



NATIONAL TRANSPORTATION SAFETY BOARD - **Public Hearing**

Conrail Derailment in Paulsboro, NJ with Vinyl Chloride Release

<b>GROUP</b>	<b>3</b>
<b>EXHIBIT</b>	
<b>A</b>	

Agency / Organization

National Transportation Safety Board

Title

## NTSB Hazardous Materials Group Chairman's Factual Report



# National Transportation Safety Board

Washington, D.C. 20594

Report Date: June 17, 2013

## Hazardous Materials Group Chairman's Factual Report

### A. Accident Identification

Carrier: Consolidated Rail Corporation (Conrail)  
Train No.: FC4230  
Location: Paulsboro, New Jersey  
Date/Time: November 30, 2012, at 6:59 a.m. EST  
NTSB No.: DCA-13-MR-002

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### C. Accident Summary

On Friday, November 30, 2012, at 6:59 a.m. EST, southbound Consolidated Rail Corporation (Conrail) freight train FC4230 consisting of two locomotives and 82 cars derailed seven cars, the 6<sup>th</sup> through the 12<sup>th</sup>, near milepost 13.7 on the Conrail Penns Grove Secondary track in

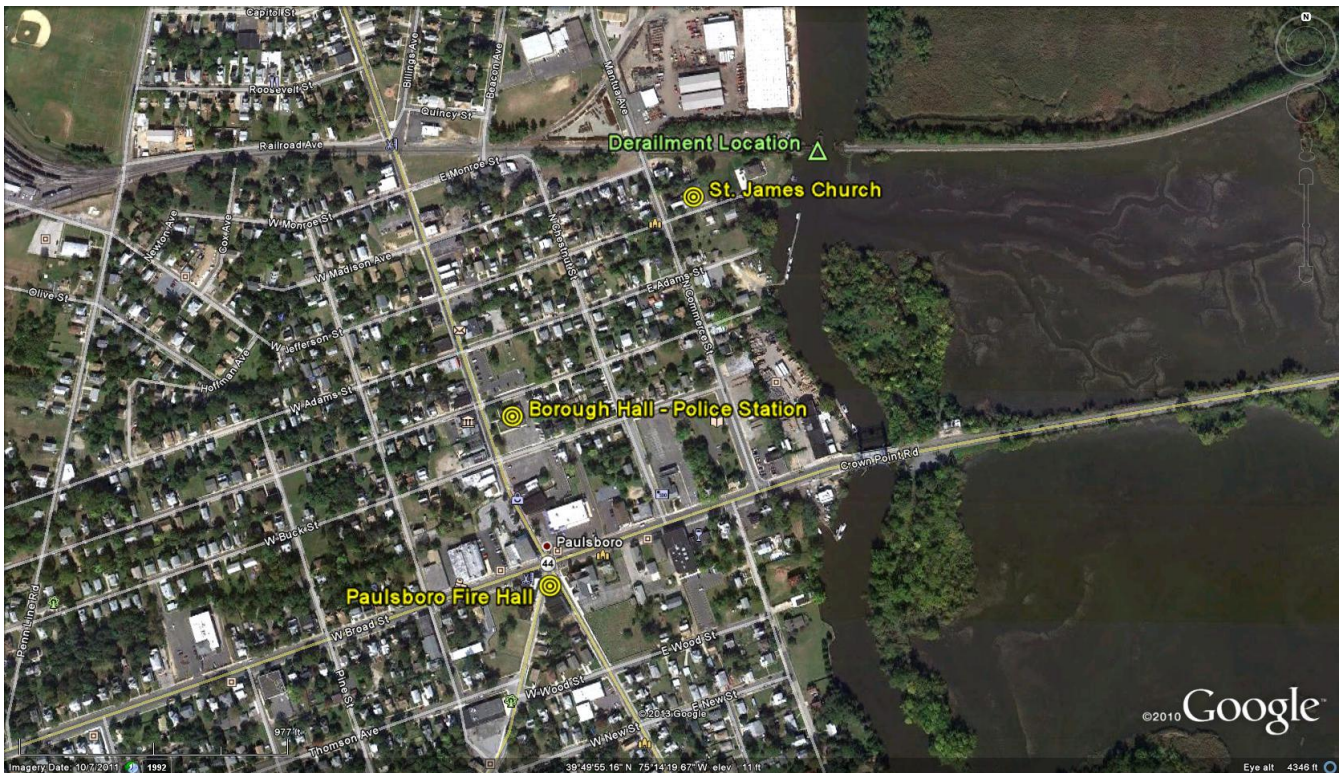
Paulsboro, New Jersey. The derailment occurred as the train traveled over the Paulsboro moveable bridge.

Four tank cars that derailed on the bridge came to rest with portions of the cars in Mantua Creek. Three of the derailed tank cars that entered the creek contained vinyl chloride, and one contained ethanol. One of the tank cars was breached during the derailment and released approximately 20,000 gallons of vinyl chloride into the environment. Eyewitnesses reported seeing a vapor cloud rise from the scene immediately following the accident. The initial damage estimates are \$450,654, which does not include response and remediation costs.

On the morning of the accident, 23 local residents were treated for possible vinyl chloride exposure at nearby hospitals and released. The train conductor and numerous emergency responders were also tested for vinyl chloride exposure.

Mantua Creek is a navigable waterway in Gloucester County, New Jersey, and is about 150 feet wide at the location of the derailment. It flows northwest for about 18.6 miles to the Delaware River at Paulsboro across from the Philadelphia International Airport. The FAA reported that airport operations were unaffected. The weather at the time of the incident was cloudy skies with 34 degree temperature and calm winds.

Parties to the investigation include the Federal Railroad Administration, Conrail, Trinity Tank Car, the Brotherhood of Locomotive Engineers and Trainmen, United Transportation Union.



*Figure 1 - Map of the derailment site and the surrounding area of the Borough of Paulsboro, New Jersey.*

**D. Summary of Transported Hazardous Materials**

Train FC4230 was a “key train”<sup>1</sup> with a total of 55 of the 82 cars containing materials (52 loads and 3 residue cars) designated by the U.S. Department of Transportation (DOT) as hazardous for commercial transportation purposes.<sup>2</sup> Commercial transport of such materials is subject to the regulatory requirements of the Hazardous Materials Regulations (HMR) in Title 49 of the Code of Federal Regulations (CFR).<sup>3</sup> Table 1 provides a summary of all hazardous materials and their position in the train. Five hazardous materials cars were involved in the derailment. These cars were in positions 8 through 12 in the train (not including the two locomotives). They had the following respective reporting marks: UTLX 207398, OCPX 80323, OCPX 80234, UTLX 908097, and UTLX 98041.

*Table 1: Summary of hazardous materials on Train FC4230.*

HAZARDOUS MATERIAL PROPER SHIPPING NAME	UNITED NATIONS IDENTIFICATION NUMBER	HAZARD CLASS OR DIVISION	PACKING GROUP	POSITION(S) IN TRAIN	TOTAL NUMBER OF CARS
Alcohols, n.o.s. (denatured ethanol)	1987	3-Flammable Liquid	II	8	1
Vinyl chloride, stabilized	1086	2.1- Flammable Gas	-	9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23	15
Chlorine**	1017	2.3 (5.1, 8)- Toxic Gas	-	26, 27, 28, 43	4
Petroleum gases, liquefied	1075	2.1-Flammable Gas	-	39, 44, 45	3
Petroleum crude oil	1267	3-Flammable Liquid	II	53, 54, 55, 56, 57, 58, 59, 60, 61, 62, 63, 64, 65, 66, 67, 69, 70, 71, 72, 73, 74, 75, 76, 77, 78, 79, 80, 81, 82	29
Residue car last filled with: elevated temperature liquid, n.o.s. (asphalt)	3257	9- Miscellaneous Hazardous Materials/Products, Substances or Organisms	III	49, 50, 51	3
<b>TOTAL HAZARDOUS MATERIALS CARS</b>					<b>55</b>

\*\* Poison Inhalation Hazard (PIH)

<sup>1</sup> Definition of “key train” is provided by Association of American Railroads (AAR) publication OT-55, *Recommended Railroad Operating Practices for Transportation of Hazardous Materials*. “Key trains” have speed restrictions and other operating criteria. According to the Conrail Hazardous Materials Instructions for Rail (HM-1), a key train includes a train with “one or more loaded tank cars containing materials that require the phrase ‘Poison-Inhalation Hazard’ or ‘Inhalation Hazard’ on the shipping papers.”

<sup>2</sup> See 49 CFR 172.101, Purpose and Use of Hazardous Materials Table.

<sup>3</sup> See 49 CFR 171.1, Applicability of Hazardous Materials Regulations (HMR) to persons and functions.

The train consist carried by the crew had been manually corrected by the conductor to reflect the proper position of the hazardous materials cars in the train. An inspection of the train indicated that the consist matched the physical position of the rail cars. This information was also verified by the automatic equipment identification (AEI) scan taken of the train near Paulsboro North on the morning of November 30, 2012, at 06:38 a.m.<sup>4</sup>

ATTACHMENT 2 – ORIGINAL CONSIST OF TRAIN FC4230

ATTACHMENT 3 – CONRAIL HAZARDOUS MATERIALS INSTRUCTIONS FOR RAIL (HM-1)

ATTACHMENT 4 – PAULSBORO NORTH AEI READ-OUT

### **E. Hazardous Materials Involved in the Accident**

Tank car OCPX 80234 (position 10 in the train) containing vinyl chloride was breached during the accident, releasing approximately 20,000 gallons of product into the environment. A large vapor cloud was produced that blanketed the Mantua Creek basin and traveled into the Borough of Paulsboro, New Jersey. The breach in OCPX 80234 was in contact with the body bolster of tank car OCPX 80323, which was ahead of it in the train (position 9). While separating these two tank cars, the coupler and coupler shaft of OCPX 80323 were found inside the OCPX 80234 tank car. Examination of the derailed cars confirmed only one tank car was breached. None of the other tank cars released product during or after the accident.



*Figure 2 – Close-up photograph of tank car OCPX 80323 and the breach in tank car OCPX 80234 on November 30, 2012.*

<sup>4</sup> AEI readers detect identification tags on railcars as they pass by the reader. The collected information is automatically relayed to a central computer to update the master train consist.

Tank cars OCPX 80323 and UTLX 98097, both containing vinyl chloride, fell into Mantua Creek. Tank car UTLX 98041 also containing vinyl chloride derailed, but remained on the bridge. It was coupled to and held in place by another vinyl chloride-containing tank car, OCPX 80305, which did not derail. Tank car UTLX 207398, containing denatured ethanol, fell onto its B-left side with approximately half of the tank car in the creek (during high tide). Figures 2, 3, and 4 show the positions and orientation of the tank cars after the derailment.



*Figure 3 - Aerial photograph (from the South) of the train derailment on the movable bridge in Paulsboro on December 1, 2012. (Photograph courtesy of the New Jersey State Police)*



Figure 4 - Aerial image (from the East) of the train derailed on the Paulsboro movable bridge. (Photograph courtesy of the United States Coast Guard)

## F. Pre-Accident Events

The four vinyl chloride tank cars involved in the derailment originated from Oxy Vinyls, LP in La Porte, Texas, on November 19, 2012. The shipment consignee was the Oxy Vinyls Pedricktown Plant in Pedricktown, New Jersey. The denatured ethanol tank car was shipped by Cardinal Ethanol on behalf of Murex, N.A., Ltd. from Union City, Indiana, on November 18, 2012. Cardinal Ethanol and Murex, N.A., Ltd. have an ethanol purchase and sale agreement for the purpose of marketing and distributing ethanol. The shipment consignee was Sunoco, Inc. and its destination was Pureland Industrial Park in Bridgeport, New Jersey.

### i. Vinyl Chloride Shipper's Actions - Shipment Preparation

The Oxy Vinyls La Porte Vinyl Chloride Monomer (VCM) Plant loaded tank cars OCPX 80323, OCPX 80234, UTLX 908097, and UTLX 98041 on November 19, 2012. At the plant, VCM tank cars are loaded using standard operating procedure, SOP-450-103,<sup>5</sup> that outlines

<sup>5</sup> Issued on January 13, 2012. The SOP contains proprietary information.

precautions, required inspections (pre-and post-loading), and safe practices for loading operations.

Oxy Vinyls stabilizes its vinyl chloride for tank car shipments. The stabilization is intended to inhibit VCM polymerization during transportation. Stabilization does not alter the chemical composition or properties of the vinyl chloride.

On November 18, 2012, Oxy Vinyls conducted pre-loading inspections of the tank cars. The inspection checklist covered such items as tank car securement, presence of defect cards, expiration of pressure relief valve test dates, running gear inspection, dome area leak inspection, connection thread inspection, attachment of safety items and housing area items, appropriate and visible stenciling, and application of security seals.

After determining loading quantities, the loader fills the cars and performs pre-shipment inspections to check the tank cars for leaks at the liquid and vapor valves, sample valve, pressure relief valve, and thermometer well. If no leaks are found, security seals are attached. According to Oxy Vinyls, both the pre-load and pre-shipment inspection results are recorded on a “Vinyl Chloride Tank Car Preload Inspection” Form. No exceptions were noted during inspections of the vinyl chloride tank cars involved in this accident.

A certificate of analysis for Batch 5490BBC16A, reported on November 19, 2012, indicates the purity of the vinyl chloride loaded into the tank cars was 99.99 percent by weight. Minor impurities included 1,3-butadiene, methyl chloride, and vinyl acetylene.

Oxy Vinyls provided the measured loading temperatures (sphere temperature) for each of the tank cars and their product’s specific gravity at each of those temperatures and at the loading reference temperature of 105 °F.<sup>6</sup> Oxy Vinyls reported that their product has a specific gravity of 0.87 at the reference temperature of 105 °F. Table 2 provides a summary of the data provided by Oxy Vinyls.

*Table 2 - Summary of Oxy Vinyls measured loading temperatures and specific gravities.*

CAR	LOW TEMP °F [°C]	HIGH TEMP °F [°C]	VINYL CHLORIDE MONOMER SPECIFIC GRAVITY
UTLX 98041	68.4 [20.2]	68.9 [20.5]	0.91
UTLX 98097	68.4 [20.2]	68.9 [20.5]	0.91
OCPX 80323	62.6 [17.0]	67.6 [19.8]	0.92 - 0.91
OCPX 80234	62.6 [17.0]	67.6 [19.8]	0.92 - 0.91

***ii. Tank Car Lading Capacity***

The volumes loaded into the tank cars were determined from Oxy Vinyls bills of lading and scale tickets for vinyl chloride and a Murex bill of lading for the ethanol product.

The shipping papers for UTLX 207398, OCPX 80323, OCPX 80234, UTLX 908097, and

<sup>6</sup> This is the reference temperature for loading an insulated tank car as outlined in 49 CFR 173.24b.



UTLX 98041 were examined for excessive weight and minimum outage.

Each of the vinyl chloride tank cars had been loaded to approximately 2,000 pounds less than the tank car load limits. The outage and filling limits for each tank car were calculated to determine if the tank cars met the minimum outage requirement of 1 percent of the total capacity of the tank car at the appropriate reference temperature (105 °F for an insulated vinyl chloride tank) as required by 49 CFR 173.24b. The calculations and paperwork examination indicate that only one tank car, OCPX80323, did not meet this federal requirement.

Table 3 provides a summary of tank car load capacities and lading/filling limit calculations at the appropriate reference temperature as required by 49 CFR 173.24b.

*Table 3 - Summary of tank car load capacities and lading weights and volumes.*

POSITION IN CONSIST	TANK CAR REPORTING MARKS	HAZARDOUS MATERIAL CONTENT	LOAD LIMIT CAPACITY ***	LADING VOLUME AT LOADING TEMPERATURE	LADING VOLUME AT REFERENCE TEMPERATURE	TANK OVERFILLED BY VOLUME****	TANK OVERFILLED BY WEIGHT
8	UTLX 207398	Alcohols, n.o.s (denatured ethanol)	196,600 lbs/ 30,220 wg	29,000 gallons	N/A	No	No
9	OCPX 80323	Vinyl Chloride	182,200 lbs/ 24,650 wg	180,250 lbs/ 23,786 gallons*	24,862 gallons**	YES	No
10	OCPX 80234	Vinyl Chloride	178,200 lbs/ 24,894 wg	176,200 lbs/ 23,249 gallons*	24,237 gallons**	No	No
11	UTLX 98097	Vinyl Chloride	179,200 lbs/ 25,212 wg	177,650 lbs/ 23,441 gallons*	24,437 gallons**	No	No
12	UTLX 98041	Vinyl Chloride	179,100 lbs/ 25,182 wg	177,100 lbs/ 23,368 gallons*	24,442 gallons**	No	No

\* Calculated based on loading temperature

\*\* Calculated based on reference temperature per 49 CFR 173.24b

\*\*\* wg = water gallons.

\*\*\*\* Yes, if outage is under 1 percent - Outage in tank car at 105 °F:  $(1 - (\text{vol.}@ \text{reference temp} / \text{tank max. vol.})) \times 100$

ATTACHMENT 5 – OXY VINYLs BILLS OF LADING

ATTACHMENT 6 – MUREX/CARDINAL ETHANOL STRAIGHT BILL OF LADING

ATTACHMENT 7 – VINYL CHLORIDE MONOMER LOADING STANDARD OPERATING PROCEDURES (SOP-450-103)

ATTACHMENT 8 – VINYL CHLORIDE TANK CAR PRELOAD INSPECTIONS AND CERTIFICATES OF ANALYSIS

ATTACHMENT 9 – OXY VINYLs SCALE TICKETS

ATTACHMENT 10 – OXY VINYLs LOADING TEMPERATURES

ATTACHMENT 11 – UMLER REPORT FOR TANK CARS

ATTACHMENT 12 – CERTIFICATE OF CONSTRUCTION FOR OCPX 80234

## **G. Hazardous Materials Description and Information**

### **i. Vinyl Chloride**

Vinyl chloride [CAS # 75-01-4] is a colorless gas with a mild, sweet odor that is used to make polyvinyl chloride (PVC). It is a gas at room temperature; however, it is shipped as a liquid under pressure. It is highly flammable and vapor/air mixtures are explosive. The odor threshold for detection is about 3,000 parts per million (ppm) in air. The Occupational Safety and Health Administration (OSHA) regulates occupational exposures to vinyl chloride under 29 CFR 1910.1017. Paragraph (c) of the standard mandates that no employee may be exposed to vinyl chloride at concentrations greater than 1 ppm averaged over any 8-hour period;<sup>7</sup> no employee may be exposed at concentrations greater than 5 ppm averaged over any period not exceeding 15 minutes;<sup>8</sup> and that no employee may be exposed to vinyl chloride by direct contact with liquid vinyl chloride.<sup>9</sup> Due to the significant difference between the odor threshold and the acceptable occupational exposure levels, workers can easily be overexposed without becoming aware of vinyl chloride's presence. The odor threshold is too high to provide adequate warning for hazardous concentrations.

Vinyl chloride is volatile with a flash point temperature of -108 °F. Its explosive (flammable) range is between 3.6 percent (lower explosive limit [LEL])<sup>10</sup> and 33 percent (upper explosive limit [UEL])<sup>11</sup> vapor concentration in air. It has a specific gravity of 0.91 at 68 °F (0.87 at 105 °F) and a vapor density of 2.15. When burned or heated to a high enough temperature, vinyl chloride decomposes to hydrogen chloride, carbon monoxide, carbon dioxide, and traces of phosgene.

The vinyl chloride was shipped under the following DOT shipping information: Vinyl chloride, stabilized; Class 2.1; UN 1086.

### ***Routes of Exposure and Target Organs for Vinyl Chloride***

Inhalation is the primary route of exposure to vinyl chloride. Other routes of exposure include ingestion and contact absorption. The target organs include the liver, central nervous system (CNS), blood, respiratory system, and lymphatic system.<sup>12</sup>

### ***Effects of Acute Exposure to Vinyl Chloride***

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<sup>7</sup> 8-hour Time Weighted Average (TWA) Permissible Exposure Limits (PEL) - 29 CFR 1910.1017(c)(1).

<sup>8</sup> Short Term Exposure Limit (STEL) - 29 CFR 1910.1017(c)(2).

<sup>9</sup> 29 CFR 1910.1017(c)(3).

<sup>10</sup> The minimum concentration of vapor in air below which propagation of a flame does not occur in the presence of an ignition source.

<sup>11</sup> The maximum concentration of flammable vapor in air above which propagation of flame does not occur on contact with an ignition source.

<sup>12</sup> National Institute for Occupational Safety and Health (NIOSH) Pocket Guide to Chemical Hazards.

An acute exposure to vinyl chloride primarily targets the CNS. Several minutes of exposure to high concentration (over 1000 ppm) may cause CNS depression with effects such as dizziness, drowsiness, disorientation, tingling, numbness or burning sensation of the hands and feet, impaired vision, nausea, headache, difficulty breathing, cardiac arrhythmias, unconsciousness, or even death.<sup>13</sup>

According to the Agency for Toxic Substances and Disease Registry (ATSDR) Medical Management Guidelines for Vinyl Chloride:

Vinyl chloride is thought to depress the CNS via a solvent effect on lipids and protein components of neural membranes that interrupts signal transmission. Reactive metabolic intermediates may also cause specific target organ toxicity by covalently bonding to tissue or initiating destructive chain reactions such as lipid peroxidation. There may be a latent period of hours to days between exposure and symptom onset. Vinyl chloride is rapidly metabolized and the metabolites are eliminated in the urine.

Vinyl chloride can irritate the eyes, mucous membranes, and respiratory tract. Escaping compressed gas or liquid can cause frostbite or irritation of the skin and eyes.

### ***Effects of Chronic Exposure to Vinyl Chloride***

Chronic exposure to vinyl chloride can cause permanent liver injury and liver cancer (angiosarcoma), neurologic or behavioral symptoms, and changes to the skin and bones of the hand. The U.S. Department of Health and Human Services and the International Agency for Research on Cancer (IARC) have classified vinyl chloride as a known human carcinogen. Vinyl chloride has caused angiosarcoma of the liver in heavily exposed workers. According to the ATSDR, it is also suspected to cause cancer of the brain, lungs, gastrointestinal tract, and lymphatic/hematopoietic system. Chronic occupational exposures exceeding permissible limits have produced angiosarcoma and are associated with hepatocellular cancer. Additionally, repeated exposure may result in dose-related sensory disorders, peripheral nervous system effects, blood system damage, lymphatic system changes, liver malfunction, and pulmonary insufficiency.

According to the ATSDR Medical Management Guidelines for Vinyl Chloride:

Vinyl chloride is included in *Reproductive and Developmental Toxicants*, a 1991 report published by the U.S. General Accounting Office (GAO) that lists 30 chemicals of concern because of widely acknowledged reproductive and developmental consequences. However, there is no conclusive evidence of reproductive or developmental effects in humans. A few case reports describe decreased libido or fertility in men with chronic occupational exposure, and some animal studies also support this finding. Some studies in experimental animals have reported developmental toxicity associated with high-dose exposures, but vinyl chloride is not considered a developmental toxicant.

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<sup>13</sup> Oxy Vinyls material safety data sheet for vinyl chloride.

Special consideration regarding the exposure of pregnant women is warranted, since vinyl chloride has been shown to be a genotoxin; thus, medical counseling is recommended for the acutely exposed pregnant women.

### ***Environmental Information about Vinyl Chloride***

Vinyl chloride is believed to be almost non-toxic to fish on an acute basis (LC50>100 mg/L). Vinyl chloride readily degrades under aerobic conditions and may degrade under anaerobic conditions. The atmospheric (tropospheric) half-life is estimated to be 23 hours. If released to air, it will remain in the gas phase. If released to soil, volatilization will occur, but material that does not volatilize may be highly mobile. If released to water, evaporation will occur. Bioconcentration potential is low (BCF <100 or log Kow <3).

### ***Community Exposure Guidance***

The National Advisory Committee for the Development of Acute Exposure Guideline Levels for Hazardous Substances (AEGL Committee), which is managed by the Environmental Protection Agency (EPA), developed guidelines to help both federal and local authorities, as well as private companies, deal with emergencies involving chemical spills. The development of Acute Exposure Guideline Levels (AEGLs) is a collaborative effort of the public and private sectors worldwide. AEGLs are intended to describe the risk to humans resulting from once-in-a-lifetime, or rare, exposure to airborne chemicals. These levels can be used for emergency planning and response activities related to the accidental release of hazardous substances and general public exposures.

According to the EPA, the AEGLs differ from PELs in that “they are based primarily on acute toxicology data and not subchronic or chronic data.”<sup>14</sup> The guidance does not reflect the effects that could result from frequent or occupational exposures. Unlike most occupational exposure levels, AEGLs factor in exposure effects to the elderly and children.

There are three AEGL levels (one through three) that are defined based on the expected health effects on the public. An AEGL-1 is the airborne concentration, expressed as parts per million or milligrams per cubic meter (ppm or mg/m<sup>3</sup>) of a substance above which it is predicted that the general population, including susceptible individuals, could experience notable discomfort, irritation, or certain asymptomatic non-sensory effects. However, the effects are not disabling and are transient and reversible upon cessation of exposure.

An AEGL-2 is the airborne concentration, expressed as ppm or mg/m<sup>3</sup>, of a substance above which it is predicted that the general population, including susceptible individuals, could experience irreversible or other serious, long-lasting adverse health effects or an impaired ability to escape.

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<sup>14</sup> <http://www.epa.gov/opptintr/aegl/pubs/aeglapp.html>

An AEGL-3 is the airborne concentration, expressed as ppm or mg/m<sup>3</sup>, of a substance above which it is predicted that the general population, including susceptible individuals, could experience life-threatening health effects or death.

Table 4 provides the published AEGLs for vinyl chloride.

*Table 4 –AEGLs for vinyl chloride.*

<b>Vinyl Chloride (CAS# 75-01-4)</b>					
<b>Concentration in ppm</b>					
	<b>10 min</b>	<b>30 min</b>	<b>60 min</b>	<b>4 hr</b>	<b>8 hr</b>
<b>AEGL-1</b>	450	310	250	140	70
<b>AEGL-2</b>	2,800	1,600	1,200	820	820
<b>AEGL-3</b>	12,000	6,800	4,800	3,400	3,400

The American Industrial Hygiene Association (AIHA) also developed guidelines for community emergency response to potential releases of airborne substances. Emergency Response Planning Guidelines (ERPGs) are air concentration guidelines for single exposures to agents and are intended for use as tools to assess the adequacy of accident prevention and emergency response plans, including transportation emergency planning, community emergency response plans, and incident prevention and mitigation.

There are three ERPG levels (one through three). An ERPG-1 is the maximum airborne concentration below which it is believed that nearly all individuals could be exposed for up to one hour without experiencing other than mild, transient adverse health effects or without perceiving a clearly defined objectionable odor. The ERPG-1 identifies a level which does not pose a health risk to the community, but which may be noticeable due to slight odor or mild irritation. In the event that a small non-threatening release has occurred, the community could be notified that they may notice an odor or slight irritation, but that concentrations are below those which could cause unacceptable health effects.

An ERPG-2 is the maximum airborne concentration below which it is believed that nearly all individuals could be exposed for up to one hour without experiencing or developing irreversible or other serious health effects or symptoms which could impair an individual's ability to take protective action. At air concentrations above an ERPG-2, there may be significant adverse health effects, signs, or symptoms for some members of the community which could impair an individual's ability to take protective action. These effects might include severe eye or respiratory irritation, muscular weakness, CNS impairments, or serious adverse health effects.

An ERPG-3 is the maximum airborne concentration below which it is believed that nearly all individuals could be exposed for up to one hour without experiencing or developing life-threatening health effects. The ERPG-3 level is a worst-case level above which there is the possibility that some members of the community may develop life-threatening health effects.

Table 5 provides ERPG information published for vinyl chloride.

Table 5 - ERPGs for vinyl chloride.

CHEMICAL	ERPG-1	ERPG-2	ERPG-3
Vinyl Chloride (CAS #75-01-4)	500 ppm	5,000 ppm	20,000 ppm

## ii. Denatured Ethanol

Denatured ethanol is a Class 1B<sup>15</sup> flammable liquid with a flashpoint of about -5 °F and a boiling point range of 165-175 °F. It is a clear, colorless liquid with a hydrocarbon odor. Vapor/air mixtures are explosive. The material is highly flammable or explosive in the presence of open flames, sparks, or static discharge. Flammable vapors (vapor density of 1.6 at 172 °F) may accumulate in low or confined spaces or travel considerable distance to a source of ignition. Its explosive (flammable) range is 3.3 percent (LEL) and 19 percent (UEL) vapor concentration in air. It weighs 6.6 lbs/gal and has a specific gravity of 0.79 at 60 °F. The product is volatile and may cause flash fires. Toxic products of combustion include carbon monoxide, carbon dioxide, particulate matter, and volatile organic hydrocarbons.

Denatured ethanol is a mixture of ethyl alcohol and natural gasoline that is approved for use as an octane-enhancing blending component in gasoline. The technical specifications for this product indicate that it is a mixture of ethanol (95-98 percent) and natural gasoline (2-5 percent).

The denatured ethanol was shipped under the following DOT shipping information: Alcohols, N.O.S.; Class 3; UN1987; Packing Group II.

No denatured ethanol was released during or after the accident. There were no worker or community exposures to the material.

ATTACHMENT 16 – MATERIAL SAFETY DATA SHEET FOR VINYL CHLORIDE

ATTACHMENT 17 – MATERIAL SAFETY DATA SHEET FOR DENATURED ETHANOL

## H. Post-Accident Events

### i. Emergency Response Activities (First Day)

In Gloucester County, the County Emergency Response Center (also known as the Communications Center) receives all 911 calls and dispatches emergency responders for all municipalities within the county. At 7:01 a.m., the Gloucester County Emergency Response Center received the first 911 call from the residence of the Paulsboro Assistant Fire Chief<sup>16</sup> which is located adjacent to the derailment site (approximately 50 yards away, with a direct

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<sup>15</sup> According to the National Fire Protection Association's (NFPA) Flammable and Combustible Liquids Code, NFPA 30, a Class IB Liquid is defined as "any liquid that has a flash point below 73 °F (22.8 °C) and a boiling point at or above 100 °F (37.8 °C)."

<sup>16</sup> During the call, the individual identified himself as the Assistant Fire Chief. Since the accident, the Assistant Fire Chief has become the Paulsboro Deputy Fire Chief.

line of sight). The Paulsboro Assistant Fire Chief's wife told the 911 operator that a train had derailed and the Paulsboro train bridge had collapsed. She reported that she watched the train derail and that there was smoke everywhere. The 911 operator patched the Paulsboro Police Department into the phone call. The Assistant Fire Chief began speaking to the operator and the Police Department. He repeated that the train derailed into Mantua Creek and said, "It's spewing out all kind of gas." He also reported that there was a "...tank car leaking something into the water." He told the operator to record him on-scene.

The Assistant Fire Chief established the Incident Command Post (ICP) at his residence. He radioed county dispatch and began sizing-up the incident. At 7:05 a.m., an alert for Paulsboro Fire Department response was transmitted.

After the train derailment, the Gloucester County Emergency Response Center received several 911 calls from individuals in the vicinity of the derailment site who reported a chemical release and complained of difficulty breathing.

During the incident response, police and fire department operations used two different radio channels. The police operations were carried on the zone 3 police radio channel, while fire department operations were on channel 3 fire ops. The ICP location changed four times during the incident response.

A timeline of events and communications is provided in attachment 18.

#### ATTACHMENT 18 – TIMELINE OF EVENTS AND COMMUNICATIONS

##### *Police Activities*

At 7:02 a.m., the Gloucester County Emergency Response Center dispatched the Paulsboro Police Department to the accident. The county dispatch was told that three Paulsboro Police Officers (Officer 218, Officer 210, and Sergeant 206) were on duty at the time of the incident.

Officer 218 was the first on-scene at 7:05 a.m. He was flagged down by the train conductor at the East Commerce Street railroad crossing, which was approximately 750 feet west of the derailment site. Officer 218 told NTSB investigators<sup>17</sup> that the conductor was visibly shaken. The conductor told him that the situation was "life threatening and [that] people are going to die." At 7:06 a.m., Officer 218 radioed Sergeant 206 telling him:

You need to respond out here. It's a major emergency, bridge collapsed and major hazards, potentially life threatening. I have an odor out here they are not familiar with. This odor is hazardous. Hazard released.

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<sup>17</sup> Interview of Officer 218 was conducted on December 1, 2012.

Two off-duty officers, Officer 217 and Sergeant 205, were still at the Paulsboro Police Station after coming off of the night shift. They immediately assisted with the incident.<sup>18</sup> At 7:07 a.m., Sergeant 206, Sergeant 205, and Officer 210 arrived on-scene.<sup>19</sup> Officer 217 arrived shortly after them.

There were several radio communications indicating that a chemical release had occurred. At 7:07 a.m., a police officer contacted Officer 218 to report that a gentleman - who previously worked at a propane plant - told him that he smelled and saw a propane fog while coming over the Route 44 Bridge. At 7:09 a.m., county dispatch received a radio transmission from officer 1730 stating, "I'm out on the bridge on Broad Street. There's a heavy cloud over top of this water." At 7:11 a.m., Sergeant 206 radioed, "There's a lot of smoke coming from the creek area."



*Figure 5 – Eastward view of dense, low lying cloud or fog over Mantua Creek at approximately 7:13 a.m. on November 30, 2012.<sup>20</sup> (Photograph courtesy of the wife of the Paulsboro Assistant Fire Chief)*

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<sup>18</sup> Other Paulsboro Police Officers were contacted by Sergeant 217 to respond to the incident after she staged at the Fire Hall. See interview with Sergeant 206 conducted on December 1, 2012.

<sup>19</sup> Interview of Sergeant 206 was conducted on December 1, 2012.

<sup>20</sup> Time estimate based on photograph file information and witness interview statement (interview of the wife of the Paulsboro Assistant Fire Chief on December 2, 2012).





*Figure 6 – Eastward view of dense, low lying cloud or fog over Mantua Creek taken at approximately 8:00 a.m. on November 30, 2012. <sup>21</sup> (Photograph courtesy of the wife of the Paulsboro Assistant Fire Chief)*



*Figure 7 – Southward view of dense, low lying cloud or fog over Mantua Creek and Route 44 Bridge at 8:01 a.m. on November 30, 2012. <sup>22</sup> (Photograph courtesy of the wife of the Paulsboro Assistant Fire Chief)*

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<sup>21</sup> Time estimate based on photograph file information and witness interview statement (interview of the wife of the Paulsboro Assistant Fire Chief on December 2, 2012).

Officer 218 continued speaking to the conductor who provided him with hazardous materials information from the train's consist. At 7:12 a.m., Officer 218 reported to county dispatch that the train was transporting "1987 which is ethanol alcohol and 1086 which is vinyl chloride." He told NTSB investigators that, while speaking to the conductor, he was engulfed by a visible chemical cloud and he began experiencing difficulty breathing. He also stated, "I had asked the conductor, as well as this other guy, what in fact were we -- was I breathing, and they had told me a liquefied petroleum [gas], which was basically...propane." He reported this information to county dispatch at 7:15 a.m.

At approximately 7:15 a.m., the Paulsboro Police instructed county dispatch to make notifications for school closures. Officer 210, along with other officers on-scene, commenced the evacuation of residents in the immediate vicinity of the derailment site (area between Commerce Street and East Jefferson Street).<sup>23</sup> Officer 217 told NTSB investigators that when she arrived on-scene, she observed a dense cloud from which Officer 210 emerged and told her to begin knocking on doors to get people out of the area. Officer 217 made her way towards the residence of the Paulsboro Assistant Fire Chief where she found him looking at the train derailment with binoculars. When she asked him if they should be standing where they were he responded, "Not really, but we're here."

At 7:16 a.m., Sergeant 206 radioed that the evacuation staging area was the Paulsboro Fire Hall. At 7:17 a.m., county dispatch reported that notifications were made for school closures.

Officer 218 remained with the train conductor and continued his attempts to obtain additional information. He told NTSB investigators that another Conrail employee arrived and began asking the conductor about the accident. The NTSB established that this employee was the Conrail Paulsboro Yard Trainmaster. The Trainmaster<sup>24</sup> told NTSB investigators that he responded to the incident after receiving a call from the train conductor indicating that there was a problem and that the bridge had collapsed. The Trainmaster drove towards the accident, stopping near the head-end of the train (near the Commerce Street railroad crossing). He encountered police officers evacuating residents. One of the officers yelled to him, "We got to find out what's in those cars."

The Trainmaster ran to the derailment site for a quick assessment. He encountered The Paulsboro Assistant Fire Chief and other firefighters who also told him that they needed to find out what was in the cars. The Trainmaster recalled that the Paulsboro Assistant Fire Chief told him that there was vinyl chloride in one of the tank cars.

The Trainmaster ran back towards the Commerce Street railroad crossing to locate the train crew. He met Officer 218 and the train conductor. The Trainmaster took the train consist

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<sup>22</sup> Time estimate based on photograph file information and witness interview statement (interview of the wife of the Paulsboro Assistant Fire Chief on December 2, 2012).

<sup>23</sup> Interview of Officer 217 conducted on December 2, 2012.

<sup>24</sup> Interview of Trainmaster conducted on December 5, 2012.

from the conductor and instructed him to cut the locomotives away from the train and to proceed to Paulsboro Yard. The Trainmaster ran back to the derailment site to make a more detailed assessment. Officer 218 assisted other officers with the evacuation and then reported to the ICP.

Neighboring police departments provided support to the Paulsboro Police.<sup>25</sup> Sergeant 206 sent Officer 217 to the Paulsboro Fire Hall to manage the arriving support and assistance. The in-coming units assisted with the door-to-door evacuation and site control.

At 7:26 a.m., county dispatch asked Sergeant 206 if the evacuation was mandatory. He confirmed that it was mandatory for at least 3 blocks, with Paulsboro Fire Hall as the staging and housing location for evacuees. However, at 7:29 a.m., Sergeant 205, who was at the ICP, reported a change in evacuation orders. He radioed, “Be advised...[vinyl chloride] it’s not that toxic.” He added that residents should “stay in the[ir] house[s] with the windows closed.” Officer 217 repeated the change in evacuation plan over the radio and instructed officers to tell residents to stay in their homes with the windows shut.

At 7:30 a.m., Sergeant 205 reported, “The fog we have is a non-toxic...the chlorine cars are 27 back... they’re the most dangerous.” He stated that they would be moved out of the way. At 7:33 a.m., Sergeant 206 notified county dispatch that the vapor was non-toxic and that people should shelter in place.

At 7:41 a.m., county dispatch contacted the Paulsboro Police Chief and Paulsboro Police Captain 202.

At 7:42 a.m., Paulsboro Police began to notify businesses on Broad and Delaware Streets. At 7:50 a.m., New Jersey Department of Transportation (NJDOT) support with site control was requested. NJDOT was instructed to shutdown Route 44 at the Black Bridge.

At 8:00 a.m., Paulsboro Police Captain 202 told dispatch that the ICP was at the Paulsboro Fire Hall. However, he reported to the ICP on East Jefferson Street. At 9:08 a.m., Paulsboro Police Chief also reported to the East Jefferson Street ICP.

At 9:20 a.m., Paulsboro Police Captain 202 advised that residents could return to their homes, however, once there they needed to shelter in place. Residents that were uncomfortable returning to their homes could stay at the Fire Hall where the Red Cross was on location. At 10:19 a.m., Paulsboro Police Captain 202 further advised that students and school faculty could return to their homes.

For the remainder of the day, the Paulsboro Police Department primarily focused on site control and notifications to businesses and members of the public. At approximately 5:15 p.m., the established Unified Command instructed Paulsboro Police to evacuate residents from the area between Commerce Street, Broad Street, and the railroad tracks. Residents were instructed to report to the Paulsboro Fire Hall. At 6:50 p.m., the evacuation was once

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<sup>25</sup> According to the interview of Sergeant 217, responding departments included Deptford, Greenwich Township, Glassboro, and Monroe.

again expanded. The Paulsboro Police Chief announced a mandatory evacuation order for the area between Delaware Street, Broad Street and the railroad tracks.

A curfew order was issued for the Borough of Paulsboro at 7 p.m.

None of the police officers who responded to the incident and who were engulfed in the chemical cloud used respiratory protection or any other type of personal protective equipment (PPE). Paulsboro Police Officers told NTSB investigators that their duty to evacuate residential areas outweighed their concerns of personal safety.

ATTACHMENT 19 – POLICE CAD REPORT

ATTACHMENT 20 – LOCAL EMERGENCY DISASTER DECLARATION AND AMENDMENTS

### ***Fire Department and Hazardous Materials Units Activity***

At 7:05 a.m., the Paulsboro Assistant Fire Chief (radio call number 1702) reported to county dispatch that four tank cars were in the water and three box cars were on his property. He stated, “Tank cars have been pierced and have leaked out all their contents into the creek. The creek is full of vapors from these cars.” The Paulsboro Assistant Fire Chief instructed dispatch to contact Conrail and have them send a representative to his residence. He also requested a weather report.



*Figure 8 – Paulsboro Assistant Fire Chief, wearing firefighting gear, in an area – surrounded by fog or cloud - overlooking the derailment site at approximately 7:44 a.m. on November 30, 2012.<sup>26</sup> (Photograph courtesy of the wife of the Paulsboro Assistant Fire Chief)*

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<sup>26</sup> Time estimate based on photograph file information and witness interview statement (interview of the wife of the Paulsboro Assistant Fire Chief on December 2, 2012).

At 7:06 a.m., the Paulsboro Fire Chief (call number 1701) radioed county dispatch that he was responding to the incident. County dispatch provided him with the following report:

1702 reports four tank cars in the water leaking, three box cars off the track and the bridge has collapsed.

The Paulsboro Fire Chief instructed dispatch to have Gloucester County Chemical, Biological, Radiological, Nuclear, and Explosives (CBRNE) Team start off with the train consist and to notify the Paulsboro Refining Company Hazardous Materials (HAZMAT) Team. The Gloucester County CBRNE Team and the Paulsboro Refining Company HAZMAT Team have mutual aid and assistance agreements with the Borough of Paulsboro to assist with hazardous materials incidents. County dispatch made notification to the Paulsboro Refining Company at 7:13 a.m. and the Gloucester County CBRNE Team at 7:22 a.m.

At 7:08 a.m., the Paulsboro Assistant Fire Chief reported that he was attempting to read the tank car placards with his binoculars. Within a minute, he reported that he could read a placard with the number 1086. Dispatch reported that this was vinyl chloride, stabilized. Dispatch also reported that the national weather service report indicated "...light and calm surface winds, they're vertical, west to southwest."

At 7:17 a.m., the Paulsboro Fire Chief arrived on-scene, observed the wreckage, and assumed incident command. The Paulsboro Assistant Fire Chief was assigned responsibility for fire operations. At 7:18 a.m., the Paulsboro Fire Chief ordered equipment and a firefighting apparatus to the scene. Both the Chief and his assistant began sizing-up the incident and making sure there were no fires.<sup>27</sup>

At 7:19 a.m., the Paulsboro Fire Chief informed county dispatch, "Command Post will be set up at 230... East Jefferson Street." He reported, "We have an open area, field - maybe 50 yards from the initial car [that is] overturned with the way it's punctured." The Paulsboro Fire Chief<sup>28</sup> told NTSB investigators that when he first arrived on-scene, he observed a "cloud that came out." He described it as a light haze that started getting heavier as time passed. He also stated:

We thought it was fog rolling in off the marshes. After – in hindsight it was not. It was vinyl chloride that ... came off the marches on the east side of the railroad tracks. I don't know if the wind was blowing from that way, but it came off ... and rolled up onto the ground. After about... I would say maybe 45 minutes [to] an hour, it basically burnt off and the vapors or the fog went away.

The Paulsboro Fire Chief told NTSB investigators that he could not see a leak when he first arrived.

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<sup>27</sup> Interview of Paulsboro Assistant Fire Chief on December 1, 2012.

<sup>28</sup> Interview of Paulsboro Fire Chief on December 5, 2012.

County dispatch sent alerts to neighboring boroughs. Shortly thereafter, the Paulsboro Fire Chief requested the notification of the United States Coast Guard (USCG). Radio communications indicate that responders continued their attempts to identify the contents of the other tank cars. County dispatch notified the Incident Command that Paulsboro Police reported that at least one propane tank was leaking.<sup>29</sup> No information regarding the denatured ethanol tank car was relayed over the radio to the Incident Command. At 7:25 a.m., the Paulsboro Fire Chief told dispatch, "We are getting some information...that a couple of these tanks have bad stuff, we just can't get the placards."

At 7:28 a.m., members of the Paulsboro Refining Company HAZMAT Team arrived on-scene. The Paulsboro Refining Company HAZMAT Chief<sup>30</sup> told NTSB investigators that upon his arrival to the ICP:

[The Paulsboro Fire Chief] showed me the incident... and... said he just would like help... trying to ascertain the threat, the danger, [and] make sure we were doing the right thing for evacuation, et cetera. I said... I'd like to... page out our hazmat response team...that will bring...some trained technicians to do air monitoring...to make sure that we can establish the hot, warm and cold zone. He agreed. I made that happen...The next few minutes were...spent...doing a size-up. I could see a fog, possibly chemical, too, but I could definitely see the fog in the basin. It was a very still day. It is not unusual to see a heavy fog in the water in the basin.

The Paulsboro Fire Chief told NTSB investigators that the Paulsboro Refining Company HAZMAT Chief was guiding him through the hazardous materials response and that the Paulsboro Police Department took charge of the evacuation. According to the Paulsboro Fire Chief:

[Paulsboro Refining Company HAZMAT Chief] was feeding me the information and giving me direction on which way we should go...the police department ... I think it was Sergeant [205]...he says, "I got the houses covered." ... His officers were taking care of the door knocking.

The Paulsboro Fire Chief also stated:

I truly left it [the evacuation] to Sergeant [205]... I was more concerned with the wreckage than anything that was going to happen with that [the evacuation] so ... I just passed it off ...you handle that, let me know how you're doing and we ...tried to funnel information to him [like] how far to go and I made sure he was in contact ... [with Paulsboro Refining Company HAZMAT Chief] if he's got any questions...

At 7:29 a.m., the Paulsboro Police Department evacuation policy changed from a mandatory evacuation to shelter-in-place. NTSB investigators asked the Paulsboro Fire Chief how evacuation decisions were developed. He stated:

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<sup>29</sup> No propane tank was involved in the accident.

<sup>30</sup> Interview of Paulsboro Refining Company HAZMAT Chief conducted on December 4, 2012.

Well, based on the readings you can shelter in place...We just didn't have the resources to be able to go, okay, everybody get out -- so we did the shelter in place. We did the notification to the ...reverse 911... And we did the global connect and got the message out...

The air monitoring data provided to the NTSB indicates that the earliest air sampling began at 8:33 a.m. on the morning of the accident.<sup>31</sup> The NTSB obtained chemical dispersion models that were produced by, or at the request of, the National Oceanic and Atmospheric Administration (NOAA) Scientific Support Coordinator (SSC) who was supporting the United States Coast Guard (USCG) during the incident. A plot developed by the Interagency Modeling and Atmospheric Assessment Center (IMAAC) at 9:17 a.m. indicated that there was a “90% confidence level that an AEGL-3 or AEGL-2 outcome is possible, based on atmospheric effects and weather uncertainty.”

Also at 7:29 a.m., the Paulsboro Fire Chief reported to county dispatch, “Speaking with the conductor, it looks like we have five cars with vinyl chloride.” He repeated the transmission and said, “We have the train conductor here with his sheets and he's confirmed the cars are vinyl chloride.” He then requested a quick hazard synopsis for the chemical. County dispatch reported:

Vinyl chloride says you need to handle with care, can cause reproductive damage. Contact can severely irritate and burn eyes and cause eye damage, irritate and burn the skin. Contact with liquid can cause frostbite; irritate nose, throat and lungs, causing coughing, wheezing, and other shortness of breath. Also cause headache, nausea, vomiting, dizziness, fatigue, weakness, confusion. Also can cause you to pass out, damage to liver and nervous systems and lungs. Highly flammable reactive chemical and is dangerous -- a dangerous fire and explosion hazard.

NTSB investigators established that the individual who arrived at the ICP was the Conrail Trainmaster, not the train conductor. As mentioned earlier, the Trainmaster took the train consist from the conductor and performed an assessment of the tank cars. The Trainmaster went down the consist, noting on it whether the tank cars were in the water or on land. The train consist made available to the NTSB contained the Trainmaster's marks and notes. After the Trainmaster's assessment, he reported to the Assistant Fire Chief to provide his findings. He described his actions to the NTSB as follows:

I told him [the Paulsboro Assistant Fire Chief] what I had and then some other fireman ran up and said we need to meet... [at the] temporary command post...in front of the house. So we met there and I just went down the consist and I told them... the first car was alcohol and last four were... vinyl chloride. And I told them exactly...what I could see ... I knew something was punctured but I couldn't really tell which one... [After] I finished talking to them ...[,] I went back over there [to the derailment site] to really get a good look ... I walked back up on the bridge and by this time ... [the Conrail Chief Risk Officer] showed up... I think,

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<sup>31</sup> The air sampling data was provided by the Paulsboro Refining Company.

[he] had identified which car was punctured, and I could see where there was some substance in the water. So that's when I told ... him, "Hey, we do have a punctured car."... [Then] we pulled everybody back...

At 7:40 a.m., the Paulsboro Assistant Fire Chief radioed the Paulsboro Fire Chief informing him, "We got two railroad workers on the bridge at this time confirming what's in the other cars."

The Conrail Chief Risk Officer and the Trainmaster spoke to the Paulsboro Fire Chief after completing their assessments. The Conrail Chief Risk Officer told the NTSB:

I had the clipboard with the consist. I explained to him [The Paulsboro Fire Chief] that these cars, 6 through 12, were derailed, and it looked like car number 9 was breached, and then [I] showed him the car number and told him that it ... was a vinyl chloride car... His response to me was...what do we do with that? And I pulled -- in the consist is a hazardous description, almost like a small MSDS sheet... I read it to him... it says that if it's not involved in a fire, it requires a half mile evacuation. If it's involved in a fire, it's recommended a mile evacuation. To my remembrance, he basically said, I don't think we're going to do that. And I said, well, that's your call; you are the fire chief. You are the incident commander. I told him ... I had assistance coming. I had some of the best contractors in the East heading to this site to assist Conrail in the wrecking and re-railing process.

The Paulsboro Refining Company HAZMAT Chief drew a sketch of the incident and documented information from the size-up assessments. The Paulsboro Refining Company HAZMAT Chief told NTSB investigators that the Conrail Chief Risk Officer was instrumental in the incident size-up.

NTSB investigators asked the Paulsboro Fire Chief if he issued any guidance on PPE for responders. The Paulsboro Fire Chief explained:

He's [the Paulsboro Assistant Fire Chief] standing on two legs and he's having a conversation with me, so protective breathing apparatus didn't even come into my mind because...we didn't know that there was a breach in the car...once we found out that there was a release, it was almost like the horse is already out of the barn ...you can't close the gate now, it don't help... we didn't go into SCBA mode or anything like that. I don't believe the hazmat team did either...we really didn't know that it was a release. I mean, the fog came out. The fog went away. We didn't smell anything -- or, at least, I didn't. I didn't smell anything. I didn't taste anything. I didn't -- no eye watering. My throat wasn't getting scratchy. I didn't show any signs that I needed to put respiratory protection on.

The Conrail Chief Risk Officer and the Trainmaster departed the ICP to verify the status of the other hazardous materials tank cars, specifically the chlorine tank cars, on the north end of the tracks.<sup>32</sup> They called for the assistance of a crew from Camden Yard to disconnect and

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<sup>32</sup> This was east of the derailment.



pull any intact tank cars north. The Trainmaster took the only available copy of the train consist. At 7:45 a.m., the Paulsboro Fire Chief told county dispatch, “Contact Conrail and tell them we need the consist, shipping papers.” At 8:00 a.m., county dispatch reported that Conrail was faxing the way bills. The Paulsboro Fire Chief also instructed dispatch to contact Conrail’s Hazardous Materials Risk Manager.

The Trainmaster told NTSB investigators that he retained the original consist document for several hours (approximately 3 to 3.5 hours) before returning to his office at Paulsboro Yard and producing photocopies of it. He handed those copies to Conrail’s Hazardous Materials Risk Manager for further distribution to responding parties.

The Conrail Chief Risk Officer and the Trainmaster drove around to Paradise Road using Route 295. While driving, they described encountering a very thick fog or cloud near Commerce Street and the first crossing south of the train bridge. They walked the train with the consist in hand to account for all hazardous materials cars and ensure none of them were derailed or compromised. They met the Conrail crew from Camden Yard and cut away the other cars.<sup>33</sup> Then, they returned to the ICP.

At approximately 7:30 a.m., CBRNE Lieutenant of the Gloucester County CBRNE Team arrived at the incident. Gloucester County CBRNE has several levels of response capability and its personnel come from various municipalities within the county.<sup>34</sup> Initially an assessment or overhead team is sent to the scene to conduct an assessment, identify the hazardous materials, and contain the incident, if possible. When the assessment team needs additional assistance, a full response is launched with operations level support capabilities. On the day of the incident, a full response team was deployed to provide assistance. Members of the CBRNE assessment team arrived at the ICP, while operations support members (including decon units) were initially staged at the Gloucester County Fire Academy. The operations support units were later deployed closer to the incident for assistance with the response.

The CBRNE Lieutenant was the officer in charge of the CBRNE team. He staged his vehicle two blocks away from the ICP and walked towards it. He described his actions to NTSB investigators as follows.<sup>35</sup>

As I approached, I introduced myself at the incident command post, advised them that I was with the Gloucester County hazmat team, and that we were here and being mustered if there was anything they need from us... The Incident Commander [The Paulsboro Fire Chief] informed me that he had Paulsboro Refinery hazmat en route, and, at this point, there ...[were] no decisions ...made as to exactly what our involvement's going to be ... I did make a recommendation. I felt we were too close [to the derailment site]. I said I think we need to be back at least a half mile. They said that the command post was going to be established here

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<sup>33</sup> Aerial news footage indicates that these cars were not on-scene at approximately 9:10 a.m.

<sup>34</sup> On the day of the incident, personnel from Washington Township Fire Department, Deptford Township Fire Department, Westville Fire Department, and Gloucester County Emergency Response comprised the CBRNE Team.

<sup>35</sup> Interview of the CBRNE Lieutenant on January 31, 2013.

at the location. I also interfaced with a member from the Paulsboro Refinery hazmat. I informed him as well...that we had teams being mustered and ... please let us know what assistance... we can offer.

The CBRNE Lieutenant told the NTSB:

A police officer...had asked me, “Do you think we are too close?” ... I told him I was not in charge and the fire department had command of the scene, but [that] I was going to be staying back myself because of the proximity of the incident.

The CBRNE Lieutenant returned to his vehicle and conducted further chemical research using the WISER application on his phone.

At 7:41 a.m., the Paulsboro Fire Chief ordered emergency medical service (EMS) units to be staged at the Paulsboro Fire Hall (primary staging). He stated that secondary staging was Paulsboro Plaza. However, he radioed that immediate staging should be at the ICP. At 7:42 a.m., the Paulsboro Fire Chief was notified that there were 18 patients at the Paulsboro Marine Terminal. Dispatch inquired whether EMS assistance could be sent to them. He responded, “Negative – get them out of there.”

At 7:44 a.m., county dispatch notified the Paulsboro Fire Chief that the USCG was responding to the incident. The Paulsboro Fire Chief ordered the notification of several businesses in the surrounding area. Shortly after 8 a.m., he requested support from Miller Environmental to place booms on the creek to contain a chemical sheen on the water. Miller Environmental was notified and responded to the site.<sup>36</sup>



*Figure 9 – View of derailed tank cars (at approximately 7:11 a.m. on November 30, 2012) in a fog or cloud with visible ice on the tank cars and in the water.<sup>37</sup> (Photograph courtesy of the wife of the Paulsboro Assistant Fire Chief)*

<sup>36</sup> Aerial news footage indicates that the boom was put in place at approximately 9:15 a.m.

<sup>37</sup> Time estimate based on photograph file information and witness interview statement (interview of the wife of the Paulsboro Assistant Fire Chief on December 2, 2012).

At 8:28 a.m., the ICP was moved to St. James Church, located near the intersection of Commerce Street and Jefferson Street. This location was approximately 300 feet away from the earlier ICP. Paulsboro Refining Company HAZMAT Chief recommended relocation to the Church, instead of the open area near the derailment site. He told the NTSB:

[I] did suggest to the chief that we try to get non-essential personnel moved back and suggested we try to get some type of makeshift field command post. [The Paulsboro Assistant Fire Chief], councilman and former fire chief, his house was involved, suggested why don't we use our living room? I said, no, we shouldn't be tromping in your house, perhaps your garage or, better yet, maybe this church next door. If we could open the door and at least get everyone inside out of the elements ... until we got some instrumentation to determine if we were in harm's way or not... [The Paulsboro Assistant Fire Chief's wife], was going to make that happen, and she did.

At 8:34 a.m., a representative from the New Jersey State Police (NJSP), Office of Emergency Management (OEM) arrived at the ICP. At approximately the same time, a Paulsboro Refining Company air sampling team (identified as Incident Monitoring Team) arrived. The team immediately began air monitoring using Industrial Scientific MX6 photoionization detectors (PID) with 10.6eV lamps. These instruments measured volatile organic compounds (VOC). The team's Certified Industrial Hygienist (CIH) had researched the detection capability of their instrumentation prior to arriving on-scene. He found that vinyl chloride had an ionization potential of 9.99eV, which could be detected using PIDs with 10.6eV lamps. The team's PIDs were calibrated using 100 ppm isobutylene gas. According to the PID manufacturer's response factors table, a response factor multiplier of 1.9 was needed to convert measured VOC readings to an equivalent vinyl chloride concentration.<sup>38</sup> The team reported VOC results (readings without applying the response factor) to the Incident Command.<sup>39</sup>

The Paulsboro Refining Company CIH told NTSB investigators:<sup>40</sup>

We immediately got three errors on our instrumentation when we attempted to zero our meters. And what zeroing does is it calibrates it to clean air. So it would read your normal oxygen, zero LEL, PID, and anything else that happens to be on that specific instrument. We obtained three PID failures. We started up a fourth PID without going into the zero[ing] mode and it immediately went into alarm, at which time there was nothing obvious in the air other than a fog... the hazmat team realized that we were probably in a hot zone. The team wanted to evacuate. I requested that they hold up. And I went into the command area, which was the

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<sup>38</sup> For example, 100 ppm on a Paulsboro Refinery PID would be 190 ppm of vinyl chloride (assuming this is the only material present). The response factors were researched after the incident monitoring data was obtained. The highest measured reading of 760 ppm of VOC, with the response factor applied, is approximately 1,444 ppm of vinyl chloride.

<sup>39</sup> The NTSB was provided the computer downloaded data from the PIDs used on scene.

<sup>40</sup> Interview of Paulsboro Refining Company CIH conducted on January 18, 2013.

annex of the church. I walked into that room and there...[were] about 20 or so people in that room, almost all of which I did not know... I told them what happened with our instrumentation. They asked us how high the numbers were, so I reported [the numbers] ...I had everybody's attention because it was very quiet. Everybody was looking at me. So...they were all aware that the numbers were over 500 parts per million as read on my PID uncorrected for vinyl chloride. They had asked me what the threshold was. I had said the only threshold that I know right now is the OSHA PEL, Permissible Exposure Limit, is 1 part per million. That's all I have to reference, so I'm guessing that we're in an area that you shouldn't be.

The Paulsboro Refining Company CIH told NTSB investigators that the room remained calm during his statement. He quickly left with his team, moving westward towards a clean area to zero their meters and conduct more monitoring. The NTSB asked the Paulsboro Refining Company CIH how his team remained in contact with the Incident Command. He stated, "There was no further communication from the initial report [in the church] until the 11:30 meeting." He also stated:

We took it upon ourselves to obtain air monitoring readings. Nobody instructed us specifically to obtain air monitoring readings. When I found out the material of concern was vinyl chloride and we had detection capabilities, that is when we took our instrumentation along on our call.

The Paulsboro Refining Company CIH also stated that he was not contacted for additional support by the Incident Command. He said: "Nobody asked about our data. We provided it. We left it behind, but nobody asked for it."

A Paulsboro Refining Company mutual aid summary report provided to the NTSB indicates that the following Paulsboro Refining Company teams were supporting the incident:

1. Incident Command Post Team.
2. Incident Monitoring Team.
3. Paulsboro Refinery (PBR) Monitoring Team.
4. Southwest Monitoring Team.

Table 6 provides a summary of the air monitoring data collected by Paulsboro Refining Company sampling teams and their notes.

*Table 6 -Summary of Paulsboro Refining Company air monitoring data.*

<b>TIME (A.M.)</b>	<b>VOC READING (PPM)</b>	<b>NOTES</b>	<b>LOCATION</b>
8:33	631	HazMat Team arrive on location, cannot zero equip., obtain high level alarms, informs IC of high levels.	Corner of Commerce and Jefferson
8:34	694		Corner of Commerce and Jefferson
8:37	760		Corner of Commerce and Jefferson
8:40	0	HazMat Teams leaves incident and goes West to zero instruments.	Delaware and Billings
8:44	193	Shortly after zeroing equipment, obtain readings >100 near Heritages	Delaware and Billings
8:48	111		Delaware and Billings
8:55	35	HazMat (Incident Monitoring) Team moves Northwest out of high readings zone	Delaware and Roosevelt
8:55	35		Delaware in front of Paulsboro HS
9:00	4		Delaware and Roosevelt
9:05	0-5		Delaware in front of Paulsboro HS
9:30	11	PBR Monitoring Team	Billingsport Road - ExxonMobil Parking Lot
9:30	0		Billingsport Road - Paulsboro Refinery Main Gate
9:40	0	Southwest Monitoring Team	
9:55	10	HazMat Team return to Incident Location	Conrail Shack North Side of RR Tracks, West side of Mantua Creek
10:00	1.2	Southwest Monitoring Team	Billingsport Road and Broad Street - Ames Parking Lot
10:05	7		Billingsport Road and Broad Street - Ames Parking Lot
10:10	9	PBR Monitoring Team	Billingsport Road RR Tracks Overpass
10:15	7	Southwest Monitoring Team	Billingsport Road and Broad Street - Ames Parking Lot
10:21	16		Billingsport Road and Broad Street - Ames Parking Lot
10:30	12		Billingsport Road and Broad Street - Ames Parking Lot
10:43	0	NuStar Air Monitoring Report	NuStar Main Gate
10:43	1		NuStar Refinery Peak Reading
10:55	2	Incident Monitoring Team	Broad Street (Rt. 44) Bridge
11:00	0	Southwest Monitoring Team	Broad Street - Gibbstown Fire Dept, Old Wawa, Broad St. School

At approximately 8:45 a.m., an EPA-contracted Removal Support Team (RST) conducted air monitoring with MultiRAE gas detectors in the Paulsboro area. The team performed air monitoring until approximately 12 p.m. Their collected VOC sampling data is provided in attachment 29.

At 8:46 a.m., a radio transmission to the Paulsboro Fire Chief asked if the Command Post was going to move. The Chief replied, “Standby on that... The readings themselves are changing down here...we may not be moving.” At 8:47 a.m., the county dispatch asked, “Where are you moving your Command Post to? Last I have is the St. James Church.” The Paulsboro Fire Chief replied, “We are staying at St. James for now.” He told county dispatch that the secondary Command Post would be Borough Hall.

The Paulsboro Fire Chief was notified, “County EMS is refusing to go into the hot zone to treat the patients... until they have been deconed.” The Gloucester County CBRNE decon

unit (Decon 10) was sent to the Ames parking lot at (Billingpost Road and Broad Street) to decon these patients. The team, led by CBRNE Member 1, set up tents and conducted gross decon. CBRNE Member 1 told NTSB investigators, “There was no direction as to the kind of decontamination we were going to do, where we were putting them, if we were decontaminating them and then taking them to the hospital.” CBRNE Member 1 said, “We couldn't really even monitor them [the patients] to see if they were exposed to anything because the meters that we have... weren't operable.” He added:

We just had them [the patients] strip down. From what we were told...removing their clothes...was going to take a lot of the hazard away from them. So we waited until Gloucester County EMS came with ... four or five ambulances. We had the people strip down. We placed all their stuff in trash bags and then they were transported to Underwood Hospital...

At 9:02 a.m., the Paulsboro Fire Chief requested the notification of Airco Industries (Linde, LLC) because their pipeline was in the derailment area. The NTSB established<sup>41</sup> that the pipeline was a 6-inch diameter carbon steel pipeline that transports pure nitrogen with an operating pressure of 470 psig. The pipeline is buried 3-4 feet deep in a trench located approximately 50 feet from the east rail. Linde, LLC sent personnel to the scene and determined that the derailed rail cars were not encroaching on their right-of-way. Company personnel were in contact with the Incident Command and arranged to provide watch during wreckage removal operations.

At 9:08 a.m., USCG personnel, members of a forward assessment team, arrived at the ICP. According to the Hazardous Substance Incident Annex of the USCG-Sector Delaware Bay Area Contingency Plan, a forward assessment team should: determine the extent of the emergency and mitigation actions; determine if the incident commander needs federal assistance; evaluate the responsible party's willingness to conduct removal operations; determine the availability of an Emergency Response Plan and Site Safety Plan; and evaluate the use of appropriate PPE, air monitoring procedures and cleanup operations.

At 9:10 a.m., a representative from the New Jersey Department of Environmental Protection (NJDEP) arrived on-scene.

The Paulsboro Refining Company CIH told NTSB investigators at approximately 9:30 a.m., he was introduced to the CBRNE Lieutenant. At that time, he was informed that the County CBRNE Team did not have operational air monitoring instrumentation. The Paulsboro Refining Company CIH was given responsibility for the collection of all air sampling data.

At 9:31 a.m., the Paulsboro Fire Chief was notified, “Poly Vinyl [Oxy Vinyls] is on location ... they have a couple of meters that can meter the chemical and they also have the MSDS sheets.” Gloucester County CBRNE sent two technicians to the ICP with these representatives. The Oxy Vinyls representatives brought two direct-reading air monitors (PIDs) to the scene. One of the PIDs (meter number 09050X6-003) was handed over to a

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<sup>41</sup> Based on discussion with Linde, LLC Operations Supervisor.

CBRNE team member, CBRNE Member 2, to perform air monitoring. The other meter remained with the Oxy Vinyls representatives.

CBRNE Member 2 told the NTSB:

I started [air sampling] over in West Deptford at Crown Point and Natural Grove by the trailer park ...and ... the utilities authority...we just walked ...going toward Paulsboro and then walked down Commerce Street towards the incident. We did metering and monitoring...on both sides...on the marine terminal side as well as on the residential side.

CBRNE Member 2 indicated that readings up to 50 ppm of VOC<sup>42</sup> were detected near the derailment site when the wind blew his way. The readings were not consistent and they fluctuated from 0 to 50 ppm. He indicated that no one from Oxy Vinyls was concerned about the numbers he was detecting. He asked one of the Oxy Vinyls representatives if he needed to bring his respirator with him and he was told it was not needed. He told NTSB investigators that he felt comfortable with the Oxy Vinyls guidance because it was their product. Oxy Vinyls provided the NTSB with downloaded PID data which is provided in attachments 31 through 37.



*Figure 10 - Image of emergency responders in an open area near the derailment site at approximately 9:17 a.m. on the morning of the accident.<sup>43</sup> (Photograph courtesy of the wife of the Paulsboro Assistant Fire Chief)*

An Incident Command briefing was held at St. James Church at approximately 9:40 a.m. NTSB interview statements indicate that representatives from Conrail, CSX, Oxy Vinyls,

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<sup>42</sup> A response factor of 1.9 needs to be applied to obtain vinyl chloride concentration.

<sup>43</sup> Time estimate based on photograph file information and witness interview statement (interview of the wife of the Paulsboro Assistant Fire Chief on December 2, 2012).

Paulsboro Refining Company HAZMAT, NJSP-OEM, NJDEP, and Gloucester County CBRNE were present at this briefing. The CBRNE Lieutenant told the NTSB:

During that meeting, there was some discussion...[about] what exactly we had, what some of the plans were, which included approaching the scene and getting a detailed closer-up view of the damage to the railcars and ... [tank car] valves ... That was going to be headed up by -- the gentleman...from CSX... he had asked me if I would want to go with him to do the tank assessments in case there was going to be some additional involvement from some of the teams, and I said I would have no problem at all doing that.

Police Officer 218 told NTSB investigators that there was discussion at the briefing about where the ICP should be located. He said the Paulsboro Fire Chief was “pretty persistent” that he wanted the ICP at St. James Church. Officer 218 stated that NJSP-OEM representatives questioned the safety of the ICP. Officer 218 told the NTSB:

There was a lot of debate on where it [ICP] should be...State Police...questioned it big time - if this was the right place...a lot of people and I want to say ... once that second smoke came in ...were not happy with that call [The Paulsboro Fire Chief’s decision]...A lot of people said we’re out of here, and you saw people leaving...Gloucester County [CBRNE Member 3] was one that said ...we got to go.



*Figure 11 – Incident Command in an open area near the derailment at 10:19 a.m. on November 30, 2012.<sup>44</sup> (Photograph courtesy of the wife of the Paulsboro Assistant Fire Chief)*

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<sup>44</sup> Time estimate based on photograph file information and witness interview statement (interview of the wife of the Paulsboro Assistant Fire Chief on December 2, 2012).



At 10:28 a.m., the Gloucester County CBRNE Decon Team was moved to the ICP. CBRNE Member 1 stated:

There was still no direction as to what we were doing. We stood around probably for 30 to 45 minutes. Then we finally met up with members from the Paulsboro Refinery who had meters. We started doing air monitoring with them. I coordinated, along with [Paulsboro Refining Company HAZMAT Member 2]...we broke into teams, two guys from our hazmat team and one guy from Paulsboro Refinery...we did a grid and ... did some air monitoring throughout the Borough.... That probably took 30 to 45 minutes. And at that time everybody was getting negative readings.... We weren't getting any high levels of anything...After ...air monitoring, it was more staging...There was really not much direction as to what our job function was. And that continued until, for me, approximately 12:30...

As mentioned earlier, the Paulsboro Refining Company was recording all of the air sampling data collected by the CBRNE members and the Refining Company teams.

Members of the County CBRNE team told NTSB investigators that they were not given a safety briefing when they arrived at the ICP and that there was no delineation of the hot zone. They stated that no one in the area was wearing PPE, specifically respiratory protection.

At approximately 10:45 a.m., a press conference was held at the Paulsboro Fire Hall. A New Jersey State Assemblyman and the Mayor of Paulsboro provided the media with a briefing of the incident. A representative from NJDEP told the media that the airborne hazard had dissipated. However, an EPA situation report released at 11:00 a.m., stated:

EPA OSCs [on-scene coordinators] have arrived on-scene and are currently assessing the situation with local fire and police, NJDEP, County HazMat, USCG, Conrail representatives, and other responders. NJDEP is conducting air monitoring activities with hand-held photo-ionization detectors (PID). Readings indicate high levels of vinyl chloride over a half-mile away from the derailment scene. EPA is assisting in determining a location for establishment of the Command Post given the readings. EPA will be supplementing air monitoring support with the deployment of ERT's TAGA and contractor resources from SERAS and RST. It is anticipated that EPA will be assisting with air monitoring in the communities and areas near the derailment.

In addition to the EPA RST team air monitoring, the EPA brought in its Trace Atmospheric Gas Analyzer (TAGA) bus to conduct real-time air monitoring of vinyl chloride at approximately 1:30 p.m. A record of the route and logged results are provided in attachments 39 and 40.

Also, at approximately 10:45 a.m., Conrail's Hazardous Materials Risk Manager, a CSX Hazardous Materials representative, and the Gloucester County CBRNE Lieutenant went out to the wreckage using a Miller Environmental boat. The CBRNE Lieutenant told NTSB investigators:

[CSX Hazardous Materials Representative]<sup>45</sup>...checked all the valves, opened up some of the dome lids, indicated there was no additional leakage, [and] assessed the one car that was breached. We noticed that there was snow [on] everything...so we know we definitely had a release. It was obvious. At that point, the [air monitoring] meter did go in[to] alarm. So we ... back[ed] off and ...re-approached in a different area. But we weren't getting alarms or anything on the meters, [we] completed the tank car assessment...



*Figure 12 - Image of emergency responders climbing on tank car OCPX 80323 to inspect the breach in tank car OCPX 80234 at 10:49 a.m. on the morning of the accident.<sup>46</sup> (Photograph courtesy of the wife of the Paulsboro Assistant Fire Chief)*

At 10:46 a.m., the Paulsboro Fire Chief told dispatch, “We are moving operations to Borough Hall [1211 Delaware Avenue] which will probably be a better spot because it’s a half-mile evacuation area and when they start the lifting of these tanks that are full, we are not going to be in this area.”

<sup>45</sup> The Conrail Hazardous Materials Risk Manager also performed this task.

<sup>46</sup> Time estimate based on photograph file information and witness interview statement (interview of the wife of the Paulsboro Assistant Fire Chief on December 2, 2012).



*Figure 13 – Close-up photograph of the Incident Command in an open area near the derailment on November 30, 2012.<sup>47</sup> (Photograph courtesy of the USCG)*

At 11:04 a.m., Sunoco Logistics contacted the Paulsboro Police to report that the Sunoco Logistics pipelines were closed. There were two Sun Oil pipelines in a trench across the creek, buried approximately 10-15 feet below the creek. The Sun Oil Damage Prevention Coordinator told the NTSB that they had personnel on-scene on the day of the accident.

At approximately 1 p.m., the Paulsboro Fire Chief and representatives from Paulsboro Refining Company HAZMAT, NJDEP, NJSP-OEM, Conrail<sup>48</sup>, and Paulsboro Police discussed the establishment of a Unified Command. The Paulsboro Refining Company HAZMAT Chief told NTSB investigators that he began putting together a formal ICS-201 and attempted to develop a list of initial objectives for a Unified Command. Conrail was identified as the responsible party.<sup>49</sup>

At this meeting, there was a discussion about who should be the responsible federal on-scene coordinator, USCG or EPA. The accident location fell under USCG jurisdiction, however, the evacuation or affected area included EPA response areas. USCG Captain of the Port arrived and assumed the role of the federal on-scene coordinator. Shortly thereafter, a Unified Command was formed between the USCG, Conrail, NJSP-OEM, NJDEP, and the Paulsboro Fire Department.

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<sup>47</sup> USCG lists the time as 11:21 am; however, the NTSB believes that the photograph may have been taken prior to 10:49 a.m.

<sup>48</sup> The Paulsboro Refining Company HAZMAT Chief indicates in his interview that a Conrail representative was not at Borough Hall; however, the NTSB established that Conrail representatives were present at Borough Hall at approximately 1:15 pm.

<sup>49</sup> See definitions in 33 United States Code (USC) § 2701. According to the USCG, the responsible party of an incident is the person, business, or entity that has been identified as owning the vessel or facility that caused the spill. The term does not imply criminal negligence. (<http://www.uscg.mil/npfc/glossary.asp>)

At approximately 1:30 p.m., the Conrail contractor, Center for Toxicology and Environmental Health (CTEH), began air monitoring in the Borough of Paulsboro. A summary of the air monitoring capabilities and results are provided in attachments 41 and 42.

At approximately 2 p.m., the ICP was moved to the Gloucester County Fire Academy located at 212 County House Road in Clarksboro.

At approximately 4 p.m., consistently high levels of vinyl chloride were detected at the derailment site. The area was cordoned off and the evacuation was expanded. The Paulsboro Fire Department began vapor suppression operations at approximately 4:30 p.m. to reduce the airborne vinyl chloride levels.

The Unified Command's initial response objectives and actions included:

1. Ensuring the safety and health of response personnel and the public.
2. Continue assessment of all environmentally sensitive areas and ensure protective measures are consistent with the area contingency plans, including protection of affected wildlife.
3. Determine HAZMAT fate and effect (trajectory) plume.
4. Collect and disseminate accurate trajectory information.
5. Manage a coordinated interagency response.
6. Implement measures to effectively contain, cleanup, recover, and dispose of potential product discharge.
7. Keep the public and stakeholders informed of response activities.
8. Utilize assessment data to remove oil and hazardous substances from containers within the navigable waters and adjoining shoreline.
9. Implement scene integrity and evidence preservation procedures as per NTSB.
10. Restoration of the transportation infrastructure and commerce.

On December 1, 2012, the Unified Command finalized and approved the following:

1. Incident Summary.
2. Area Sampling Plan.
3. Safe Work Plan.
4. Water Sampling Plan.
5. Incident Action Plan.

On the first day of emergency response operations, Conrail Hazardous Materials personnel estimated that roughly 4,000 to 5,000 gallons of vinyl chloride product had remained in the breached tank car. The Unified Command ICS 201, dated December 1, 2012, recorded approximately 3,000-4,000 gallons of vinyl chloride that remained in the breached tank car.

ATTACHMENT 21 – FIRE EMS CAD REPORT

ATTACHMENT 22 – GLOUCESTER COUNTY MUTUAL AID AGREEMENT AND SOPS

ATTACHMENT 23 – PAULSBORO REFINING COMPANY MUTUAL AID DISPATCHING PROCEDURES

ATTACHMENT 24 – PAULSBORO REFINING COMPANY MUTUAL AID SUMMARY (AIR MONITORING AND EQUIPMENT RESPONSE FACTOR)  
ATTACHMENT 25 – INTERAGENCY MODELING AND ATMOSPHERIC ASSESSMENT CENTER DISPERSION MODELING  
ATTACHMENT 26 – NOAA MODELING-1  
ATTACHMENT 27 – NOAA MODELING-2  
ATTACHMENT 28 – NOAA MODELING-3  
ATTACHMENT 29 – EPA AIR MONITORING SUMMARY  
ATTACHMENT 30 – USCG HAZARDOUS SUBSTANCE ANNEX  
ATTACHMENT 31 – OXY VINYLs EXPLANATION OF AIR MONITORING ACTIVITIES  
ATTACHMENT 32 – OXY VINYLs AIR MONITORING (SESSION 1\_09050X6-004)  
ATTACHMENT 33 – OXY VINYLs AIR MONITORING (SESSION 2\_09050X6-004)  
ATTACHMENT 34 – OXY VINYLs AIR MONITORING (SESSION 3\_09050X6-003)  
ATTACHMENT 35 – OXY VINYLs AIR MONITORING (SESSION 4\_09050X6-003)  
ATTACHMENT 36 – OXY VINYLs AIR MONITORING (SESSION 5\_09050X6-003)  
ATTACHMENT 37 – OXY VINYLs CALIBRATION AND BUMP TEST RECORD  
ATTACHMENT 38 – NJDEP COPY OF EPA PAULSBORO TRAIN DERAILMENT – UPDATE #4  
ATTACHMENT 39 – NJDEP COPY OF EPA TAGA BUS ROUTE ON NOVEMBER 30, 2012 (NJDEP-0204-NJDEP-0205)  
ATTACHMENT 40 – EPA TAGA DATA  
ATTACHMENT 41 – CTEH AIR SAMPLING AND MONITORING WORK PLAN SUMMARY  
ATTACHMENT 42 – CTEH AIR SAMPLING AND MONITORING SUMMARY FOR NOVEMBER 30, 2012  
ATTACHMENT 43 – UNIFIED COMMAND SIGNED INCIDENT SUMMARY (ICS-201, ICS-205, ICS-207, AND ICS-209)  
ATTACHMENT 44 – UNIFIED COMMAND APPROVED CTEH AIR SAMPLING AND MONITORING PLAN  
ATTACHMENT 45 – SPSI SAFE WORK PLAN  
ATTACHMENT 46 – WATER SAMPLING PLAN  
ATTACHMENT 47 – UNIFIED COMMAND INCIDENT ACTION PLAN #1  
ATTACHMENT 48 – EPA VS. USCG JURISDICTION (NJDEP-0017-NJDEP-0019)

## **I. Hazardous Waste Operations and Emergency Response (HAZWOPER) Standards**

The Occupational Safety and Health Administration’s (OSHA) standard at 29 CFR 1910.120, Hazardous Waste Operations and Emergency Response (HAZWOPER), applies to “emergency response operations for releases of, or substantial threats of releases of, hazardous substances.”<sup>50</sup> The standard defines emergency response as “response efforts by employees from outside the immediate release area or by other designated responders (i.e., mutual aid groups, local fire departments, etc.) to an occurrence of an uncontrolled release of a hazardous substance.”<sup>51</sup> Paragraph (q) of the standard covers the specific requirements applicable to emergency response operations to hazardous substance releases.

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<sup>50</sup> 29 CFR 1910.120(a)(1)(v).

<sup>51</sup> 29 CFR 1910.120(a)(3)

The OSHA standard requires the establishment of an emergency response plan (ERP)<sup>52</sup> that addresses several elements such as pre-emergency planning and coordination with outside parties, personnel roles and lines of authority, emergency recognition and prevention, safe distances and places of refuge, site security and control, and PPE and emergency equipment.

The OSHA standard also outlines requirements and procedures for handling emergency response.<sup>53</sup> The standard specifies that an incident command system (ICS) must be used. Additionally, it requires the incident commander to identify all hazardous substances and perform a site analysis, implement appropriate emergency operations, and assure that appropriate PPE is used. For workers engaged in “emergency response and exposed to hazardous substances presenting an inhalation hazard or potential inhalation hazard,” it requires these workers to “wear positive pressure self-contained breathing apparatus while engaged in emergency response, until such time that the individual in charge of the ICS determines through the use of air monitoring that a decreased level of respiratory protection will not result in hazardous exposures to employees.”<sup>54</sup>

The OSHA standard specifies the required training levels and qualifications for workers engaged in response operations.<sup>55</sup> The required training levels are based on worker duties and functions. The levels of training qualification are: first responder awareness, first responder operations, hazardous materials technician, hazardous materials specialist, and on-scene commander. Both initial and annual refresher training are required for each level of worker qualification.

Appendix E of 29 CFR 1910.120 provides non-mandatory training curriculum guidelines. These guidelines reference the knowledge competencies covered in the National Fire Protection Association (NFPA) 472 standard, Standards for Competence of Responders to Hazardous Materials/Weapons of Mass Destruction Incidents.

NFPA 472, Chapter 4,<sup>56</sup> Core Competencies for Awareness Level Personnel, states that awareness level personnel must be able to perform the following:

- (1) Analyze the incident to determine both the hazardous materials/WMD present and the basic hazard and response information for each hazardous materials/WMD agent by completing the following tasks:
  - (a) Detect the presence of hazardous materials/WMD.
  - (b) Survey a hazardous materials/WMD incident from a safe location to identify the name, UN/NA identification number, type of placard, or other distinctive marking applied for the hazardous materials/WMD involved.
  - (c) Collect hazard information from the current edition of the DOT Emergency Response Guidebook.

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<sup>52</sup> 29 CFR 1910.120(q)(1) and (2)

<sup>53</sup> 29 CFR 1910.120(q)(3)

<sup>54</sup> 29 CFR 1910.120(q)(3)(iv)

<sup>55</sup> 29 CFR 1910.120(q)(6)

<sup>56</sup> Section 4.1.2.2 of

- (2) Implement actions consistent with the authority having jurisdiction (AHJ), and the current edition of the DOT *Emergency Response Guidebook* by completing the following tasks:
  - (a) Initiate protective actions
  - (b) Initiate the notification process

NFPA 472, Chapter 5,<sup>57</sup> Core Competencies for Operations Level Responders, states that operations level responders must be able to perform the following:

- (1) Analyze a hazardous materials/WMD incident to determine the scope of the problem and potential outcomes by completing the following tasks:
  - (a) Survey a hazardous materials/WMD incident to identify the containers and materials involved, determine whether hazardous materials/WMD have been released, and evaluate the surrounding conditions
  - (b) Collect hazard and response information from MSDS; CHEMTREC/CANUTEC/SETIQ; local, state, and federal authorities; and shipper/manufacturer contacts
  - (c) Predict the likely behavior of a hazardous material/WMD and its container
  - (d) Estimate the potential harm at a hazardous materials/WMD incident
- (2) Plan an initial response to a hazardous materials/WMD incident within the capabilities and competencies of available personnel and personal protective equipment by completing the following tasks:
  - (a) Describe the response objectives for the hazardous materials/WMD incident
  - (b) Describe the response options available for each objective
  - (c) Determine whether the personal protective equipment provided is appropriate for implementing each option
  - (d) Describe emergency decontamination procedures
  - (e) Develop a plan of action, including safety considerations
- (3) Implement the planned response for a hazardous materials/WMD incident to favorably change the outcomes consistent with the emergency response plan and/ or standard operating procedures by completing the following tasks:
  - (a) Establish and enforce scene control procedures, including control zones, emergency decontamination, and communications
  - (b) Where criminal or terrorist acts are suspected, establish means of evidence preservation
  - (c) Initiate an incident command system (ICS) for hazardous materials/WMD incidents
  - (d) Perform tasks assigned as identified in the incident action plan
  - (e) Demonstrate emergency decontamination
- (4) Evaluate the progress of the actions taken at a hazardous materials/WMD incident to ensure that the response objectives are being met safely, effectively, and efficiently by completing the following tasks:

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<sup>57</sup> Section 5.1.2.2.

- (a) Evaluate the status of the actions taken in accomplishing the response objectives
- (b) Communicate the status of the planned response

**J. New Jersey Public Employee Occupational Safety and Health (PEOSH) Program**

New Jersey operates a public sector-only occupational safety and health program under a plan approved by the U.S. Department of Labor. The Public Employee Occupational Safety and Health Program (PEOSH) covers safety and health for all state, county and local government agencies, public authorities, fire departments, and school districts within New Jersey. Federal OSHA maintains jurisdiction over all private sector workplaces, federal agencies, maritime employers, military facilities, Indian sovereignty workplaces, and the U.S. Postal Service.

The New Jersey Department of Labor and Workforce Development (NJDLWD) is the designated state agency responsible for administering the plan throughout the state. However, different departments within the state have responsibility for the enforcement of safety and health regulations. NJDLWD enforces workplace safety regulations, while the New Jersey Department of Health (NJDOH) enforces workplace health regulations.

***Regulations and Standards***

The PEOSH Program has adopted, identically, all federal OSHA standards and regulations, with only two exceptions (29 CFR 1910.1200 and 1910.158). The NJDOH - PEOSH Program is the lead enforcement agency for the HAZWOPER standard, 29 CFR 1910.120. NJDOH provides an ERP Guide to assist municipalities with the development of their individual plans. This guide is publicly available on the Agency's website.

***PEOSH Performance Plan***

The PEOSH five-year strategic plan for fiscal years (FY) 2009 through 2013 consisted of three strategic goals. Goal number one was the reduction of injuries, illnesses, and fatalities by 1percent per year from FY 2009 through FY 2013 totaling 5 percent for the 5-year Strategic Plan in the following industries:

- State agencies for Transportation Support Services (NAICS 488).
- State Nursing and Residential Care Facilities (NAICS 623)
- Local Fire Protection (NAICS 92216).
- Local Police Protection (NAICS 92218).

The OSHA Region II Federal Annual Monitoring Evaluation (FAME) Report for October 1, 2010, through September 30, 2011, indicates that PEOSH did not meet its goal to reduce non-fatal injuries and illnesses by 2 percent in both the Transportation Support Services (29 percent increase over the 2008 baseline) and Local Fire Protection (9.4 percent increase over the 2008 baseline). The report indicates that the PEOSH planned to continue “enhanced



enforcement and outreach for the Transportation Support Services and Fire Protection sectors in an effort to foster improvement in those sectors.”

In the FAME Report, the PEOSH claimed that if the 2005 injury and illness rates were used as the baseline, instead of the 2008 data, there would be an overall 7.2 percent decrease in injury and illness rates.

The 9.4 percent increase in non-fatal injuries and illnesses in the NAICS 92216 occurred despite the PEOSH exceeding its projected number of enforcement inspections for FY 2011 (67 projected inspections; however, a total of 394 were conducted).

ATTACHMENT 49 – FEDERAL ANNUAL MONITORING EVALUATION (FAME) REPORT FY 2011

## **K. Hazardous Materials Guidance for First Responders**

Hazardous materials guidance to assist first responders in making initial decisions upon arriving at the scene of a transportation incident involving hazardous goods is contained in the Emergency Response Guidebook (ERG).<sup>58</sup> The ERG states, “It is primarily a guide to aid first responders in quickly identifying the specific or generic hazards of the material(s) involved in the incident, and protecting themselves and the general public during the initial response phase of the incident.” The ERG defines the initial response phase as “that period following arrival at the scene of an incident during which the presence and/or identification of dangerous goods is confirmed, protective actions and area securement are initiated, and assistance of qualified personnel is requested.”

The ERG specifies the protective actions and isolation/evacuation distances for the safety of responders and the public. It instructs responders to become familiar with the guidebook and its content before an emergency, to “resist the urge to rush in,” to approach the incident from upwind, and to stay clear of all spills, vapors, fumes, smoke and suspicious sources. It also states, “Do not assume that gases or vapors are harmless because of lack of smell-odorless gases or vapors may be harmful.”

The ERG numbered guide for vinyl chloride is 116, Gases-Flammable (unstable). ERG Guide 116 instructs responders to keep unauthorized personnel away and stay upwind of the incident. It further states that for a large spill of vinyl chloride, an initial downwind evacuation of at least a half-mile should be considered. If a tank car is involved in a fire, it recommends an isolation zone of one mile in all directions and an initial evacuation of one mile in all directions as well. With respect to protective clothing, ERG Guide 116 recommends that responders wear positive pressure self-contained breathing apparatus (SCBA) and advises that structural firefighters’ protective clothing will only provide limited protection. It also warns that vapors may cause dizziness or asphyxiation without warning.

Emergency responders can obtain more specific chemical information from the NIOSH Pocket Guide to Chemical Hazards. The NIOSH Pocket Guide is intended as a source of general industrial hygiene information on several hundred chemicals for workers, employers

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<sup>58</sup> The latest edition published in 2012. The prior edition was published in 2008.

and occupational health professionals. Guidance provided for occupational exposure to vinyl chloride advises that the OSHA permissible exposure limit (PEL) indicates a time weighted average (TWA) of 1 ppm, with a ceiling level of 5 ppm for a 15 minute exposure. At concentrations above the PEL, NIOSH recommends the use of self-contained breathing apparatus that has a full facepiece, or a supplied air respirator. For escape, workers may use a full face air purifying respirator with appropriate cartridges that provide a protection factor (APF) of 50.

For assistance with chemical cloud dispersion analysis, NOAA and the EPA have jointly developed a free and commonly used software program known as ALOHA (Areal Locations of Hazardous Atmospheres). ALOHA allows first responders and planners to quickly model chemical releases and estimate how a chemical cloud may disperse after an accident release. It also provides the user with the ability to model several fire and explosion scenarios, including BLEVEs (Boiling Liquid Expanding Vapor Explosions), jet fires, vapor cloud explosions, and pool fires. Depending on the user-entered conditions of the incident, the ALOHA program will provide estimates of a threat zone and the corresponding types of hazards (such as toxicity, flammability, thermal radiation, or damaging overpressure) based on levels of concern, such as the AEGLs or the ERPGs.

None of the initial first responders wore respiratory personal protective equipment. Many initial first responders remained in a chemical cloud while evacuating areas and evaluating the accident. Photographs taken during the first several hours of the emergency response and interview statements confirm that operations involving police, fire department, railroad, and contractors occurred without the use of respiratory protective equipment. Health screening was offered to the first responders who were exposed to the chemical.

#### **L. Paulsboro Fire Department**

The Paulsboro Fire Department has 25 volunteer firefighters that are mostly trained to firefighter level I. The department has one rescue and two pumper vehicles. The Paulsboro Fire Chief told the NTSB that the department performs only defensive hazardous materials response since it has no offensive response capabilities. If offensive hazardous materials response capabilities were needed, the Borough through its mutual aid agreements, requests assistance from the Gloucester County CBRNE or the Paulsboro Refining Company HAZMAT team.

Most of the firefighters are trained to the hazardous materials awareness and operations level.

#### ***New Jersey Firefighter Training and Certification Laws***

Chapter 73 of Title 5 of the New Jersey Administrative Code (NJAC) provides standards for fire service training and certifications in the State of New Jersey. The intent of these standards is “to control all matters relating to qualifications for, and the training and certification of all members of the fire service, including firefighters and officers engaged in, or to be engaged in, fire suppression activities, and all fire service instructors.” Subchapter 6, Hazardous Materials/Incident Management System Certification, specifically addresses

requirements for the management of hazardous materials including the levels of training and continuing education. Subchapter 6.5 states “continuing education requirements set forth in 29 CFR 1910.120 shall apply to all individuals holding Hazardous Materials--Awareness, Hazardous Materials--Operational and/or Hazardous Materials On-Scene Commander certification(s).”

***Paulsboro Fire Department Hazardous Materials Training***

The NTSB requested from the Paulsboro Fire Department to provide training certificates for the Fire Chief, the Assistant Fire Chief, and Paulsboro Fire Captain (Paulsboro’s Emergency Management Coordinator). Table 7 provides a summary of the most recent (since November 29, 2011) hazardous materials or safety officer training for these fire department members. Copies of the certificates are provided in attachments 49 through 51.

*Table 7 -Summary of most recent (since November 29, 2011) hazardous materials or safety officer training on record for these fire department members.*

NAME	TRAINING COURSE (HAZARDOUS MATERIALS OR SAFETY OFFICER COURSE)	TRAINING PROVIDER	DATE OF COMPLETION
Fire Chief	Hazardous Materials Level 2 Operations Competency Refresher	Gloucester County Fire Academy	April 10, 2012
Assistant Fire Chief	None	N/A	N/A
Fire Captain and Emergency Management Coordinator	Hazardous Materials Level 2 Operations Competency Refresher	Gloucester County Fire Academy	April 10, 2012
	Hazardous Materials Awareness Refresher and Usage of the 2008 ERG Book	Gloucester County Fire Academy	March 27 2012

ATTACHMENT 50 – PAULSBORO FIRE CHIEF TRAINING RECORDS

ATTACHMENT 51– PAULSBORO ASSISTANT FIRE CHIEF TRAINING RECORDS

ATTACHMENT 52– PAULSBORO EMERGENCY MANAGEMENT COORDINATOR TRAINING RECORDS

**S. Transportation Community Awareness and Emergency Response (TRANSCAER) of New Jersey**

The NTSB obtained training attendance records from TRANSCAER of New Jersey to determine if Paulsboro Fire Department members attended any of the recent training sessions held in the local area. A review of the provided documents indicates that no one from the Paulsboro Fire Department attended the free tank car training that was held at Woodbury Yard on April 20 and 21, 2012. The purpose of the training was to educate emergency responders and familiarize them with railroad hazardous material tank cars.

ATTACHMENT 53 – TRANSCAER TRAINING ATTENDANCE RECORDS AND COURSE DESCRIPTIONS

**M. Borough of Paulsboro Emergency Operations Plan (EOP)**

The New Jersey Civilian Defense and Disaster Control Act mandates that “each county and municipality in the State shall prepare a written Emergency Operations Plan with all appropriate annexes necessary to implement the plan.”<sup>59</sup> The Act requires:<sup>60</sup>

Each county and municipal Emergency Operations Plan shall conform to all relevant federal and State statutes, rules and regulations concerning emergency operations and shall include the identification of significant hazards affecting the jurisdiction. Each county and municipal Emergency Operations Plan shall be based upon planning criteria, objectives, requirements, responsibilities and concepts of operation for the implementation of all necessary and appropriate protective or remedial measures to be taken in response to an actual or threatened emergency as determined by the State Director of Emergency Management. Each county and municipal Emergency Operations Plan shall be reviewed and updated at least every two years.

It also states:<sup>61</sup>

Each county and municipality shall submit an Emergency Operations Plan to the State Office of Emergency Management. No Emergency Operations Plan shall take effect without approval by the State Office of Emergency Management. The State Office of Emergency Management shall review the plans and determine their compatibility with the State Emergency Operations Plan Guidelines and shall either approve, conditionally approve, or disapprove the plan. The State Office of Emergency Management shall set forth in writing its reasons for disapproval of any plan or, in the case of the issuance of a conditional approval, shall specify the necessary amendments to the plan. If the State Office of Emergency Management fails to approve, conditionally approve, or disapprove an Emergency Operations Plan within 60 days of receipt of the plan, it shall be considered approved by the State Office of Emergency Management.

NJSP approved a Paulsboro EOP on July 27, 2006. NJSP sent a letter to Paulsboro’s Emergency Management Coordinator informing him of the plan approval and that it would require recertification by July 31, 2010.

A letter from the Gloucester County Office of Emergency Management was sent to Paulsboro’s Emergency Management Coordinator on April 19, 2010, requesting the Borough’s revised EOP for recertification. A copy of the letter was also sent to the Mayor of Paulsboro and NJSP-OEM. However, the EOP has not been recertified since July 31, 2010.

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<sup>59</sup> App.A:9\_43.2. County, municipal written Emergency Operations Plans

<sup>60</sup> App.A:9\_43.3. Guidelines for Emergency Operations Plans

<sup>61</sup> App.A:9\_43.4. Approval by State Office of Emergency Management

The NTSB requested additional documentation or communication regarding any follow-up activities that the Gloucester County Office of Emergency Management submitted to the Borough. The Director of Gloucester County Office of Emergency Management responded to the NTSB and stated, “All discussions with Paulsboro regarding EOP status were conducted verbally.”

The Paulsboro Emergency Management Coordinator provided the NTSB with an unsigned and undated copy of the Paulsboro EOP.<sup>62</sup> The plan includes several annexes. Annex F addresses evacuation procedures and available resources. Annex H outlines the procedures to be followed and implemented during a hazardous materials incident in the Borough. The plan states that incident management will be implemented and actions will be in accordance with 29 CFR 1910.120. It also designates responsibilities to various agencies within the borough, county and state.

ATTACHMENT 54 – PAULSBORO EMERGENCY OPERATIONS PLAN (UNSIGNED AND UNDATED)

ATTACHMENT 55 – NJSP APPROVAL OF PAULSBORO EOP 7-27-2006

ATTACHMENT 56 – GLOUCESTER COUNTY APPROVAL OF EOP 7-19-2006

ATTACHMENT 57 – GLOUCESTER COUNTY LETTER TO PAULSBORO REGARDING EOP  
RECERTIFICATION AND RESPONSE TO NTSB QUESTIONS

## **N. Derailed Tank Cars**

### ***i. Tank Car Descriptions***

Tank cars OCPX 80234 and OCPX 80323 were manufactured by TrinityRail. Tank cars UTLX 207398, UTLX 98097, and UTLX 98041 were manufactured by Union Tank Car.

Oxy Vinyls owns tank cars OCPX 80323 (position 9 in the train) and OCPX 80234 (position 10) and it leases UTLX 98097 (position 11) and UTLX 98041 (position 12) from the Union Tank Car Company. Murex N.A., LTD, leases tank car UTLX 207398 (position 8) from Union Tank Car Company.

Tank cars OCPX 80323, OCPX 80234, UTLX 98097, and UTLX 98041 were DOT specification 105J300W tank cars. Tank car UTLX 207398 (position 8) was a DOT specification 111A100W1 general service car. Each tank car has a maximum gross rail load (GRL) of 263,000 lbs.

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<sup>62</sup> Paulsboro was unable to produce a copy of a dated, signed, and approved EOP.



*Figure 14 – Image of OCPX 80234 prior to the November 30, 2012, accident. (Photograph courtesy of the USCG)*

Tank car OCPX 80234 was manufactured on November 1, 1990. The car had a capacity of 24,650 gallons and a load limit of 178,200 pounds. The tank shell and heads were constructed of 9/16-inch Association of American Railroads (AAR) TC-128 Grade B normalized steel with no lining. The tank was wrapped with insulation (0.65-inch Fiberfrax with 4-inches of fiberglass insulation compressed to 3.5 inches total thickness) and an 11 gauge steel jacket.<sup>63</sup> The general drawings provide that 1/2-inch thick full-height head shields were built into the jacket. The tank car had a stub sill underframe. Valves and fittings include one Midland spring-loaded pressure relief device with a start-to-discharge pressure of 247.5 psig. The manufacturer provided that the top fittings protective housing contains air and liquid valves for loading and unloading, a thermometer well to measure temperature, a liquid gauging device, and a sample line. The car was not equipped with a bottom outlet.

Tank car UTLX 207398 was a general service non-insulated stub sill design. This car was fitted with a bottom outlet valve, hinged and bolted manway, and a single pressure relief device (PRD). This tank car specification does not require head shields, jackets, or thermal protection.

Table 8 provides a summary of information retrieved from the certificates of construction, tank car manufacturers' drawings, and the Universal Machine Language Equipment Register (UMLER).

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<sup>63</sup> Information obtained from TrinityRail drawings of tank car.

Table 8: Hazardous Materials Tank Car Information.

POSITION IN TRAIN	REPORTING MARKS	TANK CAR MANUFACTURER	BUILD DATE	DOT SPECIFICATION	SHELL	HEADS	PRESSURE RELIEF DEVICE (NUMBER ON TANK)	STENCILED LOAD LIMIT (LBS)
8	UTLX 207398	Union Tank Car	4/1/2007	111A100W1	0.4375" AAR TC 128 Gr. B	0.4688" A 516-70	165 psig (1)	196,600
9	OCPX 80323	Trinity Tank Car	3/1/2006	105J300W	0.5625" AAR TC 128 Gr. B - Norm	0.5625" AAR TC 128 Gr. B - Norm, 1/2" full head shield	247.5 psig (1)	182,200
10	OCPX 80234	Trinity Tank Car	11/1/1990	105J300W	0.5625" AAR TC 128 Gr. B - Norm	0.5625" AAR TC 128 Gr. B - Norm, 1/2" full head shield	247.5 psig (1)	178,200
11	UTLX 98097	Union Tank Car	2/1/1978	105J300W*	0.5625" AAR TC 128 Gr. B  [except center shell 0.5938" thick]	0.5938" AAR TC 128 Gr. B, 1/2" half head shield - Norm	247.5 psig (1)	179,200
12	UTLX 98041	Union Tank Car	1/1/1978	105J300W*	0.5625" AAR TC 128 Gr. B  [except center shell 0.5938" thick]	0.5938" AAR TC 128 Gr. B, 1/2" half head shield - Norm	247.5 psig (1)	179,100

\* Certificate of Construction F-777118 provides that the tank cars were stenciled 105A300W at the time of construction. No R-1 was provided that documents alterations/repairs.

***ii. Maintenance History of Tank Car OCPX 80234***

Tank car OCPX 80234 was maintained by Occidental Chemical Company (Parent Corporation to Oxy Vinyls, LP). The most recent maintenance and repair work involved the following:

January 25, 2007:

- HM-201 Tank Qualification<sup>64</sup>
- Service equipment with Midland safety valve and test
- Bubble leak air test valve and fittings
- Replace gaskets and O-rings
- Rebuild angle valves
- Stub sill inspection found no exceptions or cracks in welds or parent metal

The next tank car inspection was due in 2017. The next safety valve (PRD) test was due in 2012. Since this car had tank car qualification in 2007, it was not due for requalification inspections until 2017.

### **iii. Applicable Tank Car Regulations**

Title 49 of the Code of Federal Regulations (CFR) Part 179 outlines the federal requirements for tank cars. Subpart B of Part 179 contains general design requirements, while Subpart D contains the specifications for non-pressure tank car tanks (classes DOT-111AW and 115AW). Subpart C contains general construction standards applicable to specification DOT-105 tank cars. Additional tank car industry standards, incorporated in the HMR by reference, are the Association of American Railroads (AAR) Manual of Standards and Recommended Practices, Section C-Part III, Specifications for Tank Cars, Specification M-1002.

Other hazardous materials regulations pertinent to vinyl chloride loading and use of tank cars include:

- 173.24(b) and 173.314(c) outage and filling requirements. Liquefied gases, such as vinyl chloride, must be loaded with at least one percent outage at a reference temperature of 105 °F.
- 173.31(3) tank head puncture resistance requirements. Tank cars transporting a Class 2 material must have a tank-head puncture resistance system that conforms to the requirements of 179.16.
- Part 180, Subpart F qualification and maintenance of tank cars. Tank cars are required to successfully pass periodic inspections at a frequency determined by the type of tank car and the products transported. Such inspections include, but are not limited to, the following:
  - Internal and external visual inspection of the tank shell and heads for abrasion, corrosion, cracks, dents, distortions, defects in welds, or any other condition that makes the car unsafe for transportation.
  - Structural integrity inspections and tests, including transverse and fillet welds at certain locations on the tank using non-destructive testing techniques.
  - Thickness of tank shell and heads to within specified tolerances in 180.509 (g)
  - Testing of PRD valves.

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<sup>64</sup> *Federal Register*, vol. 60, no. 183 (September 21, 1995), p. 49048. Rulemaking in HM-201 allows the use of non-destructive testing techniques in lieu of hydrostatic pressure testing.



The minimum head and shell thickness authorized for DOT-111A100W1 tank cars by 49 CFR 179.201-1 is 7/16-inch (0.4375-inch), and these metals must be of specification AAR TC 128, grade B or ASTM A 516 grade steels.

ATTACHMENT 58 – OCPX 080234 TANK CAR MAINTENANCE RECORDS

ATTACHMENT 59 – TRINITYRAIL TANK CAR DRAWING – FOR OFFICIAL USE ONLY (FOUO)

## **O. Tank Car Damages**

The NTSB was unable to examine the tank cars at the accident site due to the hazardous materials and emergency response activities on-scene. The NTSB requested from Conrail to adequately document the accident scene and provide collected photographs and video footage before any tank cars or wreckage was moved. The Hazardous Materials Group submitted a checklist of investigative requirements to Conrail. These requirements primarily focused on the collection and documentation of the physical condition of the tank cars as they were oriented. This checklist can be found in attachment 60.

The Hazardous Materials Group noted observations of the position of wreckage are provided in table 9. These observations are based on photographs obtained from the FRA, NTSB, and NJSP - OEM.

Table 9: Summary of tank car positions and orientation after the accident.

POSITION IN TRAIN	CAR REPORTING MARKS	CAR TYPE	HAZARDOUS MATERIALS COMMODITY	DERAILED POSITION
8	UTLX 207398	DOT111A100W	Ethanol	On left-side with B-end and half of car in water. A-end facing South. Tank car is on eastside of track at approximately 30 degree angle to track.
9	OCPX 80323	DOT105J300W	Vinyl Chloride	On right-side with B-end in water. B-end facing South. A-Left bolster web inside OCPX 80234. Tank car is laying 10 degrees to rail and 60 degrees from vertical.
10	OCPX 80234	DOT105J300W	Vinyl Chloride	A-end in water. Right side laying on bridge, bridge wall, and bolster web of OCPX 80323. Breach center of right-side at side ladder. Car laying 10 degrees to track.
11	UTLX 98097	DOT105J300W	Vinyl Chloride	Standing vertical with B-end in water and A-end on bridge. A-end stub sill in contact with UTLX 98041.
12	UTLX 98041	DOT105J300W	Vinyl Chloride	B-end derailed to west-side of track and facing South. B-end in contact with UTLX 98097. A-end right wheels lifted. Tank car coupled to OCPX 80305 to prevent tip over.
13	OCPX 80305	DOT105J300W	Vinyl Chloride	Not derailed. On track anchoring UTLX 98041.



Figure 15 - Image of breach in OCPX 80234 on November 30, 2012. (Photograph courtesy of the FRA)



*Figure 16 - Image of head damage to UTLX 98041 on November 30, 2012.  
(Photograph courtesy of the FRA)*

The Hazardous Materials Groups determined the orientation of the tank cars based on AEI information and aerial photographs. UTLX 207398 was traveling with the B-end trailing, OCPX 80323 was traveling with the B-end leading, OCPX 80234 was traveling with the B-end leading, UTLX 908097 was traveling with the B-end leading, and UTLX 98041 was traveling with the B-end leading.

The Hazardous Materials Group examined the derailed tank cars on January 30, 2013, after they were emptied of their contents, cleaned, purged, and moved to Camden Yard. Two coupon samples from the breached tank car and the coupler from tank car OCPX 080323 were collected for further examination at the NTSB Materials Laboratory in Washington, DC. The factual information collected during the January examination and the future metallurgical evaluation will be documented in an addendum to this factual report.

#### ATTACHMENT 60 – HAZARDOUS MATERIAL GROUP INVESTIGATIVE NEEDS CHECKLIST

#### **P. NTSB Weather Support**

Information obtained from witness interviews indicated that there was discussion at the ICP at St. James Church regarding whether or not the “fog” that enveloped the accident location was a natural fog or a chemical cloud. The Hazardous Materials Group obtained support from the on-duty NTSB meteorologist to document weather conditions at the site on the day of the accident. The weather assessment that was provided to the group was based on information gathered remotely (in Washington, DC), mainly from the Philadelphia

International Airport (KPHL) across the river (approximately 2 miles north of the accident). The following information was provided:

- At 7:00 a.m. on November 30, there were good surface observations across the river at KPHL. The airport reported calm winds throughout the period, which would limit mixing of air from the surface upward. Also, data from two commercial aircraft departing KPHL at approximately 8:00 a.m. indicated a 4-5 °C temperature inversion through the first 1,500 feet agl.
- Sunset (at approximately 4:30 p.m.) on November 30, local surface wind magnitudes were higher at approximately 8 mph. Out of 7 aircraft departing Philadelphia, two suggested a very weak inversion very near the surface. There was no fog at this time.
- The temperature was near/at freezing on the morning of the accident.

The NTSB meteorologist spoke with a weather observer at KPHL who came on duty at 6:55 a.m. on the morning of the accident. The weather observer had a view of Paulsboro from his position at KPHL, and indicated that there was no (wide-scale) fog in the KPHL area at the time of the accident. Visibilities were 6-7 statute miles. The weather observer described the morning time as more “hazy.” He stated that because of the terrain, he was unable to see the accident location. When asked about why he began to carry “mist” in his weather observations at 7:32 a.m., he indicated that this was because of specific requirements for issuing a weather observation when prevailing visibility drops to 6 statute miles due to the runway configuration at KPHL. It was not related to the accident.

#### **Q. Railroad Hazardous Materials Routing Analysis**

According to 49 CFR 172.820, each rail carrier transporting in commerce one or more of the following materials is subject to the additional safety and security planning requirements outlined in the section:

1. More than 2,268 kg (5,000 lbs) in a single carload of a Division 1.1, 1.2 or 1.3 explosive;
2. A quantity of a material poisonous by inhalation in a single bulk packaging; or
3. A highway route-controlled quantity of a Class 7 (radioactive) material, as defined in § 173.403 of this subchapter.

The rail carrier is required to analyze the safety and security risks for the transportation route(s), identified in the commodity data collected. The route analysis must be in writing and include the factors contained in Appendix D of the standard. The safety and security risk analysis must consider current data and information as well as changes that may reasonably be anticipated to occur during the analysis year. Factors to be considered in the performance of this safety and security risk analysis include:

1. Volume of hazardous material transported;
2. Rail traffic density;

3. Trip length for route;
4. Presence and characteristics of railroad facilities;
5. Track type, class, and maintenance schedule;
6. Track grade and curvature;
7. Presence or absence of signals and train control systems along the route (“dark” versus signaled territory);
8. Presence or absence of wayside hazard detectors;
9. Number and types of grade crossings;
10. Single versus double track territory;
11. Frequency and location of track turnouts;
12. Proximity to iconic targets;
13. Environmentally sensitive or significant areas;
14. Population density along the route;
15. Venues along the route (stations, events, places of congregation);
16. Emergency response capability along the route;
17. Areas of high consequence along the route, including high consequence targets as defined in § 172.820(c);
18. Presence of passenger traffic along route (shared track);
19. Speed of train operations;
20. Proximity to en-route storage or repair facilities;
21. Known threats, including any non-public threat scenarios provided by the Department of Homeland Security or the Department of Transportation for carrier use in the development of the route assessment;
22. Measures in place to address apparent safety and security risks;
23. Availability of practicable alternative routes;
24. Past incidents;
25. Overall times in transit;
26. Training and skill level of crews; and
27. Impact on rail network traffic and congestion.

Railroads must enter their hazardous materials routes and commodity data into the Rail Corridor Risk Management System (RCRMS) to conduct a route comparison analysis. The NTSB obtained the Conrail Security Sensitive Information (SSI) Route Analysis for the line where the accident occurred. Given that the route was a shortline or terminal line, no risk comparison or alternate route options are evaluated by the software program.

*Muhammed A. El-Zoghbi*  
*Safety Engineer/Hazardous Materials Accident Investigator*

## ATTACHMENTS

ATTACHMENT 1 – NOAA WEATHER REPORT  
ATTACHMENT 3 – CONRAIL HAZARDOUS MATERIALS INSTRUCTIONS FOR RAIL (HM-1)  
ATTACHMENT 4 – PAULSBORO NORTH AEI READ-OUT  
ATTACHMENT 4 – NORTH PAULSBORO AEI READ-OUT  
ATTACHMENT 5 – OXY VINYL BILLS OF LADING  
ATTACHMENT 6 – MUREX/CARDINAL ETHANOL STRAIGHT BILL OF LADING  
ATTACHMENT 7 – VINYL CHLORIDE MONOMER LOADING STANDARD OPERATING PROCEDURES (SOP-450-103) – FOR OFFICIAL USE ONLY (FOUO)  
ATTACHMENT 8 – VINYL CHLORIDE TANK CAR PRELOAD INSPECTIONS AND CERTIFICATES OF ANALYSIS  
ATTACHMENT 9 – OXY VINYL SCALE TICKETS  
ATTACHMENT 10 – OXY VINYL LOADING TEMPERATURES  
ATTACHMENT 11 – UMLER REPORT FOR TANK CARS  
ATTACHMENT 12 – CERTIFICATE OF CONSTRUCTION FOR OCPX 80234  
ATTACHMENT 13 – CERTIFICATE OF CONSTRUCTION FOR OCPX 80323 AND 80305  
ATTACHMENT 14 – CERTIFICATE OF CONSTRUCTION FOR UTLX 98041 AND UTLX 98097  
ATTACHMENT 15 – CERTIFICATE OF CONSTRUCTION FOR UTLX 207398  
ATTACHMENT 16 – MATERIAL SAFETY DATA SHEET FOR VINYL CHLORIDE  
ATTACHMENT 17 – MATERIAL SAFETY DATA SHEET FOR DENATURED ETHANOL  
ATTACHMENT 18 – TIMELINE OF EVENTS AND COMMUNICATIONS  
ATTACHMENT 19 – POLICE CAD REPORT  
ATTACHMENT 20 – LOCAL EMERGENCY DISASTER DECLARATION AND AMENDMENTS  
ATTACHMENT 21 – FIRE EMS CAD REPORT  
ATTACHMENT 22 – GLOUCESTER COUNTY MUTUAL AID AGREEMENT AND SOPS  
ATTACHMENT 23 – PAULSBORO REFINING COMPANY MUTUAL AID DISPATCHING PROCEDURES  
ATTACHMENT 24 – PAULSBORO REFINING COMPANY MUTUAL AID SUMMARY (AIR MONITORING AND EQUIPMENT RESPONSE FACTOR)  
ATTACHMENT 25 – INTERAGENCY MODELING AND ATMOSPHERIC ASSESSMENT CENTER DISPERSION MODELING  
ATTACHMENT 26 – NOAA MODELING-1  
ATTACHMENT 27 – NOAA MODELING-2  
ATTACHMENT 28 – NOAA MODELING-3  
ATTACHMENT 29 – EPA AIR MONITORING SUMMARY  
ATTACHMENT 30 – USCG HAZARDOUS SUBSTANCE ANNEX  
ATTACHMENT 31 – OXY VINYL EXPLANATION OF AIR MONITORING ACTIVITIES  
ATTACHMENT 32 – OXY VINYL AIR MONITORING (SESSION 1\_09050X6-004)  
ATTACHMENT 33 – OXY VINYL AIR MONITORING (SESSION 2\_09050X6-004)  
ATTACHMENT 34 – OXY VINYL AIR MONITORING (SESSION 3\_09050X6-003)  
ATTACHMENT 35 – OXY VINYL AIR MONITORING (SESSION 4\_09050X6-003)  
ATTACHMENT 36 – OXY VINYL AIR MONITORING (SESSION 5\_09050X6-003)  
ATTACHMENT 37 – OXY VINYL CALIBRATION AND BUMP TEST RECORD  
ATTACHMENT 38 – NJDEP COPY OF EPA PAULSBORO TRAIN DERAILMENT – UPDATE #4

ATTACHMENT 39 – NJDEP COPY OF EPA TAGA BUS ROUTE ON NOVEMBER 30, 2012  
(NJDEP-0204-NJDEP-0205)

ATTACHMENT 40 – EPA TAGA DATA

ATTACHMENT 41 – CTEH AIR SAMPLING AND MONITORING WORK PLAN SUMMARY

ATTACHMENT 42 – CTEH AIR SAMPLING AND MONITORING SUMMARY FOR NOVEMBER 30,  
2012

ATTACHMENT 43 – UNIFIED COMMAND SIGNED INCIDENT SUMMARY (ICS-201, ICS-205, ICS-  
207, AND ICS-209)

ATTACHMENT 44 – UNIFIED COMMAND APPROVED CTEH AIR SAMPLING AND MONITORING  
PLAN

ATTACHMENT 45 – SPSI SAFE WORK PLAN

ATTACHMENT 46 – WATER SAMPLING PLAN

ATTACHMENT 47 – UNIFIED COMMAND INCIDENT ACTION PLAN #1

ATTACHMENT 48 – EPA vs. USCG JURISDICTION (NJDEP-0017-NJDEP-0019)

ATTACHMENT 49 – FEDERAL ANNUAL MONITORING EVALUATION (FAME) REPORT FY 2011

ATTACHMENT 50 – PAULSBORO FIRE CHIEF TRAINING RECORDS

ATTACHMENT 51 – PAULSBORO ASSISTANT FIRE CHIEF TRAINING RECORDS

ATTACHMENT 52 – PAULSBORO EMERGENCY MANAGEMENT COORDINATOR TRAINING  
RECORDS

ATTACHMENT 53 – TRANSCAER TRAINING ATTENDANCE RECORDS AND COURSE  
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