

SUPPLEMENT 10

Guidelines for Decontamination of Fire Fighters and Their Equipment Following Hazardous Materials Incidents

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Guidelines for Decontamination of Fire Fighters and Their Equipment Following Hazardous Materials Incidents

Editor's Note: The following supplement is a reprint of a document published by the Canadian Association of Fire Chiefs. It includes guidelines for decontaminating fire fighters and their equipment after exposure to hazardous materials and for planning decontamination procedures before an incident occurs. We are grateful for the opportunity to include this detailed, practical guide in the Hazardous Materials Response Handbook.

Note to Readers

The contents of this decontamination guide are based on information and advice believed to be accurate and reliable. The Canadian Association of Fire Chiefs Inc., its officers, and members, jointly and severally, make no guarantee and assume no liability in connection with this booklet. Moreover, it should not be assumed that every acceptable procedure is included or that special circumstances may not warrant modified or additional procedures.

The user should be aware that changing technology or regulations may require a change in the recommended procedures contained herein. Appropriate steps should be taken that the information is current when used.

The suggested procedures should not be confused with any federal, provincial, state, municipal, or insurance requirements, or with national safety codes.

Introduction

The number of hazardous materials incidents to which the fire service is called increases year by year. At each of these incidents, there is a good chance that the responding fire fighters may become contaminated with the hazardous material. Frequently, however, the matter of decontamination is never thought of, or is only performed cursorily.

The Dangerous Goods Sub-Committee of the Canadian Association of Fire Chiefs, in 1986-87, undertook the preparation of a series of guidelines for decontamination, to be adopted by any fire department that wishes to do so, either as printed here or with local variations due to their own circumstances. Note that these are indeed *guidelines, not standards*.

The procedures listed are designed so they can be carried out by any department, rural or urban, volunteer or full-time, with a minimum of investment in special equipment.

Background of the Study and Rationale for Its Conclusions

In 1986 the Dangerous Goods Sub-Committee carried out an extensive study of fire services across the world to investigate the different approaches to decontamination of fire fighters following hazardous materials incidents.

Procedures were reviewed in detail from North America (Phoenix, San Francisco, Colorado, Metropolitan Toronto area) and England (Hampshire, Cambridgeshire, Greater Manchester, London, and the Home Office Guidelines). In addition, information was requested from Hong Kong, New Zealand, Australia, the People's Republic of China, France, Germany, Switzerland, Italy, Sweden, and the Netherlands. From these latter countries no formal replies were received, however, and indications are that decontamination procedures are either limited or absent. Japanese fire officials wrote back to indicate that they were studying various options but had not yet finalized any procedures.

Many magazine articles from the various periodicals published for the European and North American fire service market were reviewed. Furthermore, members consulted with chemical manufacturers, nuclear medicine physicists, hazardous waste disposal companies, industrial hygienists, toxicologists, and various jurisdictional agencies such as the Atomic Energy Control Board and provincial and federal Ministries of Health, Labour, and Environment.

All this research led to the conclusion that there were three basic philosophies in existence:

1. Wet and dry procedures
2. Dispose or retain runoff
3. Severity and type of the material

The idea of a dry procedure made sense because of easier containment and no reaction with water. A single wet procedure, however, was not deemed to be sufficiently comprehensive; on the other hand some wet procedures called for making up solutions of a variety of chemicals, and these were deemed to be too complicated for use by every fire department.

The dispose or retain philosophy is usually considered a wet procedure; however, to base one's procedures solely on the concern about run-off appeared to be overly simplistic. Note, however, that concerns about run-off are addressed later in this document.

The third philosophy was examined in more detail. The methods of determining the severity and type of material were defined by various fire departments along the following lines:

1. By UN class
2. By effects on the environment
3. By chemical characteristics
4. By physiological effects on people
5. By broad groups

The first alternative was deemed unsuitable because there are too many variables within a class (e.g., some flammable liquids are highly toxic, others are not). The second alternative was deemed to be of secondary importance to fire fighter safety (see the section on Environmental Considerations later in this document). It was found that alternatives three and four could in fact be used to arrive at alternative five, and this was the route taken to define the procedures in this document.

The procedures that were developed are therefore broken down as follows:

- Three general procedures for light, medium, and extreme hazards
- Two specific procedures for substances that do not fit into the three general groups above (although they share many common factors)
- One initial routine performed in some cases prior to the start of one of the other procedures

The authors realize that if the procedures listed here are to be completed thoroughly, a number of decontamination operatives and a Decontamination Officer to oversee them are needed. Typically, this will require the services of at least one fire-fighting company. Attention to detail and careful execution of all steps should lead to successful and safe completion of fire fighter decontamination.

Decontamination—General Observations

Six levels of decontamination are outlined. The incident commander will determine which level is applicable for the substance involved, using any reference sources that may state the applicable level. In the absence of such sources, advice should be sought from experts such as toxicologists, chemical company representatives, CANUTEC, CHEMTREC, and so on.

The levels are:

- A—for light hazards
- B—for medium hazards
- C—for extreme hazards
- D—dry contamination for water-reactive and certain dry substances
- E—for etiologic agents and certain dry pesticides and poisons
- R—for radioactive materials

Note that A-level decontamination, the most common, need only be done at the station. However, other levels need to be started at the incident scene as well as being continued on return to the station.

The most stringent level for the most toxic substances, C-level decontamination, may involve the destruction of all clothes worn.

In a few cases, scrubbing of clothes must be done while wearing SCBA as vapors released during cleaning may be harmful.

D-level decontamination is almost always followed by one of the other levels of decontamination, which will be dependent on the substance involved.

The procedures should be initiated if personnel are known or suspected to have been directly exposed to the chemical or its vapors, products of combustion, etc.

Officers should be aware of any cuts, wounds, lesions, or abrasions that their crews may have. If the apparatus is sent to an incident involving hazardous materials, such personnel should wherever possible exercise special care to avoid the chance of contamination through such wounds. Chemicals absorbed through the skin will be absorbed much faster if the skin is cut or abraded, thereby presenting a serious health hazard.

Adequate awareness is necessary to realize when decontamination will be required, so that early action can be taken to bring to the scene the equipment and manpower resources needed to set up and staff the decontamination area.

Decontamination Procedures

Level A for Light Hazards

On Return to Station

1. Wash down all protective clothing with a mild (1 percent to 2 percent) trisodium phosphate solution. Rinse with water.
2. Wash down SCBA cylinders and harnesses with a mild trisodium phosphate solution. Take care to wipe, not scrub, around regulator assembly. Rinse with clean water. If damage is suspected to any part of the unit, ensure it is sent for service.
3. Scrub hands and face with soap and water.

Note: Where the scrubbing of the protective clothing may release harmful vapors caught in the fibers, it may be necessary to wear breathing apparatus while washing down protective clothing. In these cases, monitor the atmosphere around the washing area. Release of vapors may indicate commercial cleaning is required.

Level B for Medium Hazards

At the Scene

1. Do not remove SCBA facepiece. Place helmet on back of neck.
2. Assistant to flush fire fighter downwards from head to toe with copious amounts of low-pressure water. Include inside and outside of helmet, mask, harness, and inside of coat-wrists to the cuff.
3. Do not smoke, eat, drink, or touch face.

On Return to Station

4. Place apparatus temporarily out of service.
5. Remove all protective clothing and accessories. If possible, remove liner from helmet. Scrub all items, including the helmet liner, inside and out with a mild (1 to 2%) trisodium phosphate solution. Then flush with water.

Note: Where the scrubbing of the protective clothing may release harmful vapors caught in the fibers, it may be necessary to wear breathing apparatus while washing down protective clothing. In these cases, monitor the atmosphere around the washing area. Release of vapors may indicate commercial cleaning is required.

6. Scrub all other protective gear such as gloves and breathing apparatus items likewise. Be sure to flush out gloves with water. If SCBA is stored in its case while returning from incident, scrub the case also.

7. Remove all clothing worn at the scene, including underwear, and place in garbage bag for laundering and/or dry cleaning (preferably the latter). Take all garbage bags with contaminated clothing to a place

where they can be cleaned separately from other garments.

8. Shower, scrubbing all of the body with soap and water, with particular emphasis on areas around the mouth and nostrils and under fingernails. Shampoo hair and thoroughly clean mustache if you have one.

9. Do not smoke, drink, eat, touch face, or void until Step 8 is completed.

10. Put on clean clothes.

11. Do not put apparatus back in service until clean-up completed.

To Change SCBA Cylinders at the Scene. Flush empty cylinder and surrounding area of fire fighter's back with copious amounts of low-pressure water. Also flush facepiece and breathing tube to prevent inhalation of harmful materials when regulator is disconnected.

Wear gauntlet-type rubber gloves, such as those used by linemen, when changing cylinders. Flush gloves after use before removing them.

Level C for Extreme Hazards

At the Scene

1. Do not remove SCBA facepiece. Place helmet on back of neck.

2. Assistant, wearing protective clothing and SCBA (plus disposable chemical suit wherever possible), to flush fire fighter downwards from head to toe with copious amounts of low-pressure water. Include inside and outside of helmet, mask, harness, and inside of coat-wrists to the cuff.

3. Do not smoke, eat, drink, or touch face.

4. Put SCBA, used cylinders, and any equipment (including hoses and tarps) suspected or known to be contaminated in garbage bags. Seal bags and return them to the station. Where circumstances permit, remove and bag protective clothing also.

On Return to Station

5. Put bags returned from incident scene in exterior cordoned-off area away from public access. Place apparatus out of service.

6. Strip completely. Place all clothing (protective clothing and personal clothing) in plastic garbage bags. Place portable radios in a separate bag. Seal bags; place in exterior cordoned-off area.

7. Arrange for the supply of a number of steel drums. Upon their arrival, seal garbage bags with contaminated items into drums. Mark drums and place in exterior cordoned-off area, minimum 5-meter radius.

8. Arrange for the drums to be picked up and the contents analyzed. Some or all items may be destroyed; some may be able to be decontaminated and returned.

9. Shower, scrubbing all of the body with soap and water, with particular emphasis on areas around the mouth and nostrils and under fingernails. Shampoo hair. Thoroughly clean mustache if you have one.

Special Attention for Radioactive Incidents. After showering, scan entire body with a radiation contamination monitor, paying special attention to hair, hands, and fingernails. Hold monitor approximately 3 cm from body. If any reading beyond normal background level is detected, the fire fighter should shower again, scrubbing with more soap than before.

10. Do not smoke, drink, eat, touch face, or void until Step 9 is completed.

11. Put on clean clothes.

12. Report to hospital for medical examination. Inform physician which hazardous material was involved.

To Change SCBA Cylinders at the Scene. Flush empty cylinder and surrounding area of fire fighter's back with copious amounts of low-pressure water. Also flush facepiece and breathing tube to prevent inhalation of harmful material when regulator is disconnected.

Wear gauntlet-type rubber gloves, such as those used by linemen, when changing cylinders. Flush gloves after use before removing them.

Place empty cylinder in black plastic garbage bag and seal for subsequent decontamination.

The person doing the flushing and cylinder-changing must wear protective clothing and SCBA, plus a disposable chemical suit if available.

Special Note. Where circumstances, local climate, and available resources permit, the performance of *all* steps at the scene (instead of performing Steps 5-11 at the station) is preferable. The procedure is outlined as shown, however, in recognition of the fact that for many departments this will usually be impossible to achieve.

Level D for Water-Reactive Hazards

At the Scene

1. Set up a suitable vacuum cleaner with power supply. Provide a dry brush and a containment capture method for materials falling off the contaminated personnel. Assistants to don full protective clothing and SCBA, plus disposable chemical suits if available and appropriate.

2. If this is a radiation incident: The fire fighters suspected of being contaminated will be scanned carefully with a radiation monitor suitable for detecting surface contamination. All parts of their clothing and personal equipment will be scanned, including the soles of the boots. If no readings are found, the personnel that have been checked can leave the decontamination area.

3. If not a radiation incident, or if the fire fighter was found to be radioactively contaminated: Stand fire fighter in center of containment area, clean helmet and place on back of neck, then clean inside of helmet.

4. Commence cleaning from head downwards. Include all external areas. Slacken SCBA harness to allow cleaning behind straps and backplate. Likewise, loosen the hose-key belt and clean behind it.

5. When fire fighters have been fully vacuumed or brushed off, they will step out of the containment area. As they do so, their boots, including the soles, must be cleaned off so any contaminant will remain within the containment area.

6. Procedures will then continue as follows:

- Radioactive incident—go to Level "R" routine.
- Etiological or dry pesticide incident—go to Level "E" routine. Other incidents—go to Level "B" routine (unless advice is received that Level "C" is more appropriate).

7. All used filters and collected waste are to be placed in a garbage bag, sealed and tagged, and disposed of in a manner acceptable to the agency having jurisdiction.

Level E for Etiologic Hazards

Special Equipment Required. A presentation spray can (such as used for pesticide spraying), biological neutralizing substance (such as bleach, commercial sterilizing agent, etc.), orange garbage bags, black garbage bags, sterilization bags as used by hospital laundries, and a box of surgical masks.

At the Scene

1. If using bleach, make up a 5 percent to 6 percent bleach solution in the spray can. Take note of the bleach concentrate percentage when calculating the make-up of the solution. Many brands as purchased in the store are already 6 percent.

If using a commercial sterilizer, follow the manufacturer's directions.

2. Flush the fire fighter downwards from head to toe with low-pressure *water*. SCBA facepiece can now be removed. Place helmets in black plastic garbage bag(s) and seal. Place surgical mask on fire fighter.

3. If using bleach, spray the fire fighters' boots (but not their bunker gear) and any tools, hoses, and other equipment used (except for portable radios) with the *bleach* solution in the spray can. Leave for 10 minutes, then flush with water.

If using a commercial sterilizer, follow the manufacturer's instructions.

4. Remove SCBA. Place in black plastic garbage bag and seal. Remove fire fighters' protective clothing

(except boots) and gloves. Place in orange plastic garbage bag and seal. Remove any portable radio worn. Place in black plastic garbage bag and seal. Discard surgical masks.

5. Do not smoke, eat, drink, or touch face.
6. Before leaving the scene, a fire fighter wearing SCBA should attempt to spray as much of the ground exposed to the material and the wash-down water as possible with bleach solution. Then flush the outside of the spray can with clean water.
7. Before leaving the scene, seal the orange garbage bags into the sterilization bags.

On Return to Station

8. Place apparatus temporarily out of service.
9. One fire fighter should dress in protective clothing and SCBA, and in an outside area perform the following tasks:
 - Open the black plastic garbage bags, wipe all helmets, portable radios, SCBA sets, and used cylinders with a rag lightly dampened with a 6 percent bleach solution. After 10 minutes, wipe these items again with a rag dampened with clean water. If using a commercial sterilizer, follow the manufacturer's directions.
 - Seal all used black garbage bags and rags into another bag and put out for normal garbage pick-up. If using bleach, empty the spray can and flush out to remove bleach residue.
10. Remove all clothing worn at the scene, including underwear, and place in garbage bag for laundering and/or dry cleaning (preferably the latter). Take all garbage bags with contaminated clothing to a place where they can be cleaned separately from other garments.
11. All personnel should shower, scrubbing all of the body with soap and water, with particular emphasis on areas around the mouth and nostrils and under fingernails. Shampoo hair and thoroughly clean mustache if you have one.
12. Do not smoke, eat, drink, touch face, or void until Step 11 is completed.
13. Put on clean clothes. Place apparatus back in service when decontamination is completed.
14. Have cleaned firehose and SCBA checked by competent personnel before placing it back in service.
15. Arrange for the sterilization bags to be taken to a hospital laundry facility for cleaning and sterilization of the protective clothing, gloves, and any other garments sent in.

Reminder. Black garbage bags are to be used for items retained at the station. Orange bags are for items sent away for sterilization.

To Change SCBA Cylinders at the Scene. Flush empty cylinder and surrounding area of fire fighter's back with copious amounts of low-pressure water. Also flush facepiece and breathing tube to prevent inhalation of harmful material when regulator is disconnected.

Wear gauntlet-type rubber gloves, such as those used by linemen, when changing cylinders. Flush gloves after use before removing them.

Place empty cylinder in black plastic garbage bag and seal for subsequent decontamination.

The person doing the flushing and cylinder-changing must wear protective clothing and SCBA.

Level R for Radioactive Hazards

At the Scene

1. Preparation

- (a) Mark off a decontamination area with two parts.
- (b) Make up a solution of detergent and water. Obtain scrub brushes.
- (c) Set out a reserve air supply, preferably with a workline unit or otherwise with a spare SCBA.
- (d) In the first part of the decontamination area, set up a runoff capturing method, either with wading pools or through the use of tarpaulins.
- (e) If appropriate, a "walkway" of polyethylene sheeting (weighted down if necessary) can be placed from the exit from the incident scene to the decontamination area, to prevent possible contamination of the ground.

2. The decontamination crew will don SCBA and, where available, disposable chemical suits.

3. The fire fighters suspected of being contaminated will be scanned carefully with a radiation monitor suitable for detecting surface contamination. All parts of their protective clothing and personal equipment will be scanned, including the soles of the boots. If no readings are found, the personnel that have been checked can leave the decontamination area.

4. Personnel found to be contaminated will be scrubbed down thoroughly with the detergent solution by the decontamination crew. This is followed by a flushing off using low-pressure water. Efforts should be made to capture the runoff.

5. The fire fighters will then move to the second part of the decontamination area, where they will be scanned again with the radiation monitor. If any readings are found, they will return to the first part of the decontamination area and Step 4 will be repeated.

6. When all personnel have been cleaned of contamination, the decontamination crew themselves will be hosed down. The matter of the captured runoff water will be discussed with environmental authorities and disposal arranged in a manner acceptable to them.

7. In the event fire fighters being decontaminated run out of breathing air, the reserve supply set out in Step 1 will be passed to them. They should hold their breath while changing facepieces.

8. In the event that, despite repeated scrubbing, any fire fighters cannot be decontaminated, they will remove as much of their clothing as possible in the second part of the decontamination area, and don clean or spare clothing. The clothing that has been taken off will be sealed into garbage bags and returned to the station. This evolution must be executed in such a manner as not to contaminate the clean clothing.

9. Any equipment suspected or known to be contaminated will be sealed into garbage bags and returned to the station.

On Return to Station. Follow the Level "C" procedure Steps 5 to 12 for those fire fighters who were found to be contaminated in Step 3, and for any contaminated equipment.

To Change SCBA Cylinders at the Scene. Personnel emerging from the incident to have their breathing apparatus cylinder changed will be scanned with a radiation contamination monitor in a manner identical to Step 3.

If no readings are found, the fire fighter can proceed to the SCBA cylinder change area and may then return to the incident with a fresh cylinder.

Personnel found to be contaminated may not return to the incident. They will be put through the full Level "R" decontamination procedure, and other fire fighters will be sent in to the incident to replace the fire fighters withdrawn.

Before the replacement fire fighters go in, they should attempt to obtain information as to where the other personnel might have received their contamination, in order to allow them to take the necessary caution when approaching that area.

Note: Steps 1 and 2 of the Level "R" procedure must be in place by the time the first fire fighter emerges from the incident. If circumstances permit, these preparations should be made before personnel even enter the incident area for the first time.

Decontamination—Specific Observations

Pre-Incident Planning. Review the procedures and, if they are suitable for your location, assemble the equipment necessary into an easily transported container. Some departments, for instance, have all the

special items needed for etiologic decontamination carried in a "Level E Decontamination Kit."

Many departments will have infrequent need to use these procedures. To prevent skill decay, and to prevent certain critical steps in the procedures being accidentally left out, it is suggested that a copy of the procedures be available at the scene and that regular training in the procedures take place. Executing these procedures accurately is not as easy as it would seem.

The time when you have twenty garbage bags with contaminated clothing sitting on your apparatus floor is not the time to start looking for a laundry that will clean them. Most commercial cleaning companies will not be interested in handling contaminated clothing.

Furthermore, it should be recognized that at some incidents the nature or extent of the contamination may be such that full decontamination is beyond the resources of the fire department (especially with Levels C, E, and R) and will require specialist treatment. With these three levels, consideration should be given to the destruction of all permeable items in case of serious exposure. You should therefore make prior arrangements for the following:

- Obtaining steel drums at any time of the day or night. The drums must be clean and must have a removable lid—not just a bung and vent-hole.
- Analysis and expert decontamination of equipment and clothing contaminated by severely hazardous substances. This is needed for Level C and Level R, although different companies are likely to be needed for the two levels.
- Acceptable methods of disposal for items that cannot be cleaned, or that would be uneconomical to attempt to clean, for Level C, E, and R contaminants.
- The use of a hospital laundry service to perform Level E decontamination on protective clothing. This laundry should be approached for the loan of a number of sterilization bags, which are typically used in the hospitals to put dirty laundry in for shipment to the laundry service. Check that the hospital laundry service can take bunker coats—in some cases the buckles may bash the inside of their machines too much.
- Check the availability of replacement protective clothing and equipment that can be used while the original items are out being decontaminated under Levels C, E, or R.

You may want to establish a policy regarding personal items such as rings, wallets, watches, etc. Many of these, especially leather items, cannot be decontaminated and may have to be destroyed. Fire fighters should be aware of their department's policy with regard to recompense or replacement.

One further item of preplanning will always stand you in good stead: Note the names and contact numbers of any local experts who could assist and advise you during the incident and its subsequent decontamination.

Plastic Bags. Notwithstanding the fact that throughout the preceding procedures "black" garbage bags have been mentioned, there is a distinct advantage to using clear, plastic bags. These will permit the contents to be identified without opening them.

They should be at least 6 mil gauge and should be large enough that they can also be used as drum-liner bags.

Decontamination Area Layout

When choosing the location of the decontamination area, consider the following:

- Prevailing weather conditions (temperature, precipitation, etc.)
- Wind direction
- Slope of the ground
- Surface material and porosity (grass, gravel, asphalt, etc.)
- Availability of water
- Availability of power and lighting
- Proximity of the incident
- Location of drains, sewers, and watercourses

When setting up the area, provide the following features:

- Containment of wash-down water if that is necessary
- Spare supply of breathing air (extra SCBA, extra cylinders, or workline units)
- A supply of industrial-strength garbage bags, double- or triple-bagged if necessary
- Clearly marked boundaries, not just a rope lying on the ground
- Clearly marked entry and exit points with the exit upwind, away from the incident and its contaminated area
- A waiting location at the entry point where contaminated personnel can await their turn without spreading contamination further
- Access to triage and other medical aid upon exit if necessary
- Protection of personnel from adverse weather conditions
- Security and control from the setting up of the area to final clean-up of the site

Environmental Considerations

One fundamental concept forms the basis for these decontamination procedures: "The human being comes before the environment."

Notwithstanding the above, where containment of runoff is called for, genuine attempts must be made if only to avoid possible legal consequences. Examples of containment basins are:

- Children's wading pools
- Portable tanks (as used in rural fire fighting)
- Tarps laid over a square formed by hard suction hose or small ground ladders
- Diking with earth, sandbags, etc. covered with tarps

Fire fighters stepping out of a containment basin should lift one foot, have it rinsed off so the water falls inside the basin, step out with that foot, and repeat for the other foot.

When the containment basin is full, it should be able to be siphoned or pumped off into drums or into a vacuum truck for controlled disposal in a manner acceptable to the authority having jurisdiction.

Any runoff that is not contained will eventually enter sewers and water-courses, or if it sinks into the ground will ultimately reach the water-table. The Department of Mechanical and Fluid Engineering at Leeds (U.K.) University has determined that provided a chemical is diluted with water at the rate of approximately 2000:1, pollution of water-courses will be significantly reduced.

There is also a change in attitude coming with the environmental authorities, whereby they recognize that the small amount of chemical likely to be washed off contaminated fire fighters with adequate dilution will result in minimum damage to the environment, especially when compared to the results of the spill that generally led to the personnel contamination in the first place.

Any substances that enter sewers and water-courses should be reported to environmental authorities and to the sewage treatment plant likely to receive it. If necessary, advise water authorities downstream from the decontamination area of actual or potential pollution.

The most appropriate decontamination for materials that have a severe effect on the environment will usually be to use minimal amounts of water, with runoff containment. Other substances should be deluged off personnel with the 2000:1 factor as a minimum guideline.

Weather

If decontamination is done indoors because of bad weather, ensure that the drains go into a holding tank and not directly into the sewers.

If the hazardous material involved requires Level D decontamination, and it is raining or snowing, protect fire fighters from the precipitation until they have been processed.

Take care when using instruments in wet weather. Extreme cold may affect the operating effectiveness of instruments, especially delicate ones originally designed for use in laboratory environments.

Under extreme weather conditions (heat or cold), decontamination personnel must be rotated more frequently.

These decontamination procedures should be reviewed in light of your local climate and adapted if necessary where your area's weather conditions dictate.

Fluid Replacement

At hazardous materials incidents, especially when chemical suits are worn, serious dehydration can occur in fire fighters. Replacement of fluids should only be permitted if at least gross decontamination is performed—a washdown especially around the head and upper body.

The preferable method of consuming liquids is by means of drinking boxes with straws (the straw inserted by someone with uncontaminated hands), or by means of a squeeze bottle with an attached drinking tube as used by athletes.

The above should form part of comprehensive rehabilitation procedures which should be developed in consultation with your EMS providers.

Chemical Suit Decontamination

When a chemical suit is taken off its wearer, a suitably protected assistant should roll it in on itself in order to keep the outside of the suit from coming into contact with the wearer.

Because of the inherent smoothness and impermeability of chemical suits, it is usually only required that the on-scene washdown part of fire fighter decontamination is performed. Upon return to the station, instead of doing the steps listed in the appropriate procedure, fire fighters should wash and rinse the chemical suits and examine them carefully for damage caused at the incident. Zippers should be lubricated with their special lubricant.

Follow-up communication with the suit manufacturer as to the exposure, as well as follow-up from the exposing chemical's manufacturer, is useful in determining long-term effect of exposure to chemical-protective ensembles. Any questionable or unusual findings anywhere in the decontamination or testing process should be immediately referred to the manufacturers; the clothing should be placed out of service until it can be repaired or reevaluated. If a limited-use (disposable) suit becomes contaminated,

after gross decontamination it should be bagged and disposed of in a manner acceptable to the authority having jurisdiction.

Vacuum Cleaners for Level D

When selecting a vacuum cleaner, the following points should be taken into consideration:

- Can it operate off a generator, or is it unforgiving so far as voltage fluctuations are concerned?
- Will it operate safely in an area where it might get wet?
- How effective are the filters?
- Can the unit be safely cleaned out itself?
- Are replacement hoses easy to come by?

Although you won't want to operate your vacuum cleaner under water, it might accidentally get splashed so some basic water protection will be of benefit.

The degree of filtering achieved is important. Most wet/dry industrial type vacuums will achieve a reasonable effectiveness. Some specialized cleaners, equipped with HEPA (High Efficiency Particulate Air) filters will go down to 0.3 micron but they are expensive. The small, cigarette-lighter plug powered car interior cleaners are not suitable as they filter very little, instead blowing most particulate they pick up back out through their exhaust ports.

Easy removal of contaminated filters will help, as will good access to the machine's insides for its own decontamination. You will usually find that it is impossible to guarantee the effectiveness of cleaning of the accordion-style hose, and you should consider replacing these if they become contaminated.

Remember not to operate a vacuum cleaner in a flammable or explosive atmosphere, unless yours is intrinsically safe.

Bleach

Bleach, as shown on the bottle's label, is corrosive. Do not spray bleach on fire fighters' skin—it hurts! It is also reactive—do not let it come in contact with fuels and solvents, as a heat-generating reaction (and possible fire) will result.

Do not spray bleach on protective clothing, as it deteriorates and discolors the garment. It also impairs its fire retardancy.

Regular bleach containers are often made of a hard plastic and are liable to crack or leak around the cap when carried on a vehicle. Consider transferring the bleach to a container such as a new, unused plastic gasoline can, which is far sturdier, but then be sure to label the gas can as containing bleach. Never put bleach in a metal container, as it will react.

At room temperature, bleach shielded from sunlight will degrade about 1 percent per year, i.e., from 6

percent to 5 percent (faster in warmer temperatures, slower at colder temperatures). You should therefore replace the bleach at the appropriate time with a fresh supply, as its strength will have decreased with time.

It is recommended that, if possible, nonchlorinated bleach be used in case the bleach accidentally contacts the protective clothing.

Record Keeping

A member of the crew responsible for performing the decontamination should maintain written records of the following:

- Fire fighter's name, material involved, length of exposure
- Level of decontamination performed
- Any ill effects observed
- Where fire fighter went, i.e., returned to station, sent to rest area, removed to hospital, reassigned to other duties at the scene, etc.

At the station, entries should be made on the fire fighters' medical records of the incident date, material involved, and decontamination performed, where exposure is known or suspected. This will assist both in tracing future sickness through synergistic effects of chemicals in the body and with support of any later injury or sickness claims.

If appropriate, records should also be kept of the length of time each chemical suit was exposed, and what substance it was exposed to. This will permit the tracking of cumulative degradation of the suit material due to exposure to a variety of chemicals or due to repeated exposure to one particular substance.

Contamination of Vehicles

Any vehicle driven through a contaminated area must be washed down, including the undercarriage, chassis, and cab. Air filters on vehicle (and, where appropriate, generator) engines must be replaced. Porous items such as wooden hose beds, wooden equipment handles, seats, and cotton jacketed hose may be difficult to clean completely and may have to be discarded.

It is therefore better to take the "uphill and upwind" approach and keep vehicles at a suitable distance from incidents.

Precautionary Decontamination

There are occasions when an apparently normal alarm response turns into a hazardous materials incident. Frequently, most of the initial assignment crews will have gone into the incident area, and have the potential of being contaminated.

It is essential that all members so involved remove themselves from the area at once, call for decon capability, and stay together in one location. They must

not wander around, climb on and off apparatus, and mix with other personnel since there is a potential for them to be contaminated.

Fire fighters so exposed should be given "gross decontamination" (a simple on-scene washdown) as a precautionary measure. Knowledgeable haz mat personnel such as the decontamination sector officer, in conjunction with the incident commander, should determine whether any further, more definitive decontamination is necessary.

Remember, the primary objective of decontamination must be to avoid contaminating anyone or anything beyond the hot zone. When in doubt about contamination, decon all affected personnel, equipment, and apparatus.

One Final Observation

The entire foregoing contents of this document have probably made you realize by now that it is much more desirable to handle hazardous materials incidents with chemical suits than with regular fire fighting turnouts. The cost of disposable suits is relatively cheap; even for a small department, throwing away a few hundred dollars' worth of disposable suits after one use will be cheaper than replacing fire fighting clothing or paying for commercial cleaning. In many jurisdictions, the fire service is permitted to recover the cost of destroyed equipment from the party responsible for the incident's occurrence, and the cost of disposable chemical suits can thus be recovered.

Always remember: If the emergency response crew is not equipped with gear suitable for entry into a hazardous or toxic atmosphere, then the option of "no go" should be considered the most appropriate tactic.

Speed—A Case for Exception?

Decontamination should emphasize thoroughness, not speed. Under noncritical conditions certain commonsense actions should be taken, such as decontaminating the fire fighter with the lowest air reserve first.

Speed is only important where a victim is involved and even then decontamination should be as thorough as is practicable.

Circumstances may dictate that emergency decontamination becomes necessary, examples of such situations being where a protective suit has become split or damaged, or when a fire fighter is injured. Emergency decontamination may also be applicable when contaminated civilians or other emergency workers (police, ambulance, etc.) are involved.

Emergency Decontamination Procedure

Paragraphs 1 to 6 below, although arranged in a basic chronological order, do not necessarily have to be

undertaken in the exact sequence outlined. The officer-in-charge should act in the most expedient manner appropriate without worsening the situation.

The procedure outlined should be carried out as quickly as possible.

To protect the ambulance crew and hospital staff as well as the victim, every attempt must be made to perform at least this emergency procedure prior to transporting the victim to the hospital.

1. Remove the victim from the contaminated area into the decontamination zone and provide a supply of uncontaminated air or oxygen.

2. Remove fire helmet if worn and immediately wash with flooding quantities of water any exposed parts of the body that may have been contaminated.

3. If the victim is wearing SCBA, release the harness and remove the set leaving the face mask in position.

4. Remove all contaminated clothing (if necessary by cutting it off the victim) ensuring where practicable that the victim does not come into further contact with any contaminant. Maintain the washing of the victim while the clothing removal is taking place.

5. Remove the victim to a clean area. Render first aid as required, but do not apply mouth-to-mouth resuscitation. Send victim for medical treatment as soon as this emergency decontamination procedure has been completed.

6. Ensure hospital/ambulance personnel are informed of the contaminant involved.