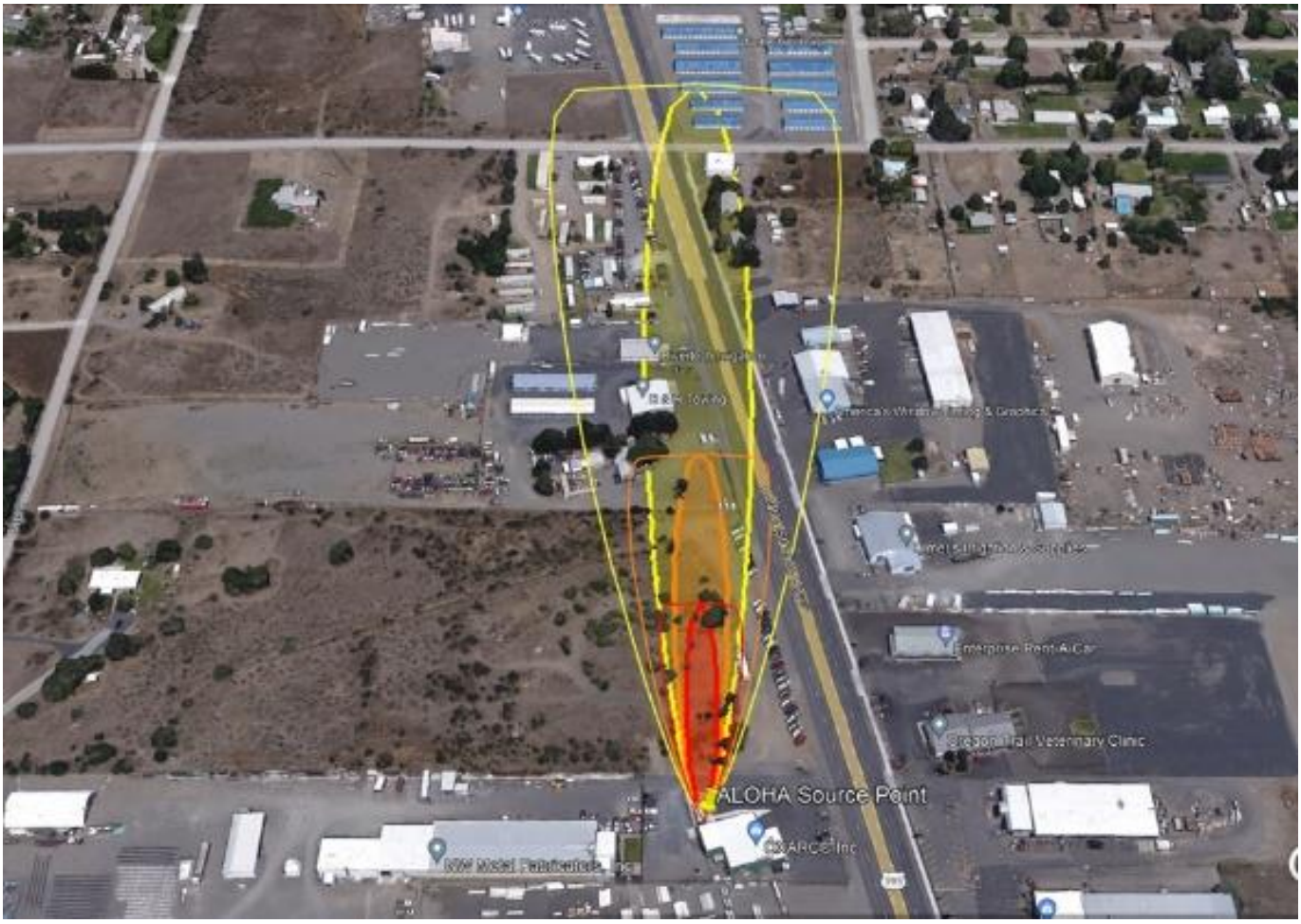
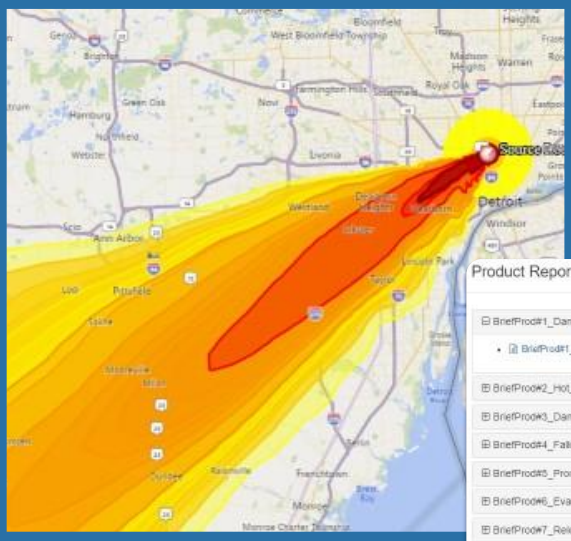
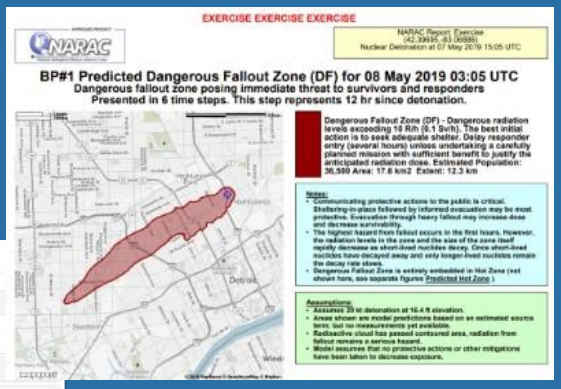
One Plan – Plan to Plume Response



https://www.fema.gov/sites/default/files/2020-07/fema_imaac_fact-sheet.pdf

IMAAC Portal as part of the CBRNResponder Suite





Page 298

TABLE 1 - INITIAL ISOLATION AND PROTECTIVE ACTION DISTANCES

ID No.	Guide	NAME OF MATERIAL	SMALL SPILLS (From a small package or small leak from a large package) First ISOLATE in all Directions Meters (Feet)	SMALL SPILLS Then PROTECT persons Downwind during DAY Kilometers (Miles)	SMALL SPILLS Then PROTECT persons Downwind during NIGHT Kilometers (Miles)	LARGE SPILLS (From a large package or from many small packages) First ISOLATE in all Directions Meters (Feet)	LARGE SPILLS Then PROTECT persons Downwind during DAY Kilometers (Miles)	LARGE SPILLS Then PROTECT persons Downwind during NIGHT Kilometers (Miles)
——	153	Soman **(when used as a weapon)**	60 m (200 ft)	0.4 km (0.3 mi)	0.7 km (0.5 mi)	300 m (1000 ft)	1.8 km (1.1 mi)	2.7 km (1.7 mi)
——	153	Tabun **(when used as a weapon)**	30 m (100 ft)	0.2 km (0.1 mi)	0.2 km (0.1 mi)	100 m (300 ft)	0.5 km (0.4 mi)	0.6 km (0.4 mi)
——	153	Thickened GD **(when used as a weapon)**	60 m (200 ft)	0.4 km (0.3 mi)	0.7 km (0.5 mi)	300 m (1000 ft)	1.8 km (1.1 mi)	2.7 km (1.7 mi)
——	153	VX **(when used as a weapon)**	30 m (100 ft)	0.1 km (0.1 mi)	0.1 km (0.1 mi)	60 m (200 ft)	0.4 km (0.2 mi)	0.3 km (0.2 mi)
1005	125	Ammonia, anhydrous	30 m (100 ft)	0.1 km (0.1 mi)	0.2 km (0.1 mi)	**Refer to table 3**		
1005	125	Anhydrous ammonia						
1008	125	Boron trifluoride	30 m (100 ft)	0.2 km (0.1 mi)	0.7 km (0.5 mi)	400 m (1250 ft)	2.3 km (1.4 mi)	5.1 km (3.2 mi)
1008	125	Boron trifluoride, compressed						
1016	119	Carbon monoxide	30 m (100 ft)	0.1 km (0.1 mi)	0.2 km (0.1 mi)	200 m (600 ft)	1.2 km (0.7 mi)	4.3 km (2.7 mi)
1016	119	Carbon monoxide, compressed						
1017	124	Chlorine	60 m (200 ft)	0.3 km (0.2 mi)	1.4 km (0.9 mi)	**Refer to table 3**		
1026	119	Cyanogen	30 m (100 ft)	0.1 km (0.1 mi)	0.4 km (0.3 mi)	60 m (200 ft)	0.3 km (0.2 mi)	1.1 km (0.7 mi)
1040	119P	Ethylene oxide	30 m (100 ft)	0.1 km (0.1 mi)	0.2 km (0.2 mi)	**Refer to table 3**		
1040	119P	Ethylene oxide with Nitrogen						
1045	124	Fluorine	30 m (100 ft)	0.1 km (0.1 mi)	0.2 km (0.1 mi)	100 m (300 ft)	0.5 km (0.3 mi)	2.3 km (1.4 mi)
1045	124	Fluorine, compressed						
1048	125	Hydrogen bromide, anhydrous	30 m (100 ft)	0.1 km (0.1 mi)	0.2 km (0.2 mi)	150 m (500 ft)	1.0 km (0.6 mi)	3.4 km (2.1 mi)
1050	125	Hydrogen chloride, anhydrous	30 m (100 ft)	0.1 km (0.1 mi)	0.3 km (0.2 mi)	**Refer to table 3**		

HOW TO USE TABLE 3 – INITIAL ISOLATION AND PROTECTIVE ACTION DISTANCES FOR LARGE SPILLS FOR DIFFERENT QUANTITIES OF SIX COMMON TIH (PIH in the US) GASES

Table 3 lists Toxic Inhalation Hazard (TIH) materials that may be more commonly encountered.

The selected materials are:

- UN1005 - Ammonia, anhydrous
- UN1017 - Chlorine
- UN1040 - Ethylene oxide and UN1040 – Ethylene oxide with nitrogen
- UN1050 - Hydrogen chloride, anhydrous and UN2186 - and Hydrogen chloride, refrigerated liquid
- UN1052 - Hydrogen fluoride, anhydrous
- UN1079 - Sulfur dioxide/Sulphur dioxide

The materials are presented in numerical order of ID number and provide Initial Isolation and Protective Action Distances **FOR LARGE SPILLS** (more than 208 liters or 55 US gallons) involving different container types (therefore different volume capacities, see below) for day time and night time situations and different wind speeds.

- Rail tank car: 80 000 kg (176 368 lbs.)
- Highway tank truck or trailer: 20 000 – 25 000 kg (44 092 – 55 115 lbs.)
- Agricultural nurse tank: 3785 L (1000 gallons)
- Small cylinder: 72 L (19 gallons)
- Ton cylinder: 757 - 1135 L (200 - 300 gallons)

Estimating Wind Speed from Environmental Clues

mph	km/h	Wind Description	Specifications
< 6	< 10	Low wind	Wind felt on face; leaves rustle; ordinary vane moved by wind
6 - 12	10 - 20	Moderate wind	Raises dust, loose paper; small branches are moved
> 12	> 20	High wind	Large branches in motion; whistling heard in telephone wires; umbrellas used with difficulty

(Data taken from the Beaufort Wind Scale has been reworked in order to create 3 categories of wind speed: Low, Moderate and High)

Page 350

TABLE 3 - INITIAL ISOLATION AND PROTECTIVE ACTION DISTANCES FOR LARGE SPILLS FOR DIFFERENT QUANTITIES OF SIX COMMON TIH (PIH in the US) GASES

	First **ISOLATE** in all Directions		Then **PROTECT** persons Downwind during											
			DAY						**NIGHT**					
			Low wind (< 6 mph = < 10 km/h)		**Moderate wind** (6-12 mph = 10 - 20 km/h)		**High wind** (> 12 mph = > 20 km/h)		**Low wind** (< 6 mph = < 10 km/h)		**Moderate wind** (6-12 mph = 10 - 20 km/h)		**High wind** (> 12 mph = > 20 km/h)	
	Meters	**(Feet)**	**km**	**(Miles)**	**km**	**(Miles)**	**km**	**(Miles)**	**km**	**(Miles)**	**km**	**(Miles)**	**km**	**(Miles)**
TRANSPORT CONTAINER	**UN1005 Ammonia, anhydrous: Large Spills**													
Rail tank car	300	(1000)	1.9	(1.2)	1.5	(0.9)	1.1	(0.6)	4.5	(2.8)	2.5	(1.5)	1.4	(0.9)
Highway tank truck or trailer	150	(500)	0.9	(0.6)	0.5	(0.3)	0.4	(0.3)	2.0	(1.3)	0.8	(0.5)	0.6	(0.4)
Agricultural nurse tank	60	(200)	0.5	(0.3)	0.3	(0.2)	0.3	(0.2)	1.4	(0.9)	0.3	(0.2)	0.3	(0.2)
Multiple small cylinders	30	(100)	0.3	(0.2)	0.2	(0.1)	0.1	(0.1)	0.7	(0.5)	0.3	(0.2)	0.2	(0.1)
TRANSPORT CONTAINER	**UN1017 Chlorine: Large Spills**													
Rail tank car	1000	(3000)	10.1	(6.3)	6.8	(4.2)	5.3	(3.3)	11+	(7+)	9.2	(5.7)	6.9	(4.3)
Highway tank truck or trailer	600	(2000)	5.8	(3.6)	3.4	(2.1)	2.9	(1.8)	6.7	(4.3)	5.0	(3.1)	4.1	(2.5)
Multiple ton cylinders	300	(1000)	2.1	(1.3)	1.3	(0.8)	1.0	(0.6)	4.0	(2.5)	2.4	(1.5)	1.3	(0.8)
Multiple small cylinders or single ton cylinder	150	(500)	1.5	(0.9)	0.8	(0.5)	0.5	(0.3)	2.9	(1.8)	1.3	(0.8)	0.6	(0.4)

Page 351

TABLE 3

"+" means distance can be larger in certain atmospheric conditions

TABLE 3 - INITIAL ISOLATION AND PROTECTIVE ACTION DISTANCES FOR LARGE SPILLS FOR DIFFERENT QUANTITIES OF SIX COMMON TIH (PIH in the US) GASES

	First **ISOLATE** in all Directions		Then **PROTECT** persons Downwind during											
			DAY						**NIGHT**					
			Low wind (< 6 mph = < 10 km/h)		**Moderate wind** (6-12 mph = 10 - 20 km/h)		**High wind** (> 12 mph = > 20 km/h)		**Low wind** (< 6 mph = < 10 km/h)		**Moderate wind** (6-12 mph = 10 - 20 km/h)		**High wind** (> 12 mph = > 20 km/h)	
	Meters	**(Feet)**	**km**	**(Miles)**	**km**	**(Miles)**	**km**	**(Miles)**	**km**	**(Miles)**	**km**	**(Miles)**	**km**	**(Miles)**
TRANSPORT CONTAINER	**UN1052 Hydrogen fluoride, anhydrous: Large Spills**													
Rail tank car	500	(1500)	3.5	(2.2)	2.1	(1.3)	1.8	(1.2)	6.6	(4.1)	3.1	(1.9)	2.0	(1.2)
Highway tank truck or trailer	200	(700)	2.0	(1.2)	1.0	(0.7)	0.9	(0.6)	3.7	(2.3)	1.6	(1.0)	0.9	(0.6)
Multiple small cylinders or single ton cylinder	100	(300)	0.8	(0.5)	0.4	(0.2)	0.3	(0.2)	1.7	(1.1)	0.5	(0.3)	0.3	(0.2)
TRANSPORT CONTAINER	**UN1079 Sulfur dioxide/Sulphur dioxide: Large Spills**													
Rail tank car	1000	(3000)	11+	(7+)	11+	(7+)	7.2	(4.5)	11+	(7+)	11+	(7+)	10.1	(6.3)
Highway tank truck or trailer	1000	(3000)	11+	(7+)	6.2	(3.8)	5.3	(3.3)	11+	(7+)	8.2	(5.1)	6.2	(3.9)
Multiple ton cylinders	500	(1500)	5.4	(3.4)	2.4	(1.5)	1.8	(1.1)	7.8	(4.8)	4.2	(2.6)	2.9	(1.8)
Multiple small cylinders or single ton cylinder	200	(600)	3.2	(2.0)	1.5	(0.9)	1.1	(0.7)	5.8	(3.6)	2.5	(1.6)	1.5	(0.9)

Page 353

TABLE 3

"+" means distance can be larger in certain atmospheric conditions

N95 respirators are the most common of the seven types of particulate filtering facepiece respirators. This product filters at least 95% of airborne particles (0.3 microns), but is not resistant to oil. N95 filtering facepiece respirators do not protect against gases and vapors.

Powered air-purifying respirators (PAPR) force ambient air through the air-purifying cartridge or filter into the facepiece. A PAPR does not supply oxygen or air from a separate source (e.g., cylinders).

CHEMICAL PROTECTIVE CLOTHING AND EQUIPMENT

For you to safely use this type of protective clothing and equipment, you need specific skills developed through training and experience. This type of special clothing may protect against one chemical but be readily permeated by chemicals for which it was not designed. Therefore, do not use this type of protective clothing unless it is compatible with the released material. Also, be aware that it offers little or no protection against heat and/or cold.

Examples of this type of equipment have been described as:

(1) Vapor Protective Suits (NFPA 1991), also known as Totally-Encapsulating Chemical Protective Suits or Level A* protection (OSHA 29 CFR 1910.120, Appendix A & B)

(2) Liquid-Splash Protective Suits (NFPA 1992), also known as Level B* or C* protection (OSHA 29 CFR 1910.120, Appendix A & B), or suits for chemical/biological terrorism incidents (NFPA 1994), class 1, 2 or 3 Ensembles and Standard CAN/CGSB/CSA-Z1610-11 – Protection of first responders from chemical, biological, radiological, and nuclear (CBRN) events

No single protective clothing material will protect you from all hazardous materials/dangerous goods. Do not assume any protective clothing is resistant to cold and/or heat or flame exposure, unless certified by the manufacturer (NFPA 1991 5-3 Flammability Resistance Test and 5-6 Cold Temperature Performance Test).

*Consult the glossary for more information about protection levels under the heading "Protective Clothing."

FIRE AND SPILL CONTROL

FIRE CONTROL

Water is the most common and generally most available fire extinguishing agent. Use caution in selecting a fire extinguishing method, as there are many factors to consider. Water may be ineffective in fighting fires that involve some materials.

Fires Involving a Spill of Flammable Liquids

These fires are usually controlled by applying a firefighting foam to the surface of the burning material.

Fighting flammable liquid fires requires:

- foam concentrate that is chemically compatible with the burning material
- correct mixing of the foam concentrate with water and air
- careful application and maintenance of the foam blanket

There are two general types of firefighting foam: regular and alcohol-resistant. Examples of regular foam are protein-base, fluoroprotein, and aqueous film-forming foam (AFFF).

You can control some flammable liquid fires, including many petroleum products, by applying regular foam. Other flammable liquids, including polar solvents (flammable liquids that are water soluble), such as alcohols and ketones, have different chemical properties. You cannot easily control a fire that involves these materials with regular foam, and should use alcohol-resistant foam instead.

Polar solvent fires may be difficult to control and require a higher foam application rate than other flammable liquid fires (see NFPA Standards 11 for further information). Refer to the appropriate guide to determine which type of foam to use. For flammable liquids which have subsidiary corrosive or toxic hazards, it is difficult to make specific recommendations. However, alcohol-resistant foam may be effective for many of these materials.

Contact the emergency response telephone number on the shipping paper, or the appropriate emergency response agency, as soon as possible for guidance on the proper fire extinguishing agent to use.

How you decide to control the fire depends on factors such as:

- incident location
- exposure hazards
- size of the fire
- environmental concerns
- availability of extinguishing agents and equipment at the scene

WATER-REACTIVE MATERIALS

Water is sometimes used to flush spills and reduce or direct vapors in spill situations. Some of the materials covered by this guidebook can react violently or even explosively with water. In these cases, consider letting the fire burn or leaving the spill alone (except to prevent its spreading by diking) until you can get more technical advice.

DECONTAMINATION

The ways to decontaminate people and equipment can vary. If you need help with decontamination, contact the emergency response telephone number provided on the shipping papers or the agencies listed on the inside back cover. These resources may be able to put you in contact with the chemical manufacturer to determine the appropriate procedure if not otherwise available.

Decontamination is the process of removing or neutralizing hazardous materials/dangerous goods that have contaminated people and equipment during an incident.

Contamination happens in the area generally referred to as the Hot Zone. Everything and everyone entering this zone should be decontaminated when leaving, including emergency response personnel. This reduces the chances that more contamination will occur.

There are two main types of contamination:

- **Direct contamination** happens in the Hot Zone.
- **Cross contamination** happens when someone or something outside the Hot Zone was not properly decontaminated and comes in contact with another object or person, usually in the Warm or Cold Zone.

To decontaminate, you must:

- physically remove contaminants; and/or
- chemically neutralize contaminants*.

The NFPA 472, Chapter 3, describes the following four kinds of decontamination.

(1) **Gross decontamination:** Quickly removing surface contamination, which usually happens by mechanically removing the contaminant or rinsing with water from handheld hose lines, emergency showers, or other nearby water sources.

(2) **Technical decontamination:** Reducing contamination to a level as low as possible by chemical or physical methods. A hazmat team will perform this kind of decontamination.

(3) **Mass decontamination:** Reducing or removing surface contaminants as fast as possible from a large number of people in potentially life-threatening situations.

(4) **Emergency decontamination:** Immediately reducing contamination of people in potentially life-threatening situations with or without formally setting up a decontamination corridor. This process should be performed upwind and uphill from victims. Responders should avoid contact with victims, runoff or spray from the decontamination process.

Emergency and mass decontamination can be done with firefighting and rescue operations equipment. Nozzles can be put on wide-angle fog patterns and sprayed towards the ground to create a decontamination shower. Responders can also place nozzles on the discharge ports of engines.

Contaminated clothing and equipment must be removed after use and stored in a controlled area (Warm Zone) until cleanup procedures can begin. Sometimes protective clothing and equipment cannot be decontaminated and must be disposed of properly.

*Chemical neutralization releases heat. DO NOT PERFORM on a victim.

EPA United States Environmental Protection Agency

Environmental Topics | Laws & Regulations | Report a Violation

Related Topics: Acute Exposure Guideline Levels

Chlorine Results - AEGL Program

Chlorine AEGL Technical Support Document (pdf)

Chlorine 7782-50-5 (Final)

	10 min	30 min	60 min	4 hr	8 hr
ppm					
AEGL 1	0.50	0.50	0.50	0.50	0.50
AEGL 2	2.8	2.8	2.0	1.0	0.71
AEGL 3	50	28	20	10	7.1

Ammonia Results - AEGL Program

Ammonia 7664-41-7 (Final)

	10 min	30 min	60 min	4 hr	8 hr
ppm					
AEGL 1	30	30	30	30	30
AEGL 2	220	220	160	110	110
AEGL 3	2,700	1,600	1,100	550	390

Ammonia AEGL Technical Support Document (pdf)

Sulfur Dioxide Results - AEGL Program

Sulfur Dioxide 7446-09-5 (Final)

	10 min	30 min	60 min	4 hr	8 hr
ppm					
AEGL 1	0.20	0.20	0.20	0.20	0.20
AEGL 2	0.75	0.75	0.75	0.75	0.75
AEGL 3	30	30	30	19	9.6

Sulfur dioxide AEGL Technical Support Document (pdf)

Chlorine Safety Data Sheet

https://www.hillbrothers.com/pdf/downloads/msds/sds/chlorine-sds.pdf

Ammonia Safety Data Sheet

https://www.airgas.com/msds/001003.pdf

Sulfur Dioxide Safety Data Sheet

https://www.airgas.com/msds/001047.pdf

Detailed Safety Plan Checklist

General Safety: (Reference ICS Form 208, Entry Team Checklist)

- ☐ Decon (air or water for NH_3)
- ☐ Emergency medical readiness
- ☐ Zones and controls (hot, warm, cold zones; PAD)
- ☐ Risk Assessment:
  1. Controlled and Contained
  2. Controlled but not Contained
  3. Uncontrolled and Uncontained
- ☐ Medical fitness of Entry Team
- ☐ Backup Team
- ☐ PPE Accountability–Zone Specific Controls
- ☐ Wind and weather monitoring (current and forecasted) **www.noaa.gov**

Hand Signals	
Hands gripping throat	Out of air/Breathing difficulty
Grip partner's wrist	Leave area immediately
Hands on waist	Leave area immediately
Hands on top of head	Need assistance
Thumbs up	I'm OK/I understand
Thumbs down	I'm not OK
Tag Line Rope Signals–OATH	
Okay–one tug	Entrant is okay
Advance–two tugs	Entrant needs rope
Take up slack–three tugs	Entrant is retreating
Help–four tugs	Entrant needs help
Emergency Escape Signal	
Repeated triple horn blast	Move out of Exclusion Zone

- ☐ SOPs and safety policies enforced (lock out/tag out, valve operations, fall protection, and system controls, etc.)
- ☐ Review hand signals, tag line protocol, and emergency escape signal
- ☐ Hose-line laid and ready for fire control and/or quick decon
- ☐ Communications link between Command, Safety, and Entry Teams

Entry Team Safety: (Reference the Entry Team checklist.)

- ☐ Risk assessment recommend entry after Emergency Shut-down is completed and when threat conditions have peaked and getting better
- ☐ Set clear objectives and tasks (5 minute tasking) on IAP and Safety Plan
- ☐ Communications check between command, Entry Team Leader, and Backup Team Leader
- ☐ Air contaminate monitoring before and during entry
- ☐ PPE Readiness check: Respiratory, hearing, head, and foot protection, chemical exposure, flammability, flash protection, cryogenic, cold temperature below freezing
- ☐ Breathing air supply monitoring while working in the Hot Zone
- ☐ Decon, emergency medical (pre/post surveillance), and rehab (rest, cool down, and hydrate) readiness

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ChemResponder – FEMA

Chemical Response Platform