish emphasized the rates that RailAmerica would charge, culminating in a calculation of the profits that would result from the implementation of STS.[6]

In short, the discovery materials supplied by RailAmerica and the deposition testimony of its executives plainly demonstrate that no real expertise was brought to bear to determine whether the STS proposal actually enhanced safety at all, much less by how much, or whether the supposed risk reduction warranted the substantially higher cost of STS. Indeed, RailAmerica's discovery documents reveal that the only truly detailed analysis performed by RailAmerica was of the cost and profitability associated with the adoption and implementation of STS.

B. Reiner Verified Statement

In contrast to the total lack of expertise brought to bear by RailAmerica upon its STS proposal, the President of the Chlorine Institute, Inc., possesses extensive qualifications as a rail tank car design and performance expert. Mr. Reiner presently serves on the AAR Tank Car Committee precisely because of his expertise in TIH tank cars. The Tank Car Committee is responsible for making design and performance recommendations to the DOT for incorporation into DOT safety regulations.

[5] Shefelbine Depo. Tr. at pp.69-73.

[6] Shefelbine Depo. Tr. at pp.53-55 and Exhibit 2 at p. 19.

As Mr. Reiner points out in his Verified Statement (Attachment C), when cars are operated in accordance with those regulations and in accordance with reasonable safety measures, they will not suffer catastrophic failures and releases. Further, Mr. Reiner also points out that there is no logical safety justification for reducing TIH train speeds to the levels reflected in the RailAmerica STS tariff provisions when FRA regulations otherwise permit higher speeds. In fact, he points out that having trains moving at different speeds on the same tracks can cause additional risk rather than reducing risks. This point was also made by RailAmerica subsidiary railroad employees in communications with RailAmerica management.[7] Mr. Reiner also points out that slow moving TIH trains may actually increase security risks. There is absolutely no analysis of this consideration anywhere in the RailAmerica pleadings or the discovery record herein.

III. ARGUMENT

RailAmerica has consistently attempted to make the facially implausible contention that its STS program is not designed to make profits, but merely to recover its costs of providing the service.[8] Whether or not that contention is credible, the issue here is not whether the charges imposed for services performed by RailAmerica's subsidiaries are justified by the cost of providing STS. The issue is whether the Special Train Services that RailAmerica's subsidiaries insist on performing can be justified without any real explanation as to why those services are necessary in the first place.

[7] Shefelbine Deposition, Exhibit 13.

[8] The Alabama Gulf Coast Railway, for example, publishes a rate of $15,000 per car for a 22 mile movement from Mobile to Saraland, Alabama, at the same 10 mph speed as its regular train service. Arguing that this is mere cost recovery is absurd.

There is no question that the DOT and TSA have comprehensive authority to establish all manner and means of performing TIH rail transportation services from tank car design and construction to and including rail operating speeds, practices and operations. RailAmerica has made no effort to petition those agencies for any modifications of any rules or regulations that it believes necessary to improve safety or security. The "safety" measures that RailAmerica would impose by tariff have been specifically and categorically rejected by the DOT and TSA. Certainly, safe operating speeds for all rail track segments and with respect to all commodities moving by rail are fundamental in DOT regulations. Car inspection and handling procedures are similarly specified by DOT. Security procedures for hand-off and transfer of custody of TIH cars are specifically set forth in TSA regulations. The DOT and TSA completely occupy the safety and security regulatory realms of rail transportation of TIH materials, including all aspects that RailAmerica purports to "enhance" through STS. Absent some compelling showing that local conditions require additional or different procedures there can be no justification for allowing RailAmerica to institute its own quasi-regulatory regime. RailAmerica has not made any such showing, or even attempted to do so.

The law governing this case is very clear. As the Court held in *Consolidated Rail Corp. v, I.C.C.*, 646 F.2d 642, 648 (1981):

> The safety measures for which expenditures are made must be reasonable ones, which means first, that they produce an expected benefit commensurate to their cost; and second, when compared with other possible safety measures, they represent an economical means of achieving the expected safety benefit.

The record in this case is equally clear: (1) RailAmerica performed no analysis as to what safety benefits could be expected from its STS measures; (2) although RailAmerica spent an extensive amount of effort to assess its costs of providing STS in order to determine what rates it should charge, RailAmerica did not perform any analysis as to whether the unidentified safety benefits of STS are commensurate with their cost; and (3) RailAmerica considered no other possible means of achieving those unidentified safety benefits through such means as upgrading their own track or making other safety improvements within their own system. The STS program is an unreasonable practice within the holding in *Consolidated Rail, supra,* and should be prohibited as such.

IV. CONCLUSION

In view of the foregoing, the Board should rule that the STS program of RailAmerica and its subsidiary carriers is an unreasonable practice and should be ceased immediately.

Respectfully submitted,

/s/ Paul M. Donovan
LaRoe, Winn, Moerman & Donovan
1250 Connecticut Ave. N.W.
Suite 200
Washington, DC 20036
Telephone: (202) 298-8100
Email: paul.donovan@laroelaw.com

Jeffrey O. Moreno
Thompson Hine LLP
1920 N Street, N.W. Suite 800
Washington, DC 20036
(202) 331-8800
Email: jeff.moreno@thompsonhine.com

Certificate of Service

I hereby certify that on this13th day of January 2012, a copy of the foregoing Opening Evidence and Argument on behalf of American Chemistry Council, Arkema, Inc, the Chlorine Institute, Inc., The Fertilizer Institute and PPG Industries, Inc. was served by electronic delivery on all parties of record in these proceedings.

/s/ Jeffrey O. Moreno

Attachment A

Deposition Transcript of James Shefelbine

HIGHLY CONFIDENTIAL

Attachment B

Deposition Transcript of Harry Shugart

HIGHLY CONFIDENTIAL

Attachment C

Verified Statement of Frank Reiner

BEFORE THE
SURFACE TRANSPORTATION BOARD

Finance Docket No. 35517

CF INDUSTRIES, INC. v. INDIANA & OHIO RAILWAY, POINT COMFORT AND NORTHERN RAILWAY, AND THE MICHIGAN SHORE RAILROAD– PETITION FOR DECLARATORY ORDER

VERIFIED STATEMENT OF FRANK REINER.

I. Qualifications

Current Position

I am currently President of the Chlorine Institute. Prior to that I was Vice President of Transportation and Emergency Preparedness. In both of these positions I served as the Chlorine Institute representative on the Association of American Railroads Tank Car Committee. This Committee has authority/responsibility delegated by DOT to review new tank car designs and to make recommendations to the department regarding packaging specifications.

Education

I hold a bachelor's degree in Civil Engineering with a structural concentration from the Illinois Institute of Technology and a Master's Degree in Management from Purdue University. I am a registered Professional Engineer in the State of Illinois.

Work Experience

I began work as a structural engineer with General Dynamics Electric Boat Division in 1983 and had assignments of increasing responsibility until leaving the company to accept a position at Union Tank Car Company in 1989. Union Tank Car is a railroad tank car manufacturing, leasing and repair company based in Chicago, IL. I worked as a Project Engineer with responsibility for structural analysis until 1993 at which time I was promoted to oversee the work of 5 engineers responsible for all new car builds. In 1997 I joined Trinity Industries as Director of Tank Car Development and Engineering Services. In 1998 I rejoined Union Tank Car as Chief Product Engineer which included responsibility for approximately 35 engineers, designers and draftsman. In 2001 I moved to Union Tank Car's Repair Group becoming Director of Shop Operations in 2002 which included operating responsibility for U.S. and Mexican repair facilities with approximately 1200 employees. In 2005 I joined the Chlorine Institute.

Tank Car Design Background

Since joining the rail transportation industry in 1989 I have been deeply immersed in tank car design. At Union Tank Car in the Project, Product and Chief Engineer positions I had ultimate responsibility for assuring the structural soundness of all designs. This included learning from service experience. As a large fleet owner and repair operation we were well positioned to observe the entire service life of the railcars. This provided me with significant opportunity for review of older designs and to develop a deep understanding of the service environment. In this role I was involved in industry task groups which oversaw the application of Damage Tolerance Analysis(DTA) to Tank Cars and was responsible for the DTA analysis of the Union Tank Car designs. At Trinity I had the opportunity to oversee those doing analysis not only on tank cars but also on other car types. The assignment at

Trinity helped me develop an even more complete understanding of the rail environment and its effect on different car types and details. At both Trinity and Union Tank I was an active participant on numerous industry design task groups. During my tenure in repair shop operations I had the opportunity to see failures of all types and to oversee the repair/modification process to remedy these failures. Since joining the Chlorine Institute I have been keenly involved in the various efforts to improve the design and performance of chlorine railcars. I served on the external advisory panel to the Dow/UP/UTC Next Generation Rail Tank Car Project. I have served as the lead shipper representative on the Advanced Tank Car Collaborative Research Program. These roles gave me first hand involvement with recent efforts to improve design performance.

Experience with Tank Car Failures and Investigations

During my many years of responsibility for the design of and/or repair of a large rail fleet and my significant involvement with industry committees I am not aware of any TIH rail incident involving a major release that was not the result of operational or railroad maintenance failure.

II. History

Since 2002 there have been 3 major TIH rail accidents that resulted in a significant quantity TIH release. In each of these cases the speeds in question were significantly above the 10 mph suggested by the RailAmerica SOP. In fact, in all three incidents, the trains were operating at speeds in excess of 40 mph Design requirements for pressure car heads include resistance to puncture at speed of impact significantly greater than 10 mph and we should understand that the impact speed is significantly below the derailment speed due to derailment dynamics which result in deceleration. This leads to the conclusion that the safety need for the RailAmerica SOP has no basis in fact - at least based on car design.

In both cases the accident occurred because of failure to follow DOT requirements and the most basic of safety procedures. It is not apparent how or why limiting the number of TIH cars transported in a consist will improve safety or security. Certainly this is not something that either DOT or TSA has identified as a factor to improve safety or security performance.

The third incident which involved an anhydrous ammonia car was caused by a rail failure. This rail failure is attributable to an inadequate track inspection regimen according to the NTSB. In response to the findings from that incident the FRA adopted enhanced requirements for track inspection plans.

Releases in all three of these incidents would have been averted if the operating railroads were in compliance with DOT regulations and sensible safety procedures. It is not clear what safety advantages would be gained from the SOP that has been outlined.

III. Regulatory Basis for Design

All tank cars built to transport regulated commodities including all Cl_2cars and other TIH cars are fully approved by AAR under authority delegated to it by DOT. All meet the packaging specification requirements developed through the FRA rulemaking process and codified in the DOT regulations. Further, all tank cars are operated under pervasive DOT and TSA regulations. All of these regulations are developed to set an acceptable standard for safety.

A process is in place for any interested party to petition the DOT to amend its regulations should an entity or member of the public have information which could so justify such a change. In fact the AAR Tank Car Committee is charged with making such recommendations if it finds such a change is advisable. DOT has well-established procedures to consider such proposals. RailAmerica has not sought any modifications in tank car design or any changes in operating regulations.

IV. Conclusion

Based on my experience and the historical record, TIH tank cars operated in a manner consistent with DOT/TSA regulations and in accordance with reasonable safety measures, will not suffer catastrophic failure. In fact, I am unaware of any such failure ever occurring, without a failure of the rail carrier to observe the regulations and the most basic safety precautions. It is not apparent to me how reducing operating speeds to the level RailAmerica proposes provides any real safety benefits and in fact may reduce safety by putting trains operating at different speeds on the same tracks. Some of the measures proposed or implemented by RailAmerica may in fact raise security concerns. While I am uncertain of the motivation for reducing speeds to 10 mph for TIH cars there is no logical safety justification based on the packaging design.

VERIFICATION

I, Frank Reiner, declare under penalty of perjury, that the foregoing statement is true and correct and that I am qualified and authorized to file this statement.

Executed: January 12, 2012

Frank Reiner

Frank Reiner

STB Finance Docket No. 35504

UNION PACIFIC R.R. – PETITION FOR DECLARATORY ORDER

OPENING EVIDENCE AND ARGUMENT
OF
NORFOLK SOUTHERN RAILWAY COMPANY

EXHIBIT 9

222823

BEFORE THE SURFACE TRANSPORTATION BOARD

Ex Parte No. 677 (Sub-No. 1)

**COMMON CARRIER OBLIGATION OF RAILROADS—
TRANSPORTATION OF HAZARDOUS MATERIALS**

**WRITTEN STATEMENT OF
THE DOW CHEMICAL COMPANY**

Pursuant to the Notice of Public Hearing ("Notice") of the Surface Transportation Board ("Board"), served June 4, 2008, as amended by the decisions of June 19 and 23, 2008, The Dow Chemical Company ("Dow") hereby submits its written statement on the common carrier obligation of railroads to transport hazardous materials Cindy Elliott, Dow's Global Supply Chain Sourcing Director, and Jeffrey Moreno, Dow's legal counsel, will present oral testimony at the hearing on July 22, 2008

I. IDENTITY AND INTEREST OF DOW.

Dow is a diversified chemical company that harnesses the power of science and technology to constantly improve what is essential to human progress Dow offers a broad range of innovative products and services to customers in more than 175 countries, helping them to provide everything from fresh water, food and pharmaceuticals to paints, packaging and personal care products In order to provide many of these essential products and services, Dow both produces and uses hazardous materials, including materials that are classified as toxic inhalation hazards, or "TIH" materials The broad range of products that Dow produces span virtually every industry, including railroads, and make possible approximately 90% of the goods people use every day

Precisely because many of the materials that it produces and uses every day are hazardous, Dow has developed a culture of safety and responsibility that pervades all of its activities. This culture has generated a long track record of innovation and investment to improve Dow's safety performance in the production, use and transportation of hazardous materials.

Dow recognizes the risks inherent in transporting hazardous materials and is continually designing and re-designing its supply chain to minimize those risks This includes efforts to reduce or eliminate the shipment of highly hazardous materials. However, it is not possible to eliminate the transportation of all hazardous materials. Currently, 20 percent of Dow's 2 2 million product shipments annually are regulated as hazardous materials or dangerous goods Dow's collaborative efforts with carriers across all transportation modes have achieved an incident-free rate of 99.97 percent and earned it award recognition from Norfolk Southern, CSX, Canadian Pacific, Canadian National and BNSF for leadership and performance in safety practices

Dow's major manufacturing sites in the United States are located in Texas, Louisiana, Michigan, California and West Virginia. These sites, and others around the country, are dependent upon railroads for the safe, secure and reliable transportation of raw materials and products. Dow's business model is built on the fact that rail transportation of hazardous materials represents the safest, most efficient, most economical and most socially acceptable way to transport large volumes of these materials long distances over land

Because rail is the most effective, lowest risk over land mode of transport for large volumes of hazardous materials over long distances, the common carrier obligation is integral to the safe transportation of hazardous materials Without the common carrier obligation, many in the rail industry have made it absolutely clear that they would not haul TIH materials at all, and might also refuse to haul other categories of hazardous material The consequences would compromise public safety and the overall public welfare because these hazardous materials either would move by a less safe mode or not at all

The Board recently held a hearing on the common carrier obligation on April 24-25 Although that hearing encompassed all aspects of the common carrier obligation, a large portion of the testimony focused on hazardous materials, and particularly TIH materials The railroad industry expressed concern that the common carrier obligation requires railroads to haul TIH materials that subject them to potentially "ruinous liability" for an accidental release The chemical industry emphasized the critical role of TIH materials in the daily lives of all Americans and the essential role of railroads in providing safe transportation of TIH materials

In response to that testimony, the Board scheduled this hearing to focus upon the liability issue raised by the railroads and the appropriate role of the Board to address that issue. In addition, the Board asked parties to discuss the efforts of other federal agencies to address the transportation of hazardous materials. The Board also asked parties to comment upon what constitutes a reasonable request for rail transportation of TIH materials, which is the only statutory qualification upon the common carrier obligation Finally, the Board has asked whether there are unique costs associated with the transportation of hazardous materials, and if so, how railroads recover those costs [1]

[1] Although the Board has posed this last question in the context of railroad costs, shippers also have extensive costs associated with hazardous materials transportation, which the Board should consider in this proceeding

Any action by the Board to narrow or eliminate the railroads' common carrier obligation to transport hazardous materials, or even just TIH materials, would have significant unintended safety consequences that are contrary to the public interest This concern is magnified by the limited scope of the Board's jurisdiction that renders the Board unable to address holistically both the economic and safety aspects of the liability issue Accordingly, Dow believes that the liability issue is best addressed by Congress, which is the only governmental body capable of balancing all of the multiple conflicting safety and economic concerns that are implicated by the liability issue.

II. THE BOARD'S JURISDICTION TO ADDRESS RAILROAD LIABILITY FOR HAZARDOUS MATERIALS TRANSPORTATION IS LIMITED.

Although the Board has jurisdiction to consider the liability issue raised by the rail industry, its options to address the issue are constrained in three significant ways. First, the approaches available to the Board are constrained by its limited jurisdiction Second, to the extent the Board acts within its jurisdiction, it must do so in a way that does not adversely impact the safety of transporting TIH materials Third, the Board must not act inconsistent with a recently enacted statute in which Congress expanded the liability of railroads for their own negligence

A. The Board's Role in Addressing the Liability Issue is Limited to Its Unreasonable Practice Jurisdiction.

Congress has granted the Board jurisdiction over "transportation by rail carrier" 49 U S C 10501(a)(1). That jurisdiction extends to "remedies with respect to rates, *classifications, rules. , practices, routes, services, and facilities of such carriers* " 49 U.S.C. 10501(b)(1). This jurisdiction covers the operations of rail carriers and the terms and conditions of carriage between carriers and shippers

There are essentially three approaches to address the railroad liability issue liability caps, insurance pools, and indemnification The first two approaches are clearly beyond the ability of the railroads, or the Board, to implement The Board's authority does not extend to third parties not engaged in transportation by rail carrier, such as the victims of a rail accident who would be affected by a liability cap. Nor is the Board authorized to preempt state laws governing tort liability or to create and administer insurance pools

The third approach, indemnification, may fall within the Board's authority under 49 U S C 10704 to review the reasonableness of railroad practices established pursuant to 49 U S C 10702 Thus, if a railroad were to publish a tariff provision that required a shipper to indemnify the railroad for damages caused by a release of TIH materials in a rail accident caused by the railroad's own negligence, the Board could determine whether that provision is reasonable. Even then, however, it is difficult to conceive of a circumstance in which the Board could approve a tariff indemnification provision without reaching beyond its jurisdiction and intruding upon the domain of state tort laws.

As a general matter, the law does not favor contract provisions that relieve a person from his own negligence. The Connecticut Supreme Court recently reviewed the reasons underlying this principal

> [E]xculpatory [contractual] provisions undermine the policy considerations governing our tort system "The fundamental policy purposes of the tort compensation system [are] compensation of innocent parties, shifting the loss to responsible parties or distributing it among appropriate entities, and deterrence of wrongful conduct . It is sometimes said that compensation for losses is the primary function of tort law [but it] is perhaps more accurate to describe the primary function as one of determining when compensation [is] required <u>An equally compelling function of the tort system is the prophylactic factor of preventing future harm The courts are concerned not only with compensation of the victim, but with admonition of the</u>

> wrongdoer " (Citations omitted, internal quotation marks omitted) *Lodge v Arett Sales Corp , 246 Conn 563, 578-79, 717 A 2d 215 (1998)*

Hanks v Powder Ridge Restaurant Corp , 885 A 2d 734, 742 (Conn 2005) [underline added]

Indemnification clauses are a form of exculpatory clause because they relieve the negligent actor of liability for its conduct Because a tariff indemnification provision would vitiate the prophylactic policy considerations underlying state law tort systems, such provisions would be unenforceable under most state laws.

An often cited case on the public policy enforceability of exculpatory clauses is *Tunkl v The Regents of the University of California*, 383 P 2d 441 (Cal 1963) After surveying various decisions from other states, the California Supreme Court noted that those decisions are uniform in one respect "The cases have consistently held that the exculpatory provision may stand only if it does not involve 'the public interest.'" *Id* at 443. The Court then proceeded to identify the following six factor test to determine whether a contract is affected with a public interest.

> [1] It concerns a business of a type generally thought suitable for public regulation. [2] The party seeking exculpation is engaged in performing a service of great importance to the public, which is often a matter of practical necessity for some members of the public. [3] The party holds himself out as willing to perform this service for any member of the public who seeks it, or at least for any member coming within certain established standards. [4] As a result of the essential nature of the service, in the economic setting of the transaction, the party invoking exculpation possesses a decisive advantage of bargaining strength against any member of the public who seeks his services [5] In exercising a superior bargaining power the party confronts the public with a standardized adhesion contract of exculpation, and makes no provision whereby a purchaser may pay additional reasonable fees and obtain protection against negligence [6] Finally, as a result of the transaction, the person or property of the purchaser is placed under the control of the seller, subject to the risk of carelessness by the seller or his agents

Id at 444-46 [footnotes omitted] Although it is not necessary to satisfy each and every factor to affect a contract with a public interest, *id* at 446, it is quite clear that common carrier transportation of TIH materials in fact does satisfy each factor Indeed, many states and the Restatement of Contracts have abridged this list by referring specifically to common carriers.[2]

Because indemnification clauses are exculpatory clauses that violate fundamental tort law principals within the jurisdiction of the states, they are beyond the Board's exclusive and preemptive jurisdiction under 49 U S C 10501(b) Indeed, to the extent that Congress has preempted state tort laws, it has done so in the Federal Rail Safety Act, at 49 U S C 20106, rather than the Interstate Commerce Act. Thus, a tariff indemnification provision would not be enforceable in most states

B. The Board May Not Exercise Its Jurisdiction In a Manner That Adversely Affects Safety.

The Sixth Circuit, in *Akron, Canton & Youngstown R R Co v ICC*, 611 F 2d 1162, 1170 (6th Cir 1979) ("*Akron*"), observed that, "[a] question of possible liability for damage resulting from carriage of a commodity is . within the Commission's jurisdiction as the regulator of the economics of interstate rail transport " *Akron*, 611 F 2d at 1170. But the court also noted that questions of safety and risk liability are closely related, that the Department of Transportation ("DOT") has exclusive authority to promulgate industry-wide safety standards; and that the ICC/STB may permit carriers to make more, but not less, stringent rules for their carriage of hazardous materials. *Id* Thus, it follows that the Board's economic jurisdiction over liability issues must not be exercised in a manner that adversely impacts safety.

[2] *See Hanks* at 743 (surveying state decisions applying variations on the *Tunkl* factors), Restatement 2d Contracts, § 195 ("A term exempting a party from tort liability for harm caused negligently is unenforceable on grounds of public policy if the term exempts one charged with a duty of public service from liability to one to whom that duty is owed for compensation for breach of that duty.")

Liability limits inherently affect safety in multiple ways. First, by absolving railroads of financial responsibility in whole or even in part for their own negligent acts, liability limits reduce incentives for safe behavior. The most serious rail accidents involving the release of TIH materials have occurred at Minot, ND, Macdona, TX, and Graniteville, SC The National Transportation Safety Board ("NTSB") attributed all three accidents to conditions that were within the control of the railroads.[3] If the railroads are not held responsible for their own deficiencies, their incentives to fix the problems and to implement preventative measures in the future are substantially lessened

Second, liability limits distort the economic incentives for investments in safety-related equipment and infrastructure The three accidents described above may have been avoided altogether, or the magnitude of damage may have been reduced, by such investments For example, the Graniteville accident occurred in "dark" (i e unsignaled) territory In signaled territory, the misaligned switch that caused the accident might have been detected and the train stopped before the collision with the second train In addition, the presence of double-shelf couplers on all cars in the train might have prevented one or more tank cars from being

[3] Derailment of Canadian Pacific Railway Freight train 292-16 and Subsequent Release of Anhydrous Ammonia Near Minot, North Dakota, January 18, 2002, NTSB/RAR04-01, PB 2004-916301, Notation 7461A (March 9, 2004) at vi, 32-33, 55-57, 68-69 (stating that the accident was caused by inadequate track inspection, which failed to identify failed track joints and noting that inadequate training and maintenance of training activity reports were contributing factors), Collision of Union Pacific Railroad Train MHOTU-23 with BNSF Railway Company Train MEAP-TUL-126-D with Subsequent Derailment and Hazardous Materials Release, Macdona, Texas, June 28, 2004, NTSB/RAR-06-03, PB2006-916303, Notation 765D (July 6, 2006) at vi, 16-18, 26-31, 36-43, 58-59 (finding that the accident was caused by the train crew's failure to follow a stop signal according to operational rules, the crew's lack of sleep and long duty tours, the conductor's alcohol consumption, the likelihood that the conductor slept for most of the train trip, and limbo time as it related to crew fatigue), Collision of Norfolk Southern Freight Train 192 with Standing Norfolk Southern Local Train P22 with Subsequent Hazardous Materials Release at Graniteville, South Carolina, January 6, 2005, NTSB/RAR-05/04, PB2005-916304, Notation 7710A (November 29, 2005)(finding that the accident was caused by the train crew's failure to reline a mainline after use leading to an unexpected diversion of train 192 where it struck P22 and derailed, also finding that the failure to reline may have been due to the crew's inattentiveness to the switch due to their attempt to secure the train before reaching hours-of service-limits, and the location and lack of visibility of the switch to the crew, also noting that if the conductor had followed operating rules and held a job briefing, the crew may have attended to the main line switch, which would have prevented the accident)

punctured in the derailment, thereby preventing the release of TIH material. Although safety investments may be costly, those costs are likely to be significantly less than the damages caused by an accidental release of TIH material Liability limits distort that cost-benefit analysis against such investments

Third, selective liability limits that apply only to railroads, and shift liability to shippers, may encourage shippers to shift more traffic to trucks because there would be no similar liability exposure with that mode This incentive would be especially strong if the shippers, themselves, are required to bear the liability risk for railroad negligence through indemnification provisions in rail tariffs. Since approximately four trucks are required to transport the same volume as a single rail car, any shift from rail to truck would have a cascading risk effect on both the transportation and loading/unloading of TIH materials. Furthermore, added truck volumes would compound practical concerns around highway congestion, accident prevention and a shortage of specialized tank trucks and drivers. This would be detrimental to the public need for the safe transport of TIH materials

The Board must account for these factors in deciding what, if any, action to take within its limited jurisdiction to address the liability issue Failure to do so could constitute unreasonable restrictions upon the common carrier obligation and an impermissible intrusion upon the safety jurisdiction of the Pipeline and Hazardous Materials Safety Administration ("PHMSA") and the Federal Railroad Administration ("FRA")

C. In Recent Legislation, Congress Expressed Its Intent That Railroads Be Liable for Their Negligence.

Recent Congressional action makes it clear that Congress intends for a railroad to be liable for its own negligence Congress passed and the President signed into law the Recommendations of the 9/11 Commission Act of 2007, Pub L. No 110-53, which amended 49

U.S.C 20106 so that the Federal Railroad Safety Act no longer preempts all state law negligence claims Accordingly, this legislation calls into question the legitimacy of any liability limitation the Board might consider.

Congress enacted this provision in response to several federal court decisions holding that state law tort claims for the accidental release of anhydrous ammonia, a TIH material, arising from a Canadian Pacific derailment near Minot, North Dakota, were completely preempted by the Federal Railroad Safety Act *E g*, *Lundeen v Canadian Pac Ry Co*, 447 F 3d 606 (8th Cir 2006) ("*Lundeen*"); *Mehl v Canadian Pac Ry*, 417 F Supp 2d 1104 (D.N.D 2006) The courts had held that preemption is complete not just when a railroad has complied with minimum federal safety regulations, but also even when it has not done so In amending Section 20106, Congress declared that state law causes of action are not preempted when a railroad has failed to comply with federal regulations or with the railroad's own standards created pursuant to federal regulation. 49 U S.C. 20106(b)(1) (2008) In a decision issued by the Eighth Circuit only last week, the Court vacated *Lundeen* based upon its determination that "[t]he statute's clear language indicates state law causes of action are no longer preempted under § 20106." *Lundeen v Canadian Pac Ry Co*, No 07-1656, slip op at 17-18 (July 2, 2008)

The link between this legislation and the Minot incident is explicit in the legislative history, which states that the retroactivity provision in subsection (b)(2) "applies to all pending State law causes of action arising from activities or events occurring on or after January 18, 2002, the date of the Minot, North Dakota derailment." H R. Rep. No. 110-259, 100th Cong 1st Sess. at 351 (2007) Thus, just last year, Congress enacted an express statutory provision to ensure that railroads are liable for damages resulting from accidents due to a railroad's own negligence, including accidents involving the release of TIH materials. This Board must not take any action that is inconsistent with Congress' intent.

III. WHAT IS A REASONABLE REQUEST FOR TRANSPORTATION OF TIH MATERIALS?

The Board has asked for comment on what constitutes a reasonable request for service involving the movement of TIH materials. The answer to that question is best informed by reviewing the origins and evolution of the common carrier obligation and applying those standards in the context of the overall public interest in the safe transportation of TIH materials This analysis reveals a heavy presumption of reasonableness that may only be rebutted in narrow and compelling circumstances that do not adversely affect rail safety The liability issue does not constitute such a compelling circumstance.

A. Public Needs Define the Boundaries of the Common Carrier Obligation.

The common carrier obligation, which is rooted in the English common law system, is older than railroading itself The American legal concept of common carriage for railroads has evolved from this common law into an explicit statutory framework that defines the common carrier obligation in terms of the public need for rail transportation

The common law duty of common carriage did not automatically extend to all goods and services Courts did not force a carrier to undertake the carriage of goods that it was unaccustomed to carrying *Akron*, 611 F 2d at 1166 ("It is true that common law carriers could pick and choose which goods they transport in common carriage.") However, once it was established that a carrier did hold itself out to transport certain goods, the duty to transport those goods upon reasonable request became part of its common carrier obligation

Although the United States began to regulate rail transportation via statute with the passage of the Act to Regulate Commerce in 1887, the common carrier obligation itself remained a derivative of common law for several more decades *See Missouri Pac Ry Co v Larabee Flour Mills Co*, 211 U.S 612 (1909) (noting that in the absence of a federal law addressing common carrier duties in interstate commerce, a state could enforce such a duty based on the common law) Under the common law, courts held that "[w]hile no one can be compelled to engage in the business of a common carrier, yet when he does so certain duties are imposed which can be enforced by mandamus or other suitable remedy " *Id* at 619

The Transportation Act of 1920 codified the common law obligations of railroads as common carriers *See American Trucking Association, Inc v Atchison, T & Santa Fe Ry Co*, 387 U S 397, 406 (1967) The Act also codified specific common carrier duties, including the provision of transportation upon reasonable request. This was the first statutory attempt to clearly delineate the common carrier obligation and to vest jurisdiction that had previously rested solely in the courts with the Interstate Commerce Commission ("ICC") [4]

The ICC and the courts have interpreted the 1920 Transportation Act and subsequent legislation to impose common carrier duties upon railroads beyond those that exist in the common law For example, although at common law only carriers who "held themselves out to the public" were common carriers, the Interstate Commerce Act defined common carrier as including railroads. *Akron*, 611 F 2d at 1166 Also, while the common law permitted common carriers to pick and choose the goods that they would transport in common carriage, railroads "whose property and facilities are affected with a public interest, (were) ordinarily held to be common carriers of goods delivered to them for transportation " *Id*, *quoting* 13 C.J.S Carriers § 6 This declaration of the common carrier status of railroads has been considered just

[4] Frank Cusham, *Manual of Transportation Law*, The Transportation Press, Dallas, TX, 1951 at 95

and reasonable "in view of the governmental largess which railroads have received, and in view of the unique importance to commerce of rail transportation "[5] *Id* [footnote omitted].

The *Akron* decision, at page 1168, succinctly summarizes the present state of the law

> [I]n the almost one hundred years since the passage of the Act there has developed a new "common" law of transportation under which the public duty of railroads has been broadened beyond that extant under the common law of carriers It is not only "common carriage," but transportation which is subject to the Act and to the Commission's statutory powers See, e.g., Cincinnati, N O & T P Ry v Chesapeake & O Ry, 441 F. 2d 483 (4th Cir 1971); Republic Carloading Co v Missouri Pacific R.R., 302 F. 2d 381 (8th Cir 1962) (per Blackmun, J.). *A carrier's statutory duties run not to shippers alone, but to the public* Brotherhood of Ry Clerks v Florida E C Ry, 384 U.S. 238, 86 S Ct. 1420, 16 L Ed 2d 501 (1966). *Therefore, public needs must shape the boundaries of these duties* [italics added]

Thus, railroads may no longer pick and choose the commodities that they haul, but instead are required to provide service for all commodities tendered upon reasonable request to fulfill the transportation needs of both shippers and the general public [6]

B. The Public Need for the Safe Transport of TIH Materials is Fundamental to Whether a Request for Rail Transportation is Reasonable.

As noted above, because the public need for rail transportation of TIH materials defines the boundaries of the common carrier obligation, *see Akron* at 1168, it is an essential factor in determining whether a request for rail transportation of TIH materials is reasonable The importance of TIH materials to the public health and welfare, particularly the importance for chlorine and anhydrous ammonia which represent the largest volume TIH materials, was

---

[5] Examples of such governmental largess include public land grants, loans and subsidies, antitrust exemptions, extensive preemption of state and local laws, eminent domain powers, more permissive merger review standards, and bottleneck franchise protections

[6] Although there are exceptions to the general statutory common carrier obligations of railroads, those exceptions are limited to a few clearly defined circumstances *Akron*, 611 F 2d at 1166-67 None of these circumstances are relevant to the common carrier obligation to transport TIH materials

repeated many times at the April 24-25 STB hearing on the common carrier obligation That testimony has left no doubt that there is a great public need for the safe transportation of TIH materials Furthermore, there is broad agreement among railroads and shippers, which is shared by both PHMSA and FRA, that rail transportation is the safest mode by which to transport TIH materials over land for long distances. 73 Fed Reg 17818, 17838 (April 1, 2008) This overriding public need, and the long history of railroads transporting TIH materials as common carriers, establishes a strong presumption of reasonableness for any request to transport TIH materials in compliance with applicable safety regulations. It is incumbent upon a railroad to rebut this strong presumption

The principal arguments against the reasonableness of a request to transport TIH materials relate to safety and liability. Both issues have been addressed in multiple federal court and ICC decisions Only in the most limited of circumstances may either of these issues render a request for transportation of TIH materials unreasonable

1. There is an overriding public interest in rail transportation of TIH materials that meet DOT safety standards.

Two lines of ICC decisions affirmed by the courts that involved the transportation of radioactive materials have rejected safety arguments as grounds to narrow the common carrier obligation when there is an important public need for rail transportation of a hazardous material. In both lines of cases, the overriding public interest in transporting the radioactive materials and the role of rail transportation as the safest mode has prevailed over all claims that such transportation is unsafe The courts, however, have provided guidance as to when railroads may impose more stringent safety requirements than those adopted by DOT, although no such requirements ever have been approved under those guidelines

The first line of safety cases held that a railroad may not ask the Board "to take cognizance of a claim that a commodity is absolutely too dangerous to transport, if there are DOT. regulations governing such transport, and these regulations have been met" *Akron*, 611 F 2d at 1169 *See also, U S Dept of Energy v The B & O R R Co*, 364 I C C 951, 959 (1981) ("*DOE*") There are extensive DOT regulations, promulgated by PHMSA and FRA, that govern the safe transportation of TIH materials by rail. Moreover, significant additional safety enhancing regulations either recently were adopted or are under consideration by PHMSA, FRA and TSA *See* Part IV, *infra* Also, just as with radioactive materials, "no other mode of transportation is more suited to the economical carriage of these materials than train carriage " *Akron* at 1168 [7] Thus, there can be no claim that TIH materials are too dangerous to transport; nor has the rail industry made such a claim.

The second line of safety cases held that "railroads may. seek to prove the reasonableness of additional safety measures, but the burden is upon them to show that, for some reason, the presumptively valid [DOT] regulations are unsatisfactory or inadequate in their particular circumstance" *Consolidated Rail Corp. v ICC*, 646 F 2d 642, 650 (D C Cir. 1981) ("*Conrail*"), *See also, DOE* at 959-60 In general, "(no) party has a right to insist upon a wasteful or excessive service for which the consumer must ultimately pay" *Conrail* at 647, *quoting Atchison Ry Co v U S*, 232 U S 199, 217 (1914). "The safety measures for which expenditures are made must be reasonable ones, which means first, that they produce an expected safety benefit commensurate to their cost, and second, that when compared with other possible safety measures, they represent an economical means of achieving the expected safety

[7] The ICC found that "truck shipments of nuclear wastes would, because of the greater number of smaller shipments required, increase the probability of accidents involving nuclear materials " *Id* The same would be true of TIH materials

benefit " *Id* at 648 Because DOT has paramount jurisdiction over rail safety matters, there is a rebuttable presumption "that expenditures for safety measures not specified by [it] are unnecessary and fail to satisfy the criteria of reasonableness. ." *Id.* at 650.

2. *Railroads are not entitled to special treatment for their liability risks just because they are obligated as common carriers to transport TIH materials in the public interest.*

In contrast to the safety issues, the liability issue has dominated the current discussion over when a request to transport TIH materials is reasonable. The railroad industry's principal concern is its potential liability exposure in the event of an accidental release of TIH materials. The industry contends that, because railroads have a common carrier obligation to handle TIH materials that is imposed upon them for the public interest, their liability should be limited This contention has raised the question whether a request for transportation of TIH materials without liability limits is reasonable What the rail industry seeks, however, is special treatment of a risk that is not unique to it. The mere fact that railroads are obliged to assume this risk by the common carrier obligation does not justify special treatment

In the absence of a Congressional determination to the contrary, the law actually disfavors liability limits upon common carriers precisely because they are vested with a public interest In particular, the strong public need for rail transportation of TIH materials that is a practical necessity for most TIH shippers, the relative bargaining strength of the railroads over TIH shippers, and the exclusive control exercised by railroads over TIH materials during transport fit squarely within the key factors that have prompted most states to void exculpatory clauses in contracts for one's own negligence *See* Part II A , *supra*, and the state law cases discussed therein Furthermore, as discussed in Part II.C., *supra*, Congress expressly amended 49 U S C 20106 to ensure that railroads would be liable for their actions under state tort laws.

In addition, although the liability issue poses economic questions that are within the Board's jurisdiction to decide, it cannot be divorced from the safety issues, which are within the jurisdiction of DOT *Akron* at 1170 ("Questions of safety are also questions of risk liability ") Consequently, the Board must be cognizant of the safety implications of any action it takes within its economic jurisdiction to address railroad liability. Thus, the Board cannot limit the railroads' liability for their own negligence through caps or indemnification, since doing so would undermine their incentives to provide service in the safest manner possible, or would cause shippers to shift to other, potentially higher risk, transportation modes. *See* Part II B , *supra*. To the extent the Board's actions adversely affect the safety of TIH transportation, those actions would constitute an unreasonable restriction upon the common carrier obligation

3. TIH liability risks are not unique to the rail industry.

But, even before considering these other issues, the Board first must critically scrutinize the reasonableness of railroad claims that, but for the common carrier obligation, they would not haul TIH materials because of their liability exposure. The reasonableness of those claims must be established before they can form a basis for questioning the reasonableness of a request for TIH transportation

History demonstrates that railroads voluntarily chose to transport TIH materials For nearly 100 years, railroads have continuously competed for business hauling TIH materials for their financial gain This competition was open, and pitted railroads against one another and other modes of transport The railroads cannot re-write this history to evade the obvious Having chosen to compete for and transport TIH materials as common carriers, the railroads cannot now abdicate their responsibility to transport TIH materials in light of the strong public need for such transport.[8]

Although the rail industry claims that times have changed, the common carrier obligation does not permit the *a la carte* selection of commodities based upon the convenience to each railroad at any particular point in time. Moreover, the changed circumstances alleged by the rail industry implicate broader tort reform issues, which are not unique to railroads and have imposed greater liability risks upon all industries. This is a subject that only Congress can address through more comprehensive reforms well beyond just the rail industry

In addition, because railroads are the only entity in the TIH supply chain of producers, consumers, and transporters who claim that TIH materials are too risky, their claims of unfairness lack credibility. Most notable is the fact that trucking firms choose to transport TIH commodities without liability limits Accordingly, railroad claims that the common carrier obligation is unfair to them without liability limits do not seem reasonable when no other TIH industry participant with similar liability risks has made such claims. Moreover, railroad claims that TIH liability imperils their ability to obtain investor capital in the financial markets is belied both by the strong financial performance of the rail industry without liability limits and by the ability of other industries with similar risks to raise capital.

Finally, unlike the trucking industry, where if one trucker does not want to transport a product, another trucker can readily serve the shipper, there are substantial barriers to entry in the rail industry. If one railroad decides that it does not want to transport TIH materials, there is no alternative that would be equally as safe, and in some cases no alternative at all But for these barriers, the rail industry would not be in a position to argue for special treatment of its liability

[8] *Cf Akron*, 611 F 2d at 1167 ("[I]t is the long history of the present petitioners' carriage of nuclear materials, and the continuing national need for such carriage, which takes the petitioners' transport of nuclear materials from the realm of 'accommodation or special engagement' where the Act's ratemaking provisions do not apply ")

risks when transporting TIH materials. Indeed, it is the common carrier obligation itself that ensures that TIH materials are transported by the safest mode possible, because it guarantees that rail transportation is always available, despite the railroad market power created by barriers to entry. By imposing liability limits as part of a reasonable request for rail transportation of TIH materials, the Board would improperly abet railroad attempts to use the market advantage provided to them by high barriers to entry to abdicate their liability risks,.

IV. REGULATORY AND PRIVATE INITIATIVES TO ENHANCE HAZARDOUS MATERIAL TRANSPORTATION SAFETY.

The transportation of hazardous materials has never been safer and there are extensive regulatory and private initiatives underway to further enhance safety and reduce risk PHMSA and FRA are the two federal agencies with paramount jurisdiction over rail safety matters In addition, the Transportation Security Administration ("TSA") has jurisdiction over rail transportation security. All three agencies either have concluded or are currently conducting rulemakings directed to the safety and security of transporting hazardous materials by rail. Moreover, Dow has engaged in multiple collaborative agreements with railroads, tank car builders, and government entities to increase safety and reduce risks. Finally, in the case of terrorist acts, Congress has enacted a law that would provide liability limits for the rail industry.

A. Regulatory Initiatives.

1. Routing Rules.

PHMSA and FRA have promulgated interim final rules that incorporate the Recommendations of the 9/11 Commission Act of 2007 (Pub. L. 110-53) regarding safety and security measures for the transport of hazardous materials by rail 73 Fed Reg 20752 (April 16, 2008) The rule revises the Hazardous Materials Regulations ("HMR") to require carriers to compile data regarding hazardous commodities transported and routing for such commodities

The carriers then are required to utilize the accumulated data to assess potential safety and security risks and to propose additional alternative routing that is economically practical Such analysis must be conducted annually and carriers must complete a comprehensive review of all operational changes, infrastructure modifications, traffic adjustments, or other changes within five years The rule also addresses transportation delays and interim storage safety concerns and requires pre-transportation security inspections All of these measures are directed towards reducing transportation risks

2. Tank Car Standards.

PHMSA and FRA recently issued a Notice of Proposed Rule Making that proposes new tank car safety standards to address tank car structural integrity in the wake of the Minot, Macdona, and Graniteville accidents 73 Fed Reg 17817 (April 1, 2008) The rules create new requirements for tank car construction that increases puncture resistance on tank car shells and heads while increasing the maximum allowable weight for tank cars to accommodate the increased weight imposed by the new construction requirements The proposed rules also set the maximum speed for trains carrying TIH materials at 50 miles per hour, and further restricted to 30 miles per hour in non-signaled territory for trains carrying TIH materials in tank cars that do not meet the new standards. These measures are designed to make tank cars safer by reducing the risk of a TIH release in the event an accident occurs

3. Human Factor Rules.

FRA recently amended its railroad operating rules and practices to address the problem of human error as a primary factor in railroad accidents 73 Fed Reg 8442 (February 13, 2008) The rules require railroads to qualify testing officers who will be charged with conducting safety tests and inspections. They also require railroads to conduct at least a minimum number of tests per year and require a qualified inspector to conduct quarterly reviews to determine trends regarding the rules most often violated as well as relationships between rules that have been violated and accidents or incidents. The rules also allow employees to make good faith challenges when requested to perform actions that violate operating rules and require enhanced communication in the form of pre-work job briefings prior to engaging in certain tasks such as pushing and shoving and hand operated cross over switches.

4. Track Safety Standards.

FRA has revised its track safety standards in response to several accidents, including derailments on the Canadian Pacific in Minot, ND, and the Union Pacific in Rico Rivera, CA, where rail joint failure was a key contributing factor. 71 Fed. Reg. 59677 (Oct 11, 2006). The rules address the inspection and maintenance of continuous welded rail ("CWR") They focus on CWR joints and require track owners to address CWR joints in their CWR plans, or alternatively, to inspect CWR joints at minimum intervals based on class of track, annual tonnage, and passenger/freight carriage. The rules also require FRA reporting when a cracked CWR joint is found during an inspection and they establish preventative measures to prevent CWR joint cracking by utilizing inspection to determine CWR failures based upon an FRA list of conditions In addition, FRA's Office of Research and Development is funding research to develop an automated vehicle-mounted visual imaging system to conduct CWR joint inspections in the future

5. TSA Rail Security Rulemaking.

TSA has proposed rules to address the security risks associated with the shipment of TIH materials 71 Fed. Reg 76852 (Dec 21, 2006) The rules augment and compliment PHMSA's regulatory regime by expanding inspection to require hazardous materials shippers to conduct inspections prior to tendering a shipment to the carrier. The rules also provide chain of custody requirements, which include monitored and protected transfer locations and documented transfers for TIH shipments Similarly, the rules require location reporting in high threat urban areas ("HTUAs") to allow for quick response in the event that an incident occurs. The rules also will require shippers, carriers, receivers, and transit systems to appoint a Rail Security Coordinator to interface with TSA regarding security issues Finally, they instill reporting requirements where carriers, receivers, and shippers must report threats, incidents, and suspicious activities to the Department of Homeland Security.

B. Dow Individual and Joint Safety Initiatives.

In addition to the minimum measures required by federal regulations for the safe transport of hazardous materials by rail, Dow is proactively engaged in multiple projects, both on its own and with various stakeholders in hazardous materials transportation, including railroads, tank car builders, and the local communities through which Dow's hazardous materials are transported, to enhance safety and reduce risks.

Under the umbrella of Responsible Care®, the chemical industry and its supply chain partners have worked successfully for many years to improve the safety of hazardous materials transportation. Dow also has joined with its largest rail service provider, Union Pacific ("UP"), to improve rail safety and security This initiative focuses upon eight areas (1) supply chain redesign, (2) next generation rail tank car design; (3) improved shipment visibility, (4) a strengthened commitment to TRANSCAER®; (5) improved rail operations safety and accident prevention, (6) hazardous materials routing, (7) deployment of communication-based train control/anti-collision systems; and (8) elimination of Non-Accidental Releases

Dow's various joint and individual initiatives reflect its comprehensive transportation risk management framework. In general, *hazardous material transportation risk is a function of the probability of an event occurring and the potential consequences of the event should it occur.* By addressing these two primary factors, Dow is contributing to enhanced safety and reducing the overall risk of an accidental release, as well as the magnitude of harm in the event a release does occur

When this risk relationship is broken into smaller pieces, the probability of an event occurring is largely a function of three factors. (1) the number of trips and the miles traveled per trip, (2) the accident frequency rate along the route of travel, and (3) the probability of release should an accident occur

The number of trips and the miles traveled per trip can be affected by shipper sourcing decisions. Longer term, this may involve consideration of opportunities for co-location of production and consuming facilities, where practical In addition, railroad routing decisions also affect miles traveled Dow is addressing these issues in the context of its own supply chain redesign initiative Furthermore, where practical, Dow is evaluating ways to convert highly hazardous products to less hazardous derivatives before shipping Dow's overall objective is to reduce the shipment of highly hazardous materials by 50 percent from 2005 levels by 2015 As an example of Dow's historical success in this area, the company has reduced chlorine shipments by 80 percent since 1999

The accident frequency rate along the route of travel most commonly is a function of human factors and infrastructure This is largely an area that only the railroads themselves can address In addition, the FRA rulemakings discussed above are intended to address these factors.

The probability of release should an accident occur is a function of the rail tank car design and the operating conditions surrounding the event Shippers can impact this probability by improving rail tank car designs and railroads can do so through operating practices, such as train speed, train configuration and tank car placement. Dow, in cooperation with UP and Union Tank Car Company, is addressing these factors within the context of the Next Generation Rail Tank Car Project Their highest priority is to design and implement a "breakthrough" next generation rail tank car for TIH materials that achieves a step change improvement in crashworthiness over existing cars. Drawing on the results of this Project, tank car builders will be designing, building and testing new prototype cars in the coming months. The results of this Project have been, and will continue to be, shared with FRA as it considers new tank car standards To date, Dow has spent nearly $7 5 million on this Project and expects to spend over $160 million to upgrade its TIH tank car fleet with these new design concepts and technologies

The consequence component of the risk framework is a function of the area potentially impacted and the population potentially exposed in that area. The potential impact area is affected by multiple factors, including the characteristics of the hazardous material, the temperature and pressure of the material inside the container, the possibility of auto-refrigeration, and the size of the shipping container The potential population exposure is affected by routing decisions and by working with local officials to ensure effective emergency preparedness and response plans are in place Dow is addressing these factors through its efforts to improve shipment visibility and its commitment to TRANSCAER®

Dow has improved shipment visibility by installing GPS and sensor technologies on its fleet of TIH tank cars at a capital cost of $1 2 million and an annual operating cost of $250,000 This technology enables Dow to know both the location and condition of its tank cars, so that emergency responders have the information they need when they need it. This will augment information that already is available to responders through CHEMTREC® and the railroads.

Dow and UP founded TRANSCAER® in 1986 to provide community awareness and emergency responder training so that communities are better prepared for potential chemical transportation emergencies. Through a strengthened commitment to TRANSCAER®, Dow is in the midst of a 6 year effort, in collaboration with its railroad carriers, to provide enhanced emergency responder training for the communities along railroad transportation routes for highly hazardous materials. The cost of this program to Dow averages $500,000 annually plus the cost of additional special events. Dow also is collaborating on research into new sensor technologies to provide early warning of a leak, and the potential for self-sealing technologies that would limit the amount of material released during an incident.

Safe transportation of hazardous materials requires a safe and reliable rail transportation system. That, in turn, requires cooperation among shippers, railroads, rail car builders, and regulators. As the leading chemical manufacturer in the United States, Dow strives for continuous improvement in the safe production, transportation and use of its products. Dow is committed to working in partnership with the rail industry, first, to prevent accidents, and second, to mitigate any potential harm that may be caused by any accidents that may occur. In Dow's safety culture, our commitment is to achieve a safety performance of zero accidents, zero releases, and zero harm to employees, the public and the environment.

C. Statutory Liability Limits for Terrorist Acts.

In the Support Anti-terrorism by Fostering Effective Technologies ("SAFETY") Act of 2002, Congress enacted a law that could extend liability limits to railroads for terrorist acts. This law, which was enacted as part of the Homeland Security Act of 2002 (Title VIII, Subtitle G), would eliminate or minimize tort liability for a railroad which obtained certification or designation for anti-terror technologies, including products and services, if tort suits were ever filed against them following an act of terrorism. The SAFETY Act was drafted to stimulate the development and deployment of technologies that combat terrorism and encourage preparedness that could mitigate harms resulting from malicious acts. In exchange for a company implementing an effective program to defend against or respond to or recover from a terrorist act, the company could be awarded with limitation of liability under the SAFETY Act

A railroad can submit its anti-terrorism plans to the Department of Homeland Security ("DHS") for a SAFETY Act award If designation or certification is granted, the railroad is entitled to the benefit of liability limits determined by DHS, provided it also maintains the minimum insurance required by DHS Typically, DHS has established the liability cap at the required minimum insurance level Despite the availability of this program for several years, to Dow's knowledge, no railroad has applied for its protection Dow has obtained an award under the SAFETY Act for its site security services at several of its chemical manufacturing facilities.

Because a Congressionally-enacted program establishing liability limits for terrorist acts already is in place, no action to limit railroad liability for terrorist acts is necessary or appropriate.

V. A PRICE-ANDERSON MODEL MUST CAREFULLY BALANCE LIABILITY, SAFETY, AND COMPENSATION ISSUES.

The Board has shown particular interest in the Price-Anderson Act of 1957 ("PAA") as a model for addressing the railroads' liability concerns. Although there may be arguable merits to adopting a PAA model for TIH liability, any such model would have to be adopted by Congress after carefully analyzing the risks and benefits and weighing competing public policy considerations Furthermore, the PAA, which applies to the nuclear power industry, is not easily adapted to the railroad industry due to significant differences between the two industries and the Congressional objectives underlying the PAA Although the rail industry has advocated a PAA-model, its only proposal to date lacked most of the essential features of the PAA that are needed to balance liability, safety, and compensation issues

A. A Price-Anderson Model Would Be Very Difficult To Adapt To The Railroad Industry.

Under the PAA, as amended, nuclear reactor licensees are required to obtain the maximum amount of private insurance available to them, which the Nuclear Regulatory Commission ("NRC") has determined to be $300 million at present 10 C F R 140 10 If the financial damages from a nuclear incident exceed this private insurance coverage, all nuclear reactor licensees, after an accident, must contribute proportionately up to $100.6 million per reactor per incident into a secondary insurance fund *Id* Total liability for a nuclear incident is capped at the sum of these two insurance pools, which currently is over $10 billion Although both insurance pools are funded only by reactor licensees, the proceeds cover the liability of all entities associated with the nuclear industry, from reactor designers and parts manufacturers to the transporters of radioactive waste.

Congress had two main objectives when it adopted the PAA To ensure that the public would be compensated if an accident occurred at a nuclear facility, and to set a limit on the liability of private industry to remove a major deterrent to private participation in the development of nuclear energy S Rep No 99-310, 99th Cong , 2d Sess. 3 (1986) Congress had opened up the nuclear industry to the private sector in the Atomic Energy Act of 1954, but, there was little interest due to liability concerns in the event of a reactor meltdown, S Rep No 296, 85 Cong., 1st Sess , 2 U S.C.C.A.N 1803-04, and the unavailability of substantial private insurance (approximately $60 million in 1957), *id* at 1808

Because Congress designed the PAA to cover the entire nuclear industry, rather than a single participant, a true PAA-based model for TIH liability would cover the activities of all participants in the TIH industry, not just the railroads This would include, at a minimum, the activities of TIH producers, consumers, tank car manufacturers, and all transporters.[9] However, the entire TIH industry is not threatening a mass market exodus due to liability risks, not even other TIH transporters Accordingly, serious questions exist as to whether the rail industry's liability risks are so different as to warrant special legislation for only its benefit

A PAA-model for the rail industry would impose most, if not all, of the costs upon the railroads themselves. Although the PAA only requires reactor licensees to contribute to the insurance pools that cover all nuclear industry participants, a reactor licensee, as the operator of a nuclear reactor, is the single entity most likely to be in control over the most serious and costly nuclear incidents Indeed, the legislative history to the PAA indicates that Congress was most concerned with damages caused by the operation of nuclear reactors.[10] When Congress extended the PAA's protection to third parties, it had in mind isolated situations such as the negligent maintenance of an airplane engine that caused the plane to crash into a reactor.[11] The extension of protection to carriers, such as railroads, was made with the expectation that a reactor licensee

[9] Unless all transporters of TIH material are covered by a PAA model, a railroad-only liability cap and insurance pool would encourage shippers to favor other, less safe, modes that are not subject to caps or indemnification

[10] 2 U S C C A N at 1803 ("[T]he problem of possible liability in connection with the operation of reactors is a major deterrent to further industrial participation in the program "), 1804 ("the companies which are interested in participating in the reactor program are hesitant about assuming the liabilities which could ensue in the remote event of a reactor meltdown"), 1807 (Congress requested a study "of the possible effects of a runaway reactor "), 1810 ("If a runaway reactor should cause any further damages beyond [the coverage provided by the PAA], the way was left open for Federal contributions "), 1813 ("Congress should not only try to give financial protection to innocent members of the public who might suffer in the unexpected case of a runaway reactor, but should also provide all possible statutory requirements for assuring that reactors should be as safe as possible ")

[11] *Id.* at 1818

would "see that appropriate safety measures are taken during the shipment."[12] Thus, Congress gave substantial consideration in the PAA to keeping liability with the entity able to exercise the most control over safe operations. This would be a particularly important factor in a PAA model for railroad liability, since all three of the most costly TIH releases during rail transport have been attributed to conditions within the control of the railroads.[13]

A PAA model for railroad liability also would require each railroad to purchase the full amount of private insurance coverage available to it. This requirement ensures that the railroads retain liability, and thus their safety incentives, to the maximum extent insurable. Whereas, the nuclear industry has access to only $300 million in private insurance, it is generally believed that the rail industry has access to over $1 billion.

Furthermore, a PAA model would require each railroad to contribute to a secondary insurance pool to the maximum extent of its ability, without jeopardizing its rail investment and subjecting stockholders, bond holders, and rate payers to unreasonably high financial risk. These are the same factors that Congress considered when it determined that reactor licensees should contribute $100.6 million each to the PAA's secondary insurance fund. H.R. Rep. 99-310, 99th Cong. 2d Sess. at 8 (1986). This requirement further reinforces the safety incentives of the rail industry to the maximum extent, but without causing financial ruin because the greatest liability risks are spread across all railroads.

There is a fundamental difference, however, between the nuclear and railroad industries that could require grossly inequitable changes in a PAA model for railroad liability. Due to the substantially smaller number of Class I railroads (7) compared to reactor licensees (104), and the

[12] *Id.* Another reason for extending coverage to all persons under a single policy was to parallel the policies at the request of the insurance companies, which wanted to avoid pyramiding of insurance at a reactor that could result from designers, owners, contractors, and other parties taking out separate insurance policies. *Id.* at 1818-19.

[13] *See* note 3, *supra*.

smaller financial resources of Class II and III railroads, individual railroad contributions to a secondary insurance fund would be much greater Depending upon the desired amount of total coverage, additional contributors could be needed to fund a sizeable secondary insurance pool As the most obvious potential source of additional funding, the small number of TIH shippers would not significantly expand the size of this pool Moreover, it would be inconsistent with a PAA model, and fundamentally unfair, to require TIH shippers to fund the secondary pool without also expanding the liability caps and insurance coverage to their operations Although expanding the pool to all hazardous materials shippers might provide a critical mass of contributors, all hazardous materials do not pose the same risks or have the same potential to cause damages beyond private insurance coverage limits. Thus, a policy decision would have to be made to require hazardous materials shippers to subsidize an insurance pool that would never benefit them

Finally, any practical PAA-based model for railroad liability will be more difficult to administer than the PAA itself The NRC can easily enforce the PAA through its licensing of nuclear reactors In addition, the NRC only collects the secondary insurance pool after an accident where damages exceed private insurance coverage, which has never occurred A railroad insurance pool, however, would need to collect funds from potentially thousands of shippers, possibly on a per shipment basis, before a TIH incident to ensure their prompt availability Furthermore, another governmental entity would have to be created to manage the collection, maintenance, and disbursement of funds

Although one justification for a PAA-model for TIH liability might be to ensure that the public will be compensated if an accident occurs, determining whether a PAA model is the best means to address this issue requires a thorough analysis of the potential costs of a TIH release during transportation, the probability of such a scenario, the available insurance protection, and the railroad industry's capacity to make up the difference Furthermore, these questions must be evaluated in the context of all participants in the TIH supply chain — since it may be necessary to include them within the scope of any PAA liability model. The costs and benefits of creating and administering such a complex model for a catastrophic event that may never occur must be weighed against other, *ad hoc*, alternatives

Finally, because the PAA model presents potential trade-offs between accident prevention, damage mitigation, and compensation, there must be a complete and careful assessment of multiple economic and safety issues Such issues should only be addressed by Congress, just as it did in the PAA.

B. The Only Price-Anderson Model Proposed By The Rail Industry Failed To Balance Liability, Safety, and Compensation Issues.

Approximately one year ago, the AAR circulated draft legislative language that purported to adopt a PAA-based liability model for the TIH industry That proposal, however, lacked many key features of the PAA that are essential to balancing the liability, safety and compensation issues. The AAR proposal was unacceptable because:

1 Railroads were required to maintain only $300 million of private insurance to cover their own negligence, even though they have access to over $1 billion of private insurance

2 Railroads were not required to contribute at all to the secondary insurance pool, much less assume joint liability for any damages in excess of private insurance coverage Although the AAR proposal established a $5 billion liability cap, the negligent railroad's portion would only be $300 million, or just 6% of the total damages permitted by the overall liability cap.

3. Under the AAR proposal, each railroad was responsible only for its own negligence, while all shippers were held jointly liable for the balance, which would be 94% of all liability under the cap A PAA model does not impose liability upon utility ratepayers, who have no control over the safety practices of nuclear reactor operators. Similarly, it is inappropriate to shift liability for the secondary insurance pool to railroad customers, which have no control over railroad safety practices

4. Despite placing 94% of a potential $5 billion liability upon shippers and receivers, there was no liability protection extended to shippers for their own activities beyond rail transportation

5. The AAR proposal required shippers and receivers of all hazardous materials, not just TIH materials, to contribute to a secondary insurance pool, although most hazardous materials do not pose the same risks or have the same potential to cause damages beyond the private insurance coverage limits

6. The AAR proposal failed to address many questions concerning its application to third parties which have not contributed to the secondary fund, but may be at fault, such as tank car manufacturers and rail car repair facilities

In summary, the AAR proposal focused solely upon minimizing railroad liability to the greatest extent possible by shifting that liability to non-negligent third parties who would have no control over railroad operations and who would receive little or no benefit from the liability caps or the insurance pools. This legislation would have been both substantially inequitable and tremendously detrimental to the safe transportation of TIH materials Despite AAR's claims, these features are the anti-thesis of a Price-Anderson model.

VI. ANY REVISION TO THE CURRENT LIABILITY REGIME MUST BE CAREFULLY CONSIDERED.

The current liability regime for damages caused by the release of TIH materials is based upon fault, *e g* negligence This regime establishes a standard of care and assigns liability for damages caused by a breach of that standard to the party or parties at fault For the rail industry, federal safety standards adopted by DOT establish the proper standard of care. Congress has determined that, if a railroad breaches that standard, it should be responsible for the damages caused by its negligence 49 U S C 20106(b)(1). Conversely, however, if a railroad has an accident despite meeting that standard of care, a state law tort action would be preempted. *Crabbe v Norfolk Southern*, 2007 U.S. Dist LEXIS 8095 (E D. Mich 2007) (preemption still applied where plaintiff did not allege a failure to follow federal regulation). Thus, Congress already has established an artificial liability limit that would not apply in the absence of federal preemption Any alteration to this regime must not be made lightly, or hastily

Furthermore, changes to the liability regime require a holistic assessment of economic and safety issues that only Congress can and should make. The issues and potential solutions are difficult, complex and controversial The Board, to which Congress has assigned responsibility for only a portion of these issues, cannot fairly and holistically make the necessary judgments

Finally, any policy solution to the liability issue, if ultimately deemed necessary and desirable, and whether adopted by the Board or Congress, should adhere to certain basic principals First, any solution must continue to assign liability to the responsible party to the maximum extent practicable without causing financial ruin This means requiring the responsible actors to secure the maximum insurance coverage available to them, and ensuring that they are major contributors to any secondary insurance pools Second, the application of a liability limit, whether through caps or indemnification, must be contingent upon measurable demonstrations of a railroad's commitment to safety Potential measures include a commitment to continuous improvement in safety practices and performance through participation in collaborative industry safety programs such as the Responsible Care® Partner Program and the national TRANSCAER® community emergency response training initiative, compliance with DOT safety regulations, and a strong record of excellent safety performance These principals would provide the limits sought by the railroads while mitigating the adverse safety impacts of those limits

VII. CONCLUSION.

The Board should refrain from taking any steps to address the liability issue at this time for four basic reasons

First, the railroads are unable to demonstrate that there is a need for any action that affords them special treatment In particular, the current balance of responsibilities and liabilities involved in the transport of TIH materials works well. Importantly, railroads have an excellent overall safety record for transporting hazardous materials that has improved dramatically over the past thirty years under the current fault-based liability regime. Any change to the incentives could have significant – and disastrous – consequences for the public health and safety

Second, the purported need for relief is highly suspect when the Board considers that railroads are the only entities in the TIH supply chain raising liability concerns even though they are not the only entities at risk from an accidental release. This includes the trucking industry that would likely bear the load of changes in shipping patterns attendant to liability limits for railroads In addition, the issues raised are not unique to railroads, but rather are more reflective of concerns with our tort system in general

Third, the railroads have engaged in extensive cooperation with shippers, tank car manufacturers, and other TIH stakeholders to improve safety and reduce risk through research and training and the implementation of voluntary measures Changes in the liability allocations that could impact such cooperation would be contrary to the public interest

Fourth, the federal agencies responsible for setting rail safety and security standards, FRA, PHMSA and TSA, are adopting even more stringent standards that need to be given a chance to demonstrate that they will reduce risk. A rush by the Board now to impose, or even advocate to Congress, liability limits for railroads will risk undermining these efforts

Respectfully submitted,

Jeffrey O. Moreno
Jennifer A Gartlan
Thompson Hine LLP
1920 N Street, NW
Washington, DC 20036
202-263-4107

Counsel for The Dow Chemical Company

STB Finance Docket No. 35504

UNION PACIFIC R.R. – PETITION FOR DECLARATORY ORDER

OPENING EVIDENCE AND ARGUMENT
OF
NORFOLK SOUTHERN RAILWAY COMPANY

EXHIBIT 10

BEFORE THE

SURFACE TRANSPORTATION BOARD

223337

Ex Parte No. 677 (Sub-No. 1)
COMMON CARRIER OBLIGATION OF RAILROADS—
TRANSPORTATION OF HAZARDOUS MATERIALS

SUPPLEMENTAL COMMENTS

of

AGRICULTURAL RETAILERS ASSOCIATION, THE AMERICAN CHEMISTRY COUNCIL, CF INDUSTRIES, INC., THE CHLORINE INSTITUTE, THE DOW CHEMICAL COMPANY, EDISON ELECTRIC INSTITUTE, E.I. DU PONT DE NEMOURS AND COMPANY, THE FERTILIZER INSTITUTE, ILLINOIS FERTILIZER & CHEMICAL ASSOCIATION, THE MCGREGOR COMPANY, NATIONAL GRAIN AND FEED ASSOCIATION, THE NATIONAL INDUSTRIAL TRANSPORTATION LEAGUE, OCCIDENTAL CHEMICAL CORPORATION, OLIN CORPORATION, PPG INDUSTRIES, INC., TERRA INDUSTRIES, INC. AND WESTLAKE CHEMICAL CORPORATION

August 21, 2008

TABLE OF CONTENTS

PAGE

BEFORE THE

SURFACE TRANSPORTATION BOARD

Ex Parte No. 677 (Sub-No. 1)
COMMON CARRIER OBLIGATION OF RAILROADS—TRANSPORTATION OF HAZARDOUS MATERIALS

SUPPLEMENTAL COMMENTS

of

AGRICULTURAL RETAILERS ASSOCIATION, THE AMERICAN CHEMISTRY COUNCIL, CF INDUSTRIES, INC., THE CHLORINE INSTITUTE, THE DOW CHEMICAL COMPANY, EDISON ELECTRIC INSTITUTE, E.I. DU PONT DE NEMOURS AND COMPANY, THE FERTILIZER INSTITUTE, ILLINOIS FERTILIZER & CHEMICAL ASSOCIATION, THE MCGREGOR COMPANY, NATIONAL GRAIN AND FEED ASSOCIATION, THE NATIONAL INDUSTRIAL TRANSPORTATION LEAGUE, OCCIDENTAL CHEMICAL CORPORATION, OLIN CORPORATION, PPG INDUSTRIES, INC., TERRA INDUSTRIES, INC. AND WESTLAKE CHEMICAL CORPORATION

I. INTRODUCTION

The Surface Transportation Board ("STB" or "Board") held a public hearing on the common carrier obligation of railroads to transport hazardous materials on July 22, 2008. All of the shippers and associations identified above ("Shipper Parties") testified at that hearing and/or submitted comments. At the conclusion of the hearing, the Board announced that the record would remain open to receive supplemental evidence for thirty days. The Shipper Parties hereby jointly submit these Supplemental Comments, and the attached Verified Statement of Tom O'Connor, to assist the Board in this important matter.

II. A POLICY STATEMENT THAT PERMITS RAILROADS TO REQUIRE SHIPPERS TO INDEMNIFY A RAILROAD FOR THE RAILROAD'S OWN NEGLIGENCE WOULD BE IMPROPER.

A. Amendments to the Federal Rail Safety Act in 2007 Evidence Congressional Intent to Lodge Liability for Railroad Negligence With the Railroads.

The railroads, both individually and through the Association of American Railroads ("AAR"), urge the Board to limit their liability for incidents involving Toxic Inhalation Hazard ("TIH") materials, by requiring shippers to indemnify the railroads for their own negligence as a condition to their common carrier obligation to transport TIH materials. It should first be noted that, in cases where the railroads are not at fault, the law already limits their liability. In fact, until last year, courts generally held that state law negligence claims related to the transportation of TIH materials were preempted by federal law (including, in particular, the Federal Rail Safety Act ("FRSA")), regardless whether the railroad complied with federal regulations[1] However, in 2007, Congress amended the FRSA to clarify that state law negligence claims based on a railroad's failure to comply with federal regulations, with state regulations not otherwise preempted by federal law, or with a railroad's own operating procedures are not preempted by federal law.[2] It is thus the express intent of Congress that, as part of the federal railroad safety scheme, ***railroads are to be liable for their own negligence.***[3]

As the Eighth Circuit recently observed, Congress clarified that, prior to the 2007 amendment to the FRSA, it was not Congress' intent "that an injured person be denied the mere chance to ***hold a railroad accountable*** when its negligence not only violated state common law

---

[1] *See, e g, CSX Transp. Inc v Easterwood*, 507 U S 658 (1993) ("*Easterwood*"), *Norfolk S. Ry Co v Shanklin*, 529 U S. 344 (2000) ("*Shanklin*"), *Lundeen v Can Pac Ry Co*, 447 F 3d 606 (8th Cir 2006); *Mehl v Can Pac Ry, Ltd*, 417 F Supp. 2d 1104 (2006) ("*Mehl*")

[2] Pub L. No 110-53, § 1528, 121 Stat. 266 (2007) (codified at 49 U.S C § 20106(b))

[3] *Lundeen v Can Pac Ry Co*, 532 F.3d 682, 696-98 (8th Cir 2008)

standards, but the very federal laws and regulations approved by Congress in an effort ***to further railroad safety.***"[4] The circumstances that caused Congress to change the law — and the railroads' attempt to circumvent it in this proceeding — all involved railroads that did something wrong The Board cannot overturn Congress and absolve railroads of liability for their wrongful actions.

In the wake of the Minot and Graniteville incidents, Congress accepted the Eighth Circuit's invitation to amend the FRSA to remove blanket protection for the railroads.[5] The change in law was given retroactive effect to "apply to all pending State law causes of action arising from events or activities occurring on or after January 18, 2002," *viz*, the date of the Minot train derailment.[6]

As amended, 49 U.S.C. § 20106(b)(2) clarifies that "[n]othing in this section shall be construed to preempt an action under State law seeking damages for personal injury, death, or property damage alleging" the following. (i) a violation of the federal standard of care established by regulation or order issued by the Secretary of Transportation (with respect to railroad safety) or the Secretary of Homeland Security (with respect to railroad security); (ii) a party's violation of, or failure to comply with, its own plan, rule, or standard that it created pursuant to a regulation or order issued by either of the two Secretaries; and (iii) a party's violation of a state standard that is necessary to eliminate or reduce an essentially local safety or security hazard, is not incompatible with a federal law, regulation, or order, and does not

[4] *Id.* at 690.

[5] Pub. L. No. 110-53, § 1528, 121 Stat 266 (2007) (codified at 49 U.S C § 20106(b)).

[6] 49 U S.C. § 20106(b)(2).

unreasonably burden interstate commerce.[7] The amendment was intended to "rectify the Federal court decisions related to the Minot, North Dakota accident."[8]

Courts have since held the effect of the amendment to the FRSA is to "allow[] state tort law claims to proceed if a railroad did not comply with a railroad safety federal regulation even if such regulation covered the subject matter of the state requirement."[9] Courts have held that the changes to the FRSA, while not overruling the Supreme Court's decisions in *Shanklin* and *Easterwood*, alter "the approach courts take when analyzing whether state law is preempted by federal law."[10] Common law negligence claims remain preempted to the extent that the claims are covered by federal regulations on the same subject; however, "non-compliance with federal regulations or rules created pursuant to a federal regulation," and the "purpose of the regulation or rule," must now to be taken into account.[11] The amendment thus operates to save state law tort claims from preemption "specifically when a party has failed to comply with a federal standard of care established by a federal regulation or order or when it has failed to comply with its own plan, rule or standard."[12]

B. The Policy Statement Requested by the AAR Would Unlawfully Invade State Tort Law and Be Contrary to the Federal Common Law and Public Policy.

Questions of indemnification and exculpation for negligent or grossly negligent conduct are matters that arise under state tort law. Even federal courts are required to apply the law of

---

[7] *Id* § 20106(b)(1)

[8] *See* H R Rep. No 110-259, 110th Cong, at 351 (2007).

[9] *Murrell v. Union Pac R. Co*, 544 F.Supp.2d 1138, 1145 (D. Or 2008).

[10] *Id* at 1148

[11] *Id*

[12] *Id*

the state in which the case arose when deciding questions of negligence or gross negligence. *Erie R Co. v Tompkins*, 304 U.S. 64 (1938).[13] For the Board to assert any jurisdiction in the area of state common or statutory law governing negligence or gross negligence, it must find that Congress gave it authority to preempt state tort law by enacting 49 U.S.C. § 10501(b) of the ICCTA. No such finding can be made in this matter.

The law regarding preemption of state tort law with respect to rail operations was set forth in the leading case of *Easterwood*. Here the Supreme Court quoted from an earlier decision stating the well-established rule that "a court interpreting a federal statute pertaining to a subject traditionally governed by state law will be reluctant to find preemption...unless it is 'the clear and manifest purpose of Congress.'" *Easterwood* at 507 U.S. 664, quoting from *Rice v. Santa Fe Elevator Corp* 331 U S 218, 230 Looking at the plain language of Section 434 of the FRSA (45 U S C. § 434) the Court held that FRSA specifically preempted state tort law in matters of railroad safety when the Secretary of Transportation had issued regulations that covered "the same subject matter as Georgia negligence law pertaining to the maintenance of, and the operation of trains at grade crossings." *Easterwood*, at 664.

The preempted issue in *Easterwood* involved how fast a train could be moving at a grade crossing. The DOT rules provided for a certain speed at the crossing in question and the plaintiff sought to have Georgia tort law hold that CSX was negligent for operating its train at or below that speed. Under Article VI, Clause 2 of the U.S. Constitution, the state law claim had to give way. The key to the case, however, was the very specific language of the FRSA and the plain intent of Congress to preempt any state statute or common law rule that would conflict with the federal railroad safety law.

---

[13] As will be discussed below, the exception to this rule is where there is no state common law involved as in cases in admiralty such as *Bisso v ,Inland Waterways Corp* 349 U.S 85 (1955).

No one could seriously contend that the Board would have jurisdiction to hear a suit brought by or against a railroad for negligence based on the language of 49 U.S.C. § 10501(b). Tort actions do not constitute the kind of economic regulation of "rates, classifications, rules (including car service, interchange, and other operating rules), practices, routes, services, and facilities of such carriers...and construction, acquisition, operation, abandonment or discontinuance of spur, industrial, team, switching, or side tracks, or facilities" so carefully described in that section. Further, the Conference Report accompanying the ICCTA specifically points out that the Congress had no intention of preempting the general laws of the various states. H.R. Report 104-422, 104th Cong., 1st Sess., 167 (1995). State tort law subsumes the appropriateness and effect of any indemnification provision entered into by parties to any contract including rail contracts whether by tariff or by exempted contracts. The Board therefore has no authority to intrude into that state domain.

For an exculpatory or indemnification clause in a contract to be valid, each party must be a free bargaining agent *Valhal Corp v. Sullivan Associates, Inc.*, 44 F.3d 195 (3d Cir. 1995) (applying Pennsylvania law). If the parties to an exculpatory or indemnification agreement are not on equal footing, so that one is compelled to submit to a provision relieving the other from liability for future negligence, the provision is invalid. *Baltimore & O S W Ry v Voigt*, 176 U.S. (1900); *Del Raso v U.S.*, 244 F.3d 567 (7th Cir. 2001) (applying North Carolina law); *Kansas City Power & Light Co v United Telephone Co of Kan.*, 458 F.2d 177 (10th Cir. 1972) (applying Kansas law).

When federal tort law does apply, as in cases such as admiralty, the Supreme Court has voided exculpatory or indemnification provisions in cases involving transportation entities such as tow boat operators. In *Bisso v Inland Waterways Corp*, 349 U.S. 85 (1955), the Court held that under federal admiralty law towage companies should not be allowed to relieve themselves of liability for negligence in the performance of their transportation activities. The Court explained the reasons for such a public policy:

> The two main reasons for the creation and application of the rule have been (1) to discourage negligence by making wrongdoers pay damages, and (2) to protect those in need of goods or services from being overreached by others who have power to drive hard bargains....And both reasons apply with equal force whether tugs operate as common carriers [under the Interstate Commerce Act] or contract carriers. 349 U.S. at 91

A railroad publishing a "take it or leave it" tariff has complete bargaining power and a shipper seeking to move its TIH materials in order to stay in business has virtually none In these circumstances, the Board could not properly permit the use of a tariff publication to require a shipper to indemnify a railroad for its own negligence

Other federal agencies have recognized that sound public policy does not permit a transportation entity with unequal bargaining power to insist on indemnification as a condition of service. For example, the Federal Maritime Commission prohibits marine terminal operators, who have considerably less market power than do railroads, from publishing tariff schedules containing provisions that exculpate or relieve the marine terminal operator from its own negligence or impose on others an obligation to indemnify the marine terminal operator for its own negligence. 46 C.F.R § 525.2(a) (1).

There is every reason to require that the party controlling the transportation and able to prevent an incident should and must be the party responsible for doing so. Shifting liability away from a party able to prevent an incident involving the transportation of TIH materials that are so essential to the Nation's economy and so essential to the welfare of its people, would be irresponsible and unlawful.

C. The Policy Statement Requested by the Railroads Invades the Jurisdiction of Another Federal Agency, the FRA, Whose Safety Mandate Would Be Directly Affected.

Our Constitution is grounded in the bedrock of a defined and limited delegation of legislative power from the people to the Congress.[14] This elemental constitutional precept applies to executive agencies acting within the modern administrative state. Because legislative power under the Constitution comes ultimately by way of delegation from the people, it may come to rest in executive agencies only via valid statutory delegations from Congress, the repository of the people's lawmaking authority in the first instance. The Supreme Court has thus recognized that "an agency literally has no power to act ... unless and until Congress confers power upon it."[15] The Administrative Procedure Act ("APA") likewise requires courts to "hold unlawful and set aside agency action" that exceeds the scope of an agency's "statutory jurisdiction" or "authority."[16]

It is therefore significant that Congress vested in the Secretary of Transportation authority to "prescribe regulations and issue orders for every area of railroad safety,"[17] and that the Secretary in turn delegated authority over railroad safety and hazardous materials transportation to the FRA and PHMSA — not to the Board.[18] Acting pursuant to authority delegated under the

---

[14] *See Marbury v Madison*, 5 U S. (1 Cranch) 137, 176 (1803) (the "powers of the legislature are defined, and limited, and that those limits may not be mistaken or forgotten, the constitution is written").

[15] *New York v FERC*, 535 U S. 1, 18 (2002) (quoting *Louisiana Pub Serv. Comm'n v FCC*, 476 U S 355, 374 (1986)); *see also Motion Picture Ass'n of Am, Inc v FCC*, 309 F 3d 796, 801 (D C Cir 2002) (with statutory authorization, an agency may not "promulgate even reasonable regulations that claim the force of law"); *Kelley v EPA*, 15 F 3d 1100, 1108 (D C Cir 1994) (absent delegated authority, an agency may not take policy position and enact them as binding legislative or interpretive rules carrying the "force of law")

[16] 5 U S C § 706(2)(c)

[17] 49 U S C § 20103(a) (2002)

[18] *See* 49 *U S.C §§ 103 & 108 (2002 & 2004), see also* 49 C F.R. §§ 1 49, 1 53(b)

federal hazardous material transportation law, 49 U.S.C. § 5101, *et seq.*, the PHMSA has "prescribe[d] regulations for the safe transportation ... of hazardous materials in intrastate, interstate, and foreign commerce." Similarly, acting pursuant to authority delegated under the federal railroad safety laws, 49 U.S.C. § 20101, the FRA has promulgated and enforced a comprehensive regulatory program over all areas of railroad transportation safety.[19] In contrast, the Board has been delegated no authority to regulate either railroad transportation safety or the transportation of hazardous materials, as recent court decisions have unequivocally confirmed.[20]

As Deputy Federal Railroad Administrator Clifford Eby testified at the July 22nd hearing, DOT's regulation of the transportation of TIH materials is extensive and active. Consistent with the Secretary's delegation of authority, the FRA and PHMSA are currently conducting extensive proceedings addressing various aspects of the transportation of TIH materials.[21] Current proposals include, for example, increasing the amount of energy a tank car must absorb before catastrophic failure by 500%, significantly enhancing tank-head and shell puncture resistance performance standards; and expedited replacement of tank cars manufactured before 1989 with non-normalized steel.[22]

---

[19] *See* 49 CFR parts 200-244

[20] *Boston and Maine Corp v Surface Transp. Bd*, 364 F.3d 318, 321 (D C Cir 2004) ("primary jurisdiction over railroad safety belongs to the FRA, not the Board"), *Tyrrell v Norfolk S Ry Co*, 248 F 3d 517, 523 (6th Cir 2001) (there is "no evidence that Congress intended for the Board to supplant the FRA's authority over rail safety").

[21] Docket No FRA-2006-25169 (railroad tank car design specifications for tank cars transporting TIH materials), Docket No PHMSA-RSPA-2004-18730 (data compilation regarding transportation of hazardous materials); Docket No. FRA 2007-28573 (appeal of routing decisions for hazardous materials)

[22] *Hazardous Materials Improving the Safety of R R Tank Car Transp of Hazardous Materials*, 73 Fed. Reg 17,818, 17,831 (Apr 1, 2008)

These DOT proceedings have considered <u>precisely</u> the same liability issues on which the railroads have focused their comments to the Board.[23] DOT has nonetheless chosen not to discourage or otherwise prohibit the shipment of hazardous materials. Instead, it has implemented a comprehensive regulatory system that is designed to manage risk (not eliminate it), taking into account that hazardous materials, including TIH materials, "are essential" to our economy and that "the vast majority of hazardous materials shipped by railroad tank car each year arrive at their destinations safely and without incident."[24] In response to a question at the July 22nd hearing, Mr. Eby stated that, had these new tank car standards been in place at the time of the Minot, Graniteville and Macdona incidents, no release would have occurred.

If this Board were to accept the railroads' invitation to issue a policy statement finding that shifting liability arising from a railroad's negligence to shippers is a reasonable condition of carriage, such a policy statement would conflict with the FRA's and PHMSA's responsibility to strike a delicate balance between the safe and economical transportation of hazardous materials and whatever limitations on such transportation are absolutely and unavoidably necessary.[25] Any Board action that imposes additional or different burdens on shippers of hazardous materials will unavoidably upset the FRA's and PHMSA's own reconciliation of competing federal interests.

---

[23] *Id* (addressing railroads' concern that "'railroads can suffer multi-billion dollar judgments' from accidents involving highly-hazardous materials").

[24] *Id*, 73 Fed Reg. at 17,819, 17,822 ("The hazardous material regulatory system is a risk management system that is prevention-oriented and focused on identifying a safety or security hazard and reducing the probability and quantity of a hazardous material release ").

[25] *Cf. Rodriguez v United States*, 480 U S 522, 528 (1987) ("[d]eciding what competing values will or will not be sacrificed to the achievement of a particular objective is the very essence of legislative choice — and it frustrates rather than effectuates legislative intent simplistically to assume that whatever furthers the statute's primary objective must be the law")

The Board should therefore defer to the FRA and PHMSA with respect to safety issues and *should not interfere with the carefully calibrated regulatory judgments made* by the FRA and PHMSA concerning the transportation of hazardous materials. Rather, as Mr. Eby suggested, the railroads and shippers should work together to find market-based solutions to reduce risk and liability exposure and DOT and the Board need to promote such solutions. As Mr. Eby further noted, the Administration is willing to work with all parties to shape legislation to govern liability appropriately. The testimony of TIH shippers at the July 22nd hearing shows that shippers, railroads, and DOT are cooperating through multiple projects to reduce risk and liability exposure.

D. The "Policy Statement" Requested by the Railroads is Not a Policy Statement Because It Would Have a Binding Effect on Shippers.

The AAR requests that the Board, "based upon the record at this hearing ... " issue a general policy statement to the effect that:

> It would not be an unreasonable practice for a rail carrier, under the provisions of 49 U S.C. 11101(a) and 49 U.S.C. 10702, to require (if it elected to), as a condition of providing common carrier transportation services, that a TIH material shipper indemnify and hold harmless the railroad against liability arising from a release of such materials in excess of (1) the maximum amount of insurance that the railroad carries for TIH transport or (2) $500 million for Class I railroads, whichever is greater; and to provide reasonable assurances in the form of insurance or other means to support such indemnity.[26]

There is no doubt that the APA, 5 U.S.C. § 553(b),[27] and the Board's own rules, 49 C.F.R. 1110.3,[28] permit the Board to issue a "general statement of policy ... without notice or

[26] AAR written testimony, July 10, 2008, p 24 AAR notes that separate minimum thresholds would be established for Class II and Class III railroads

[27] 5 U S.C. § 553 authorizes agencies to engage in rulemaking with certain exceptions, including "general statements of policy "

other public rulemaking proceedings." What AAR has proposed, however, is not a general policy statement but instead is a rule that will bind shippers [29]

A general policy statement announces "the agency's tentative intention for the future," *Pacific Gas & Elec Co v Fed Power Comm'n*, 506 F.2d 33, 38 (D.C. Cir. 1974) There is, however, nothing "tentative" about the proposed AAR rule; as explained below, it will set in stone circumstances under which shippers will be liable to railroads without the exercise of any further agency discretion, fixing the obligations of shippers for the future The proposed rule thus cannot qualify as a general policy statement because it is dispositive of a party's rights. *Panhandle Producers & Royalty Owners Assn. v Economic Regulatory Admin*, 822 F.2d 1105, 1110 (D.C. Cir. 1987).

It is not necessary to go beyond the AAR's own filing in order to find proof that the railroads propose a system that will preordain shipper liability or redefine a railroad's common carrier obligation in a manner that permits it to refuse shipments it is obliged by law to transport today. The binding, inflexible nature of the AAR's proposal is evident in the language of the proposal itself, which states that it "would not be an unreasonable practice for a rail carrier ... to require (if it elected to), as a condition of providing common carrier transportation services, that a TIH materials shipper indemnify and hold harmless the railroad against liability arising from a

---

[28] 49 C F R § 1110.3 allows the Board to issue "general statements of policy" without notice and comment rulemaking.

[29] AAR's proposal also is an attempt to circumvent the exemption standards adopted by Congress at 49 U S.C. 10502(a). AAR requests that railroads be excused from their common carrier obligation under 49 U.S.C 11101(a) and 10702, unless a shipper agrees to indemnify the railroad for liability in excess of $500 million. This would be like a railroad asking the Board to issue a policy statement saying that it is not unlawful for the carrier to refuse to transport automobiles unless the shipper agreed to accept transportation terms dictated by the carrier The key in both cases is that the carrier position rests on a withdrawal of service But a railroad may only be excused form compliance with a provision of the Act requiring it to provide service when it has satisfied the standards in Section 10502(a) With regard to TIH transportation, it is difficult to conceive of even an isolated circumstance in which railroad could satisfy those standards, much less make such a showing for all TIH transportation in general

release of such materials in excess of (1) the maximum amount of insurance that the railroad carries for TIH transport or (2) $500 million for Class I railroads, whichever is greater."

That proposal does not leave any discretion to the Board. Under the proposal, it "would not be an unreasonable practice" for a railroad to choose to withhold common carrier service if it did not receive an indemnity of a satisfactory nature. The Board would have nothing further to say if and when a carrier elected to take the steps outlined, creating what AAR terms a "safe harbor."[30] Depriving the Board of the ability to exercise discretion on a transactional basis contradicts the claim that the AAR proposal can be viewed as a policy statement. *American Bus. Ass'n v United States.*, 67 F.2d 525, 529 (D.C. Cir. 1980).

The Board should not allow itself to be misled by the AAR's suggestion that "a carrier should also be allowed to establish conditions of transport setting lower thresholds of carrier liability. . . Those conditions could be assessed by the Board on a case-by-case basis."[31] The Board, however, would have no opportunity to exercise discretion unless a carrier attempted to establish lower thresholds of carrier liability, which it is not required to do under the proposed rule. In those instances where there is "liability arising from a release of [TIH] materials in excess of (1) the maximum amount of insurance that the railroad carries for TIH transport or (2) $500 million for Class I railroads," and the carrier elects not to establish "lower thresholds of carrier liability," the proposed rule acts to establish a binding outcome that would be fully determinative of the rights of shippers who seek TIH transportation. The AAR proposal thus cannot qualify as a policy statement because it "establishes a standard of conduct which has the force of law." *Pacific Gas*, 506 F.2d at 38.

---

[30] *See* AAR statement at 25.

[31] AAR Statement at 25.

E. The Record Does Not Support Issuance of the Proposed Policy Statement.

The AAR's pleading, as well as its verbal presentation to the Board, rely on the supposition that a TIH incident will cause a catastrophic level of monetary liability that no railroad can meet on its own Fortunately, TIH events fulfilling the AAR's doomsday prophecy have not occurred, and the insurance market has been adequate to fulfill railroad liability. If the Board were to accept AAR's assertion that the insurance market cannot fulfill a railroad's reasonable insurance needs, the Board would be indulging AAR in speculation.

Although AAR urges the Board to find that there are extremely high costs that will have to be met by any carrier engaged in TIH transportation, AAR makes no effort to provide a factual basis for any level whatsoever of costs associated with TIH transportation. The Shipper Parties are not suggesting that railroads must wait until they have been involved in catastrophic TIH accidents before presenting a factually reliable record of TIH costs. Surely, however, railroads can quantify their TIH insurance costs, and explain to the Board the nature of the insurance available in the market, *i.e*, deductible amounts, and other options available to the carrier, such as the costs of self-insurance. Most carriers have neglected quantification of insurance costs altogether BNSF provided some evidence regarding self-insurance, but without the costs associated with that approach.

The Chlorine Institute has submitted the only transparent evidence of railroad insurance costs in this proceeding. Contrary to railroad allegations of spiraling casualty and insurance costs, the CI evidence shows an overall decline of insurance costs for the U.S. Class I railroads from 2003 to 2007.[32] Although there were spikes in insurance costs immediately following the Minot, Macdona, and Graniteville incidents for the railroads involved, even those railroads today

[32] Written Testimony of the Chlorine Institute, Inc. pp 10-11 (July 10, 2008)

have experienced an overall decline in costs. The CI analysis is based upon the R-1 data submitted by the railroads themselves. No railroad witness attempted to refute that data at the July 22nd hearing.

On August 15, 2008, NS filed a letter with the Board claiming that its insurance costs have increased by 248% since 2001. This statement is not accompanied by any analysis or supporting data and is rife with ambiguity. NS has not identified the source of its data. Nor has NS provided the dollar amounts used to calculate the 248% figure to determine how much of a cost increase 248% represents. NS also has not explained how or why its figure differs so significantly from its own R-1 reports[33] NS inappropriately pegs its insurance cost increase to 2001 levels, which is prior to the TIH releases at Minot, Macdona, and Graniteville that gave rise to the liability concerns raised in this proceeding. Finally, NS does not even define what insurance costs it is measuring or why those costs increased. For example, NS could be including all categories of insurance, not just its casualty insurance costs relevant to TIH liabilities; and/or its premiums could have increased because it chose to acquire additional coverage, not because existing coverage costs increased. It simply is not possible to answer these questions and many others from the NS letter. In short, the NS claims have no support in the record and NS has not made any attempt to refute the CI testimony, which has extensive support in the record.

Some of the railroads alluded to additional costs that arise in connection with the transportation of TIH shipments, including, presumably, operating costs, insurance costs, and train costs. However, none of the costs of that nature were quantified by any railroad.

[33] According to the NS R-1 Reports, its casualty costs increased from $124 million in 2001 to $153 million in 2007, which is an increase of 24%, not 248% *See* the attached Verified Statement of Tom O'Connor A 24% increase over a six-year span that included both 9/11 and the Graniteville accident is far from "spiralling "

Additionally, the FRA reports that "[m]inimally, shipping rates for PIH materials have doubled; however, many shippers report larger increases (including at least one shipper which has had its rates increased over 4.8 times in a two-year period)."[34] These rate increases are far above any likely railroad cost increases, which again, have not been documented.

Perhaps it may seem to the Board that it is foolish for shippers to be critical of the absence of finite cost evidence because the overarching issue is whether shippers can be required by a railroad to participate in costs arising from TIH transportation. The fact is, however, that the railroads have not presented an abstract proposal. They have proposed a very specific general policy statement for prescription by the Board. The AAR proposal sets forth exact numbers representing the burdens to be assumed by each specific shipper of TIH materials if the carrier demands an assumption of responsibility from the shipper. Shippers are thus entitled to know the basis for the AAR claims The AAR general policy proposal is fatally lacking in supporting detail.

F. Any Policy Statement Would Be Unjustified Because, Under *Akron*, a Detailed Inquiry into Specific Facts is Required.

Even if the Board possessed authority to issue the policy statement requested by the AAR, despite the preceding arguments to the contrary by the Shipper Parties, any policy statement authorizing railroads to publish indemnification requirements in their tariffs would be inappropriate because such a decision must only be made after a detailed inquiry into specific facts. The Sixth Circuit made this absolutely clear in *The Akron, Canton & Youngstown R R. Co v. ICC*, 611 F. 2d 1162 (6th Cir. 1979) ("*Akron*").

---

[34] Notice of Proposed Rulemaking, Hazardous Materials. Improving the Safety of Railroad Tank Car Transportation of Hazardous Materials, Docket No FRA-2006-25169, 73 Fed. Reg 17818, 17831 (April 1, 2008)

At the July 22nd hearing, many of the Shipper Parties and the Board itself cited to the *Akron* Court's *dicta* that "[q]uestions of safety are also questions of risk of liability." *Id.* at 1170. Therefore, even if the Board had jurisdiction to address the economic issues associated with liability risks through an indemnification requirement (which it does not), it must be careful not to exercise that jurisdiction in a manner that adversely impacts safety. In this case, reducing the liability exposure of the railroads for non-compliance with the regulatory scheme imposed by Congress and the FRA would adversely impact safety. The Board does not have the authority to reduce the liability of the railroads imposed by the FRSA.

Even if the Board had the authority to consider the railroads' request, it has not undertaken the analysis required to decide such a matter. The *Akron* Court held that a railroad cannot refuse to haul any materials that meet DOT safety standards, but that it may seek approval of a stricter practice that is shown to be just and reasonable. *Id* at 1169. In considering whether a stricter practice is reasonable, the Court stated that the ICC was required to review multiple factors specific to the transportation service at issue. According to the Court, "[t]hese factual matters are properly to be explored after the publication of tariffs. ., not in deciding whether such publication should be ordered." *Id* at 1169-70 [underline added]. This holding logically extends to consideration of such factual matters in deciding whether to authorize indemnification requirements, because indemnification requirements have a detrimental impact upon safety. No such analysis is possible in the context of a general policy statement where no specific tariff provision has been published for the Board's consideration.

The D.C. Circuit reinforced this holding in *Consolidated Rail Corp. v ICC*, 646 F. 2d 642 (DC Cir. 1981) ("*Conrail*"). In that case, the railroads attempted to publish tariffs that required special train service for hauling spent nuclear fuel, a stricter standard than required by DOT The Court observed that:

> The basic issue in this case is whether the ICC properly determined that the railroads' tariffs based on STS [special train service] were unreasonable. In resolving it, we must answer two questions: first, to what extent did the ICC have authority independently to evaluate the need for STS safety measures; second, was there sufficient evidence in this record to support the Commission's conclusion that STS was unnecessary as a safety measure.

Id. at 647 [footnote omitted].

In response to the first question, the Court defined the issue as "whether the practice and the tariff based on it is reasonable when viewed from the public perspective of the Commission, which must reconcile a multitude of factors in exercising its expert judgment on tariff issues, including economy, efficiency, fair wages and working conditions, and safety, in addition to the financial condition of the carriers." *Id.* at 647-48. Agreeing with the *Akron* decision, as far as it went, the *Conrail* Court added that "railroads may indeed seek to prove the reasonableness of additional safety measures, but the burden is upon them to show that for some reason, the presumptively valid DOT/NRC regulations are unsatisfactory or inadequate in their particular circumstance." *Id* at 650.

Similarly, even if an indemnification requirement were permissible (and it is not) the railroads have the burden of proving that such a requirement is both reasonable and necessary. That burden cannot be satisfied in the abstract setting of a policy statement. All of the factors identified by the *Akron* and *Conrail* Courts can only be thoroughly weighed and considered in the context of a detailed factual inquiry based upon an actual tariff indemnification provision.

III. THE CONCERNS VOICED AT THE HEARING DO NOT WARRANT A POLICY STATEMENT.

A. The Board Cannot Overturn Congress' Legislative Judgment and Relieve Railroads from Liability Arising from Their Own Negligence.

In the Minot, Macdona and Graniteville incidents, it was a *failure of the railroads* that led to the breach of tank cars and the subsequent release of TIH materials These incidents resulted in negligence cases being brought against the railroads. Prior to the amendment to the FRSA, these cases likely would have been preempted and the railroads shielded from liability for their own negligence. Now, however, Congress has clearly declared its intent that railroads be held liable for their negligence. It is this change — Congress' clear and unambiguous amendment to the FRSA removing this shield from liability in response to the Minot incident — that has given rise to the railroads' resurrected concerns regarding the transportation of TIH materials.

This Board should not interfere with Congress' decision, even indirectly. For the Board, as with any administrative agency, "must give effect to the unambiguously expressed intent of Congress."[35] As the Supreme Court has recognized in other contexts, the common law forms an integral part of the law's comprehensive regulation of private conduct.[36] Taken in combination with statutory and regulatory enactments, the common law imposes a continuous spectrum of

---

[35] *Chevron U.S A , Inc. v Natural Res Def Council, Inc* , 467 U S. 837, 842-43 (1984) (if "Congress has directly spoken to the precise question at issue," both the agency and courts "must give effect to the unambiguously expressed intent of Congress") *See also Federal Election Comm'n v Democratic Senatorial Campaign Comm* , 454 U.S 27, 38 (1981) (rejecting agency actions that are "inconsistent with" a "statutory mandate or that frustrate the policy that Congress sought to implement"), *Independent Ins Agents of Am , Inc v Hawke*, 211 F 3d 638, 643 (D C. Cir 2000) (an agency interpretation must be "reasonable and consistent with the statute's purpose"), *NLRB Union v Federal Labor Relations Authority*, 834 F 2d 191, 198-99 (D C Cir 1987) (where agency interpretations are "clearly at odds" with "Congress' intent," then "they must be struck down"); *National Ass'n of Broadcasters v FCC*, 740 F 2d 1190, 1203 (D C Cir. 1984) ("agencies must 'seek out the broader purposes-the overriding statutory goals-constitutive of the general categorical term in which Congress has embodied its will.'"), *National Wildlife Federation v Gorsuch*, 693 F 2d 156, 171 (D.C Cir 1982) (where an agency position is "inconsistent with" statute or "'frustrate[s] the policy that Congress sought to implement,' no amount of deference can save it")

[36] *See, e g , Medtronic, Inc v. Lohr*, 518 U S 470 (1996), *Cipollone v. Liggett Group, Inc* , 505 U S 504 (1992)

legal requirements, obligations, and standards that are designed to influence and regulate the actions of businesses and individual citizens. Congress' decision to subject railroads to legal liability in certain narrowly defined circumstances where a railroad is negligent reflects a legislative judgment that imposing additional layers of regulation on the private conduct of the nation's railroads is appropriate.

Against this backdrop, it is clear that the railroads are seeking to be excused from liability flowing for their own negligence. In particular, they seek either a Board endorsement of an impermissible distortion of the common carrier obligation or a Board-created liability shifting mechanism that would transfer to third parties liability imposed on the railroads by Congressional amendment of the FRSA — liability which arises from a railroad's own negligence. The Board lacks authority to take either step because both would conflict with Congress' determination that, as part of the federal safety regulations governing rail transportation, railroads should be liable for their own negligence. Neither the Board nor any other governmental agency should look lightly upon Congress' considered judgment that railroads should be held liable for their own negligence. It is Congress' amendment to the FRSA with which the railroads take issue and it is before Congress that the railroads must air their complaint.

B. Claims That Railroads Face *Strict* Liability in Moving TIH Materials Are Groundless, and in Fact Railroads Are Immune From Many Forms of Tort Liability if They Follow Prescribed DOT Safety Regulations.

Throughout these proceedings, the AAR and various railroads have alluded to, without citation or explanation, a nightmare scenario where a railroad can be held liable for "ruinous liability" even though it has done nothing wrong and is not negligent in any way. In other words, the railroads suggest that they face strict liability for handling TIH materials. No support is offered for this contention, nor could there be any. Railroads face liability only when they are negligent, or worse, to the same degree as every other enterprise conducting business every day in this country. In fact, the railroads already enjoy limited immunity from liability that others do not enjoy.

In *CSX Transp v Easterwood*, 507 U.S. 658 (1993), the Supreme Court reaffirmed that, when railroads comply with safety regulations promulgated by the DOT, they cannot be found negligent or be forced to pay damages under state tort law. State tort law is fully preempted by the Federal Railroad Safety Act. In such cases, the railroads are protected as a matter of law, and a preempted claim cannot go to the jury. Virtually no other industry enjoys that kind of tort law protection Thus, railroads have greater protection against state tort law liability than do other industries, and enjoy unique protections against involuntary bankruptcy liquidation. Accordingly, the requested indemnification policy statement should be viewed for what it is; nothing more than an attempt to use the substantial market power of the railroads to demand that blameless shippers pay the costs associated with providing insurance to protect the railroads from their negligent and grossly negligent conduct.

C. U.S. Tort Law is Founded on the Principle that the Party Who Causes the Damage Should Bear the Liability, and the Railroads Proposal Would Undermine That Fundamental Precept.

It is a fundamental principle of the American legal system that the party causing an injury should be required to bear the cost of making victims whole.[37] The *Restatement of the Law on Torts*—a summary of the law undertaken by eminent scholars—states that "[a]n actor's liability is limited to those physical harms that result from the risks that made the actor's conduct

[37] *See, e g*, W PAGE KEETON, ET AL, PROSSER AND KEETON ON TORTS § 33, at 203-04 (5th ed. 1984) (discussing this general principle), *see also id* § 51, at 341-43 (same in the context of indemnity)

tortious."[38] In other words, the law uniformly recognizes that entities are properly held responsible only for their own tortious conduct, and conversely, that where a party is not negligent, or is not in a position to control the activities that result in harm, that party should not be made to bear liability. The railroads seek through their proposal to undo those fundamental principles, because they would seek to transfer liability to shippers even though it is the railroads that supervise and handle freight during transport, and shippers are excluded from any control over their products after they are tendered to the railroad providing the transportation.

Case law shows that liability is consistently placed on the party responsible for undertaking the action whose negligent execution (or lack of execution) causes harm. *See, e g*, *In re New Orleans Train Car Leakage Fire Litig.*, 795 So. 2d 364, 373-79 (La. Ct. App. 2001) (awarding damages where railroad negligently failed to inspect tank car); *CSX Transp Co. v. ExxonMobil Oil Corp.*, 401 F. Supp. 2d 813 (N.D. Ohio 2005) (rejecting railroad's attempt to impose liability on shipper where the railcar during the relevant period was under the control of the railroad); *Gulf Oil Corp. v. Atlantic Coast Line R Co.*, 196 So. 2d 456 (Fla. Dist. Ct. App. 1967) (concluding that, notwithstanding a broad contractual indemnity agreement, the railroad should not be indemnified for its own negligence).

---

[38] RESTATEMENT (THIRD) ON THE LAW OF TORTS—PERSONAL HARM § 29 (tentative draft Mar 2008); *see also id* § 29, comment d ("Central to the limitation on liability . is the idea that an actor should be held liable only for harm that was among the potential harms—the risks—that made the actor's conduct tortious. The term 'scope of liability' is employed to distinguish those harms that fall within this standard and, thus, for which the defendant is subject to liability and, on the other hand, those harms for which the defendant is not liable This limit on liability serves the purpose of avoiding what might be unjustified or enormous liability by confining liability's scope to the reasons for holding the actor liable in the first place.")

Buttressing the concept that each party bears responsibility for its tortious actions, the law also recognizes the doctrine of superseding cause, whereby "an act of a third person or other force which by its intervention prevents the actor from being liable for harm to another which his antecedent negligence is a substantial factor in bringing about " RESTATEMENT (SECOND) ON THE LAW OF TORTS § 440 (1965).

Once shippers have ensured that the proper tank cars have been selected for their products, have complied with other regulatory requirements such as placarding and labeling requirements,[39] and have placed their products in the care of the railroads, it is, and should remain, the railroads' responsibility to ensure the safe transport and delivery of that cargo. That well-established principle of American tort law should remain undisturbed, and a railroad should not be permitted to force indemnification upon shippers for instances where the railroad itself is negligent

The case law developed in the context of maritime shipping – a federal common law of torts developed under federal courts' admiralty jurisdiction – is also instructive. As the U.S. Supreme Court has held, "liability should properly fall upon the party best situated to adopt protective measures and thereby to reduce the likelihood of injury " *Italia Societa per Azioni di Navigazione v Oregon Stevedoring Co*, 376 U.S. 315, 323-24 (1964).[40] *See also Bisso v. Inland Waterways Corp.*, 349 U.S. 85, 91 (1955) (voiding a contractual indemnification provision demanded by a tow boat operator because allowing a common carrier to shift liability for its own negligence would remove incentives discouraging wrongdoing by making those responsible pay for any harms). The same rule should apply to railroads, which like maritime carriers are entities who accept and transport freight on behalf of their shipping customers, and maintain exclusive control over the goods transported until the product is tendered to the consignee.

[39] Regarding tank specifications and other regulatory requirements governing hazardous materials transportation, *see generally* 49 CFR Parts 172 and 173

[40] *See also David Crystal Co v Cunard S S Co*, 399 F 2d 295, 300 (2d Cir 1964) (same), *Mitchell v Lone Star Ammunition, Inc*, 913 F 2d 242, 245 (5th Cir 1990)(tort liability principles properly seek to impose liability on the wrongdoer whose act or omission caused the injury)

In sum, the Board should be careful not to undermine this well-established principle of American law by short-circuiting any liability that should properly be placed on railroads whenever their conduct is negligent.

D. The Specter of "Ruinous Liability" Resulting in a Liquidation Under the Bankruptcy Laws is Not Only Unfounded but Legally Impossible.

The railroads have suggested that some undefined event involving TIH materials could cause "ruinous liability" for a railroad. Such ruinous liability could, it is further suggested, even result in a filing for liquidation under Chapter 7 of the Bankruptcy Code. There are two distinct problems with this line of reasoning. First, never in the history of this Nation has a single catastrophic event resulted in a jury verdict so high as to force an enterprise the size of a Class I railroad into bankruptcy. Second, even if such an unprecedented scenario would occur, the railroad at issue could not be forced into Chapter 7 liquidation (11 U.S.C § 1161), but rather would be managed by a trustee required to consider the public interest in addition to the interests of the debtor, creditors, and equity security holders, 11 U.S.C. § 1165, with the Board participating in the proceedings to insure the protection of the public interest. See, 11 U.S.C. § 1164. Thus, under the law applicable to rail carriers, Chapter 7 liquidation is not even a theoretical result of a catastrophic accident involving hazardous materials, as implied by the railroads and even by some Board members' comments at the July 22nd hearing.

E. Forced Indemnification Would Undermine Safety.

If railroads were to succeed in transferring liability to shippers for the railroads' own negligence, this could drastically undermine public safety, because it would free railroads from incentives to prevent accidents and improve their safety practices.

Courts have long recognized that there is a societal interest in giving incentives to parties to act safely and limit potential torts.[41] "Before any societal benefit can be derived from the deterrent effects of tort liability," one court has stated, "the party in a position to correct the tortious act or omission must be held accountable for the damages caused and thus motivated to prevent future torts."[42] This is not an academic point, as federal accident investigators have determined that the most recent accidents involving the release of TIH materials resulting in fatalities have been caused by railroad operating errors.[43]

Should the railroads succeed in forcing indemnity provisions upon shippers, the railroads would have less incentive to maintain the highest standards of safety, and the societal benefit of tort deterrence would hence be compromised. As the Court in *Akron* noted, "questions of safety are also questions of risk liability " *Akron*, at 1170.

The Shipper Parties do not mean to suggest that railroads consciously would choose to act unsafely. Rather, their concern is with railroad decisions to incur certain costs for projects and investments that affect safety. For example, the cost-benefit analyses that underlie investment decisions, such as whether to signal certain track segments or to invest in positive train control, become distorted because, when liability is limited, the benefit side of the equation is artificially deflated. That may result in a railroad deciding not to make a safety-enhancing

---

[41] *See, e g*, *Bisso, supra*, 349 U.S at 91, *Johnston v United States*, 568 F Supp 351, 353 (D Kan 1983) ("The imposition of tort liability on a wrongdoer can have a strong prophylactic effect, tortfeasors held liable for damages that flow from their wrongdoing have a strong incentive to prevent the occurrence of future harm ")

[42] *Mesman v Crane Pro Servs*, 512 F.3d 352, 358 (7th Cir 2008) (Posner, J)

[43] *See, e g* (1) NTSB report on Graniteville, SC, accident, RAR-05-04, available for download at http //ntsb gov/Publictn/R_Acc htm, which determined that the accident was caused by the failure of Norfolk Southern crew members to properly realign a switch; (2) NTSB report on Macdona, TX accident, NTSB Report RAR-06-03, available for download at http//ntsb gov/Publictn/R_Acc htm, which determined that the accident resulted from crew fatigue and (3) NTSB report on accident at Minot, ND, RAR-04/01, available for download at http //www ntsb gov/publictn/2004/RAR0401.htm, which determined that the accident was caused by failures in inspection and maintenance of continuous welded rail, and that the use of non-normalized steel in the tank car was also a factor.

investment when the cost-benefit analysis would have supported such investment absent liability limits.

F. The Railroads and Their Investors Voluntarily Accepted the Common Carrier Obligation with Full Knowledge of the Risks and Rewards.

The railroad industry has been subject to the common carrier obligation since the existence of the first public rail line. Very early in the history of railroads, that obligation included the transportation of hazardous materials, including TIH materials, and the liabilities associated with such transportation. Throughout this history to the present day, railroad investors have factored this risk into their decisions to purchase railroad stocks and bonds.

The "fairness" concerns raised by the railroads and some Board Members at the July 22nd hearing do not justify special treatment for railroads by shifting liability for their own negligence onto their customers. Indeed, "fairness" concerns should prevent the Board from taking such action.

At the hearing, during questioning of a panel of individual chemical companies, Commissioner Buttrey compared the railroad common carrier obligation to a hypothetical new government mandate that TIH producers continue to produce TIH materials even if they no longer desire to do so. But the two situations are not comparable. Railroads have been subject to the common carrier obligation since they entered the business of railroading, and therefore, they knew that they could not selectively choose the traffic that they would transport and that they would be exposed to the risks associated with transporting TIH materials. Anyone who invests in a railroad today also knows these facts before they decide to invest their money, since this information is published in the railroads' Securities and Exchange Commission reports. In contrast, Commissioner Buttrey's hypothetical presupposes imposition of a common carrier-like obligation upon TIH producers long after they entered that business. Consequently, current investors would be denied any opportunity to consider the risks when deciding whether to invest their money in the TIH production industry. This distinction establishes the "fairness" of the common carrier obligation in contrast to the "unfairness" of Commissioner Buttrey's hypothetical.

The policy statement requested by the AAR would impose a similar type of inequity upon TIH shippers. By requiring TIH shippers to indemnify a railroad for the railroad's own negligence, the Board would grant a windfall to railroad investors at the expense of TIH shippers and their investors. While railroad investors have factored TIH liability risks into their investment decisions, investors in TIH shippers have not factored into their investment decisions potential liability for the negligent acts of a railroad over whose activities they have absolutely no control. Not only would there be a transfer of risk, that risk would be magnified by the fact that liability no longer rests with the responsible actor. That is a far greater "unfairness" than a common carrier obligation that was known to railroad investors before they made their investment decisions.

G. A Policy Statement Would Undermine, Rather Than Advance, Efforts to Address Liability Concerns Through Private Sector Discussions.

At the July 22nd hearing, Chairman Nottingham expressed a view that the Board might facilitate private sector discussions over the railroad TIH liability issue by issuing the policy statement requested by the AAR. Apparently, the Chairman believes that, by shifting a portion of the railroads' TIH liability to shippers, those shippers will be more motivated to change the status quo. This view is flawed in several respects.

First, by shifting liability to TIH shippers, the Board would grant the railroads the very solution that they desire. Consequently, there will be nothing left for the railroads to negotiate. The Fertilizer Institute, which the Chairman commended as the only shipper or shipper group he believes is taking this matter seriously, stated this in clear and unequivocal terms at the hearing. Specifically, if the railroads are permitted to adopt indemnification requirements in their TIH tariffs, the negotiations between TFI and the railroads would come to an abrupt halt, because the railroads will have obtained more than TFI has offered without providing any consideration in return.

Second, the Chairman's view erroneously assumes that shippers are throwing up road blocks to private sector discussions. The liability issue, however, has significant economic and safety ramifications for TIH shippers as well as railroads. TIH shippers are first and foremost concerned with the safe and secure production, transportation, and consumption of TIH materials. They do not want to rush into a solution that will provide fewer incentives for railroad investments in safety-related infrastructure, such as signaling dark territory and positive train control. Nor do they desire solutions that could encourage the use of trucks over rail. In addition, TIH shippers want assurances that, if railroads are relieved of the TIH liability risk that they claim is not justified by any rate level, there will be an appropriate reduction in skyrocketing rates for TIH transportation. To date, however, the railroads have not offered acceptable assurances to address these safety and economic concerns.

Third, the TIH shipping community is working in many different ways to reduce the risk of TIH transportation by rail, so that special liability measures that could compromise safety are not needed. TIH shippers have established partnerships with railroads and tank car manufacturers to enhance the structural integrity of tank cars in the event of an accident. They have supported proposed rules to minimize the human factor component that has been the cause of some of the largest TIH releases. Some TIH shippers also have voluntarily taken steps to reduce the route-miles traveled by TIH materials. All American Chemistry Council members participate in Responsible Care® and TRANSCAER® is a cooperative program between shippers and railroads to improve safety and to enhance awareness and emergency preparedness in local communities along TIH routes. By addressing both the potential for an accidental release and the magnitude of any release that might occur, these measures reduce the overall risk of transporting TIH materials, and thus the liability exposure of the rail industry to such risks.

H. "Changing Shipper Behavior" on Safety Matters Is Not the Proper Role of the Board, Especially Because the Matter Is Being Handled By DOT Through Its Section 333 Conference

The Federal Government is addressing rail safety and security with respect to the shipment of TIH and other hazardous materials, so separate action by the Board is neither necessary nor advisable.

Apart from DOT's TIH rail safety rulemaking on rail operations and tank car design,[44] there is an ongoing proceeding to explore possible ways to reduce the risk of shipping TIH materials – specifically chlorine and anhydrous ammonia, which together account for more than 80 percent of TIH tank car shipments. Those proceedings were initiated by DOT under Section 333 of 49 U.S. Code, at the joint request of the Association of American Railroads and the American Chemistry Council. Section 333 authorizes the Secretary of Transportation to conduct such proceedings, known as "conferences," in a manner that provides immunity from action "under the antitrust laws of the United States for any discussion at the conference and for any agreements reached at the conference, that are entered into with the approval of the Secretary to achieve or determine a plan of action to carry out the unification or coordination project."[45]

---

[44] Hazardous Materials: Improving the Safety of Railroad Tank Car Transportation of Hazardous Materials, Docket No. FRA-2006-25169, 73 Fed. Reg 17818 (April 1, 2008) See also Petitions for Interim Standards for Rail Tank Cars Used to Transport Toxic-by-Inhalation Hazard Materials, Docket No PHMSA-2008-0182, 73 Fed. Reg 42765 (July 23, 2008)

[45] 49 U.S. Code §333(d)(2)

The conference has considered strategies for reducing the ton-miles of such products that are shipped, including by re-routing such shipments among railroads and the "swapping" of customers among competing TIH producers. Conferences were convened with specific focus on chlorine and anhydrous ammonia (with shippers represented, respectively, by The Chlorine Institute and The Fertilizer Institute). In addition to FRA, to which the Secretary has delegated implementation of Section 333, other agencies – including the Board – have also participated While the views of the participating antitrust regulatory agencies precluded multilateral discussion of customer swaps among TIH producers,[46] participating shippers have been encouraged to implement swaps on an individually negotiated bilateral basis where possible.

Finally, the Board has jurisdiction to regulate only carriers and the economic aspects of transportation, not shippers.

I. The Alleged Ability of Shippers to Assume the Costs of Indemnification and Damages Is Irrelevant to the Lawfulness or Propriety of AAR's Request.

Some have suggested that, because certain companies that ship TIH material are of substantial size, they are in a financial position to, as AAR has proposed, "indemnify and hold harmless the railroad against liability arising from the release of such material" There is simply no valid basis for that suggestion. The relative size of a shipper and a carrier are not relevant. Indeed, the rail industry's proposed policy statement would apply to all TIH shippers, with no exclusion for those that happen to be of a smaller financial size than a particular railroad.

Tort liability relates to fault, not to size. As addressed elsewhere in these supplemental comments, the American legal system is based on sound principles. To shift liability in an

[46] The Department of Justice and Federal Trade Commission representatives participating in the Sec 333 conference determined that, as the statutory purpose of Sec 333 involved coordination of rail transportation, shipper discussions were not covered by the antitrust protection afforded by the section

arbitrary fashion onto the party that is perceived to have the "deeper pockets" would be counter to those fundamental legal principles and would embrace a flawed approach to public policy.

IV. THE BOARD SHOULD NOT REVISE ITS SMALL RATE CASE RULES TO ACCOUNT FOR ALLEGEDLY "UNIQUE COSTS" OF TRANSPORTING TIH MATERIALS.

The AAR alleges that railroads bear a multitude of unique costs associated with TIH materials that they are precluded from recovering in STB rate proceedings. But, the AAR and individual railroads have offered only generalized assertions that they incur additional costs for various types of activities, without making any attempt to quantify those costs. Furthermore, the Shipper Parties do not believe there is any need to modify the small rate case procedures to account for TIH handling costs because the current procedures already are capable of doing so.

AAR refers generally to current and proposed DOT regulations as examples of special TIH handling costs that have been or soon may be imposed upon railroads. The AAR's examples are DOT requirements for security plans and route assessments, proposed speed limits, chain-of-custody requirements, and various security measures in High Threat Urban Areas. However, not a single railroad has attempted to quantify the cost of any of these requirements, despite representations that some of these measures already have been taken. In addition, railroads have shifted some of these costs to shippers (*e g* requiring shippers to construct sufficient storage tracks in secured areas for TIH tank cars), and thus are not in fact incurring all those expenses.

The vagaries of costs, such as speed limits, also are not unique to TIH materials. The AAR asserts that speed limits slow other trains on a rail line, which increases capital and operating costs across the rail network. But every form of traffic imposes similar costs on the rail network For example, heavier trains may travel at slower speeds that could impact other traffic on the rail network. Conversely, lighter intermodal trains consume more capacity than other trains because of their need to travel at higher speeds and to accommodate railroad traffic prioritization. Speed limits also may not impose additional costs unless a rail line already is at capacity.

To the extent that there are additional costs associated with TIH traffic that can be identified and assigned to specific movements, the small rate case procedures account for such costs in two ways. First, those costs will be reflected in the rates of the comparable traffic group. Because the small rate case procedures focus upon R/VC ratios (*e.g* the relationship of revenue to variable costs), not rates, the R/VC ratios of the comparable TIH traffic group already include revenue that the railroads presumably believe are needed to cover the costs of TIH transportation No movement-specific adjustments to URCS are necessary, since any understatement or overstatement of TIH costs in URCS will be reflected in both the issue traffic and the comparison group R/VC ratios.

Second, to the extent a railroad can prove that specific TIH handling costs are not captured in the comparison group R/VC ratios, the Board permits parties to introduce such costs as "other relevant factors" Thus, contrary to AAR's claims, the small rate case rules permit railroads to include any unique costs of TIH materials transportation in the rates of TIH shippers.

Finally, movement-specific URCS adjustments for just TIH traffic would grant railroads a monetary windfall. URCS reflects system-average costs. If movement-specific adjustments are made to reflect allegedly above system average costs for TIH traffic, then the costs of some other traffic must be reduced by a corresponding amount. If that does not occur, railroads will over-recover their total costs. In addition, because not all TIH costs would be above system average, there would need to be corresponding off-sets for those lower cost categories.

The fact is that the railroads have not attempted to quantify the allegedly unique and higher costs of handling TIH traffic; they have not demonstrated that such costs are inadequately

accounted for in the small rate case procedures; and they have not shown the amount of any alleged distortion caused by the small case procedures.

V. CONCLUSION

The Board is respectfully requested to consider the above views in this proceeding.

Respectfully submitted,

Jeffrey O Moreno
Nicholas J. DiMichael
Karyn A. Booth
Thompson Hine LLP
1920 N Street, NW, Suite 800
Washington, DC 20036

Counsel for
E.I du Pont de Nemours and Company
PPG Industries, Inc
The Dow Chemical Company
The Fertilizer Institute
The National Industrial Transportation League

Dan Weber
Chairman – Board of Directors
Agricultural Retailers Association
1156 15th Street, NW, Suite 301
Washington, DC 20005

Thomas E. Schick
Senior Director – Distribution
American Chemistry Council
1300 Wilson Boulevard
Arlington, VA 22209

Mitchell F. Hertz
Patrick E. Groomes
Kirkland & Ellis LLP
655 Fifteenth Street, NW
Washington, DC 30005

Counsel for CF Industries, Inc.

Michael F McBride
Van Ness Feldman, PC
1050 Thomas Jefferson Street, NW, Suite 700
Washington, DC 20007-3877

Counsel for Edison Electric Institute and Occidental Chemical Corporation

Andrew Goldstein
McCarthy, Sweeney & Harkaway, PC
2175 K Street, NW, Suite 600
Washington, DC 20006

Counsel for National Grain and Feed Association

John L. McIntosh
Vice President
Olin Corporation
490 Stuart Road, NE
Cleveland, TN 37312

Paul M. Donovan
LaRoe, Winn, Moerman & Donovan
1250 Connecticut Avenue, NW, Suite 200
Washington, DC 20036

Counsel for The Chlorine Institute

Jean Payne
President
Illinois Fertilizer & Chemical Association
P.O. Box 1326
Bloomington, IL 61702-1326

Kendell W. Keith
President
National Grain and Feed Association
1250 I Street, NW, Suite 1003
Washington, DC 20005

Alex McGregor
The McGregor Company
401 Colfax Airport Road
Colfax, WA 99111-0740

Joseph D. Giesler
Senior Vice President, Commercial Operations
Terra Industries Inc.
600 Fourth Street
Sioux City, IA 51102-6000

John H. LeSeur
Peter A Pfohl
Slover & Loftus
1224 Seventeenth Street, NW
Washington, DC 20036

Counsel for Westlake Chemical Corporation

ATTACHMENT

BEFORE THE

SURFACE TRANSPORTATION BOARD

STB Ex Parte No. 677 (Sub-No. 1)

COMMON CARRIER OBLIGATION OF RAILROADS-
TRANSPORTATION OF HAZARDOUS MATERIALS

Verified Statement of

Tom O'Connor
Snavely King Majoros O'Connor & Lee, Inc.
1111 14th St NW
Washington DC

August 20, 2008

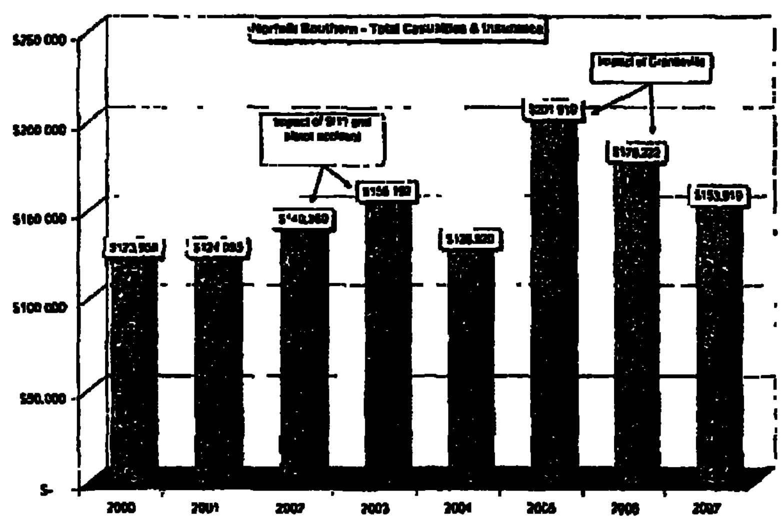
My name is Tom O'Connor: I am Vice President of Snavely King Majoros O'Connor & Lee Inc I am the same Tom O'Connor who submitted a report in this proceeding in July 2008 on behalf of the Chlorine Institute A summary of my experience and qualifications was included in that report.

As requested by Counsel, Snavely King has reviewed the descriptions of insurance cost increases filed by the Norfolk Southern Railway ("NS") in its August 15, 2008 letter to the Surface Transportation Board ("STB" or "Board") in Ex Parte 667 (Sub-No.1), Common Carrier Obligations of Railroads – Transportation of Hazardous Materials[1]

In NS's letter to the commissioners, NS states the following.

> *First, NS was asked to provide the percentage increase in its insurance costs since 2001 Since 2001, the amount NS has paid for insurance has increased 248% The largest increases year over year were in 2002, following the attacks of September 11, 2001, and the accident in Minot, North Dakota, and in 2005 and 2006, following the Graniteville, South Carolina accident.*

Our analysis of NS s R-1 data for the time period shows different results From 2001 – 2007 SK calculates the percentage increase in NS's reported Total Casualties and Insurance to be 24%.



[1] See NS letter to STB Commissioners dated August 15, 2008

NS's largest Other Casualties and Insurance account, Train Operations. Casualties and Insurance costs, saw a 20% increase from 2001 to 2007. Another significant dollar account which saw a large increase between 2001 and 2007 was Repair and Maintenance, Casualties & Insurance – running, which increased 52%. Both of these increases are well below the 248 percent increase in "the amount NS has paid for insurance"

In its letter to the STB, NS did not dispute Snavely King's analysis submitted on behalf of the Chlorine Institute Instead NS merely stated "the amount NS has paid for insurance has increased"

The percentage increase in the data NS reported in its 2001 through 2007 R-1 reports to the STB differs from the percentage increase in the "amount NS paid for insurance" stated in the NS August 15, 2008 letter.

VERIFICATION

I. Tom O'Connor, declare that the foregoing statement is true and correct and was prepared by me or at my direction Further, I certify that I am qualified and authorized to file this statement

Executed on August 20, 2008

Tom O'Connor

Tom O'Connor

Subscribed and sworn to before me this 20th day of August 2008 in the District of Columbia.

Notary Public

My Commission expires: March 14, 2011

1111 14th St N W ▪ Suite 300 Washington, DC 20005 ▪ 202 371-9149

STB Finance Docket No. 35504

UNION PACIFIC R.R. – PETITION FOR DECLARATORY ORDER

OPENING EVIDENCE AND ARGUMENT
OF
NORFOLK SOUTHERN RAILWAY COMPANY

EXHIBIT 11

222858

Robert T. Opal
General Commerce and FRA Counsel

July 15, 2008

Via E-Filing

The Honorable Anne Quinlan
Acting Secretary
Surface Transportation Board
395 E Street, SW
Washington, D.C. 20024

Re: Ex Parte No. 677 (Sub-No. 1) Common Carrier Obligation of Railroads – Transportation of Hazardous Materials (Corrected UP Written Testimony)

Dear Secretary Quinlan:

This refers to Union Pacific Railroad Company's Written Testimony filed July 10, 2008 in the above proceeding.

We have discovered that some wording was inadvertently omitted from the first bullet point on p. 16. The first sentence should read as follows:

> "UP crews handling TIH cars now must perform *or soon will be required to perform* a series of tasks that previously were not required." (additional language italicized)

Rather than submitting a corrected page, we are submitting with this letter a corrected copy of the entire submission, which should be substituted for the original. We have also taken this opportunity to make made some other minor, non-substantive corrections to the document (primarily formatting and punctuation).

Very truly yours,

Robert T. Opal

Att:

UNION PACIFIC RAILROAD 1400 Douglas Street STOP 1580 Omaha, NE 68179 ph (402) [illegible] fx (402) [illegible] [illegible]

CORRECTED

BEFORE THE
SURFACE TRANSPORTATION BOARD

EX PARTE NO. 677 (SUB-NO.1)

COMMON CARRIER OBLIGATION OF RAILROADS - TRANSPORTATION OF HAZARDOUS MATERIALS

WRITTEN TESTIMONY
OF
UNION PACIFIC RAILROAD COMPANY

PRESENTED BY

DIANE K. DUREN

VICE PRESIDENT & GENERAL MANAGER - CHEMICALS

UNION PACIFIC RAILROAD COMPANY

Date of Submission· July 10, 2008
Date of Public Hearing: July 22, 2008

TABLE OF CONTENTS

BEFORE THE
SURFACE TRANSPORTATION BOARD

EX PARTE NO. 677 (SUB-NO. 1)

COMMON CARRIER OBLIGATION OF RAILROADS - TRANSPORTATION OF HAZARDOUS MATERIALS

WRITTEN TESTIMONY
OF
UNION PACIFIC RAILROAD COMPANY

INTRODUCTION

My name is Diane Duren. I am the Vice President & General Manager – Chemicals for Union Pacific Railroad. I am responsible for the marketing, sales and customer relationship management activities for the Chemicals Business Group at Union Pacific Railroad. Chemical products include plastics, fertilizers, soda ash, LPG and petroleum products, as well as various liquid and dry chemicals. Most Hazardous Materials and all TIH commodities fall within the jurisdiction of the Chemicals Business Group. The Chemicals Group represents over $2 billion in annual revenue and approximately 900,000 carloads.

I began my career with Union Pacific Railroad in 1985 and have held a variety of positions in Finance and Marketing and Sales. In 1995, I was named Director of Sales for UP's Food Group; in 1997, Director of Logistics for Agricultural Products. In 2000, I became Vice President & General Manager - Agricultural Products, and performed in that role until appointment to my current position. I earned a Bachelor's degree in Business Administration with a major in Accounting from Creighton University in 1981.

My experience in both Finance and Marketing and Sales at Union Pacific has provided me with a unique perspective on Union Pacific's role and responsibilities as a participant in the TIH supply chain. The multiple issues involved in the production, transportation, consumption and end-use of TIH are of critical importance to our nation's economy, the communities through which these commodities travel, the producers and users of TIH, the transportation industry at large and Union Pacific. As I will explain, the safe and efficient handling of TIH throughout the supply chain is one of our highest priorities, but so also is fairly apportioning and balancing the burdens of risk and liability across this supply chain. Union Pacific believes that all participants in the TIH supply chain must bear responsibility for risk and liability for surface transportation of TIH; and further, that railroads should not be disproportionately burdened with the lion's share of that risk. We accept our obligation as a common carrier to transport TIH in the absence of safer, more logical alternatives, but we should not be forced to accept the full burden of risk and liability exposure associated with TIH transportation

I.

SUMMARY OF UNION PACIFIC'S POSITION ON COMMON CARRIER OBLIGATION OF RAILROADS TO TRANSPORT TIH

Union Pacific joins in supporting the AAR's comments. I will not address or repeat all the points made in the AAR comments but instead will focus on

Union Pacific's views of the TIH supply chain and the roles that the participants in that chain play.

To put my testimony into proper perspective, Union Pacific ranks the transportation of TIH chemicals as its most serious corporate risk. A TIH incident in the wrong place under the worst conditions, could bankrupt the company to say nothing of its effects on the public. With that in mind, my testimony will detail the following key points that are fundamental to our positions on TIH and the processes we employ (and are enhancing) to handle TIH as safely as possible and to minimize the risk and liability exposure we and the public face in transporting these commodities:

- An important set of solutions to TIH risk challenges are safer chemicals, product substitutions, improved tank cars, and actions external to railroads (use of pipelines and production of TIH commodities at the site of consumption), all of which would reduce the need for surface transportation of TIH, and the risks associated with this transportation.

- Product "Swaps" among producers could reduce TIH surface transportation by allowing TIH users to be supplied from the nearest production facility, but we cannot make them happen, and the Department of Justice will not apparently allow chemical companies to arrange them.

- Union Pacific and other railroads have taken, and continue to take, extensive actions to enhance TIH safety and security, including heavy investments in track and safety equipment. I will amplify what we have done to date, and our plan going forward.

- We communicate extensively with our customers about all facets of TIH transportation safety, process improvement, risk management and liability exposure and reduction.

- We collaborate with customers and other supply chain participants on safety process, infrastructure and equipment improvements.

- We are committed to changing behaviors - ours and that of our customers - in the name of improved safety and efficiency for the handling of TIH.

The government requires UP and other railroads to transport TIH chemicals. Even though we prefer not to carry TIH commodities, this government policy makes sense, in the absence of safer alternatives. Rail is the safest mode of surface transportation for these commodities --16 times safer -- than truck transportation. Because we are the safest mode of surface transportation for TIH bulk shipments, public policy makes us the mode of choice as long as TIH surface transportation is unavoidable. UP has an outstanding record in handling TIH. We invert heavily in time and money to improve TIH transportation safety and will continue to do so.

As context:

- In 2007, Union Pacific handled 533,765 hazardous materials loads and 31,622 TIH loads. Overall, UP handled 10 million carloads of total business.
- Of the 31,622 TIH loads, Chlorine and Anhydrous Ammonia combined for slightly more than 23,000 loads.
- 100% of the TIH loads were delivered without incident attributable to rail handling. UP did, however, experience six shipper caused releases of TIH, two of which occurred in High Density Population Areas [1](HDPA's).

II.
PUBLIC POLICY SHOULD ENCOURAGE ALTERNATIVES TO SURFACE TRANSPORTATION OF TIH

A. Product Substitution And On-Site Production

TIH products are currently used for agriculture, water treatment, and in the

[1] This is the new term for "High Threat Urban Areas" or HTUA's

manufacturing process for thousands of products. Although some TIH transport is presently unavoidable, the marketplace demonstrates that product substitution and on-site production -- for some TIH commodities in certain markets and applications -- is in fact feasible and economically viable. It is happening today, as several noteworthy examples show.

The first involves the reduction, and in some cases elimination, of direct field application of Anhydrous Ammonia as a fertilizer. We understand that several fertilizer producers are reconstructing their production facilities to produce less hazardous forms of nitrogen (such as urea and urea ammonium nitrate solutions) for direct field application. We applaud these efforts as they contribute to a safer supply chain for all participants. The movement to less hazardous forms of nitrogen is particularly beneficial since many receivers currently using Anhydrous Ammonia for direct field application are small businesses employing less security than a major production facility and are located in remote locations on the railroad network. In cases like this, moving an alternative to TIH provides a safer and more secure supply chain, while still allowing nitrogen to be delivered to support crop growth that is critical to our economy.

Another example involves a shift from the historic use of Chlorine as a water cleansing agent in water treatment facilities to bleach, other products or processes as substitutes. This substitution is gaining traction, and we applaud it Every carload of Chlorine that is removed from surface transportation removes an increment of risk and liability exposure from the supply chain.

We believe product substitution, even if limited in the near term, is a longer-term strategic direction that the chemical industry should pursue aggressively and that public policy should support. It will make the nation's chemical supply chain safer, and it will reduce the current risks in producing, transporting and consuming TIH. Union Pacific believes that a major reason product substitution does not occur today on a widespread basis and is not being aggressively pursued is because of cost and profit-margin motives of the producers. Public policies and economical incentives should be changed to accurately reflect risk and liability in those economic calculations.

Other feasible long-term solutions to many of the risks related to TIH transportation include improving the tank cars that carry the essential TIH shipments and co-locating production of TIH commodities near consumption. TIH can be, and often is, manufactured on the sites where it is consumed. TIH also can be, and often is, transported by pipeline without substantial risk. Ultimately and ideally, all TIH chemicals, including Chlorine and Anhydrous Ammonia, should travel by truck or train for only as few miles as is absolutely necessary.

B. Sourcing and Product Swaps

While we are willing and committed to transport TIH when alternatives are not practical or available, our experience in that TIH is often transported much longer distances over the rail network than is necessary. This occurs because producers often find it in their economic interests to market and transport TIH to distant users, and the users find it in their economic interests to purchase the product from distant suppliers rather than closer ones. Union Pacific's view is that surface transportation of TIH should be held to the absolute minimum necessary. As such, public policy – and Board policy – should encourage TIH to be sourced from the production facility closest to the point of consumption.

One way this can be done is for chemical manufacturers to sell to closer consumers, reducing the amount of TIH surface transportation. We have worked with customers to support such arrangements when we learn about these opportunities. Only the chemical manufacturers, though, can decide where and how to market and move their chemical products.

We have also tried to encourage product swaps among TIH producers. Under a "swap" arrangement, each manufacturer continues to make its own deals with end users, regardless of the distance of the users from the producer's manufacturing facilities. However, the product is actually supplied from the production facility closest to the user, regardless of the manufacturer which owns that facility. The convening, in 2007, of the FRA's Section 333 conferences, which were intended to help arrange swaps and eliminate unnecessary shipments, was a railroad industry initiative. The nation's railroads pushed aggressively for more than a year before government agencies agreed to conduct the conferences. The railroads met with the agencies to review our routes and look for route improvement opportunities. The chemical industry, however, never met with government agencies to discuss swaps, because the Department of Justice objected. We therefore must defer to the chemical manufacturers and the Department of Justice to explore the promising opportunities for product swaps on an industry-wide basis.

Union Pacific's view, again, is that producers protect their respective customer bases and perpetuate unnecessarily long, and high risk TIH movements for cost and profit motives. And the railroad and the public are left to bear the burdens of the risk and liability exposures.

Surprisingly to us, chemical producers continue to develop new, long distance TIH movements in spite of public and governmental concerns within the last eighteen months. One new plant in particular will require a large new, long-haul TIH movement. The site was selected because of the abundant, low-cost supply of other raw materials needed in the production process. There was no economic incentive for the producer to factor in the TIH transportation liability risk, and the attendant risks to the public, because the railroad and the public are expected to bear the full burden of risk and liability. We are willing to serve this plant, and accept our obligation to do so, but are not willing to accept the full burden of risk and liability exposure associated with it.

III.
RAILROADS BEAR DISPROPORTIONATE RISKS IN TIH TRANSPORTATION

For railroads, real, generally unavoidable, and possibly staggering economic consequences are associated with our common carrier obligation to transport TIH. The risk and liability exposure that goes with transporting TIH is borne largely by the railroads and, to some degree, by the communities the TIH moves through. Very little transportation related risk is shouldered today by TIH producers. Yet it is the producers and their customers who effectively make the decisions as to where TIH will be shipped. Without responsibility for transportation risk and liability exposure, producers underestimate true TIH supply-chain costs and, without accountability or responsibility for those costs, have no incentive to improve efficiency and safety by working to minimize the surface movements of TIH.

As previously discussed, Union Pacific experienced six shipper-caused, non-accident releases of TIH in 2007, two of them occurring in HDPA's. Each was a loading or equipment failure incident that was the responsibility of the shipper. Fortunately, no injuries or deaths resulted, but if they had, UP would likely have faced significant liability for failures that we did not cause.

In addition, we have experienced incidents where no member of the supply chain – not the producer, the railroad, the consumer, or the communities enroute – was responsible or at fault for an incident that could have been catastrophic. For example, in January, 2008 a train outside of Chicago was struck by a tornado, derailing 12 cars. One was a loaded Ethylene Oxide car. It landed on its side, was badly damaged, and had its steel jacket and body bolsters torn off. It did not leak, but a 1.5-mile evacuation was implemented. The point here is that UP handled a TIH car safely and according to all rules, yet came close, for reasons beyond our control, to a catastrophic incident that could have harmed the public

We are not, of course, saying that railroads are never responsible for an accident involving a TIH release. But even where the railroad may be responsible for the accident, it is the presence of TIH which can transform what otherwise would be solely a property damage event into a catastrophy.

Additional liability protection for handling TIH in situations such as these seems to be not only reasonable but intuitively just, given our common carrier obligation. Union Pacific feels strongly that all participants in the TIH supply chain should be responsible for their involvement and should share risk and liability exposure. Going forward, UP will institute new procedures intended to incent consistently safe and accident free behavior. I will elaborate further on this later in my testimony.

IV.
ACTIONS TAKEN BY UNION PACIFIC TO MAXIMIZE THE SAFE AND EFFICIENT HANDLING OF TIH

As one of the world's largest transporters of hazardous materials and TIH, Union Pacific has always been active in creating and promoting awareness about safety, both internally with its employees and externally in the communities and industries it serves. In 2007, we increased our public safety training and outreach programs and will continue this ramped-up involvement into the future.

- In reaching out to the communities we serve, we trained 6,055 emergency responders across 23 states during 2007 on hazardous material emergency management processes and procedures.

- Responsible Care, a well known American Chemistry Council Safety and Quality initiative, is a Continual Improvement Management System to which UP is committed. UP was the first railroad to be certified under the

ACC Responsible Care program and continues to be a leader in the program.

Internally, Union Pacific has a well established history of continuously refining and improving its safety practices. Consistent with that history and in response to the efforts of DHS/TSA and DOT/PHMSA to improve the security and safety of the nation's transportation infrastructure, we have taken additional steps over the past twenty-four months to ensure that all hazardous materials are handled on our network as safely, securely, and efficiently as possible. We have proactively implemented operational safety and security processes and practices that we feel will put us in full compliance with the new DOT/PHMSA regulations and with the anticipated DHS/TSA regulations when they become effective Our intent is to comply fully with all regulations. Several examples of the many safety improvement initiatives that we have recently completed or currently have in progress are:

- Strict adherence to a "no bill, no pull" policy. Under this policy Haz Mat cars are not pulled from a customer facility unless proper billing and shipping documentation is in our internal systems. We will not pull Haz Mat cars on informal instructions or documentation, such as handwritten switch lists from customer personnel. This assures that shipping documentation required by PHMSA rules is available in a form which will allow both railroad personnel and emergency responders to quickly determine a car's contents as it moves over the rail network. It has also reduced the number of Haz Mat cars sitting in yard awaiting billing instruction. Union Pacific now only moves Hazardous Material cars having waybills and is working with customers to facilitate this process.

- Reduction of TIH dwell time and substantial increases in the time that loaded TIH cars are under observation.

- Daily monitoring of all TIH movements for excess transit time, with appropriate corrective action.

- Installation of a customer Inventory Management System (CIMS), specifically for TIH, to manage inventory levels and avoid cars sitting in our terminals.[2]

- Requirement for positive hand-offs of TIH cars at points of interchange and with shippers and receivers. All customers that ship or receive TIH in a High Density Population Area (HDPA) are being contacted by a UP team to assess facility security and to discuss positive hand-off protocols.

In 2005, to further heighten our internal awareness of, and attention to, the safest possible handling of TIH, Union Pacific implemented a TIH Transportation and Compliance Program. Led by a Vice President and reporting quarterly to the Board of Directors through the railroad's Chief Compliance Officer, this initiative's purpose is to recognize and manage the inherent risks associated with TIH to achieve and maintain safe, reliable and efficient operations. This is accomplished by continually evaluating, documenting and improving our TIH transportation processes and mapping compliance versus plan for over twenty safety and process improvement projects.

To date, scores of new TIH related procedures have been implemented. Currently, TIH management process modifications are underway for:

- Consist accuracy improvements
- Hazardous material & emergency response plan revisions
- TIH dwell time reduction and process improvement
- Transportation plan review and modification
- Chemical facility inspections and security audits
- Chemical facility track and derail inspection procedures
- Positive handoff testing and deployment
- Compliance Assurance/Audit Process

[2] See UP's Comments in Ex Parte No 677, April 17, 2008, pp. 17-19 for a description of how the CIMS system was developed and how it operates.

Additionally, Union Pacific has participated for years in refining and developing safety procedures with federal, state and local law enforcement agencies and has been recognized repeatedly as a model for transportation safety analysis and improvement. Because the government requires us to transport TIH chemicals, and we regard this transportation as our top enterprise risk, we have taken extraordinary precautions to enhance security and safety. And more are under development.

Almost immediately after the September 11, 2001 attacks, and before the Department of Homeland Security (DHS) and TSA were created, Union Pacific participated with other railroads in establishing a Railroad Security Task Force. A primary goal of this task force was to help ensure the safety of rail employees and the communities in which railroads operate. Over the next several months, the task force conducted a comprehensive risk analysis of the freight rail industry. Using intelligence community "best practices," five critical action teams (consisting of more than 150 experienced railroad, customer, and intelligence personnel) examined and prioritized railroad assets, vulnerabilities, and threats. Separate critical action teams covered information technology and communications; physical infrastructure; operational security; hazardous materials; and military traffic needs.

These analyses generated the industry's Terrorism Risk Analysis and Security Management Plan, a comprehensive, intelligence-driven, priority-based blueprint of actions designed to enhance freight railroad security. The AAR adopted the plan in December, 2001 The rail security plan is robust and dynamic and has now been in effect for more than five years. It is evaluated and modified as necessary on an ongoing basis, and it has substantially raised the baseline of railroad security. We conduct exercises and tests to verify that it operates effectively. Union Pacific and the other railroads took this action without waiting for legislation or regulators to tell them what to do.

V.
THE INCREMENTAL COSTS OF HANDLING TIH

The costs associated with handling TIH in the safest manner possible, and in continuing to make the process, infrastructure and equipment improvements are significant. And they continue to escalate. We are initiating new improvement projects constantly and will continue to do so. Some of these costs are for improvements made solely for supporting TIH transportation and, as such, are well documented and can be easily quantified as TIH costs; others are still under development and/or analysis and are as yet not fully determined. Additionally, some improvements serve the rail enterprise as a whole and have an incremental impact on TIH, although the TIH-related cost portions of these are more difficult to quantify. Although we have not captured all costs, and our efforts continue to expand some examples of the costs associated with our commitment to be as safe as possible in moving TIH include:

- UP crews handling TIH cars now must perform or soon will be required to perform a series of tasks that previously were not required. The additional tasks include: verifying billing for no bill/no pull procedures; making a security inspection of each car; complying with positive handoff procedures at receipt, interchange and delivery; shoving all TIH cars to rest rather than allowing cars to roll to a stop; and entering additional information in the computer We estimate the average time to perform these tasks to be one hour per car handled. A three person crew's hourly cost is $97.59. Applied to an annual volume of 31,622 TIH cars, the incremental increase in crew costs is $3.1 million.

- Capital investments designed for TIH accident prevention and spent on locomotive safety equipment and car failure detection technology have totaled $34.5 Million. Assigned to an annual volume of 31,622 TIH cars, this equates to a capital cost of $1,091 per TIH car handled thus far.

- More than $10 million has been spent to modernize signaling on a line between Shreveport and Houston because the line handles significant TIH volumes.

The examples of TIH-related improvement costs cited above represent money spent exclusively to support TIH transportation. Were it not for TIH, these improvements and expenditures would not be made. Therefore, the allocation of these costs is appropriately applied to TIH volumes only and not to the railroad's overall volumes. In addition, several other capital projects have been completed for infrastructure, equipment and technology improvements that, while not exclusively dedicated to TIH movement, will contribute to the safer handling of TIH. While these improvements are not exclusively dedicated to TIH movements, the investment made and standards of maintenance achieved in these cases would not have been as high had there not been TIH moving on these routes. These include:

- Improvement of rail and track materials on routes that carry TIH.

- Increased maintenance on routes that carry TIH.

- Pilot program to test Positive Train Control on a route selected because of its TIH volumes.

The Board must allow UP to recover the incremental costs of handling TIH traffic from the shippers and receivers of this traffic by recognizing them when rate cases are brought against TIH rates. There is no public policy reason for requiring railroads to absorb these costs or for requiring a railroad's other customers to cross-subsidize them.

VI.
WORKING WITH OUR CUSTOMERS AND OTHER TIH SUPPLY CHAIN PARTICIPANTS

I have referred repeatedly in my testimony to the TIH supply chain. It includes chemical producers, shippers, receivers, transportation carriers, equipment manufacturers and any other people (groups or individuals) involved in the production, consumption, purchasing, selling or transportation of TIH. Many members of the TIH supply chain are our customers; others are partners in some form or another and still others are competitors.

Over the past several years, all members of the TIH supply chain have, of course, been focused on their own individual interests as the world of TIH around them was changing. UP realized shortly after 9/11/01 that communication and collaboration with some key members of the supply chain – particularly customers and partners – would be critical to our successes going forward. Since, we have worked hard to strengthen relationships and encourage dialogue. A continuum has evolved that integrates our internal activities regarding TIH with those of our customers and partners:

- We communicate to create awareness.
- We collaborate with customers and other stakeholders to create new and safer technologies and processes.
- We continually improve our internal processes and procedures which drive customer behavior changes

- We institutionalize change and then seek further improvement.

A. Communication and Awareness

We communicate extensively with our customers about all facets of TIH transportation safety, process improvement, risk management and liability exposure and reduction. Frank and honest exchanges are most important. Differences of opinion and view can often lead to creative solutions. But open and regular communication is most important.

We regularly brief customers and other members of the supply chain on developments within our company and industry that we feel will have impact on what we do together. Letters to customers containing TIH related information and "what to expect" updates go out regularly.

We also engage aggressively in direct communication with our TIH shippers and receivers – the customers. Every one of our customers is assigned an individual Union Pacific Marketing & Sales representative; that person meets regularly with the customer and arranges additional contacts within our company as needed, with whomever is needed. We also arrange customer forums and discussions where common issues and concerns can be vetted and addressed. We conduct these on an as-needed basis, and the feedback is positive. We host an Annual Safety Conference that is always well attended; last year, an entire section of the agenda focused on TIH, and a guest speaker from TSA participated on a TIH Awareness Panel.

We meet whenever necessary, or invited, with industry groups. We have found it productive to meet with industry groups to exchange views on a variety of topics and issues.

We have been willing, at the industry level, to exchange proposals with ACC for many months. The ACC's leadership has told us several times that they will deliver, in return, a proposal within as little as a few days, but they have never delivered. We do not see eye to eye with ACC on the several policy issues, but seek to keep channels open and dialogues alive.

We have a progressive and constructive dialogue ongoing with TFI (The Fertilizer Institute) concerning insurance coverage and liability caps. These issues are of prime importance to the railroads and the fertilizer industry. There is value in these discussions and hope that significant progress may be achieved.

While we hope to reach a mutually beneficial outcome to our negotiations with TFI, we believe a broader, more comprehensive solution that addresses all TIH commodities is necessary.

B. Collaboration

We have had significant success in recent years collaborating with customers and other partners within the industry on a variety of process, equipment and infrastructure issues. Some examples:

- Dow Memorandum of Cooperation: Dow Chemical and UP agreed to a Memorandum of Cooperation that establishes goals to enhance chemical transportation safety and security, ensure the long-term viability of both the railroad and chemical industries, and direct personnel from each organization to work together in a cooperative partnership to achieve critical goals.

- Tank Car of the Future: Union Tank Car Co., Dow, FRA and UP collaborated on a design for the "next generation tank car." By 2017, the goal is to develop and implement a new rail tank car design for the transportation of highly hazardous chemicals, achieving a 5 to10 fold improvement in safety and security performance over existing fleets.

- AAR Tank Car Committee: Union Pacific took the lead in encouraging the AAR's Tank Car Committee to evaluate new tank car designs. Several hundred of the new tank cars are now in service. Additional investment is on hold pending action on FRA's proposed tank car standard and uncertainty about whether the new cars will be grandfathered. Experts estimate that the new cars reduce risks of a release by approximately 65%.

- Transcaer Training on TIH Routes: In cooperation with community leaders across our system, in 2007 we trained 6,055 emergency responders in 23 states on hazardous material emergency management processes.

- Site Surveys: In 2007 and 2008, UP Operating, Customer Service, Marketing and Security personnel have made over 75 site visits to customer facilities receiving TIH in HDPA's to ensure that safety practices and protocols are in place and effective.

C. Internal Operating Practice Improvements Drive Customer Behavior Changes

Over the past several years, UP has made multiple operating practice changes that have significantly improved the safety of TIH handling and management. Many of these changes have required customers to change their own practices. Railroad crews and managers, as well as our customers, are united in believing that these changes have improved safety and reduced the risk of handling TIH. These changes include.

- No Bill/No Pull: If a car coming out of a Hazardous Material producing facility does not have proper railroad billing, UP crews will not take the car.

- CIMS for TIH: A Car Inventory Management System, built specifically for TIH loads, monitors inbound TIH cars and capacity for cars at the receiving location. It allows a customer to manage their inbound flow of TIH cars.

- Dwell Time Reductions – Cars Accepted on Arrival: Consistent with TSA's policy that railroads reduce dwell times for TIH cars, TIH cars must be accepted at the receiving location as soon as the railroad can deliver it. The railroad's intent is not to hold TIH cars.

- Positive Hand-offs: When custody of TIH cars is transferred between railroads or between the railroad and a customer, the exchange must be monitored.

- In-terminal TIH Car Handling Improvements: Cars are switched more carefully and safeguards that prohibit TIH cars from rolling free are in place

- Heightened Crew Awareness: We have increased the frequency of TIH rules, training and testing.

D. Institutionalizing Behavior Change – Customer Responsibilities

Having successfully implemented the operating practice changes detailed above, and discussed them with our customers so that there is full understanding about not only the reason for the changes, but also how they work, we plan additional steps to strengthen them. In keeping with our focus on the efficient handling of Hazardous Materials and TIH, and the safety of our employees, customers and the communities we serve and operate through, Union Pacific plans to implement six new Hazardous Material Policies and Procedures, with a particular focus on TIH commodities.

Over the near term, we will institute four new policies and procedures. These are intended to promote and ensure safe practices. Our customers are familiar with these practices. There will be charges associated with failure to comply. The initiatives are:

- Compliance with DOT Regulations (DOT Exceptions) – Covers customer responsibility DOT Exceptions discovered by UP, Federal or state inspectors.

- Safe Securement of Tankcars – Covers customer responsibility non-accidental release (NARS) occurring while a car is in UP's possession or on UP's property.

- No Bill/No Pull – Covers tendering of cars to UP from a hazardous material producing facility without proper railroad billing.

- Spot on Arrival – Covers a receiving location unable to accept a TIH car when the car is first available for delivery and UP must then hold the car.

Over a more extended term, we plan to institute two new policies and procedures. These also are intended to promote and ensure safe practices. Again, our customers are familiar with these practices, and there will be charges associated with failure to comply. The initiatives are:

- Tank Car Design – Will cover shipments of TIH shipped in pre-1989 non-normalized steel tank cars.

- Master Track Agreements – Will cover TIH shipments moving to, from or through a UP served industrial facility not covered by a UP Master Track or Industrial Track Agreement.

The purpose of the above measures is to provide customers with economic incentives for safer behavior. They are <u>not</u> revenue enhancement measures. Our objective is to change customer behavior so that the charges do not need to be imposed. We hope we will never have to charge a customer for failure to comply.

VII
CONCLUSION

Union Pacific is not asking to be relieved of its common carrier obligation to transport TIH. We recognize that, where TIH must move by surface transportation, railroads are the safest way to handle it. Accordingly, we are spending heavily to move TIH safely and plan to spend more. We are doing our part to make the TIH supply chain as safe as possible.

However, the current allocation of risks and incentives is unreasonable, both from the standpoint of the railroads and of the public. It requires railroads like UP to transport TIH regardless of the risk and liability exposure this service entails. It actually encourages unnecessary shipment of these highly dangerous materials by allowing shippers and receivers to shift the risk of their distribution decisions to the railroads. The Board's ratemaking methods also encourage unnecessary TIH transportation by preventing railroads from recovering their unusual costs. This is not sound public policy.

Accordingly, Union Pacific respectfully requests that:

- The Board issue a general policy statement recognizing that a railroad may, consistent with its common carrier obligation under 49 U.S.C.§ 11101 and its obligation to establish reasonable practices under § 10702, require that a TIH shipper provide the railroad with an indemnity covering liability from a release of the materials, above reasonable railroad liability as proposed in the separately filed comments of the Association of American Railroads. This would not only give railroads some protection against the enormous liability they face from the carriage of these highly dangerous materials, but place incentives on shippers and receivers of these materials to minimize use of surface transportation whenever possible;
- The Board allow railroads to reflect in their rates for TIH the incremental costs they incur in handling this traffic. This means that, in rate cases involving TIH, the Board would allow the use of adjusted costs that properly reflect the costs of TIH transportation; and

- The Board encourage the exploration of legislative and policy solutions to address the liability issues in TIH transport and also to create incentives to eliminate the transport of TIH over the long term, through measures such as product substitution and on-site manufacture of these commodities.

Respectfully submitted,

Diane Duren

STB Finance Docket No. 35504

UNION PACIFIC R.R. – PETITION FOR DECLARATORY ORDER

OPENING EVIDENCE AND ARGUMENT
OF
NORFOLK SOUTHERN RAILWAY COMPANY

EXHIBIT 12

UPS® TARIFF/TERMS AND CONDITIONS OF SERVICE FOR PACKAGE SHIPMENTS IN THE UNITED STATES

Effective January 2, 2012

CONTENTS

comply with federal, state, and local law, will be accepted for transportation.

–Firearms (including handguns) and firearm parts are not accepted for shipment internationally.

For more information, access www.ups.com/content/us/en/resources/ship/packaging/guidelines/firearms.html or contact UPS.

3.7 Food Transport; Assumption of Legal Responsibility

Shipments containing "food," as defined in section 201(f) of the Federal Food, Drug, and Cosmetic Act, will be accepted for transportation only according to the following terms and conditions. Shipper assumes all responsibility with respect to establishing and maintaining all records required under 21 C.F.R. Part 1 Subpart J §§ 1.326-1.363. In so doing, shipper assumes the legal responsibility under 21 C.F.R. § 1.363 for establishing and maintaining records that would otherwise be required to be maintained by UPS. Shipper agrees its records will comply with 21 C.F.R. § 1.352 and shall identify the immediate recipient of the transported food; the origin and destination points of shipment; the date the shipment is received and the date released; the number of packages shipped; a description of the freight describing the type of food received and released; and the route of movement. Shipper agrees expressly to make all records required by 21 C.F.R. § 1.352 available to FDA as required by 21 C.F.R. § 1.361. Shipper commits, and recognizes that it has the responsibility, to ensure that all such records are maintained consistent with the record retention requirements provided in 21 C.F.R. § 1.360 and the record availability requirements provided in 21 C.F.R. § 1.363. Shipper agrees that within 45 days of the date of shipment, Shipper will obtain or request from UPS any information needed from UPS to satisfy Shipper's responsibility to establish and maintain records. Shipper recognizes that the foregoing obligations with respect to establishing and maintaining records cannot be terminated. Shipper expressly agrees to immediately assume responsibility to establish and maintain records as provided in this paragraph, regardless of any FDA-designated compliance date for any provision of 21 C.F.R. Part 1 Subpart J.

3.8 Hazardous Materials Service

Hazardous Materials, defined as those materials regulated under Title 49 of the Code of Federal Regulations (49 C.F.R.) (excluding Limited Quantity/Other Regulated Materials (ORM-D) Ground shipments, as referenced below), and Dangerous Goods, defined as those materials regulated by the International Civil Aviation Organization (ICAO) and published in the International Air Transport Association (IATA) Dangerous Goods Regulations (collectively referred to as "Hazardous Materials," or "Dangerous Goods," or "International Dangerous Goods"), are accepted for transportation only as a contractual service and in accordance with the UPS Guide for Shipping Ground and Air Hazardous Materials, or the UPS Guide for Shipping International Dangerous Goods. To receive Hazardous Materials or Dangerous Goods service, the shipper must sign and agree to the provisions set forth in an approved UPS agreement relating specifically to the transportation of Hazardous Materials, Dangerous Goods, or International Dangerous Goods ("Hazardous Materials Agreement"). Contact UPS for specific information, including a list of "Common Items That May Be Classified as Hazardous Materials."

An additional charge will be assessed for each Hazardous Materials shipment. UPS may also assess an additional surcharge for packages containing certain types of Hazardous Material. Applicable surcharges are described at ups.com.

It is the shipper's responsibility to determine if a package contains a Hazardous Material and to properly classify, label, mark, and package it in accordance with applicable governmental regulations. When required, the shipper is responsible for ensuring that all of its employees involved in the preparation of Hazardous Materials for transport are properly trained, tested, and certified in accordance with 49 C.F.R. Part 172.700 through 172.704, or with IATA (Section 1.5) and for ensuring that a program exists for the retraining, testing, and certification as required by these rules.

All packaging used by the shipper for the transportation of Hazardous Materials, when required by regulation, must pass UN performance testing in accordance with 49 C.F.R. Part 178.602 through 178.609 or IATA (Section 6.0).

The shipper must use a software system, such as the most current version of WorldShip® that is acceptable to UPS for the preparation of documents for shipping Hazardous Materials, or an alternative method determined by UPS in its reasonable discretion to perform the same functions. UPS will provide shippers, upon request, a list of vendors who provide acceptable software systems.

UPS reserves the right to refuse to accept, to return, or to dispose of, in compliance with applicable laws and regulations, any Hazardous Material that it determines not to have been prepared in accordance with the UPS Guide for Shipping Ground and Air Hazardous Materials, the UPS Guide for Shipping International Dangerous Goods, and all applicable governmental laws and regulations. The shipper agrees to reimburse UPS for any costs or expenses incurred as a result of any improperly packed or prepared Hazardous Materials which shipper tenders to UPS. In addition, the shipper agrees to reimburse UPS for any costs or expenses incurred by UPS if Hazardous Materials tendered by the shipper are refused by the shipper upon return or cannot otherwise be delivered for any reason including, but not limited to, wrong delivery address or refusal of receiver to accept delivery.

UPS reserves the right, in its sole discretion and without prior notice to the shipper, to dispose of any international shipment containing Dangerous Goods refused by the receiver or which for any other reason cannot be delivered. Shipper shall be responsible for all disposal fees.

The shipper agrees to indemnify, defend, and hold harmless UPS, its parent corporation, and affiliated companies, their officers, directors, employees, agents, and their successors and assigns, from all claims, demands, expenses (including reasonable attorney's and consultants' fees), liabilities, causes of action, enforcement procedures, and suits of any kind or nature brought by a governmental agency or any other person or entity arising from or relating to the transportation of a Hazardous Materials package, from the shipper's breach of the Hazardous Materials Agreement or the Terms, or from the shipper's non-compliance with governmental laws or regulations applicable to the transportation of Hazardous Materials whether such action is brought by a governmental agency or other person or entity. Under no circumstances shall UPS be liable for special, incidental, or consequential damages arising from the transportation of a Hazardous Materials shipment.

Pursuant to 49 C.F.R. Part 173.30, in the event the shipper loads any UPS vehicle, the shipper agrees to segregate Hazardous Materials in accordance with 49 C.F.R. Part 177.848 and properly secure Hazardous Materials in accordance with 49 C.F.R. Part 177.834.

UPS does not accept Hazardous Materials in any amounts that require placarding under 49 C.F.R. Part 172, Subpart F. The shipper agrees not to tender Hazardous Materials to UPS in any amount for a single vehicle that would require placarding in accordance with 49 C.F.R. Part 172, Subpart F.

UPS reserves the right to discontinue or terminate service immediately with respect to the transportation of Hazardous Materials if the shipper fails to comply with any provisions of the Terms, or any applicable government regulations (including Limited Quantity/ORM-D shipments that are tendered without the proper shipping documentation). If a shipper tenders an undeclared Hazardous Materials package to UPS, UPS shall not be liable for the package in the event of loss, damage, delay, or misdelivery, nor shall UPS be liable for any special, incidental, or consequential damages.

If the shipper ships Hazardous Materials from more than one location, and the shipper fails to comply with any provisions of the Terms, the Hazardous Materials Agreement, or any governmental regulations, UPS may, in its sole discretion, terminate all of the shipper's shipment locations or limit such termination to those locations where the failure to comply occurred.

Shippers are prohibited from shipping and UPS will not accept for transportation packages containing any Hazardous Materials requiring shipping papers (defined as those materials regulated under Title 49 of the Code of Federal Regulations) or Dangerous Goods requiring Shipper's Declaration for Dangerous Goods documents, when such packages are presented for shipment at UPS Customer Centers, or Third-Party Retailers. Hazardous Materials requiring shipping papers cannot be picked up via UPS On-Call Pickup® service, or retrieved via any UPS Returns® Service.

Additional terms and conditions applicable to the shipment of Hazardous Materials are set forth in the UPS Guide for Shipping Ground and Air Hazardous Materials, and the UPS Guide for Shipping International Dangerous Goods, the terms of which are each incorporated here by this reference and available at http://www.ups.com/content/us/en/resources/ship/hazardous

3.9 Dry Ice

Packages containing dry ice (carbon dioxide, solid) as a refrigerant, but no other Hazardous Materials, are accepted for transportation within the United States via UPS Ground and UPS Air Services (provided such packages are prepared in accordance with all applicable governmental regulations) without a Hazardous Materials Agreement. Packages containing Hazardous Materials that use dry ice (carbon dioxide, solid) as a refrigerant are accepted for transportation within the United States via UPS Ground and Air Services only as a contractual service. Any package containing dry ice will be considered a Perishable Commodity. Packages containing dry ice may be tendered for shipment at locations of The UPS Store®, where such services are available.

3.10 Limited Quantity/ORM-D Packages

Limited Quantity/ORM-D packages are accepted for transportation without Hazardous Materials shipping papers within the 48 contiguous United States via UPS Ground or UPS Hundredweight Service® when properly classified, packaged, and marked. UPS Standard to Canada and UPS Ground (Intra-Alaska and Intra-Oahu) services are available for Limited Quantity/ORM-D shipments without a contract, provided the shipper has reviewed the required checklist and service restrictions with a UPS representative. Limited Quantity/ORM-D packages shipped via UPS Air Services and UPS 3 Day Select® within the United States and Puerto Rico are accepted for transportation on a contractual basis only.

3.11 Hazardous Waste, Mercury, and Mercury-Containing Waste

Packages containing hazardous waste, defined as a solid waste that meets any of the criteria of hazardous waste as described in 40 C.F.R. § 261.3, are not accepted for transportation.

UPS's acceptance for transportation of any elemental mercury, mercury-containing waste material, or used mercury-containing device (including, but not limited to, medical devices, spent or broken fluorescent lamps, thermostats, or

STB Finance Docket No. 35504

UNION PACIFIC R.R. – PETITION FOR DECLARATORY ORDER

OPENING EVIDENCE AND ARGUMENT
OF
NORFOLK SOUTHERN RAILWAY COMPANY

EXHIBIT 13

Rules And Special Service Charges (ABF 111-AD)

Effective: 07/25/2011 | Inquiry: 1/24/2012

Item 973 : Transportation of Hazardous Materials or Substances

(Subject to Notes 1 - 3)

ABF may accept shipments of hazardous materials or substances, as described in Title 49 CFR, for transportation in accordance with the transportation requirements of the U.S. Department of Transportation, subject to the following provisions:

1. Shipments of hazardous materials or substances will be subject to the following requirements:

A. Shipments of hazardous materials or substances which are delayed at any time due to restrictions imposed by any shipper, consignee or regulatory agency will be subject to a delay-in-transit charge of 200% of the storage charges published in Item 910 of this tariff. Such charges will begin at the time the shipment is delayed and continue until such time as transportation can be resumed or the shipment delivered to the consignee. Charges also apply on shipments delayed, by refusal or otherwise, at destination by consignee and begin upon Notice of Arrival (Item 345 of this tariff) to consignee.

B. The accrued charges will be collected from the party responsible for the delay or if delayed by a regulatory agency, charges will be collected from the shipper or party requesting movement of the shipment.

The carrier shall maintain a record of all such shipment and vehicle delays, including the arrival and departure times at points where delays occur and name of party responsible for such delays.

2. If required by federal, state or local regulations, ABF will prepare designated route plans which will set forth the routes to be utilized in transporting shipment of hazardous materials or substances from the initial origins to the final destinations. The designated route will be the shortest practical route over the highways approved by the appropriate state or local agency for the transportation of hazardous materials or substances and any interstate highway not disapproved by a state or local agency with enforcement authority. If the total distance from the initial origin to the final destination via the designated route of movement exceeds 115% of the shortest mileage from initial origin to final destination, the distance in excess of 115% will be charged for at the rate of $9.13 per mile per vehicle. All mileages shall be computed by use of Household Goods Carrier's Bureau, Agent, Mileage Guide (HGB 100 Series).

3. When special permits authorizing the transportation of specific shipments of hazardous materials or substances are required by federal, state or local regulations, the purchase costs of such permits will be paid by ABF and collected as follows:

A. The purchase costs of such permits, plus a service charge of $31.15 per permit, per state in which a permit is procured, shall be collected from the shipper or party requesting movement of the shipment.

B. Except for the service charge for each permit required, evidence of payment of all permit charges shall be furnished to the shipper or party requesting movement of the shipment upon request.

4. Any notation on the bill of lading which in any way limits or denies ABF access to the vehicle in which the shipment is loaded shall be deemed by ABF to require Exclusive Use of Vehicle services in accordance with the provisions of Item 525 herein.

5. Shipments containing Hazardous Materials, as described in Title 49 CFR, will be subject to an additional charge of $29.40 per shipment per trailer in addition to all other applicable charges.

Any fines, costs and/or penalties which are imposed on ABF as a result of the Shipper's failure to meet D.O.T. requirements will be charged back to the Shipper who shall reimburse ABF for losses incurred.

Note 1 - Nothing in this rule shall obligate carrier to transport shipments beyond the scope of their operating certificates or in violation of any law, regulation or ordinance.

Note 2 - Provisions of this Item do not apply on "HAZARDOUS WASTE(S) and/or WASTE MATERIAL" due to absence of carrier permit to transport such commodities.

Note 3 - Shipments containing hazardous materials or substances will not be accepted under ABF TimeKeeper® unless the Customer or third party payor provides full disclosure and prearranges with ABF. Complete disclosure of the commodity being shipped must be made during the quotation process and the proper description must be included on the original bill of lading at time of tender to carrier.

If ABF inadvertently accepts a shipment under the TimeKeeper program that fails to meet the above conditions, the TimeKeeper program including the service guarantee therein, shall be null and void. Further, any and all liability for damages resulting from the hazardous material shall be borne by the Customer.

ABF 111-AD, Item 973

<-Previous Item | Transportation Tax, Intrastate Shipments (Item 975)
Next Item -> | Waterborne Traffic (Item 988)

STB Finance Docket No. 35504

UNION PACIFIC R.R. – PETITION FOR DECLARATORY ORDER

OPENING EVIDENCE AND ARGUMENT
OF
NORFOLK SOUTHERN RAILWAY COMPANY

EXHIBIT 14

MATSON LOGISTICS, INC.
CUSTOMER SERVICES AGREEMENT

If Matson Logistics, Inc. ("Matson Logistics") and customer ("Customer") have not signed and executed a separate agreement pertaining to the services provided by Matson Logistics, the services described herein and in the Matson Logistics rate quote or other Matson Logistics-authorized document ("Matson Logistics Document') provided to Customer by Matson Logistics shall set forth the rights and obligations of Matson Logistics and Customer, and shall be governed by this Customer Services Agreement (the "Agreement") This Agreement has been authorized by representatives of Matson Logistics and Customer as of the date the service was first provided to Customer by Matson Logistics (the "Effective Date"). The term of this Agreement is for a period commencing on the Effective Date and until such time the services have been terminated.

Matson Logistics may change this Agreement at any time. You, the Customer, must review the Agreement on a regular basis. The changed Agreement is in effect immediately. If you do not agree to the terms of the changed Agreement, then you must stop using the Services. If you do not stop using the Services, then your use of the Services will be governed under the terms of the changed Agreement.

1. SERVICES.

1.1 - Matson Logistics, Inc. ("**Matson Logistics**") shall perform transportation brokerage services (the "**Services**") in arranging on behalf of the "**Retail Customer**" (beneficial owner, household goods forwarder, household goods carrier, steamship line, etc.), or "**Wholesale Customer**" (intermodal marketing company, logistics company, broker or other transportation intermediary, etc.), collectively where applicable, "**Customer**," noted in the statement provided by Matson Logistics to Customer setting forth pricing and terms for the intended Services (the "**Rate Quotation**") for the transportation of containers and/or trailers which may or may not include cargo (the "**Units**") between points in the continental United States (including Alaska), Hawaii, Canada, Mexico and Puerto Rico, per the terms and conditions set forth in this Customer Services Agreement (the "**Agreement**"). The terms set forth in the main body of this Agreement shall be considered in coordination with the additional terms set forth in **Exhibit A**, (Wholesale Customer-specific terms), and **Exhibit B** (household goods-specific terms), where applicable. If the terms and conditions set forth in the main body of this Agreement conflict with the terms of Exhibits A or B, the terms which provide Matson Logistics the most benefit shall govern. In the absence of written acceptance, the act of using Matson Logistics' Services shall constitute acceptance of this Agreement by Customer.

1.2 - Matson Logistics will act on behalf of Customer in arranging for the transportation of the Units. Matson Logistics does not itself provide transportation or assume carrier or insurance obligations. Matson Logistics shall use commercially reasonable efforts to obtain satisfactory performance from the underlying carriers for the Services provided. The above notwithstanding, Matson Logistics does not guarantee rail, trucking or air service on any schedule, whether published, projected, implied or otherwise. Furthermore, unless otherwise agreed to in writing, Matson Logistics does not guarantee the performance of the underlying carriers, and Customer shall not have any right, claim or cause of action against Matson Logistics resulting from the failure of underlying carriers to fulfill their obligations. Prior to the provision of Services, Matson Logistics and Customer shall agree to the origin and destination points of the transportation to be arranged for each Unit. All shipments are subject to the terms and conditions of this Agreement in effect at the time of the shipment. This is a non-exclusive agreement. Matson Logistics may offer its Services to other customers.

2. CHARGES. PAYMENTS. REMEDIES.

2.1 – The rates for Services provided by Matson Logistics, and the time such rates shall remain in effect, shall be set forth in the Rate Quotation. Domestic rates can only be used for domestic traffic. Unless specifically stated otherwise, Matson Logistics Wholesale Customer rates include only ramp-to-ramp rail linehaul charges. Matson Logistics rates are confidential and shall not be disclosed to any other party without the prior written consent of Matson Logistics.

2.2 - The rates for Services may be adjusted if the underlying carrier(s) pass on to Matson Logistics unexpected rate increases, such as fuel surcharges, at which time Matson Logistics shall have the right, upon five (5) days' notice, to increase its rates to Customer to recover such increases imposed upon Matson Logistics. Customer may not present a claim for an overcharge or overpayment unless such invoice or claim is submitted within one (1) year of the original shipment date. Customer shall, upon Matson Logistics' request, submit to Matson Logistics evidence of any applicable performance bond or other credit information. Customer shall remit payment to Matson Logistics within thirty (30) days from the date of each invoice. Customer is solely responsible for paying all charges for the Services and agrees to pay the full amount of the invoice without deduction or offset of any kind. If Customer fails to pay any invoice on or before its due date, Customer shall be subject to, and agrees to pay, a late charge of the lesser of 1.5% per month or the maximum rate permitted by law until paid in full.

2.3 - In the event a Customer fails to remit full payment of any Matson Logistics invoice within the allowable time set forth herein, such Customer and any designated consignee shall not be entitled to possession or delivery of cargo shipments in Matson Logistics' possession or control until all such unpaid invoices, whether or not the invoices relate to such cargo shipments, have been paid in full, and Matson Logistics shall have a lien upon on all cargo shipments in its possession or control until all unpaid invoices have been paid in full. In addition, as a precondition of delivery of any shipment, Matson Logistics may demand prepayment of its charges in the event Customer has failed to comply with the payment term provisions set forth herein for previous shipments The Customer is liable for all charges incidental to the Services provided herein, including, but not limited to, demurrage, detention, storage and return freight on any undelivered Units.

3. INSURANCE.

3.1 – When purchased by Customer, Matson Logistics will maintain and administer, as agent for such Customer, **all-risk cargo insurance** covering Customer's cargo, subject to policy terms and conditions. This insurance, provided by an independent insurance company (the "Insurance Company"), is summarized at www.matson.com/logistics/pdf/Insurance.pdf. Shipper's Interest all-risk cargo insurance is provided for a flat fee per container or trailer, except for special commodities and shipments that may require approval in writing prior to the loss and be individually insured under the Shipper's Premium Insurance program. All-risk cargo insurance is not available for certain less-than-truckload shipments, in which case the Matson Logistics Rate Quotation will list the underlying carrier's liability limits. The above notwithstanding, all-risk cargo insurance is not available for the transportation of household goods.

555 12th St.,
Oakland, CA 94607

- Paid freight bill.
- Commercial invoice and packing list
- Itemized claim statement (detailing claim amount)
- Signed proof of delivery receipt or record showing the condition and quantity of the cargo at the time it was unloaded.
- Survey report, verification of loss or damages and photos of damage. Digital pictures are acceptable and should be forwarded via e-mail to the Claims department. When taking pictures, take good photos of the container depicting the container number, loaded contents in the container prior to devanning, and the damage cargo in details(proof of the damaged boxes and photos of the damaged cargo within the box).
- Warehouse loading tally/packing list & unloading tally sheet.
- Shortage claims should also include that seals applied by the actual Customer and documents to show the number of pieces that were loaded and seals that were recorded at time of unloading as well as documents to show the number of pieces that were unloaded and the quantity and type of product that was noted short.
- Proof of salvage or disposition, if applicable.
- Any and all applicable supporting documents not mentioned above.

In addition, the following documents are required by the Wholesale Customer:

- Interchange documents of out-gate and in-gate at origin and destination. They must be furnished prior to filing a claim with the individual railroad.
- Original rail billing that was sent to Matson Logistics.

5. COMPLIANCE WITH LAWS. Customer is responsible for tendering the Units in compliance with all state, federal and local laws and regulations and the requirements of the underlying carriers, including, but not limited to, (i) all state, federal and carrier weight and dimensional requirements, (ii) international, federal and state laws and regulations and carrier requirements governing the transportation of hazardous materials, (iii) U.S Customs laws and regulations, and (iv) rules and regulations governing the safety of the Units (collectively the "Requirements"). Matson Logistics shall not be responsible for and Customer shall defend, indemnify and hold harmless Matson Logistics and any underlying carrier or depot operator from any loss, costs, fines, penalties or other expenses and any claims which result from non-compliance of the cargo or Units with the Requirements. Matson Logistics shall not be responsible for any rejection of the Units by the underlying carriers based on non-compliance with the Requirements. Customer shall advise Matson Logistics, at the time Customer requests Services, if a Unit requires handling as hazardous materials. Customer also shall provide Matson Logistics with all information and certifications regarding the Units necessary for Matson Logistics to arrange transportation of the Units in compliance with the Requirements.

6. RAIL CARRIER(S) TERMS AND CONDITIONS. Except where indicated, this Agreement does not govern or determine the contract of carriage between the rail carrier and the Customer, which Matson Logistics arranges as Customer's nominee. Liability, freight claims, storage charges, weight of lading, released valuation, hazardous materials rules, articles not accepted for shipment and other conditions of the rail carrier contract of carriage are as set forth in the individual rail carriers' rules and regulations, circulars, agreements, directories, memorandums and other documents as published by the rail carriers to govern intermodal shipments on their railroads.

Customer agrees and acknowledges that rail carriers have special rules and regulations pertaining to the shipment of restricted commodities, as that term is defined by each rail carrier, and that each rail shipment tendered through Matson Logistics under this Agreement is subject to such rules and regulations. Customer agrees to indemnify, defend and hold Matson Logistics harmless from and against any liability, losses, damages, claims, judgments, fines, penalties, lawsuits, expenses/costs, including, but not limited to reasonable attorney fees, related to death or personal injuries, property damage, environmental contamination, violation of local, state or federal laws or regulations or freight loss/damage resulting from or arising out of Customer's or its agent's negligence in the preparation and transportation of restricted commodities or any violation of the rail carrier's rule and regulations pertaining to such commodities.

In addition, Customer agrees to comply with rail carrier rules which stipulate, among other matters, standards for loading, blocking and bracing standards, prohibitions and restrictions on certain types of commodities, limitations of liability, requirements for shipping hazardous materials, procedures and limitations on cargo claims, and requirements for proper descriptions of commodities.

7. HAZARDOUS MATERIAL. Customer shall comply with all national, federal, state and local laws, rules and regulations, as well as all underlying carriers' rules, regulations and requirements pertaining to the loading and transportation of all hazardous materials, including explosives and dangerous articles The underlying carrier shall not be liable for damages incurred as a result of transporting hazardous materials, including damages resulting from any accident, leakage, or spillage of such materials, clean-up costs or damages claimed by third parties, unless such hazardous materials are: 1) declared in the shipping instructions, 2) correctly identified or certified pursuant to the requirements of the underlying carrier(s), and 3) loaded and secured to meet all requisite blocking and bracing requirements, including those set forth by the underlying carrier and the American Association of Railroads. Matson Logistics shall have no liability in connection with the transportation of hazardous material. All obligations set forth above shall be borne by Customer

8. WEIGHT RESTRICTIONS. Customer, not Matson Logistics, shall ensure that loaded Units meet all federal, state, and local highway loading and weight restrictions and requirements, as well those requirements set forth by the underlying carriers, where applicable

STB Finance Docket No. 35504

UNION PACIFIC R.R. – PETITION FOR DECLARATORY ORDER

OPENING EVIDENCE AND ARGUMENT
OF
NORFOLK SOUTHERN RAILWAY COMPANY

EXHIBIT 15

THE RAIL-BRIDGE CORP.®

Cargo Tracking Contacts Customer News Equipment Specifications Hub Locations Rules Circular

THE RAIL-BRIDGE CORP.®

Rules

Effective 9/15/2007

THE RAIL-BRIDGE CORPORATION®

RULES CIRCULAR 1

BINDING OBLIGATIONS OF ALL SHIPPER PARTIES IN CONNECTION WITH RBC ARRANGEMENT OF TRUCK OR RAIL TRANSPORTATION, INCLUDING ARBITRATION, INDEMNITY AND RAIL DOCUMENTATION OBLIGATIONS

THIS CIRCULAR IS EFFECTIVE ON SEPTEMBER 15, 2007, AND IS SUBJECT TO CHANGE WITHOUT NOTICE

ISSUED BY
THE RAIL-BRIDGE CORPORATION
DIVISION OF "K" LINE AMERICA, INC.
8730 Stony Point Parkway
Suite 400
Richmond VA 23235

Item 1 - General Rules

1. The provisions of this Circular apply to shipments arranged for any Shipper and its customer(s) by The Rail-Bridge Corporation® (RBC). The Rail Bridge Corporation is a Division of "K" Line America, not a separate corporation, and all references to "RBC" refer to "K" Line America, Inc. unless specifically stated otherwise. The term "Shipper" describes the entity with whom RBC deals directly, regardless of whether they are an intermediary, a carrier or cargo owner. The provisions of this Circular shall apply for the benefit of "K" Line America, Inc., its parent company, Kawasaki Kisen Kaisha, Ltd. ("K" Line) and their affiliates. It is Shipper's responsibility to make the contents of this Circular and its obligations hereunder known to all cargo interests and ensure compliance with all laws, regulations and rail or truck carrier requirements.
2. Shipper understands and agrees that RBC is acting only as an agent for Shipper (and its principals if it is not the cargo owner who is the sole Shipper party). RBC acts as nominee for Shipper in arranging domestic rail or truck services under its own name. Neither RBC, "K" Line America, nor any parent or affiliate company acts as a freight forwarder or a common or contract carrier of any kind in connection with any shipment. Shipper agrees on behalf of all cargo interests that neither RBC nor its parent or affiliates shall have liability to any person for cargo or other property loss, damage or delay or for personal injury or other damage occurring at any time. The terms and conditions governing railroad liability are contained in the railroad's governing publications and as set forth in the railroad contract clauses furnished herewith. All such terms and conditions apply to handling and movement of cargoes rranged by RBC as nominee. This Circular constitutes an offer by RBC to perform agency and nominee services. By requesting services, the Shipper accepts this offer and a binding contract is formed thereby, incorporating the obligations set forth herein. Shipper acknowledges, on its own behalf and on behalf of its customer(s) on whose behalf it acts in connection with any transaction that it has had the opportunity to declare a value for its goods and has declined to do so, thus all loss or damage limitations imposed by any carrier shall apply.
3. Shipper has the opportunity to execute an RBC Shipper Service Agreement prior to using RBC's services, but all provisions of this Circular shall apply automatically, regardless of whether such an Agreement is signed. Acceptance of RBC services is deemed to constitute agreement to all obligations imposed by this circular and all laws, *regulations and rail or truck carrier requirements*.
4. Except as otherwise agreed in writing, this Circular sets forth the terms and conditions under which RBC will arrange transportation services for any Shipper, and all other cargo interests, including cargo owners. Shipper may act only as a "Shipper" as defined below or maybe an "Actual Shipper" as defined below.
5. If any part, term, item or provision of this Circular be held by a court or by any agency to be unenforceable, illegal, against public policy, or in conflict with any federal, state, or local laws, such part, term, item or provision shall be considered severable from the rest of the Circular.

Return to Rules Listing

Vehicle: Container with or without bogie or chassis attached.

Return to Rules Listing

THE RAIL-BRIDGE CORP.

Rules

Effective 9/15/2007

Item 6 - Hazardous Material & Indemnity

Under the rules and regulations of AAR, the Department of Transportation, and applicable local, state and federal laws, a Shipper is legally bound to adhere to the provisions of the BOE6000/ US DOT 49CFR (Code of Federal Regulations) for US shipments. Shipper must also comply with TDG (Transport of Dangerous Goods) regulations for Canadian shipments. In addition, all provisions of any carrier's rules circulars, directives, memoranda, the contract provisions furnished herewith, and all other documents pertaining to the transportation of any cargo, including explosives, dangerous articles, and other hazardous materials are binding on Shipper. The rail carrier has no liability for, or in connection with any damages incurred as a result of transporting hazardous materials, including damages resulting from any accident, leakage, or spillage of such materials, clean-up costs or damages claimed by third parties, if such hazardous materials are not declared in the shipping instructions or which are not correctly identified or certified pursuant to the rules of the underlying carrier(s). RBC, as agent and nominee, shall have no liability in connection with the transportation, and all obligations under the above-referenced documentation shall be borne by Shipper, who shall defend, indemnify and hold harmless RBC, its parent and affiliates including attorney's fees, from any liability arising from any actions or transactions of any Shipper or any customers or principal of Shipper or anyone acting for Shipper.

Additionally, the Shipper shall be responsible for any fees levied by the rail carrier or other party if such hazardous materials are not declared in the shipping instructions or which are not correctly identified or placarded and prepared for transport and certified pursuant to the rules of the underlying carrier(s).

Return to Rules Listing

THE RAIL-BRIDGE CORP.

Rules

Effective 9/15/2007

Item 7 - Requirement for the Tender of Each Shipment

1. Shipper must provide complete and accurate shipping instructions to RBC at the designated RBC origin office (an up to date list is located on RBC's website www.Railbridge.com) at least two hours prior to the time the container is tendered to the rail carrier. The advance shipping instructions are necessary to provide time for the EDI billing to flow through to the rail carrier and prevent gate delays. Shipping instructions must include the following:

   A. Container Identification (Initial and Number);
   B. Origin Rail Terminal;
   C. Destination Rail Terminal;
   D. RBC Booking Number;
   E. Name of Shipper;
   F. Notify Party;
   G. Actual Shipper of Goods/Location Container to be loaded;
   H. Actual Receiver of Goods/Location Container to be unloaded;
   I. Lading Weight;
   J. Equipment Size;
   K. Seal Number;
   L. Commodity;
   M. Hazardous Material Description, if Applicable; and,
   N. RSCQ number if applicable.

2. RBC may audit the information submitted by Shipper as to commodity, actual shipper of goods, actual receiver of goods, actual origin, actual destination, applied rate, and other applicable information. Shipper will, upon reasonable request, make available to RBC sufficient documentation to substantiate the above information. If rate does not apply to the service actually provided then RBC will notify Shipper, who must

STB Finance Docket No. 35504

UNION PACIFIC R.R. – PETITION FOR DECLARATORY ORDER

OPENING EVIDENCE AND ARGUMENT
OF
NORFOLK SOUTHERN RAILWAY COMPANY

EXHIBIT 16

FedEx Ground Tariff

Tariff 200-Y, effective January 2, 2012

(Cancels Tariff 200-X, effective January 3, 2011)

Effective January 2, 2012

Contents

FedEx Ground Tariff

FedEx reserves the right to unilaterally modify, amend or supplement the rates, features of service, services, terms and conditions, and tariff in the FedEx Service Guide applicable to all customers without notice. All modifications, amendments or supplements may be authorized only by an officer in the Legal Department of FedEx Corporation or successor positions, but no other agent or employee of FedEx nor any other agent or party is authorized to do so.

The FedEx Service Guide consists of the Our Services information at fedex.com (U.S. and U.S. export), U.S., U.S. export, U.S. import and U.S. retail rates, the FedEx Express Terms and Conditions; and this FedEx Ground Tariff. The information in the Our Services section of the FedEx Service Guide is not part of the contract of carriage. To the extent that conflicts exist, if any, between the terms and conditions, other parts of the FedEx Service Guide, and the current versions, if any, of the FedEx Ground Tariff 200, the FedEx Ground Pick-Up Record, and fedex.com, the downloadable version (PDF) of the FedEx Ground Tariff (including any amendments, supplements or both) as then in effect on the date of shipment shall control.

Note. Unless otherwise specified in this tariff, the rules listed in this tariff apply to packages originating in the U.S. for transportation via a FedEx Ground service.

Scope of Tariff

A. **Participating Carriers** FedEx Ground Package System, Inc. (FedEx Ground) with packages originating in the U.S.

B. **Governing Publications** Except as otherwise provided, this tariff is governed by the following publications, supplements thereto or succeeding publications thereof FedEx Zone Locator (U.S.) and the rate information in the FedEx Service Guide in effect at the time of shipment. These publications are available at fedex.com

C. **Scope of Operations**

FedEx Ground Package System, Inc. (U.S.):

1. To operate as a CONTRACT CARRIER, by motor vehicle, in interstate or foreign commerce, over irregular routes, transporting GENERAL COMMODITIES (except Classes A and B explosives, household goods and commodities in bulk) between points in the U.S. under continuing contract(s) with commercial shippers, receivers or brokers of such commodities.
2. To operate as a COMMON CARRIER, by motor vehicle, in interstate or foreign commerce, over irregular routes, transporting GENERAL COMMODITIES (except Classes A and B explosives, household goods and commodities in bulk) in packages weighing 150 lbs. or less when transported in a motor vehicle in which no one package exceeds 150 lbs., between ground points in the U.S.
3. To operate as a common and contract carrier, by motor vehicle, in intrastate commerce, over irregular routes, transporting GENERAL COMMODITIES (except Classes A and B explosives, household goods and commodities in bulk) between points in the U.S.

Definitions

"Account-Specific Rates" are the rates paid by FedEx account holders who have discounts applied to their account and who charge their shipping to their FedEx account

"Business day" means Monday through Friday for FedEx Ground, and Tuesday through Saturday for FedEx Home Delivery, except for the following holidays

Memorial Day	Thanksgiving Day
Independence Day	Christmas Day
Labor Day	New Year's Day

Observation of holidays is subject to change. Refer to the holiday list on fedex.com for details

"Business delivery" means any delivery that is not a residential delivery

"Commercial delivery" means any delivery that is not a residential delivery

"Consolidator" means any person, corporation, partnership or other entity that is independent from FedEx and derives income from the consolidation of the packages of others for tender to us, including all FedEx Authorized ShipCenter locations and entities who have executed a Packaging and Pricing Agreement, Package Consolidator Agreement or Packaging Agreement with FedEx

"FedEx," "FedEx Ground," "our," "us" and **"we"** refer to FedEx Ground Package System, Inc., and its officers, employees and agents (but does not include cartage agents)

"In good credit standing" *means (1) that payment on the FedEx account is current,* (2) the account is not in "cash only" status, and, (3) for commercial or business accounts, the balance does not exceed the credit limit established by FedEx.

"Overcharge" means a charge based on an incorrect rate or an incorrect special handling fee, billing for the wrong type of service, or billing based on incorrect package or shipment weight or account number.

"Package" means any container and its contents, and includes any non-containerized article

"Proof of delivery" means electronically captured delivery information, which may include date, time, location and signature information

"Residential delivery" means a delivery made to a home or private residence, including locations where a business is operated from the home, and/or a delivery in which the shipper has designated the delivery address as residential. FedEx Ground also has FedEx Home Delivery service for residential packages

"Retail Rates" apply to shipments originating in the U.S. that are paid for by cash, check, debit or credit card instead of being charged to a valid FedEx account

"Return option" means FedEx Ground Package Returns Program (PRP), FedEx Ground Call Tag, FedEx Print Return Label and FedEx Email Return Label

"Service failure" means FedEx Ground did not deliver your standard ground and multiweight ground package(s) by the end of the scheduled delivery day as published on fedex.com, except as otherwise described in this tariff

"Shipment" means one or more packages shipped together to the same recipient

"Standard List Rates" are the rates paid by FedEx account holders who do not have discounts applied to their account and who charge their shipping to their FedEx account

"Transportation charges" mean amounts assessed for movement of a shipment and does not include any other fees or charges that may be assessed under the FedEx Service Guide, such as (but not limited to) declared-value charges, special handling fees, customs duties and taxes, collect on delivery (C.O.D.) charges, and surcharges

"Valid" as it relates to account numbers means a FedEx account number that has been issued by FedEx and that is in good credit standing.

"You" *or* ***"your"*** *means the shipper/sender, recipient and their agents, servants,* employees, and any other person or entity having or claiming an interest in a shipment.

Non-Waiver

Any failure by us to enforce or apply a term, condition or provision of this FedEx Ground Tariff does not constitute a waiver of that term, condition or provision and does not otherwise impair our right to enforce such term, condition or provision

Account Numbers

FedEx account holders who pay for shipments originating in the U.S. with cash, check, debit or credit card instead of charging to a valid FedEx account will be charged FedEx Retail Rates instead of FedEx Standard List Rates or Account-Specific Rates

Account numbers are issued by FedEx according to shipping location and are nontransferable. Account numbers are issued and used solely at the discretion of FedEx. FedEx may discontinue the use of accounts, in whole or in part, and terminate all or particular accounts and account numbers at any time, for any reason, at its sole discretion. Improper, illegal or any other misuse of your FedEx account may also, at the sole discretion of FedEx, result in loss of discounts or termination of the account. Improper, illegal or other misuse includes, but is not limited to, unauthorized consolidation of shipments owned by different parties, or violations of the terms and conditions in this FedEx Service Guide. If your account has been compromised or stolen, the account may be closed and you may be issued a new account. However, you will be responsible for all valid charges on the closed account. Any materials, rights or privileges that you acquire by holding a FedEx account number may not be used for any purpose other than shipping with FedEx, and FedEx may seek damages against you for any improper, illegal or other misuse of your account. If your account is terminated, we reserve the right, at our sole discretion, to deny your application for new or additional FedEx account numbers at any time in the future. All charges will be billed and must be remitted in U.S. funds

All requests for account numbers are subject to credit investigation and verification by our Credit Department and Customer Account Confirmation Department. FedEx utilizes business credit reporting agencies, audited financial statements, Standard & Poor's and Moody's bond ratings, and other sources as necessary, to determine eligibility for open

FedEx Ground Tariff

Delivery Signature Options

FedEx offers three Delivery Signature Options for shippers

A. **Indirect Signature Required.** FedEx will obtain a signature in one of three ways.

1. From someone at the delivery address, or
2. From a neighbor, building manager or other person at a neighboring address, or
3. The recipient can sign a FedEx door tag authorizing release of the package without anyone present.

B. **Direct Signature Required** FedEx will obtain a signature from someone at the delivery address If no one is at the address, FedEx will reattempt delivery

C. **Adult Signature Required.** FedEx will obtain a signature from someone at least 21 years old (government-issued photo identification required) at the delivery address If no eligible recipient is at the address, FedEx will reattempt delivery.

D. Shipments to residential addresses may be released without obtaining a signature. If you require a signature for a residential shipment, select one of the Delivery Signature Options.

E. **FedEx International Ground.** For FedEx International Ground shipments from the U.S. to residential addresses in Canada, FedEx may release the package without a signature. For FedEx International Ground shipments from the U S to nonresidential addresses in Canada, FedEx will attempt to obtain a signature

F. Special handling fees apply See Rates in the FedEx Service Guide

G. Indirect Signature Required is not available for shipments to nonresidential addresses

H. FedEx Ground may accept requests for address corrections from a shipper or a recipient for shipments involving the Direct Signature Required or Indirect Signature Required options, alcohol shipments, and shipments where no signature is required.

I. Also see the Billing, Money-Back Guarantee, Liabilities Not Assumed, Pickup and Delivery and Proof of Delivery sections.

Dimensional Weight (Volumetric Weight)

Transportation charges may be assessed based on dimensional weight, which is a volumetric standard. Dimensional-weight pricing is applicable on a per-package basis Customers who fail to apply the dimensional-weight calculation to a package may be assessed dimensional-weight charges from FedEx See the Dimensional Weight description in the Fees and Other Shipping Information section of the FedEx Service Guide for additional details

FedEx Home Delivery

A. A package is defined as a FedEx Home Delivery package if its bar code includes one of the designated FedEx Home Delivery service codes

B. Service days for FedEx Home Delivery packages are defined as Tuesday through Saturday for normal deliveries Saturday is not a service day for all areas Contact a FedEx account executive for additional information

C. FedEx Home Delivery shippers must transmit an electronic manifest that contains all package information directly to FedEx Ground in an approved electronic format The electronic transmission must include package weight, destination ZIP code, and recipient name and address. The package label must meet FedEx Home Delivery specifications, including the "H" on the bar-code label

D. FedEx Home Delivery packages may not weigh more than 70 lbs FedEx Home Delivery packages may not contain hazardous materials, except for materials classified as "Other Restricted Materials — Domestic" (ORM D), and may not be shipped under the FedEx Ground COLLECT service program

E FedEx Home Delivery packages may not be shipped in conjunction with FedEx Ground C.O D services (including C O D , Electronic C O D and Currency C O D)

F All FedEx Home Delivery packages will be considered residential, even if the packages are addressed to a business, and will be subject to the FedEx Home Delivery residential surcharge as published in the FedEx Service Guide in effect at the time of shipment

G Any FedEx Home Delivery package will be eligible for the FedEx Home Delivery Money-Back Guarantee and will not be eligible for the FedEx Ground Money-Back Guarantee. FedEx Home Delivery packages must meet all the terms and conditions of the FedEx Home Delivery service to qualify for the FedEx Money-Back Guarantee

H. Any package shipped as a FedEx Home Delivery package that fails to comply with the terms and conditions of this service may be refused by FedEx Ground, or if initially accepted by FedEx Ground, may later be returned to the shipper Noncompliance with the terms and conditions of FedEx Home Delivery may also result in additional charges upon written notice to the shipper

Firearms

A. FedEx Ground will transport and deliver firearms (excluding handguns) as defined by the United States Gun Control Act of 1968, between areas served in the U S , but only between

1. Licensed importers, licensed manufacturers, licensed dealers, licensed collectors, law enforcement agencies of the U S or any department or agency thereof, and law enforcement agencies of any state or any department agency or political subdivisions thereof, or
2. Where not prohibited by local, state and federal law, from individuals to licensed importers, licensed manufacturers or licensed dealers (and return of same)

B. If your shipment contains firearms, select the Direct Signature Required or Adult Signature Required Delivery Signature Option, depending on the requirements of your shipment See the Delivery Signature Options section for details Firearms shipments are not eligible for signature release, driver release or indirect delivery

C. FedEx Ground cannot ship or deliver firearms C.O.D.

D. Upon presenting the package for shipment, the person tendering the shipment to FedEx Ground is required to notify FedEx Ground that the package contains a firearm The outside of the package must not be marked, labeled or otherwise identify that the package contains a firearm.

E. The shipper and recipient must be of legal age as identified by applicable law

F. The shipper and recipient are required to comply with all applicable government regulations and laws, including those pertaining to labeling The Bureau of Alcohol, Tobacco, Firearms and Explosives can provide assistance.

G. FedEx Ground will transport small-arms ammunition when packed and labeled in compliance with local, state and federal law, and the Hazardous Materials section of this Service Guide Ammunition is an explosive and must be shipped separately as hazardous materials You agree not to ship loaded firearms or firearms with ammunition in the same package

H. FedEx Ground will not accept for transport handguns, assembled or disassembled

Fuel Surcharge

FedEx reserves the right to assess fuel and other surcharges on shipments without notice The amount and duration of any such surcharges will be determined at our sole discretion. By tendering your shipment to FedEx, the shipper agrees to pay the surcharges, as determined by FedEx The fuel surcharge rate, if applicable, is available at fedex com

Hazardous Materials

Packages containing hazardous materials, including materials classified as "Other Regulated Materials – Domestic" (ORM D), cannot be shipped via FedEx international services or to Hawaii or Alaska (consumer-commodity ORM-D can be shipped to Canada if properly labeled) Hazardous materials shippers must be properly qualified through a FedEx sales representative before tendering hazardous material packages via FedEx Ground

A. All packages containing hazardous materials must be properly classified, described, packaged, marked, labeled and in proper condition for transportation according to applicable regulations and FedEx Ground requirements FedEx Ground accepts only certain hazardous materials as listed in the current copy of the FedEx Ground Shipping Hazardous Materials Guide, which is incorporated herein by reference Contact a FedEx account executive, see fedex com or call 1.800.GoFedEx 1.800.463.3339 and say "hazardous materials" for more information

B. FedEx Ground does not accept for transportation hazardous waste, hazardous substances, inhalation hazards, and biohazards such as blood, urine, fluids and other noninfectious diagnostic specimens

C. Hazardous materials, except ORM-D materials, cannot be banded, strapped or taped to form a bundle Packaging restrictions and service restrictions apply Unless other U S Department of Transportation (DOT) restrictions apply, FedEx Ground does not accept hazardous materials over 70 lbs (32 kg) FedEx Ground does not accept pails or drums over 8 gallons (32 liters). All pails or drums must be in performance-oriented packaging (PCP). FedEx Ground will accept authorized pails or drums as single packaging Hazardous materials may not be shipped in any FedEx packaging

D. Hazardous material shipments, including shipments containing ORM-D materials or dry ice, are not accepted at FedEx Express Drop Box locations, FedEx Office Print and Ship Center locations FedEx World Service Center locations FedEx Express station or ramp locations, FedEx Authorized ShipCenter locations and unstaffed FedEx locations

E. Batteries, including lithium batteries, may be regulated when shipped for highway transport Shippers should refer to the most current U S Department of Transportation

(Hazardous Materials, cont.)

regulations to ensure compliance with marking, labeling and packaging requirements as they pertain to the transportation of batteries. Additional restrictions may apply to the transportation of lithium batteries between the contiguous U.S. and Alaska and Hawaii. For details, go to fedex.com and enter keyword "lithium batteries."

F. Packages containing hazardous materials are not eligible for FedEx Ground return options, except for packages shipped by preapproved shippers using the FedEx Ground Package Returns Program.

G. All damaged or leaking hazardous material packages may be properly repackaged, prepared in accordance with applicable DOT regulations and returned to the shipper. The undamaged portion of a damaged hazardous materials shipment will be returned to the shipper for recycling, reprocessing or disposal. If the shipper refuses to accept the returned shipment, or if the shipment cannot be returned to the shipper, as determined at our sole discretion, the shipper is responsible for and will reimburse FedEx Ground for all costs and fees of any type connected with the legal disposal of the shipment and all costs and fees of any type connected with cleanup of any spill or leakage.

H. No service guarantees (e.g., no FedEx Money-Back Guarantee) will apply to packages not properly prepared in accordance with DOT regulations and FedEx Ground requirements.

I. Hazardous material packages found in the FedEx Ground system not properly prepared in accordance with DOT regulations and FedEx Ground requirements will be held for customer pickup. If the shipper refuses to pick up or make other arrangements for delivery acceptable to FedEx Ground, the shipper will reimburse FedEx Ground for all costs and fees of any type connected with the legal disposal of the shipment. The shipper agrees to indemnify FedEx Ground for any and all costs, fees and expenses FedEx Ground incurs as a result of the shipper's failure to comply with FedEx Hazardous Materials shipping requirements.

J. In the event the shipper loads any FedEx Ground vehicle, the shipper agrees to segregate hazardous materials in accordance with regulations.

K. The shipper may be held accountable for all costs associated with any damaged or leaking hazardous material package that is not properly prepared in accordance with all DOT regulations and FedEx Ground requirements. Cost may include response, cleanup and disposal.

L. Materials classified as ORM-D are the only hazardous materials that can be shipped via FedEx Home Delivery.

M. Packages containing hazardous materials are not eligible for signature release, driver release or indirect delivery.

N. **Charge for Handling Hazardous Materials.** In addition to the other rates and charges named in this tariff, a charge will be assessed on each package of hazardous materials.

O. The shipper is required to transmit hazardous material shipping information using a FedEx electronic shipping solution, a FedEx-recognized hazardous materials vendor software application, a FedEx Compatible Solutions Program application or a custom solution that has the ability to transmit hazardous material shipping information electronically.

Inspection of Shipments

FedEx Ground reserves the right, but is not required, to open and inspect any package tendered to it for transport.

Liabilities Not Assumed

FEDEX GROUND WILL NOT BE LIABLE FOR ANY DAMAGES IN EXCESS OF THE DECLARED VALUE OF A SHIPMENT, WHETHER OR NOT FEDEX GROUND KNEW OR SHOULD HAVE KNOWN THAT SUCH DAMAGES MIGHT BE INCURRED.

In no event shall FedEx Ground, including, without limitation, agents, contractors, employees and affiliates, be liable for any special, incidental or consequential damages, including, without limitation, loss of profits or income, whether or not FedEx Ground had knowledge that such damages might be incurred.

FedEx Ground will not be liable for, nor shall any adjustment, refund or credit of any kind be made, as a result of any loss, damage, delay, misdelivery, nondelivery, misinformation or any failure to provide information, except such as may result from our sole negligence. FedEx Ground will not be liable for, nor shall any adjustment, refund or credit of any kind be given as a result of, any loss, damage, delay, misdelivery, nondelivery, misinformation or failure to provide information caused by or resulting in whole or in part from:

1. The act, default or omission of any person or entity, other than FedEx, including those of any local, state or federal government agencies.
2. The nature of the shipment, including any defect, characteristic or inherent vice of the shipment.
3. The shipper's violation of any of the terms and conditions contained in this tariff, as amended from time to time, including, but not limited to, the improper and insufficient packing, securing, marking and labeling of shipments, or use of an account number not in good credit standing.
4. Perils of the air, public enemies, criminal acts of any person(s) or entities, including, but not limited to, acts of terrorism, public authorities acting with actual or apparent authority, authority of law, local disputes, civil commotions, hazards incident to a state of war, local, national or international weather conditions (as determined solely by FedEx Ground), local, national or international disruptions in ground transportation networks (as determined solely by FedEx Ground), strikes or anticipated strikes (of any entity, including, but not limited to, other carriers, vendors or suppliers), labor disruptions or shortages caused by pandemic conditions or other public health event or circumstances, natural disasters (earthquakes, floods and hurricanes are examples of natural disasters), conditions that present a danger to FedEx Ground personnel, and disruption or failure of communication and information systems (including, but not limited to, FedEx Ground systems).
5. Damage or loss of articles packaged and sealed by the sender or by person(s) acting at the sender's direction, provided the seal is unbroken at the time of delivery, the package retains its basic integrity, and the recipient accepts the shipment without noting the damage on the delivery record.
6. Erasure of data from or the loss or irretrievability of data stored on magnetic tapes, files or other storage media, or erasure or damage of photographic images or soundtracks from exposed film.
7. The loss of any personal or financial information including, but not limited to, social security numbers, dates of birth, driver's license numbers, credit card numbers and financial account information.
8. Our inability to provide a copy of the delivery record or a copy of the signature obtained at delivery.
9. Failing to meet our delivery commitment for any shipments with an incomplete or incorrect address. (See the Undeliverable Shipments section.)
10. Failing to obtain the signature option requested for shipments using FedEx Delivery Signature Options.
11. Shipments released without obtaining a signature at residential addresses. (See the Delivery Signature Options section.)
12. Shipments released without obtaining a signature at nonresidential addresses if a signature release is on file. (See the Delivery Signature Options section.)
13. Our failure to honor package-orientation graphics (e.g., "up" arrows, "this end up" markings), "fragile" labels or other special directions concerning packages.
14. Damages indicated by any shockwatch, tiltmeter or temperature instruments.
15. Your failure to ship goods in packaging approved by us prior to shipment where such prior approval is recommended or required.
16. The shipment of fluorescent tubes, neon lighting, neon signs, X-ray tubes, laser tubes, light bulbs, quartz crystal, quartz lamps, glass tubes such as those used for specimens, and glass containers such as those used in laboratory test environments.
17. Your use of an incomplete, inaccurate, or invalid FedEx account number or your failure to provide a valid FedEx account number in good credit standing in the billing instructions on shipping documentation.
18. Our failure to notify you of any delay, loss or damage in connection with your shipment or any inaccuracy in such notice.
19. Performance of any services will not constitute FedEx Ground as the shipper's or anyone's agent for any purpose.
20. Damage to briefcases, luggage, garment bags, aluminum cases, plastic cases or other items when not enclosed in outer packaging, or other general shipping containers caused by adhesive labels, soiling or marking incidental to transportation.
21. Shipping of plants and plant materials is discouraged with FedEx Ground. FedEx Ground assumes no liability for damages in transit or damages resulting from delay of shipments.
22. Any package where FedEx Ground package scan records do not reflect acceptance of the package by FedEx Ground from the shipper.
23. The shipper's failure to delete all shipments entered into a FedEx self-invoicing system, Internet shipping device or any other electronic shipping method used to ship a package, when the shipment is not tendered to FedEx. If you fail to do so and seek a refund, credit or invoice adjustment, you must comply with the notice provisions in Invoice Adjustments/Overcharges in the Billing section.

STB Finance Docket No. 35504

UNION PACIFIC R.R. – PETITION FOR DECLARATORY ORDER

OPENING EVIDENCE AND ARGUMENT
OF
NORFOLK SOUTHERN RAILWAY COMPANY

EXHIBIT 17

FedEx Ground

Hazardous Materials

Shipping Guide

FedEx Ground

FedEx Ground Package Systems Inc. is committed to the safe transportation of hazardous materials. It is very important that each person engaged in the transportation of hazardous materials become thoroughly familiar with the Title 49CFR (Code of Federal Regulations). This guide is intended only to assist you in your preparation of hazardous materials shipped via FedEx Ground Package Systems Inc. It is the shipper's responsibility to ensure each hazardous material package is in compliance with applicable Department of Transportation (D.O.T.) regulations and FedEx Ground Package Systems Inc. requirements. Failure to comply with these regulations and requirements may subject the shipper and carrier to fines and penalties.

Due to the changing nature of D.O.T. regulations and other information, it is impossible to guarantee absolute accuracy of the material contained in this guide. FedEx Ground Package Systems Inc., therefore, cannot assume any responsibility for omissions, errors, misprinting, or ambiguity contained within this guide and shall not be held liable in any degree for any loss or injury caused by such omission or error presented in this publication.

The *FedEx Ground Hazardous Materials Shipping Guide* is intended to simplify Title 49 CFR. FedEx Ground Package Systems Inc. reserves the right to be more restrictive than the federal regulations (49 CFR). Customers should be thoroughly familiar with the applicable sections of this guide when shipping hazardous materials via FedEx Ground Package Systems Inc. This guide reflects current dockets under final rule published on or before March 1, 2009.

-TABLE OF CONTENTS-

FedEx Ground Prohibited Hazardous Materials:

CLASS	NAME	LABEL CODE / LABEL
1.1	Explosives	1.1 / Explosive 1.1
1.2	Explosives	1.2 / Explosive 1.2
1.3	Explosives	1.3 / Explosive 1.3
1.5	Explosives	1.5 / Explosive 1.5
2.3	Poisonous Gas	2.3 / Poisonous Gas
4.2	Spontaneously Combustible Material	4.2 / Spontaneously Combustible
4.3 *	Dangerous When Wet	4.3 / Dangerous When Wet
6.1	Poisonous Materials (PG I & II, Inhalation Hazards)	6.1 / Poison
6.1 *	Poisonous Materials (PG I & II, Non-Inhalation Hazards)	6.1 / Poison
6.1 *	Poisonous Materials (PG III)	6.1 / Keep Away From Food
6.2	Infectious Substance	6.2 / Infectious Substance
7	Radioactive Material II and III	7 / Radioactive Yellow II & III

* FedEx Ground will handle these materials only when packaged according to a DOT Special Permit, or when packaged in accordance with DOT exception 49 CFR 173.13.

Important: Hazardous materials, including ORM-D, via FedEx Ground service are acceptable within the contiguous United States. Hazardous materials, including ORM-D materials, **cannot** be shipped to Alaska or Hawaii. Consumer Commodity ORM-Ds only, can be shipped into Canada. However, you cannot ship Cartridges, small arms or Cartridges, power devices to Canada.

FedEx Ground Acceptable Hazardous Materials:

CLASS	NAME	LABEL CODE / LABEL
1.4*	Explosives	1.4 / Explosive 1.4
1.6	Extremely Insensitive	1.6 / Explosive 1.6
2.1	Flammable Gas	2.1 / Flammable Gas
2.2	Non-Flammable Gas	2.2 / Non-Flammable Gas
3	Flammable Liquid	3 / Flammable Liquid
4.1	Flammable Solid	4.1 / Flammable Solid
5.1	Oxidizer	5.1 / Oxidizer
5.2	Organic Peroxide	5.2 / Organic Peroxide
7	Radioactive Material I	7 / Radioactive White I
8	Corrosive Material	8 / Corrosive
9	Miscellaneous Hazardous Materials	9 / Class 9
ORM-D	Consumer Commodity (ORM-D)	ORM-D/Consumer Commodity
ORM-D	Cartridges, small arms (ORM-D)	ORM-D/Cartridges, small arms

* Except fireworks

FedEx Ground Conditions and Requirements:

General

All packages containing hazardous materials must be properly classified, described, packaged, marked, labeled and in proper condition for transportation according to applicable DOT regulations and FedEx Ground requirements. FedEx Ground does not accept hazardous material packages prepared under the IATA/ICAO (International Air Transport Association/International Civil Aviation Organization) regulations. HazMat packages and paperwork are inspected by FedEx Ground. Packages will not be transported if not in full compliance with DOT and company requirements.

All packages offered and prepared under a DOT Special Permit (DOT-SP) must provide a copy of the Special Permit paperwork to the accepting facility (origin terminal).

All shippers must be prepared to provide a copy of the Material Safety Data Sheet (MSDS) for their materials when requested by FedEx Ground.

Service

- Shippers must be properly qualified through a FedEx Account Executive before offering hazardous material packages via FedEx Ground. Please contact FedEx Ground Customer Service at 1-800-GO-FEDEX (1-800-463-3339) for more information.

- Hazardous materials, including ORM-D, via FedEx Ground service are acceptable within the contiguous United States. Hazardous materials, including ORM-D materials, **cannot** be shipped to Alaska or Hawaii. Consumer Commodity ORM-Ds only, can be shipped into Canada. However, you cannot ship Cartridges, small arms or Cartridges, power devices to Canada.

- Call Tag service is not available for hazardous materials, except ORM-D's.

- Guaranteed service may not apply to packages not properly prepared in accordance with DOT regulations and FedEx Ground requirements.

- Hazardous material shipments, including ORM-D's, are not accepted at FedEx Express drop box locations, FedEx Office, FedEx World Service Center locations, FedEx Authorized ShipCenters or any unstaffed FedEx locations.

Material Restrictions

Refer to column 9 of the FedEx Ground Hazardous Materials Table for additional restrictions and requirements for specific hazardous materials.

FedEx Ground does not accept:

- Reportable quantities (RQ)
- Hazardous Waste
- Any material that is an "Inhalation Hazard"
- Fireworks
- Biohazards such as blood, urine, fluids and other noninfectious diagnostic specimens.

Hazardous Materials Security

Shippers and carriers are required to develop and implement a security plan addressing risks related to the transportation of hazardous materials. FedEx Ground has a Security Plan in place and is in full compliance with this regulation, along with the security-training requirements specified in 49 CFR 172.704.

Note: Due to the sensitive nature of this information, we cannot make a copy of our security plan available to our customers.

Packaging

All hazardous materials must be packaged in United Nations Performance Oriented Packaging (UN POP) except when non-specification packaging is authorized by the 49 CFR. All packaging must meet the requirements set out in 49 CFR 173.24 and 173.24a. Packaging that is not in new or "like new" condition will not be accepted. In addition, the following requirements apply:

- FedEx Ground requires Fiberboard "Non-Specification Packaging" or "Strong Outer Packaging" to meet the following requirements:
    - For packages weighing up to 20 lbs. the outer package minimum requirements will be a 200 lb. Bursting test or 32 Edge Crush test package.
    - For packages weighing 21-50 lbs. a 250 lb. Bursting test or 44 Edge Crush test will be required.
    - For packages weighing 51-70 lbs. the outer container must be 275 lb. Bursting test or 55 Edge Crush test.

- Hazardous materials cannot be shipped in any FedEx packaging.

- Class 2 cylinders must be placed inside an overpack (outer package) marked "OVERPACK."

STB Finance Docket No. 35504

UNION PACIFIC R.R. – PETITION FOR DECLARATORY ORDER

OPENING EVIDENCE AND ARGUMENT
OF
NORFOLK SOUTHERN RAILWAY COMPANY

EXHIBIT 18

Con-way® TRUCKLOAD

MC 119399

TARIFF CTRQ 1000-E
Cancels and Replaces
CTRQ 1000-D

NAMING

GENERAL CARRIAGE

Rules, Regulations, Rates and Charges for Accessorial Services.

For governing publications, see Item 100.

:tanna

ISSUED: March 15, 2010 **EFFECTIVE: March 15, 2010**

APPLICATION	ITEM
APPLICATION OF RATES- HAZARDOUS AND/OR RADIOACTIVE COMMODITIES (Subject to Notes A, B & C)	180-30

Carrier will/will not transport hazardous and/or radioactive commodities pursuant to the following listings.

HAZARDOUS MATERIALS WILL ACCEPT / WILL NOT ACCEPT LIST

WILL ACCEPT	WILL NOT ACCEPT
Explosives 1.4	Explosives 1.1
Explosives 1.5	Explosives 1.2
Explosives 1.6	Explosives 1.3
Flammable Gas 2.1	Poison 6.1
Non-Flammable Gas 2.2	Keep Away From Food 6.1
Flammable 3	Poison Gas 2.3
Combustible	Toxic or Toxin
Flammable Solid 4.1	Spontaneously Combustible 4.2
Oxidizer 5.1	Dangerous When Wet 4.3
Corrosive 8	Organic Peroxide 5.2
Class 9	Radioactive 7
ORM-D	Hazardous Waste

Note A: All materials listed in the "Will Accept" column are subject to denial based on packaging and quantities.

Note B: Exceptions to the "Will Not Accept" column can only be made by the following Con-way Truckload Inc's personnel:
President, Vice-President - Safety, Safety Manager-Claims

Note C: Hazardous materials shipments shall be subject to an additional fee as provided in Item 569 herein.

APPLICATION OF RATES TO POINTS IN NEW YORK — ITEM 190

Except as otherwise specifically provided, rates and/or charges for shipments (1) destined for final delivery and/or stopped in transit for partial unloading; or, (2) shipments stopped in transit for partial loading; at locations with in New York zip codes 100-104 and/or 110-119, shall be subject to an additional charge of $450.00 per shipment. (See Note A) This charge will be in addition to all other applicable charges.

Note A: This charge shall not be applicable on shipments originating from the defined New York zip codes 100-104 and/or 110-119 which require no stop in transit services in New York zip codes 100-104 and/or 110-119.

STB Finance Docket No. 35504

UNION PACIFIC R.R. – PETITION FOR DECLARATORY ORDER

OPENING EVIDENCE AND ARGUMENT
OF
NORFOLK SOUTHERN RAILWAY COMPANY

EXHIBIT 19

Tariff 100 Item 540 (U.S. Domestic and Cross Border)

RULES, CHARGES AND ACCESSORIAL SERVICES

EXPLOSIVES AND OTHER DANGEROUS ARTICLES
Inquiry Date: JANUARY 18 2012
Effective date: NOVEMBER 04 2009

DEFINITION - Hazardous commodities are those as classified hazardous by the U S Department of Transportation and published in the Code of Federal Regulations (CFR), Title 49.

Except as described within this item, carrier will accept shipments of hazardous commodities within the scope of its authority and in accordance with the requirements of:

U.S. Department of Transportation
U.S. Nuclear Regulatory Commission
Environmental Protection Agency

Carrier does not accept hazardous materials or dangerous goods (as defined, and/or controlled, by the rules and regulations of IATA, ICAO or the U.S. Department of Transportation) for air transportation

Shipments containing mixtures of two or more hazardous materials will be subject to the highest charge for any individual hazardous class in the mixture.

ADDITIONAL COSTS - Shipments delayed due to restrictions imposed by consignor, consignee, or regulatory agency or refused at destination by consignee will be subject to labor and equipment or storage charges. The carrier's liability in the event of described delay will be that of a warehouseman. The charges associated with these delays will be collected from:

1) Party responsible for delay.
2) Shipper or party requesting movement of shipment if delayed by regulatory agency

LIABILITY - When packages are defective or leaking through no fault of the carrier, the consignor will be liable for all cost.

PERMITS - The carrier will pay the cost of permits and advance the charge to the consignor or party requesting movement of the shipment when required by regulatory bodies. The carrier upon request will supply evidence of payment of permits

APPLICATION - The following property will not be accepted for shipment.

Asbestos

Explosives - Division 1 1, 1 2, 1 3
Explosives - Division 1 5 greater than 1,000 lbs.

Infectious Substances - Division 6.2

Nitrocellulose

Polychlorinated Biphenyls (PCBs)

Radioactive Materials - Class 7 Radioactive Materials in Highway Route Controlled (HRC) quantities only

Toxic Inhalation Hazard Material Zone A (any quantity)

Toxic Inhalation Hazard Material Zone B (in bulk containers with a maximum capacity greater than 119 gallons (450 liters) for a liquid or water capacity greater than 1,000 lbs, (454 kg) as a receptacle for a gas.)

Waste - Hazardous and non-hazardous.

In addition to the above, the following commodities shall not be accepted for ONET shipments unless the shipper/payer obtains a quote from the YRC Customer Service Center by calling 1 (800) 610-6500, option 4:

Dangerous when wet, Class 4.3, as listed in Hazardous Materials publication CFR49

Spontaneously combustible Class 4.2, as listed in Hazardous Materials publication CFR49

Oxidizer Class 5 1, as listed in Hazardous Materials publication CFR49

Poison Class 6.1, as listed in Hazardous Materials publication CFR49

Poison gas Class 2 3, as listed in Hazardous Materials publication CFR49

ISSUED BY
Vice President, Finance
10990 Roe Avenue, Overland Park, KS 66211