NATIONAL TRANSPORTATION SAFETY BOARD
Investigative Hearing
Norfolk Southern Railway general merchandise freight train 32N derailment with subsequent hazardous material release and fires, in East Palestine, Ohio, on February 3, 2023

GROUP	H
EXHIBIT	
9	

Agency / Organization

Norfolk Southern

Title

Job Safety Analysis (JSA) Chemical Specific Worksheet

JOB SAFETY ANALYSIS (JSA)
CHEMICAL-SPECIFIC WORKSHEET

Date:	February 13, 2018
Chemical:	Vinyl chloride
Location:	Emergency Response Site
Prepared By:	Scott Skelton, MS, CIH
Version:	Vinyl Chloride_JSA2.0_2018

Emergency Procedures	
Muster Point	**Egress cross-wind, then upwind to: Entrance Gate**
Medical Emergency	1) Call 911, 2) Administer First Aid, 3) Contact Site Safety Officer
Emergency Signal	3 long horn blasts, hand signals for entry team
Site Safety Contact	John Doe, Site Safety Officer, Phone: 555-123-5555

Notice: The content included in this JSA has been prepared in advance of its use during an actual event. Workers engaged in response operations associated with vinyl chloride should use this JSA only after assessing site hazards daily to determine the effectiveness and completeness of this JSA's content. This JSA should not be used as the only safety provision for activities involving a vinyl chloride tank car.

Chemical Safety Information[1]: Vinyl chloride

GHS Label	Hazardous Property	Important Considerations & Safety Procedures
	**Health Hazards**	Inhalation of high concentrations cause dizziness, anesthesia, lung irritation. SKIN: may cause frostbite; phenol inhibitor may be absorbed through skin if large amounts of liquid evaporate. (USCG, 1999) OSHA GHS Hazard Statements: • May cause cancer, • May displace oxygen and cause rapid suffocation Exposure to vinyl chloride can cause dizziness, light-headedness, nausea, dullness of visual and auditory responses, drowsiness, and unconsciousness. Irritation of the skin and eyes can also occur. Skin contact with liquid may cause frostbite. Prolonged exposure to VC can cause thickening of the kin, contact and allergic dermatitis, fatigue, coughing and sneezing, abdominal pain, gastrointestinal bleeding, nausea, vomiting, indigestion, diarrhea, jaundice, weight loss, anorexia, and a cold and tingling sensation of the hands and feet (NIOSH 1978).
	**Flammability & Explosion**	Highly flammable, Class IA Flammable Liquid, NFPA Flammability Rating of 4. **Flash Point:** -110° F (NTP, 1992) **Lower Explosive Limit (LEL):** 3.6 % (USCG, 1999) **Upper Explosive Limit (UEL):** 33 % (USCG, 1999) **Autoignition Temperature:** 882 ° F (USCG, 1999)
	**Firefighting**	Hazardous decomposition products: Toxic gases and vapors (e.g., hydrogen chloride, phosgene, and carbon monoxide) may be released in a fire involving vinyl chloride (NIOSH Occupational Safety and Health Guideline 0621). FIRE: If tank, rail car or tank truck is involved in a fire, ISOLATE for 1600 meters (1 mile) in all directions; also, consider initial evacuation for 1600 meters (1 mile) in all directions. (ERG, 2016) Excerpt from ERG Guide 116P [Gases - Flammable (Unstable)]: DO NOT EXTINGUISH A LEAKING GAS FIRE UNLESS LEAK CAN BE STOPPED. SMALL FIRE: Dry chemical or CO2. LARGE FIRE: Water spray or fog. Move containers from fire area if you can do it without risk. FIRE INVOLVING TANKS: Fight fire from maximum distance or use unmanned hose holders or

[1] NOAA CAMEO Chemicals

		monitor nozzles. Cool containers with flooding quantities of water until well after fire is out. Do not direct water at source of leak or safety devices; icing may occur. Withdraw immediately in case of rising sound from venting safety devices or discoloration of tank. ALWAYS stay away from tanks engulfed in fire. For massive fire, use unmanned hose holders or monitor nozzles; if this is impossible, withdraw from area and let fire burn. (ERG, 2016)
	Reactivity	VINYL CHLORIDE is peroxidizable. Forms explosive polymeric peroxides in contact with air (in the presence of any of a variety of catalysts) [Bretherick 1979. p. 164]. Long storage in contact with air increases the concentration of the polyperoxides to hazardous levels [MCA Case History 1551. 1969]. The peroxides may initiate exothermic polymerization of the remaining material [Handling Chemicals Safely 1980.p. 958; Bretherick 1979. p. 160]. Light-sensitive. Many oxidizing agents apparently initiate polymerization (oxides of nitrogen, O2, etc.). May react with very hot water or steam to produce toxic fumes.
	**Pressurized System**	Vinyl chloride tankcars are typically equipped with a PRV rated for 225 psig. If using pressure assist to transfer, ensure that pressurization does not exceed the PRV capacity thus resulting in vapor emissions.
	Volatility/Mobility	**Vapor Pressure:** 3877.5 mm Hg (USCG, 1999) **Vapor Density:** 2.15 (Air = 1) (Sax's, 2004) **Specific Gravity:** 0.969 at 8.6 ° F (USCG, 1999) **Boiling Point:** 7 ° F at 760 mm Hg (NTP, 1992) **Molecular Weight:** 62.5 (NTP, 1992) **Water Solubility:** Slightly soluble (NTP, 1992) **Ionization Potential:** 9.99 eV (NIOSH, 2016)

Toxicology Information[2]: Vinyl chloride			
Exposure Route	**Dose**	**Possible Symptoms /Health Effects of Exposure**	**How to Avoid**
	Low (< 1 ppm)	No apparent observable effects or symptoms	
	Moderate (1 - 1200 ppm)	Acute effects may not be perceptible in this concentration range. OSHA PEL Ceiling of 5 ppm; Chronic exposure is linked to "vinyl chloride illness", which includes Raynaud's Syndrome and acroosteolysis. The toxic effect of greatest concern is cancer of the liver, which is largely the result of chronic exposure. TLV A1 confirmed human carcinogen.	Supplied Air Respirator (SAR)
	High (>1200 ppm)	PAC-2 of 1200 ppm; Odor threshold observed at 3000 ppm; anesthesia, drowsiness, slight visual disturbances, faltering gait, numbness and tingling of extremities. CNS depression and death from high concentrations. Exposure to 4000 ppm for 5 minutes, no effects; 8000 ppm for 5 minutes – dizziness; 20,000 ppm for 5 minutes-dizziness, light headedness, nausea, and dulling of vision (Rumack Poison Index 2016).	Supplied Air Respirator (SAR)
	Liquid contact	Frostbite; irritation of skin; contact dermatitis	Chemical-resistant protective suit. Handle liquids with care, full decontamination of CPC
	Dermal vapor exposure	Irritation of skin at very high concentrations	Chemical-resistant protective suit with properly taped seams.
	Irritation from vapor	Irritation	Full-face Respiratory protection

[2] Agency for Toxic Substances and Disease Registry (ATSDR), NIOSH Pocket Guide, ACGIH TLVs, & Emergency Response Planning Guidelines (ERPGs)

	Liquid contact	Severe chemical burns and damage to cornea, temporary blindness; Ocular irritation; conjunctivitis	Full-face Respiratory protection
	Ingestion of liquid	Severe burns and irritation to GI tract; assumed systemic toxicity after exposure to critical organs	Handle liquids with care, proper decontamination of protective clothing

First Aid Measures

Exposure	Recommended First Aid Treatment
Inhalation	IMMEDIATELY leave the contaminated area; take deep breaths of fresh air. IMMEDIATELY call a physician and be prepared to transport the victim to a hospital even if no symptoms (such as wheezing, coughing, shortness of breath, or burning in the mouth, throat, or chest) develop. Provide proper respiratory protection to rescuers entering an unknown atmosphere. Whenever possible, Self-Contained Breathing Apparatus (SCBA) should be used; if not available, use a level of protection greater than or equal to that advised under Protective Clothing.
Skin & Eye Contact	EYES: First check the victim for contact lenses and remove if present. Flush victim's eyes with water or normal saline solution for 20 to 30 minutes while simultaneously calling a hospital or poison control center. Do not put any ointments, oils, or medication in the victim's eyes without specific instructions from a physician. IMMEDIATELY transport the victim after flushing eyes to a hospital even if no symptoms (such as redness or irritation) develop. SKIN: CAUTION: Exposure of skin to compressed gases may result in freezing of the skin. Treatment for frostbite may be necessary. Remove the victim from the source of contamination. IMMEDIATELY wash affected areas gently with COLD water (and soap, if necessary) while removing and isolating all contaminated clothing. Dry carefully with clean, soft towels. If symptoms such as inflammation or irritation develop, IMMEDIATELY call a physician or go to a hospital for treatment.

PPE Matrix[3]: Vinyl chloride

Conditions		PPE Level	Respirator	Dermal Protection	
Vinyl chloride	Unknown or > 10 ppm	A	SCBA	Fire or Flash Risk	
				Suit:	Control measures first. If cannot control: Fire-protective Level A if liquid contact risk; Bunker gear otherwise
				Gloves:	Fire/chemical glove if liquid contact; NFPA otherwise
Release rate:	Unknown or Uncontrolled			Boots:	NFPA /chemical resistant
Risk of sudden release:	Unknown or High			Non-fire hazard	
Skin contact w/ vapor:	Greatest			Suit:	Chemical - encapsulating
Skin contact w/ liquid:	Greatest			Gloves & Boots:	Chemical - taped at seams
Conditions		**PPE Level**	**Respirator**	**Dermal Protection**	
Vinyl chloride	> 10 ppm	B	SCBA	Fire or Flash Risk	
				Suit:	Control measures first. If cannot control: Fire-protective Level B if liquid contact risk; Bunker gear otherwise
				Gloves:	Fire/chemical glove if liquid contact; NFPA otherwise
Release rate:	Known and controlled			Boots:	NFPA /chemical resistant
Risk of sudden release:	Moderate			Non-fire hazard	
Skin contact w/ vapor:	Moderate-low			Suit:	Chemical-hooded
Skin contact w/ liquid:	Direct, splash potential			Gloves & Boots:	Chemical – taped seams
Conditions		**PPE Level**	**Respirator**	**Dermal Protection**	
Vinyl chloride	> 1, but < 10 ppm	C[4]	APR	Fire or Flash Risk	
				Suit:	Level C is not recommended with significant fire risk
				Gloves:	Level C is not recommended with significant fire risk
Release rate:	Known and insignificant		Special Instructions	Boots:	Level C is not recommended with significant fire risk
Risk of sudden release:	Low		Cartridge: OV/AG; P100	Non-fire hazard	
Skin contact w/ vapor:	Very low - intermittent		Style: Full-face	Suit:	Chemical-hooded
Skin contact w/ liquid:	Indirect, no splash		USE FOR ESCAPE ONLY	Gloves & Boots:	Chemical – taped seams
Conditions		**PPE Level**	**Respirator**	**Dermal Protection**	
Vinyl chloride	< 1 ppm	D	None required	Fire or Flash Risk	
				Suit:	FRC clothing
				Gloves:	NFPA gloves
Release rate:	None			Boots:	NFPA
Risk of sudden release:	Low			Non-fire hazard	
Skin contact w/ vapor:	No vapor contact			Suit:	Long sleeves, reflective vest, safety glasses, hardhat
Skin contact w/ liquid:	No splash risk				

[3] NIOSH Emergency Response Safety and Health Database, Dupont Safe Spec™, Wiley Quick Selection Guide, 6th edition

[4] NIOSH does not recommend using full-face APR for VC. OSHA does permit using full-face APR in the VC standard, but limits the maximum use concentration to 10 ppm (1910.1017(f)(3)(ii)). Caution is warranted for use of APR due to the lack of supporting doc umentation by the three major respirator manufacturers. See APR changeout schedule on the following page.

Chemical Resistance Table for Suits and Gloves[5]

Key		Gloves										Suits																			
>8	Recommended >8h	Butyl Rubber	Natural Rubber	Neoprene Rubber	Nitrile Rubber	Polyvinylalcohol – PVAL	Polyvinylchloride – PVC	Viton®	Viton®/Butyl Rubber	Barrier® - PE/PA/PE	Silver Shield® - PE/EVAL/PE	Saranex®	ChemMAX® 3	ChemMAX® 4	Frontline ® 500	Interceptor®	Microchem® 4000	Trellchem® HPS	Trellchem® VPS	Tychem® SL	Tychem® CPF 3	Tychem® F	Tychem® Thermopro	Tychem® BR/LV	Tychem® Responder® CSM	Tychem® TK	Tychem® Reflector	Zytron ® 300	Zytron® 500
	Recommended >4h																														
	Caution 1-4 h																														
	Not Recom, < 1h																														
	Not Tested																														
Vinyl choride									>8	>8	>8	>8	>8		>8			>8	>8	>8	>8	>8	>8	>8	>8	>8	>8	>8	>8	>8	>8

Cartridge Life Using Full-Face APR by Brand			
Criteria	Scott AV3000 Full-Face APR	3M 60293 Full-Face APR	MSA
Site Concentration			
Exposure Limit			
Maximum Use Concentration			
Protection Factor (APF)			
Temperature			
Work Rate			
Service Life[6]	Not recommended	Not recommended	Not recommended

Site Action Levels for Airborne Vinyl chloride

[5] Taken directly from Wiley 6th Edition Quick Selection Guide to Chemical Protective Clothing

[6] The service life may far exceed 8-12 hour usage; however, it is best practice to change out cartridges before each new work shift.

Analyte	Action Level	Basis	Comments
Vinyl chloride	0.5 ppm	½ ACGIH® TLV-TWA for VC - Reading sustained for 15 minutes	Exposure at this concentration is not considered life threatening; however, workers and site management should implement controls and/or PPE to reduce exposure below the TLV-TWA for unprotected workers.
	1 ppm	ACGIH® TLV-TWA for VC Reading sustained for 15 minutes	Exposure at this concentration is not considered life threatening; however, workers and site management should implement controls and/or PPE to reduce exposure below the TLV-TWA for unprotected workers.
LEL	1%	1% of LEL for VC Reading sustained for 1 minute	Although 1% of the LEL is conservative, workers and site management should be aware of conditions and prepare for protective action to avoid reaching flammable limits
	10 %	10% of LEL for VC Reading sustained for 1 minute	10% of the LEL is a reasonable precautionary action level to hault work activity so that source mitigation techniques can be employed to reduce the flammable atmosphere prior to the continuation of work activity.

Monitoring Strategy

Flammability

Instrument	Instrument Reading	Corrected Value	Correction Factor	Basis	Action to be Taken
MultiRAE PID	1800 ppm	3600 ppm	2.0 for VC using PID	10% LEL	Egress and Notify Site Management
MultiRAE LEL Sensor	5%	10%	2.0 for VC using LEL Sensor	10% LEL	

Exposure

Instrument	Instrument Reading	Corrected Value	Correction Factor	Basis	Action to be Taken
MultiRAE PID	0.5 ppm	1 ppm	2.0 for VC using PID	ACGIH TLV-TWA	Don respiratory protection or Egress; Notify Site Management
Gastec Tube No. 131L	1 ppm	1 ppm	1.0 for VC with 2 – 100 mL pump strokes	ACGIH TLV-TWA	

Job Steps	Hazards	Hazard Controls
1. Initial Entry & Damage Assessment	1.1 Slips/Trips/Falls	1.1.1 Watch footing on loose/shifting rocks. Visualize a safe travel path. 1.1.2 Wear railroad approved work boots with ankle support.

Job Steps	Hazards	Hazard Controls
		1.1.3 Avoid climbing on wreckage if suitable walking/working surfaces and or climbing structures are not available. 1.1.4 If tank car ladder and guardrail at protective dome housing are damaged, configure a suitable fall-arrest system before accessing the protective dome housing area. 1.1.5 Ensure that entrants in Level A PPE are physically able to withstand the demands of the suit and also physically strong enough to traverse difficult terrain.
	1.2 Fire/Explosion	1.2.1 Identify all open sources of and other potential flammable liquids & gases using manifest. 1.2.2 Identify potential ignition sources, locate all active fires. 1.2.3 If potential for ignition is real: wear flash-protective bunker gear/FRC only if liquid and vapor exposure is not a threat. If protection from vapor and liquid exposure is necessary and fire risk is elevated, utilize control measures to reduce fire threat first. Using control measures to reduce the threat of fire will allow use of more common PPE. If fire threat cannot be reduced, a more aggressive flash protective suit may be necessary. 1.2.4 Conduct LEL monitoring. Action level 10% of LEL should result in egress. 1.2.5 Utilize hot work procedures before conducting activity capable of generating sparks or could ignite flammable vapors or liquid. 1.2.6 Provide fire fighting measures to control fires. 1.2.7 Use appropriate fire fighting measures to cool cars with flame impingement or adjacent to active fires or hot spots. 1.2.8 Use caution when walking among wreckage, look for subsurface pooling of liquid, especially in the vicinity of active fires.
	1.3 Chemical Exposure	1.3.1 Don Level B PPE if release conditions are unknown. Downgrade to Level C PPE to continue damage assessment if conditions permit (see PPE matrix). 1.3.2 Perform air monitoring on initial entry, document readings. 1.3.3 Observe wind direction and deploy a windsock. 1.3.4 Identify and mark areas of liquid releasing, secondary containment/ liquids, impacted soil, or standing liquid. 1.3.5 All workers entering the site in PPE must receive a full decontamination of all respiratory protection, CPC and equipment prior to exiting the warm zone. 1.3.6 Decon workers must perform decontamination activities in 1 lower-level PPE ensemble unless contamination is significant.

Job Steps	Hazards	Hazard Controls
	1.4 Heat Stress from PPE	1.4.1 Using CPC and respiratory protection can increase heat stress risk if ambient conditions are warm or hot. 1.4.2 Conduct medical monitoring prior to and after entry to evaluate worker's condition. 1.4.3 If necessary, limit the duration of each entry and maximize rest periods based on site conditions and medical monitoring information. 1.4.4 Drink plenty of water; avoid excessive use of sports drinks. 1.4.5 Rest in shaded, cool areas. Consider adding fans, misting devices, or air-conditioned rest areas (vehicles). 1.4.6 Avoid excessive intake of caffeine while at work and alcoholic beverages after work.
	1.5 Mechanical Injury from wreckage or falling	1.5.1 Stay clear of unstable or elevated wreckage. 1.5.2 Avoid reaching/walking between unstable cars/loads. 1.5.3 Use caution when tightening valves. Observe all pinch points for hands.
	1.6 Miscommunication	1.6.1 Establish effective hand signals for entrants to use if radio coms are not available. 1.6.2 Establish radio or cell phone communication with all responders. 1.6.3 Safety briefing conducted prior to initial entry.

Job Steps	Hazards	Hazard Controls
2. Release Mitigation	2.1 Fire/Explosion	2.1.1 Identify all open sources of and other potential flammable liquids & gases using manifest. 2.1.2 Identify potential ignition sources, locate all active fires. 2.1.3 If potential for ignition is real: wear flash-protective bunker gear/FRC only if liquid and vapor exposure is not a threat. If protection from vapor and liquid exposure is necessary and fire risk is elevated, utilize control measures to reduce fire threat first. Using control measures to reduce the threat of fire will allow use of more common PPE. If fire threat cannot be reduced, a more aggressive flash protective suit may be necessary. 2.1.4 Conduct LEL monitoring. Action level 10% of LEL. 2.1.5 Utilize hot work procedures before conducting activity capable of generating sparks or could ignite flammable vapors or liquid. 2.1.6 Provide fire fighting measures to control fires. 2.1.7 Use appropriate fire fighting measures to cool car(s) with flame impingement or adjacent to active fires or hot spots. 2.1.8 Use caution when walking among wreckage, look for subsurface hot spots or subsurface pooling in the vicinity of active fires. 2.1.9 All tools used during release mitigation should be non-sparking, intrinsically safe. Combustion engines or electrical tools should not be used near flammable atmospheres.
	2.2 Injury from valve or container repair	2.2.1 Use secure hoist to raise tools to the protective dome housing. 2.2.2 Avoid single-man manual lifting for loads greater than 50 lbs. 2.2.3 Ensure all connections are tight and secured. 2.2.4 Avoid body contact with high-pressure liquid streams. 2.2.5 Wear protective clothing capable of protecting from high-pressure water impact. 2.2.6 Remember, aggressive PPE will make tasks requiring good manual dexterity very difficult. Work safely and slowly to ensure proper use of valves, fittings, and tools. 2.2.7 All tools should be non-sparking (brass). 2.2.8 Avoid contact chemical protective clothing with sharp edges of damaged shell, brake lines, catwalk, railing etc. to keep the suit from tearing.

Job Steps	Hazards	Hazard Controls
	2.3 Miscommunication	2.3.1 Establish effective hand signals for entrants to use if radio coms are not available. 2.3.2 Establish radio or cell phone communication with all responders. 2.3.3 Safety briefing conducted prior to initial entry.
	2.4 Chemical Exposure	2.4.1 Don Level A PPE to approach leak source. If leak is insignificant and controlled, and worker can be upwind, then consider Level B PPE using PPE matrix. 2.4.2 Continuous air monitoring with workers during mitigation. 2.4.3 All workers entering the site in PPE must receive a full decontamination of all respiratory protection, CPC and equipment prior to exiting the warm zone. 2.4.4 Decon workers must perform decontamination activities in 1-lower level PPE ensemble.
	2.6 Mechanical Injury	2.6.1 Stay clear of unstable or elevated wreckage. 2.6.2 Avoid reaching/walking between unstable cars/loads.
	2.7 Slips/trips/falls	2.7.1 Watch footing on loose/shifting rocks. Visualize a safe travel path. 2.7.2 Wear railroad approved work boots with ankle support. 2.7.3 Abide by site fall protection safety protocols while working at elevations above 6 feet. 2.7.4 Ensure workers are prepared and trained to traverse the worksite with movement-restrictive PPE. Only fit workers with the strength to wear such PPE should be used to traverse challenging terrain or wreckage.
	2.8 High Pressure Release	2.8.1 Perform all necessary pressure checks, PRV will activate at 75 psi. 2.8.2 Ensure that valves are manipulated in a safe and controlled manner when tightening. 2.8.3 Essential personnel only at protective dome housing. 2.1.4 Conduct LEL monitoring. Action level 10% of LEL for known substances.

Job Steps	Hazards	Hazard Controls
3. Transfer of Vinyl chloride	3.1 Chemical Exposure	3.1.1 Perform air monitoring at the protective dome housing prior to connecting transfer equipment to damaged car's valve assembly. 3.1.2 Don Level B when connecting transfer hose to damaged car's liquid and vapor valves. See PPE Matrix to determine level based on conditions. 3.1.3 Ensure that transfer hoses, pumps, and compressors are free of liquid product and depressurized before opening lines. 3.1.4 Don Level B PPE (if conditions warrant-see PPE matrix) when disconnecting hoses, pumps, and compressors that have been emptied of free liquids. 3.1.5 All workers entering the site in PPE must receive a full decontamination of all respiratory protection, CPC and equipment prior to exiting the warm zone. 3.1.6 Decon workers must perform decontamination activities in CPC. 3.1.7 If pressurizing damaged car with nitrogen to transfer, be aware that excessive concentrations of nitrogen can displace oxygen and will asphyxiate unprotected workers in the area of high concentration.
	3.2 Transfer system release or pressurization	3.2.1 Be cautious of pressure buildup in lines during transfer. 3.2.2 Continue pressure checks on tank cars to monitor pressure conditions. 3.2.3 Valves should only be manipulated by competent persons. 3.2.4 Use chemical compatible, valves, fittings, and hoses. 3.2.5 Ensure all system pressures are within manufacture recommended ranges. 3.2.6 Ensure all connections are tight and secured. 3.2.7 Avoid body contact with pressurized liquid and gas streams even though worker is protected by PPE. 3.2.8 Initially and periodically monitor pumps, hoses, valves, and fittings for liquid or vapor leaks. 3.2.9 Use caution when connecting and disconnecting hydraulic pump lines; avoid pressurized release of compressed air.
	3.3 Miscommunication	3.3.1 Establish effective hand signals for entrants to use if radio coms are not available. 3.3.2 Establish radio or cell phone communication with all responders. 3.3.3 Safety briefing conducted prior to initial entry.
	3.4 Static Electrical Discharge	3.4.1 Ensure that all transfer equipment and receiving vessels are grounded and bonded according to best practice.
	3.5 Mechanical Injury	3.5.1 Stay clear of unstable or elevated wreckage. 3.5.2 Avoid reaching/walking between unstable cars/loads.

Job Steps	Hazards	Hazard Controls
		3.5.3 Ensure that tank car is secured to stabile equipment during tank car rotations.
	3.6 Slips/trips/falls	3.6.1 Watch footing on loose/shifting rocks. Visualize a safe travel path. 3.6.2 Wear railroad approved work boots with ankle support. 3.6.3 Abide by site fall protection safety protocols while working at elevations above 6 feet. 3.6.4 Ensure that workers are aware of the decrease in flexibility and mobility when wearing aggressive PPE, especially when climbing onto railcars or other equipment.
	3.7 Fire/Explosion	3.7.1 Identify all open sources and other potential flammable liquids & gases using manifest. 3.7.2 Identify potential ignition sources, locate all active fires. 3.7.3 If potential for ignition: wear flash-protective bunker gear/FRC and SCBA. If airborne concentrations are high & sustained, use control measures to reduce threat first. 3.7.4 Conduct LEL monitoring. Action level 10% of LEL for known substances. 3.7.5 Utilize hot work procedures before conducting activity capable of generating sparks or could ignite flammable vapors or liquid. 3.7.8 All tools used during release mitigation should be non-sparking, intrinsically safe. Combustion engines or electrical tools should not be used near flammable atmospheres.

Job Steps	Hazards	Hazard Controls
4. Clean and purge	4.1 Fugitive emissions	4.1.1 Use chemical compatible, valves, fittings, and hoses. 4.1.2 Ensure that vapor lines are properly secured to vapor scrubbing system if used. 4.1.3 Ensure all connections are tight and secured. 4.1.4 Initially and periodically monitor pumps, hoses, valves, and fittings for liquid or gas leaks. 4.1.6 Properly decontaminate all hoses, fittings, tools, and other equipment used during scrubbing operation. 4.1.7 If using a propane-assisted flare to control emissions, ensure flare lighting is safe by following hot work procedures, specifically, identifying all flammable materials and monitoring the area for flammable gas (LEL monitor) before lighting flare. Use caution when connecting propane lines, ensure tight fittings and vapor leaks.
	4.2 Chemical Exposure	4.2.1 Perform air monitoring at the protective dome housing prior to connecting transfer equipment to damaged car's valve assembly. 4.2.2 Don Level B PPE when connecting vapor line to damaged car's vapor valves. See PPE Matrix to determine based on conditions. 4.2.3 Ensure that transfer hoses, pumps, and compressors are free of liquid product before opening lines. 4.2.4 Don Level B or C PPE when disconnecting hoses, pumps, and compressors that have been emptied of free liquids. 4.2.5 All workers entering the site in PPE must receive a full decontamination of all respiratory protection, CPC and equipment prior to exiting the warm zone. 4.2.6 Decon workers must perform decontamination activities in CPC.
	4.3 System release or pressurization	4.3.1 Be cautious of pressure buildup in lines during purge. 3.2.2 Continue pressure checks on tank cars to monitor pressure conditions. 3.2.3 Valves should only be manipulated by competent persons. 3.2.4 Use chemical compatible, valves, fittings, and hoses. 3.2.5 Ensure all system pressures are within manufacture recommended ranges. 3.2.6 Ensure all connections are tight and secured. 3.2.7 Avoid body contact with pressurized liquid and gas streams. 3.2.8 Initially and periodically monitor pumps, hoses, valves, and fittings for liquid or vapor leaks. 3.2.9 Use caution when connecting and disconnecting hydraulic pump lines; avoid pressurized release of compressed air.

Job Steps	Hazards	Hazard Controls
	4.4 Mechanical Injury	4.4.1 Stay clear of unstable or elevated wreckage. 4.4.2 Avoid reaching/walking between unstable cars/loads.
	4.5 Slips/trips/falls	4.5.1 Watch footing on loose/shifting rocks. Visualize a safe travel path. 4.5.2 Wear railroad approved work boots with ankle support. 4.5.3 Abide by site fall protection safety protocols while working at elevations above 6 feet.
	4.6 Fire/Explosion	4.6.1 Identify all sources and other potential flammable liquids & gases using manifest. 4.6.2 Identify potential ignition sources, locate all active fires. 4.6.3 If potential for ignition: wear flash-protective bunker gear/FRC. 4.6.4 Conduct LEL monitoring. Action level 10% of LEL for known substances. 4.6.5 Utilize hot work procedures before conducting activity capable of generating sparks or could ignite flammable vapors or liquid.

Job Steps	Hazards	Hazard Controls
5. Removal of residual materials and impacted soil	5.1 Chemical Exposure	5.1.1 Provide continuous air monitoring to determine if vapors are elevated in the work areas near impacted soil. 5.1.2 Don Level B PPE to work in close proximity to impacted soils with elevated vapor. If vapor levels are high, return to using Level A until vapor concentrations are reduced. 5.1.3 All workers entering the site in PPE must receive a full decontamination of all respiratory protection, CPC and equipment prior to exiting the warm zone. 5.1.4 Decon workers should perform decontamination activities in LEVEL C PPE, but full-faced respirator may not be required if minimal contamination is present. 5.1.5 Excavation, loading, and unloading of impacted soil or debris may generate elevated vapor. Excavation operators should be prepared to don full-faced APR if conditions require respiratory protection. Ground-level workers may be required to don Level B PPE to avoid inhalation of vapor and skin contact with impacted soil.
	5.2 Vac operations	5.2.1 Use chemical compatible, valves, fittings, and hoses. 5.2.2 Ensure all system pressures are within manufacture recommended ranges. 5.2.3 Ensure all connections are tight and secured. 5.2.4 Avoid body contact with liquid streams. 5.2.5 Initially and periodically monitor hoses, valves, and fittings for liquid leaks. 5.2.6 Ensure that all vent hoses are positioned to direct vacuum exhaust away from the work area. 5.2.7 Ensure that vac trucks are parked on secure areas and are properly staged to minimize potential for unwanted equipment movements. 5.2.8 Properly ground and bond all vac truck equipment to avoid static discharge. 5.2.9 The use of a vac truck to remove liquids may require the most aggressive form of PPE if the liquid is highly concentrated, based on the volume and disposition of liquid being removed.
	5.3 Excavation operations	5.3.1 Ensure that all machinery is equipped with properly functioning audible alarms for movement. 5.3.2 Avoid unnecessary foot traffic within the operating distances of the machinery. 5.3.3 Workers within the operating distance of the machine must remain within the line-of-sight of the operator at all times. Use hand signals to signal movement once within the operating distance of the machine. 5.3.4 Keep all workers from working beneath suspended loads.

Job Steps	Hazards	Hazard Controls
		5.3.5 All receiving containers must be properly staged on a suitable foundation and secured before loading. 5.3.6 All machinery must be operated from secure locations. 5.3.7 Open trenches must be maintained within the requirements of applicable trenching/shoring standards. Workers should not enter an un-secured trench at any time. Use barricades to prevent workers from working closely to trench or pit openings.
	5.4 Slips/trips/falls	6.4.1 Watch footing on loose/shifting rocks. Visualize a safe travel path. 6.4.1 Wear railroad approved work boots with ankle support.
	5.5 Railway hazards	6.5.1 All workers must be briefed on track protection 6.5.2 All workers must abide by railroad track safety rules as covered by contractor orientation.

Additional Site Hazards	Actions to Eliminate Hazards
1.	1.
2.	2.
3.	3.
4.	4.
5.	5.
6.	6.
7.	7.
8.	8.
9.	9.
10.	10.

Name	Signature	Date Signed
