MWC

MIDWEST CONSORTIUM
FOR HAZARDOUS WASTE
WORKER TRAINING

mwc.umn.edu

Post Storm Response Safety

Participant Guide

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Midwest Consortium for Hazardous Waste Worker Training

Acknowledgments

The University of Tennessee Center for Industrial Services developed this program in conjunction with the Midwest Consortium (MWC). This activity is conducted under cooperative agreement number U45 ES 06184 from the National Institute of Environmental Health Sciences (NIEHS).

We encourage you to comment on these materials. Please give your suggestions to those leading the program in which you are now enrolled or click on the Contact page of the Midwest Consortium website: https://mwc.umn.edu/contact/

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The material was prepared for use by experienced instructors in the training persons who are or who anticipate responding to industrial emergencies. Authors of this material have prepared it for instruction as of the date specified on the title page. Users are cautioned that the subject is constantly evolving. Therefore, the material may require additions, deletions, or modifications to incorporate the effects of that evolution occurring after the date of this material preparation.

Disclaimer

The Occupational Safety and Health Administration (OSHA) rule to help ensure worker health and safety at hazardous materials responses requires annual refresher training. Refresher training requirements are specified in 29 CFR 1910.120(q)(8). This program is intended to help meet the requirements for knowledge and skills that the employer must certify annually.

Additional training is necessary to perform many activities. These activities include developing an emergency response plan, identifying materials using monitoring instruments, selecting protective equipment, and assuming the role of incident commander. For information about this matter, consult the training facilitator and/or your company emergency response plan or your company health and safety representative.

All web links are active as of August 9, 2022; if you find an error, please inform the facilitator so that it can be updated.

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INTRODUCTION

Course Objectives

After completion, you will better be able to:

- Recognize hazards encountered in a post storm environment
- Identify how to protect yourself from hazards in a post storm environment
- Define terms and concepts used frequently in a post storm environment
- Implement a FEMA Marking System
- Describe water rescue techniques

Module 1: Storm Response Safety

Objectives

When completed, you will better be able to:

- Recognize hazards encountered in a post storm environment
- Identify how to protect themselves from hazards in a post storm environment

Content for this module can be found in the NIEHS Safety Awareness for Hurricane Responders PowerPoint and Booklet.

Driving in Disasters

Objectives

When completed, you will better be able to:

- List characteristics of a defensive driver
- Recognize hazardous driving conditions
- Identify disaster driving tips

Content for this module can be found in the NIEHS Driving Hazard Awareness PowerPoint and the Safe Driving Practices Handout below.

Motor Vehicles

Safe Driving Practices for Employees

You are your employer's most valuable asset! The way that you drive says everything about you and your company. Make a positive statement by following these work-related safe driving practices.

Stay Safe

- Use a seat belt at all times – driver and passenger(s).
- Be well-rested before driving.
- Avoid taking medications that make you drowsy.
- Set a realistic goal for the number of miles that you can drive safely each day.
- If you are impaired by alcohol or any drug, do not drive.

Stay Focused

- Driving requires your full attention. Avoid distractions, such as adjusting the radio or other controls, eating or drinking, and talking on the phone.
- Continually search the roadway to be alert to situations requiring quick action.
- Stop about every two hours for a break. Get out of the vehicle to stretch, take a walk, and get refreshed.

Avoid Aggressive Driving

- Keep your cool in traffic!
- Be patient and courteous to other drivers.
- Do not take other drivers' actions personally.
- Reduce your stress by planning your route ahead of time (bring the maps and directions), allowing plenty of travel time, and avoiding crowded roadways and busy driving times.

For more information on safe driving for work, refer to "Guidelines for Employers to Reduce Motor Vehicle Crashes" at http://www.osha.gov/SLTC/motorvehicle safety/index.html.

For more complete information:

OSHA Occupational Safety and Health Administration

U.S. Department of Labor

www.osha.gov (800) 321-OSHA

OSHA 3314-08N-06

Module 3: Electrical Safety

Objectives

When completed, you will better be able to:

- Define basic electrical terms and concepts
- Recognize common situations involving electrical hazards
- Identify potential hazards related to voltage gradients and step potential
- List effects of electricity and electrical shock on the human body
- Identify hazards of downed power lines and appropriate actions to avoid them

Content for this module can be found in the SaskPower Electrical Safety PowerPoint or Electrical Safety for First Responders (SCE) video https://youtu.be/DJJLaK3yNwU as well as three handouts found below.

- SaskPower Emergency Personnel Electrical Safety Handout
- Basic Electrical Terminology
- Effects of Electrical Shock

EMERGENCY PERSONNEL

Electrical Safety

SaskPower

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PR 9315/Sept. 2015

Safety Guidelines for Emergency Personnel

How to cope with electrical hazards in rescue and fire situations

The information in this booklet is provided to assist police, fire, ambulance and emergency response personnel in emergencies involving electrical facilities before the arrival of SaskPower personnel.

SaskPower does not warrant the accuracy or completeness of the information and shall not be responsible or liable to any person in respect of loss, damage or injury resulting from the application of, reliance on or the misapplication of any of the emergency techniques described in this handbook.

For additional public safety information, please visit **saskpower.com/safety.**

1 ELECTRICITY - SOME BASIC FACTS

While it's true that electricity always seeks the easiest path to the ground, that's not the only path it takes. Electricity takes every path to the ground, whether it comes from a household lighting circuit, a high power transmission line or lightning.

If a person touches two energized wires or touches an energized wire and the ground at the same time, he or she will become part of an electrical circuit, and may be killed or injured.

Electrical Installations

Electricity is generated by power plants at voltages ranging from 2,300 to 20,000 V (volts). This voltage is stepped up for efficient transmission over long distances to switching stations. Some transmission lines operate as low as 72,000 V, others as high as 230,000 V.

At the switching stations, voltage is reduced and power is sent on distribution lines to industrial, commercial and residential customers.

Power plants, substations, underground vaults and other SaskPower installations differ greatly from other buildings. They present unusual hazards to emergency personnel that can endanger their lives. Emegency personnel entering any of these facilities will not be familiar with the surroundings and must use specialized techniques to ensure personal safety. Good communication and co-operation between SaskPower and emergency response agencies is crucial.

Common Electrical Terms and Definitions

Many electrical terms that describe how electricity travels can be

likened to the passage of water. **Voltage** is similar to water pressure. It is the force that causes the flow of electricity. **Current** can be likened to the rate of flow of water in a pipe. **Resistance** is similar to the effect of friction on the flow of water in a pipe (water flows more freely in a large pipe than in a small one.)

Different materials have different resistances to the flow of electricity. Very high resistance materials are called **insulators**, while the low resistance materials are called **conductors**.

In an electrical system, the force or pressure is measured in volts and the current flow in **amperes (amps)**. Resistance is measured in **ohms**.

Insulators, Conductors and Semi-Conductors

All materials conduct electricity in varying degrees. Materials classified as insulators conduct electricity in such small quantities it cannot normally be detected. On the other hand, materials classified as conductors conduct electricity readily in large amounts.

To cite two examples: Glass is an insulator. Metal is a conductor.

Some other materials are classified as **semi-conductors**. These include water, wood, earth and rubber tires. Depending on conditions, such as moisture content and contaminants, **semi-conductors** can conduct large amounts of electricity.

Low-Voltage Hazards

Most electrical fires originate in equipment operating below 750V. In the electricity industry, this is referred to as low voltage. Home heating systems and home appliances operate at 240V or less. Although the hazard is greater with high voltage installations, it is important for emergency personnel to realize the hazards of even relatively low voltage.

Voltage Gradient on the Ground Surface

Because electricity always takes every available path to ground, electrical systems use conductive grounding rods to ensure that any stray electricity is returned to earth safely. These rods are driven about 2.5 m (eight feet or more) into the ground to ensure deep dispersal of the current. However, if electricity is released into the ground surface, such as when a live wire lies on the ground, the electricity will fan out from the point of contact.

There is a rippling effect that can be likened to dropping a pebble into calm water. In the pool of water, the wave created at the point of contact gets smaller as it rings out. Similarly, in this pool of electricity, the energy is at full system voltage at the point of ground contact, but as you move away from the contact point, the voltage drops progressively. This effect is known as **ground gradient** – and a knowledge of how it works may someday save your life.

Step Potential and Touch Potential

The ground gradient, or voltage drop, creates two problems known as step potential and touch potential.

Let us assume that an electrically charged wire is touching the ground and has created a pool of electricity. If you were to place one foot near the point of ground contact (at x voltage) and your other foot a step away (at y voltage), the difference in potential (voltage) would cause electricity to flow through your body. This effect is referred to as **step potential**. (See illustration #3 - next page.)

Faulty Electrical Equipment

It is obvious that electricity is safe when it's properly controlled. However, hazards are created when electrical equipment or wires have become faulty as the result of being:

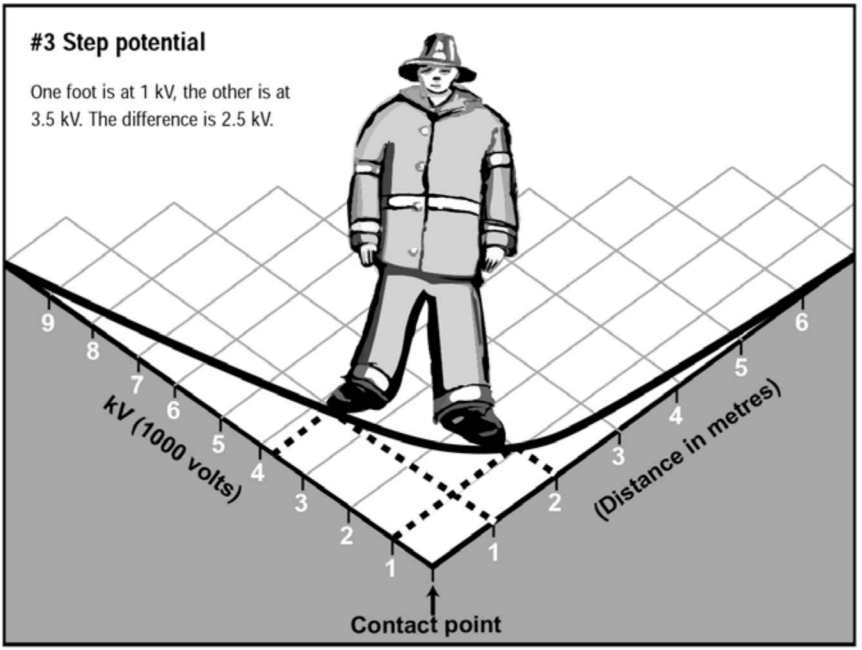
- worn out or deteriorated,
- improperly installed,

- improperly maintained,
- damaged or broken.

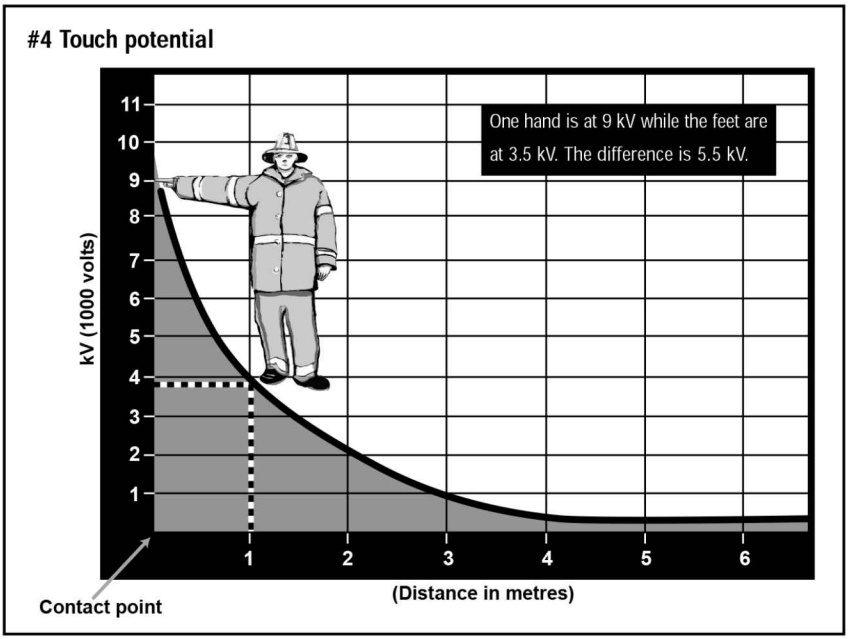
Any one of the above may cause arcing or overheating of electrical equipment – the two conditions that cause the majority of electrical fires.

An electrical arc is a sudden flash of electricity between two points of contact. An arc is extremely hot, and can ignite combustible material in the vicinity, including some insulation materials around the conductor. Hot material may be thrown into adjacent flammable material, starting a fire.

The majority of fires caused by overheating result from overloading electrical conductors and motors. When the amount of current exceeds that which conductors and equipment are designed to carry, dangerous situations are created.



If your feet were both at an equal distance from the source (both at x voltage) and you place your hand on an energized source, electricity would flow through your body. The difference in voltage in this case is referred to as **touch potential**. (See illustration #4.)



2 INJURIES CAUSED BY ELECTRICAL SHOCKS

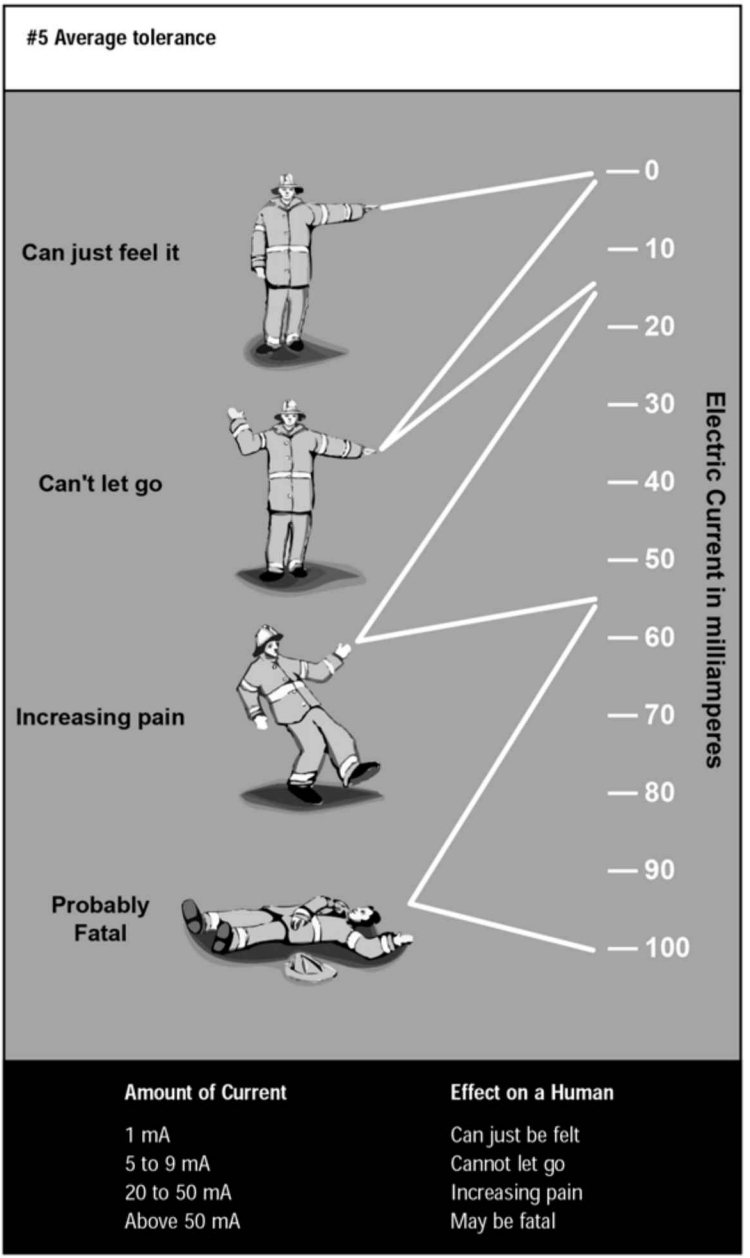
Effects of Electricity on the Body

The effect of electricity on the body is dependent on the amount of current and the length of time the body is exposed to it. The higher the current, the less time a human can survive the exposure.

The path of electricity through the body is also critical. For example, current passing through the heart or brain is more life-threatening than current passing through the fingers.

Most common household currents are one to two amps.

For example, it takes approximately one amp of current to run a 100-W light. That's 1,000 milliamps (mA) and even a fraction of that for a few seconds or more can be fatal. (See illustration #5.) Here are the effects you can expect from just a few seconds of current.



It is the amperage that kills or injures. But the voltage, which pushes the current through the body, also has an important effect.

When a person is exposed to household voltages, he or she may suffer a muscle spasm and become locked onto the electrical source until the circuit is turned off, or until the victim falls clear from the weight of his or her body. Relatively long periods of contact with low voltage are the cause of many electrical fatalities in the home.

At very high voltages (on power lines, for example), the victim is often quickly blasted clear of the circuit. This may result in less internal damage, but terrible surface burns at the entrance and exit points of the current.

A person exposed to a large electric arc can be injured by the intense heat or by ultraviolet rays which can cause serious eye damage.

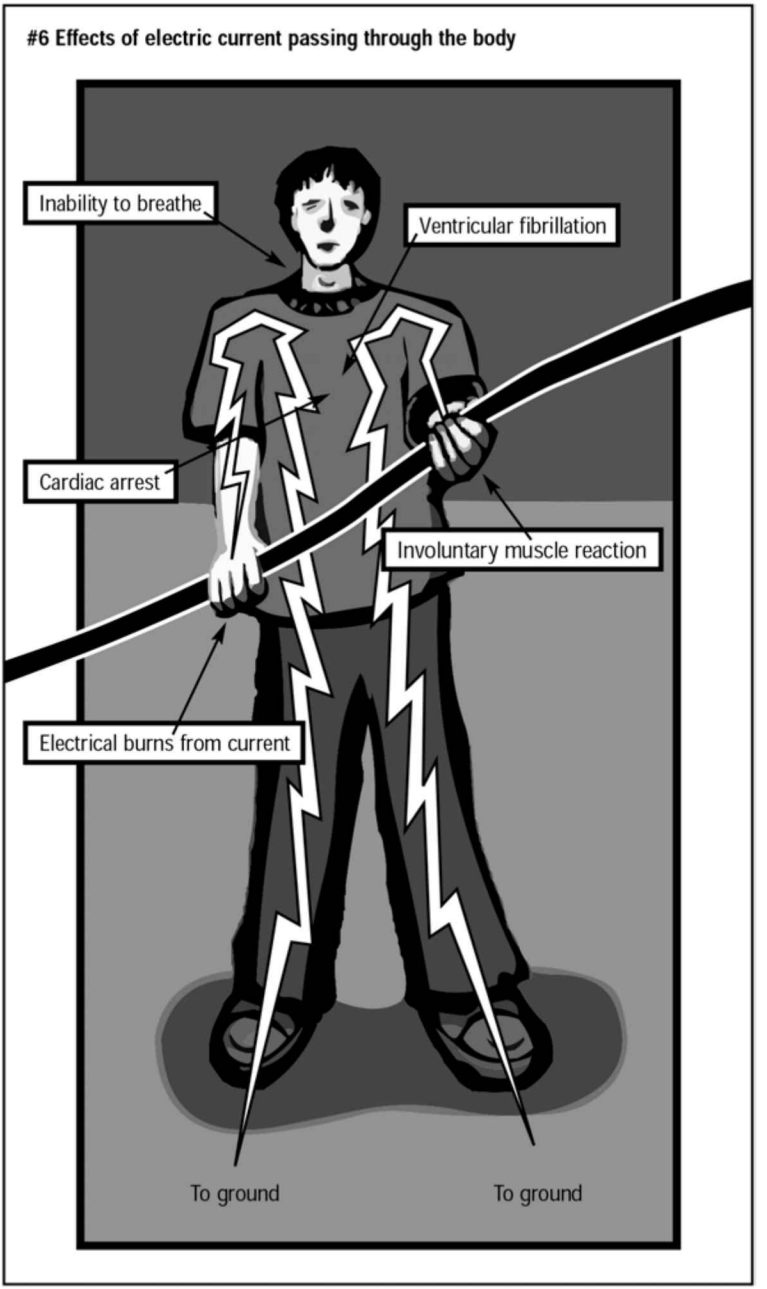
The effect of electricity on the body also depends on the condition of the skin, the area of skin exposed to the electrical source and the pressure of the body against the source. Severity of the shock will be increased if the electric current touches moist or broken skin.

Any victim of electrical shock should be examined for the following effects on the body:

1. cardiac arrest;
2. temporary paralysis of the respiratory centre, causing breathing failure;
3. ventricular fibrillation of the heart (mainly resulting from lower voltages);
4. burns to tissue at the current entrance and exit points (mainly resulting from higher voltages);
5. fractures caused by muscle spasm. (See illustration #6.)

Keep in mind that the **danger must be removed** before any treatment can be given to the patient. In some cases, the circuit can be turned off; in other cases, it cannot.

Electricity always seeks every available path to ground. If you touch an energized wire and the ground at the same time, you may be killed or injured.



3 FALLEN POWER LINES

Electrical distribution wires may be broken by storms and ice, or as the result of vehicles striking power poles.

If, during your work, you come across broken or fallen wires, do not expose yourself to needless risks while trying to eliminate the danger. **Always assume that the wires are energized and capable of injuring or even killing people.** Inform SaskPower personnel and a representative will be sent to remedy the situation.

Action to be Taken on Arriving at the Scene

1. Assess the situation before getting out of your vehicle. Make sure you are parked well away from fallen wires. At night, use a flashlight to examine the surroundings carefully from the car or truck window. If you are parked over or near the fallen wires, move your vehicle out of harm's way. (See illustration #7.)

2. Locate all wire ends. Always assume fallen power lines are live, whether they are on the ground or hanging in mid-air. If a live wire touches a vehicle, or any other object made of metal, that object will be

capable of killing people. So will a pool of water if a live wire has fallen into it. You must supervise the public to prevent any contact with enegized objects. (See illustration #8.)

3. Place a guard around the danger zone and call SaskPower for help (See illustration #9.)

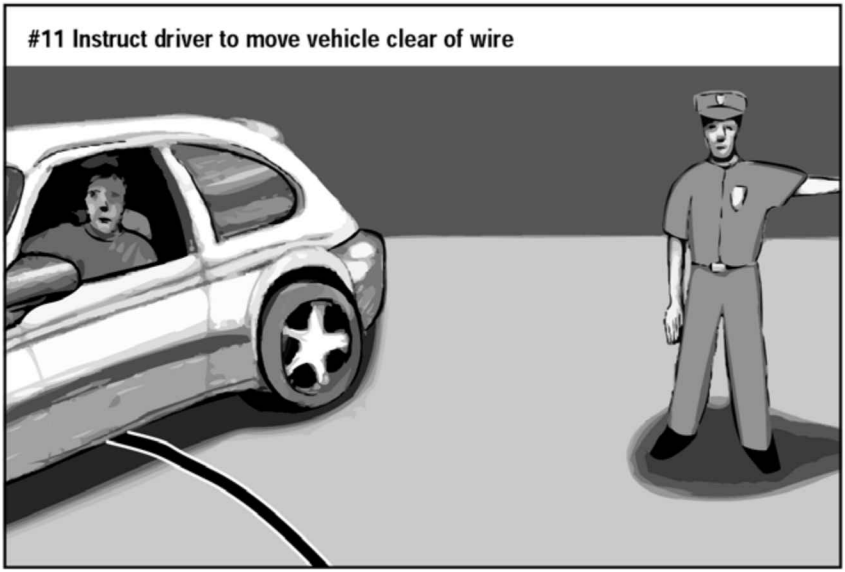
4. Keep people away from the broken or sagging wires or other electrically charged objects. Live wires in contact with objects on the ground may burn through, and one end may then curl up or roll along the ground causing injury. (See illustration #10.)

   If a wire has fallen on a metal fence or other metal object, electricity may be conducted to other points. In fact, the ground itself can be energized to a dangerous level near the fallen wire.

5. Wait for SaskPower to arrive – do not attempt to move fallen wires.

4 TRAPPED IN A VEHICLE BY A FALLEN LIVE WIRE

Wherever possible, SaskPower personnel will handle these situations. However, if SaskPower personnel are not yet on the scene, use the following guidelines for these emergency situations:



Situation 1 – A fallen wire lies under a vehicle, with one or more people inside.

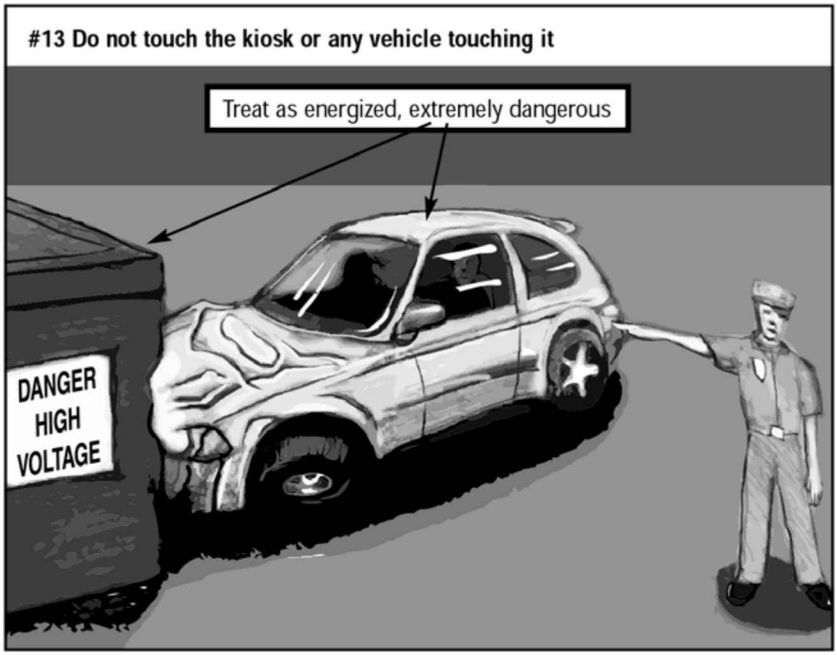
	Action
• If the driver is unhurt and can move vehicle (See illustration #11.)	Do not touch any part of the vehicle. (You could be electrocuted.) Instruct the driver to move the car away from the wire, providing no further system damage will occur. Make sure you and all onlookers are in a safe place. When the vehicle moves, the wire may spring up.

Situation 2 – A fallen wire lies across a vehicle with one or more people inside.

	Action
• If the driver is injured and cannot move his vehicle.	Instruct the driver to stay in place until the SaskPower crew arrives.
• If occupants are uninjured but the vehicle has a fire which cannot readily be extinguished, and the vehicle cannot be moved (See illustration #12.)	Instruct the occupants to get out by a standing jump. Tell them: "Keep your feet together as you jump. Do not touch the car and ground at the same time. Continue to hop or take short, shuffle steps away from the car." This can be very dangerous and should only be used as a last resort.

5 PROBLEMS RELATED TO KIOSKS

Kiosks are metal boxes, installed at ground level, which protect underground electrical installations.



Situation

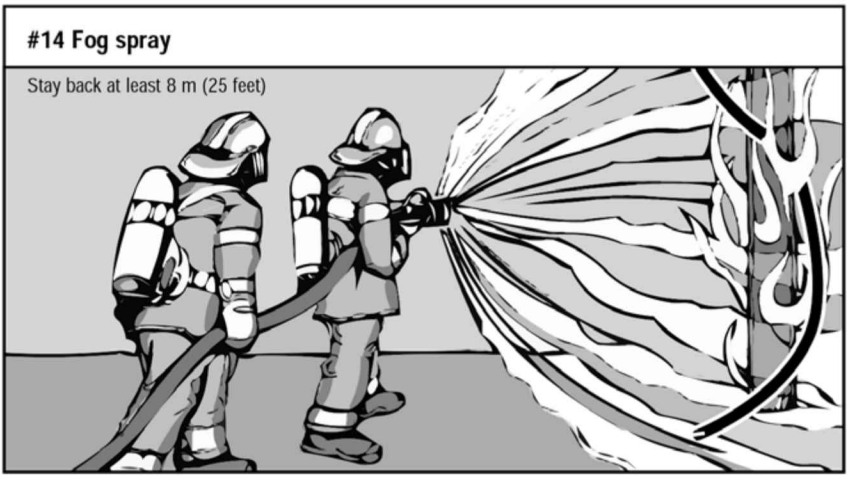
- A kiosk shows evidence of being tampered with, such as hacksaw marks or severe dents.
- A kiosk is damaged in a vehicle accident. (See illustration #13.)

Action

Call SaskPower with details of the location.

Do not touch the kiosk or any vehicle that may be touching the kiosk. Treat it as an energized object. Instruct the driver to move the car away from the kiosk if possible. If not, warn occupants to stay in car. Call SaskPower.

6 WATER & ELECTRICAL FIRES



Situation	Action
• Broken wires are tangled around a power pole, creating arcs and setting the pole on fire. (See illustration #14.)	Douse the fire with a mist/fog spray. Do not shoot a steady stream of water on an electrical fire, conductor or apparatus unless under the direct supervision of SaskPower personnel.

7 ELECTRICAL FACILITIES AND WILDFIRES

Most rural farms, acreages and rural businesses are dependent on electricity for the operation of fire suppression equipment such as water pumps. When a forest, bush or prairie fire occurs in areas where electrical lines and facilities will be affected, SaskPower will

attempt to keep the power lines and facilities live after ensuring it is safe to do so. If necessary, SaskPower will facilitate shutdowns; however, always assume that the power is still on – never assume that it is not live.

Situation	Action
• A grass fire erupts and engulfs a transformer.	Douse the fire with a mist/fog spray, not a steady stream of water. Stay at least 8 m (25 feet) away until consulting with SaskPower personnel.

8 SUBSTATION FIRES

Substations contain large quantities of oil, energized electrical equipment and, in some cases, cylinders of compressed gas.

On arriving at a substation fire, emergency personnel should be prepared to protect adjacent properties. SaskPower will advise when the substation has been made electrically safe. Emergency personnel can then proceed with conventional firefighting equipment.

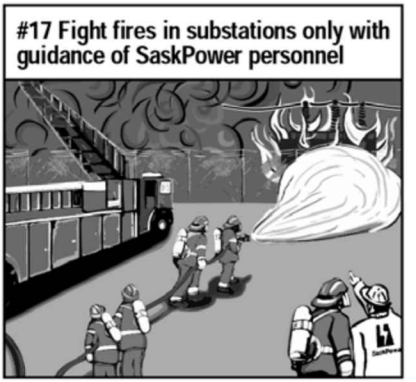
If a SaskPower representative is not present when the firefighter arrives, contact the utility to make sure one has been dispatched.

SaskPower representatives are familiar with the substations they serve and can identify the areas that are electrically safe.

Conservators

These large tanks located at the top of transformers allow for expansion and contraction of the oil when the transformer is carrying load. There will be no large build-up of pressure, but if one of these tanks were ruptured, it could provide a large supply of fuel in the event of a fire.

Situation	Action
• You have been called to a substation fire. (See illustrations #16 & #17.)	Do not enter the substation. Keep the danger zone clear of onlookers. Do not spray the fire with water or any other liquid. Await the arrival of SaskPower personnel to shut off the power and give you guidance.



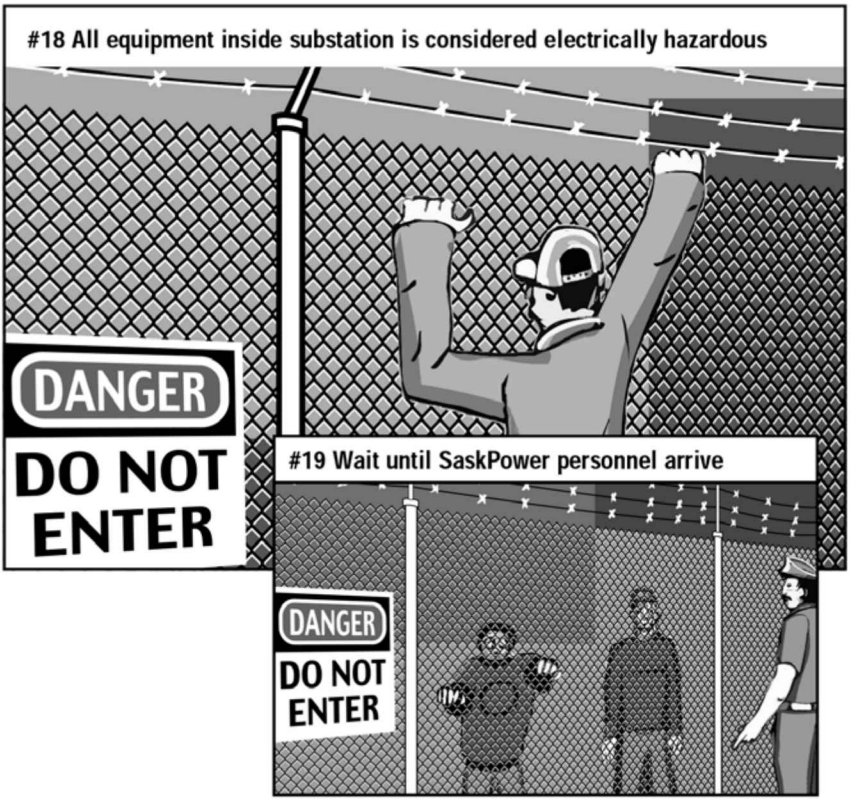
9 UNAUTHORIZED PERSONS IN SUBSTATIONS

Another dangerous situation arises from people playing around electrical installations and equipment.

Situation	Action
• People are seen climbing over a fence into a substation. (see illustrations #18 & #19.)	Ask them to remain by the fence. Warn them of the danger and call SaskPower for assistance.

- If the person in the substation is injured.

SaskPower cannot be responsible for any action you might take without SaskPower's direct guidance.



10 FIRES AND EXPLOSIONS IN UNDERGROUND ELECTRICAL VAULTS

In high-density areas of every city, and in many residential subdivisions, electrical distribution wires run through cable tunnels located under the pavement.

Transformers and switchgear for these circuits are situated underground in concrete vaults, with access provided to each vault by a manhole.

Underground electrical systems are designed to withstand great stress. However, earth movement can crack the concrete walls of cable tunnels, as well as adjacent sewer pipes, natural gas pipes and water mains. Hazardous conditions can result, including accumulation of explosive and toxic gases, and dangerously high water levels.

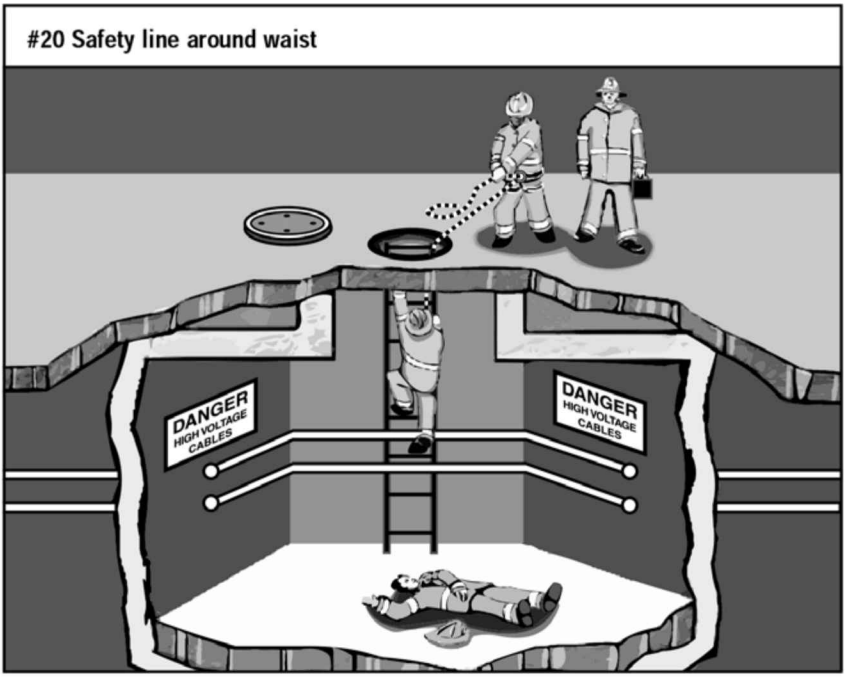
Electrical failure of a cable may result in an explosion or fire, which could damage insulation and energize all metal parts within the vault.

Firefighters and police should consult their OH&S confined space rules and regulations for guidelines regarding rescue.

Situation	Action
• If a victim is lying unconscious at the bottom of an open manhole. (See illustration #20.)	1. Call SaskPower and indicate the location and number of manholes involved. Request assurance that the cable will not be energized. 2. If there is a fire in the hole use only non-conducting fire extinguishing substances. 3. Attach a non-metallic safety line. 4. Do not touch any electric components. 5. Give first aid and wait for help to remove victim.

6. Check air quality before accessing.

7. If monitor is not available utilize self-contained breathing apparatus (SCBA).



Situation

- You have been called to the scene where smoke is escaping from the holes in a manhole cover.

Action

1. Call SaskPower and give the location and number of manholes.

2. Stop traffic and keep the public at a safe distance.

3. Do not attempt to remove the cover. It may produce a spark and cause an explosion if gases are present.

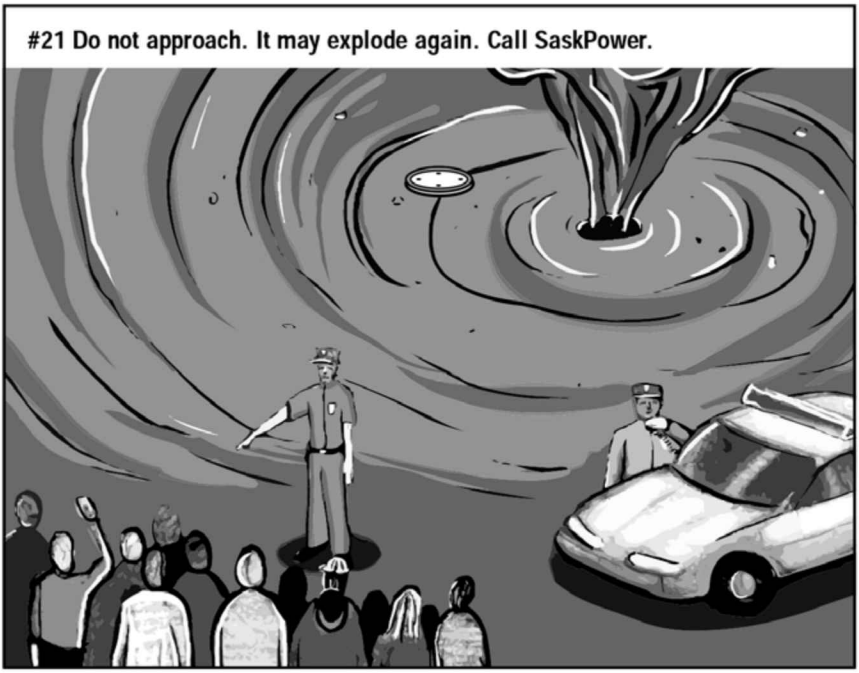
4. Maintain precautions until conditions have been evaluated.

Situation

- You have been called to the scene of an explosion in the street. Manhole covers have been blown off their seatings. (See illustration #21.)

Action

1. As above, but in this case you may have to identify or aid a victim. Approach an open manhole with caution. Beware! It may explode again.



Basic Electrical Terminology

Volts — Volts are used with numbers to describe the force of the current

Amp — Amp is short for Amperage. This is a measurement for the number of electrons flowing through the circuit, versus the force of which they are flowing.

Ohms — This is a measurement for the amount of resistance in a circuit. Resistance in the circuit is also used to create heat and light, and so it not always a bad thing.

Circuit — An electrical circuit is one loop of electrical flow. Electricity only powers when it is flowing and requires a completed circuit. Electricity will try and head towards the earth if it has nowhere to go, and that could be you. A short circuit is when electricity is not completing the normal full circuit that was created, say by two bare wires touching together somewhere they are not supposed to be. Water between two wires could cause a circuit to short out.

Open Circuit — An open or open circuit occurs when a circuit is broken, such as by a broken wire or open switch, interrupting the flow of current through the circuit. It is analogous to a closed valve in a water system.

Parallel Circuit — A circuit in which there are multiple paths for electricity to flow. Each load connected in a separate path receives the full circuit voltage, and the total circuit current is equal to the sum of the individual branch currents.

Conductor — Any material where electric current can flow freely. Conductive materials, such as metals, have a relatively low resistance. Copper and aluminum wire are the most common conductors.

Current — The flow of an electric charge through a conductor. An electric current can be compared to the flow of water in a pipe. Measured in amperes.

Service Box — This is the main electrical panel which holds all the fuses, and more modern circuit breakers and distributes electricity evenly through your home. Every circuit in your home should start and end here. This is also called the service panel or fuse box, although modern ones don't actually contain fuses

Circuit Breaker — This is the modern equivalent of a fuse. This device will automatically cut the flow of electricity through a circuit when there is an excess amount of electricity flowing through the circuit. Fuses need to be replaced, where the circuit breaker just needs to be switched back on.

Conduit — This is a term to describe the casing that electrical wires are concealed in. These are used when electrical wires need to be on exterior surfaces of your home or office. They provide additional protection against damage to the wires or shock to people near them.

Gauge — Gauge refers to the term use to describe the diameter of the electrical wire. The larger the number the thinner the wire.

Meter — The only term used to describe something that measures electricity, and don't confuse this with gauge.

AC — Alternating Current, the standard type of electricity found in your home or office. This is not the same as DC current which you will find in batteries for example.

Fuse — A circuit interrupting device consisting of a strip of wire that melts and breaks an electric circuit if the current exceeds a safe level. To restore service, the fuse must be replaced using a similar fuse with the same size and rating after correcting the cause of failure.

Ground — The reference point in an electrical circuit from which voltages are measured, a common return path for electric current, or a direct physical connection to the Earth.

Ground Fault Circuit Interrupters (GFCI) — A device intended for the protection of personnel that functions to de-energize a circuit or portion thereof within an established period of time when a current to ground exceeds some predetermined value that is less than that required to operate the overcurrent protective device of the supply circuit.

Insulator — Any material where electric current does not flow freely. Insulative materials, such as glass, rubber, air, and many plastics have a relatively high resistance. Insulators protect equipment and life from electric shock.

Service — The conductors and equipment used to deliver energy from the electrical supply system to the system being served.

Step potential — The voltage difference between the feet of a person near an energized, grounded object. A person on the ground is subjected to the risk of injury during an electrical fault simply by attempting to move toward or away from the grounding point.

Touch potential — The voltage between any two points on a person's body – hand to hand, shoulder to back, elbow to hip, hand to foot and so on. For example, if an overhead conductor falls on a car, and a person touches that car, current could pass from the energized car through the person to the ground.

Electrical shock — Electric shock occurs when a person comes into contact with an electrical energy source. Electrical energy flows through a portion of the body causing a shock. Exposure to electrical energy may result in no injury at all or may result in devastating damage or death.

Effects of Electrical Shock

A shock can cause muscle spasms

Muscles are stimulated by electricity. The effect depends on the intensity of the current and the type of muscle it travels through.

We've all felt a buzzing or tingling sensation that doesn't cause injury. That's the effect of a current as low as 0.25 milliamperes (mA) entering the body.

When a current above 10 mA travels through flexor muscles, such as the ones in our forearms that close the fingers, it causes a sustained contraction. The victim may be unable to let go of the source of the current, making the duration of the contact longer and increasing the severity of the shock.

When a current above 10 mA travels through extensor muscles, it causes a violent spasm. If the muscles affected are the hip extensors that lengthen the limbs away from the body, the victim may be propelled, sometimes many metres away!

Muscles, ligaments and tendons may tear as a result of the sudden contraction caused by an electric shock. Tissue can also be burned if the shock is lasting or the current is high.

A shock can cause cardiac arrest

If a current of 50 mA passes through the heart, it can cause cardiac arrest.

The heart is also a muscle, which beats to pump blood through the body. The rhythm of our heartbeat is controlled by electric impulses—it is these impulses that are monitored by an electrocardiogram. If a current from outside the body passes through the heart, it can mask these impulses and disturb the heart's rhythm. This irregular heartbeat is called arrhythmia and can even manifest as a total disorganization of the rhythm, known as ventricular fibrillation.

When ventricular fibrillation occurs, the heart stops pumping and the blood stops circulating. The victim rapidly loses consciousness and dies if a healthy heartbeat is not restored with a device called a defibrillator.

The arrhythmia can occur at the time of the shock or in the hours following the electric shock.

A shock can cause burns to tissues and organs

When a current above 100 mA passes through the body, it leaves marks at the points of contact with the skin. Currents above 10,000 mA (10 A) cause serious burns that may require amputation of the affected limb.

Some burns are easy to recognize because they look like the burns you can get from contact with heat. **Others may seem harmless but aren't: tiny charred craters indicate the presence of much more serious internal burns.**

Electrical burns often affect internal organs. They are caused by the heat generated from the body's resistance to the current passing through it. Internal damage may be much more serious than the external injuries suggest.

Internal burns often have serious consequences: scarring, amputation, loss of function, loss of sensation and even death. For example, if a lot of tissue is destroyed, the large amount of waste generated can cause serious kidney or blood circulation disorders.

A shock can affect the nervous system

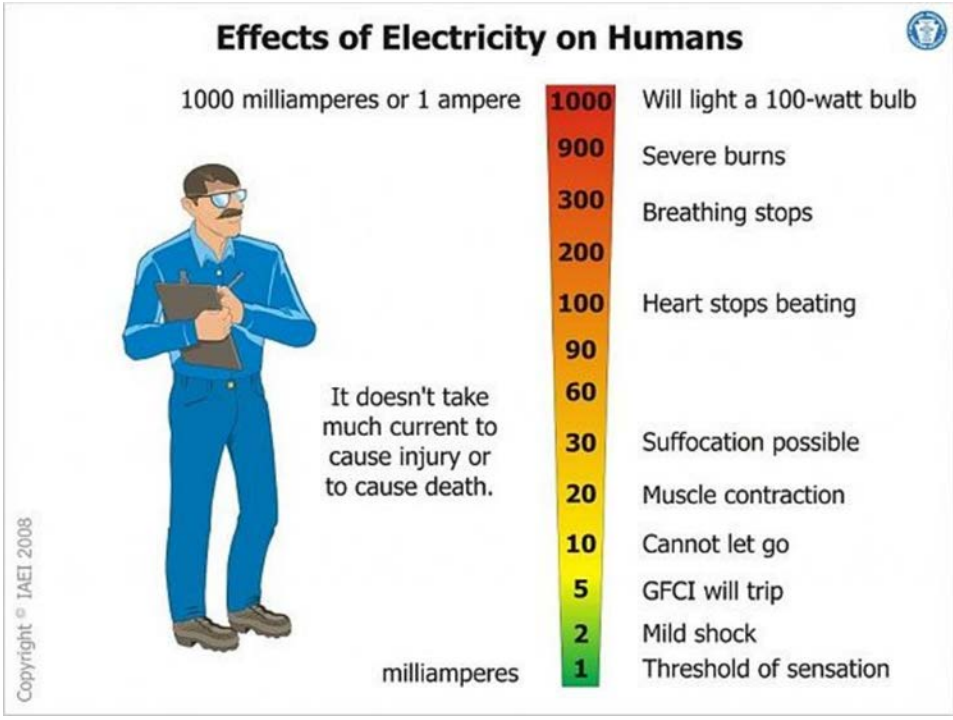
Nerves are tissue that offers very little resistance to the passage of an electric current. When nerves are affected by an electric shock, the consequences include pain, tingling, numbness, weakness or difficulty moving a limb. These effects may clear up with time or be permanent.

Electric injury can also affect the central nervous system. When a shock occurs, the victim may be dazed or may experience amnesia, seizure or respiratory arrest.

Long-term damage to the nerves and the brain will depend on the extent of the injuries and may develop up to several months after the shock. This type of damage can also cause psychiatric disorders.

A shock can have other unexpected consequences

Other disorders can appear in the weeks or months following the shock, depending on which organs the current passed through. For example, if the current passed through the eyes, cataracts may develop over time.



Module 4: FEMA Disaster Marking System

Objectives

When completed, you will better be able to:

- Define rationale for standardized marking system
- Identify structural identification strategies
- Identify structural orientation approach
- Implement FEMA Marking System

Content for this module can be found in the FEMA Marking Systems PowerPoint and Handout below. This module includes a hands-on Exercise with a Performance Checklist below.

- FEMA Marking System Handout
- FEMA Marking System Performance Checklist

ON-SITE EMERGENCY SIGNALING PROCEDURES

Effective emergency signaling procedures are essential for the safe operation of rescue personnel operating at a disaster site. These signals must be clear and universally understood by all personnel involved in the operation. Air horns or other appropriate hailing devices shall be used to sound the appropriate signals as follows:

Cease Operation/All Quiet	**1 long blast (3 seconds) (QUIET)**
Evacuate the Area	**3 short blasts (1 second each) (OUT, OUT, OUT)**
Resume Operations	**1 long and 1 short (O - KAY)**

FEMA BUILDING MARKING SYSTEM

GENERAL:

A uniform building marking system has been developed by the FEMA National US&R Response System.

There are 4 categories of FEMA US&R Markings:

Structure Identification Marking

Structure/Hazards Evaluation Marking

Victim Location Marking

Search Assessment Marking

The building marking system was established to ensure:

Differentiation of structures within a geographic area.

Communicate the structural condition and status of US&R operations within the structure.

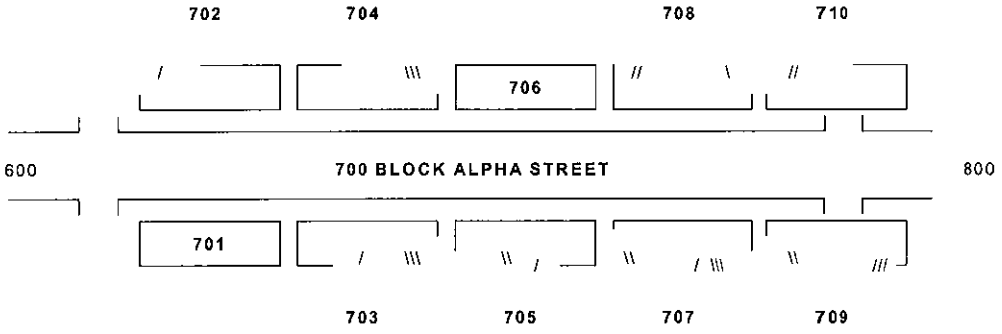
Identification markings on structures may be made with International Orange spray paint (or crayon), placed on the building surface. In the case of hurricanes where many structures are involved, a system using a "Stick-on" Label should be used

Markings should be placed on normal address side of the structure.

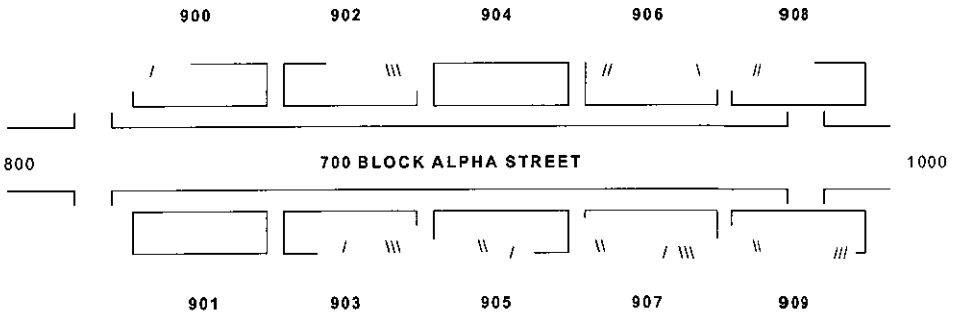
STRUCTURE IDENTIFICATION MARKING

If at all possible, the existing street name and building number will be used. If some numbers have been obliterated, attempt should be made to reestablish the numbering based on nearby structures.

If no numbers are identifiable on a given block, then US&R personnel will assign and identify the street name and numbers based on other structures in the proximity. The structures shall then be numbered to differentiate them (using paint or crayon).



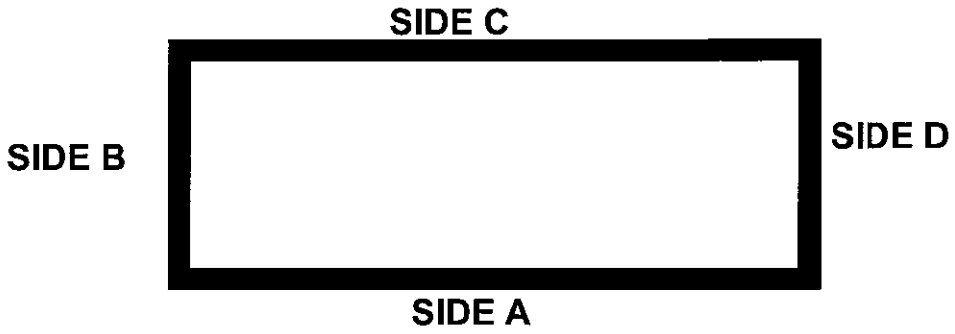
CASE 1 – IF SOME NUMBERS ARE KNOWN, FILL IN BETWEEN



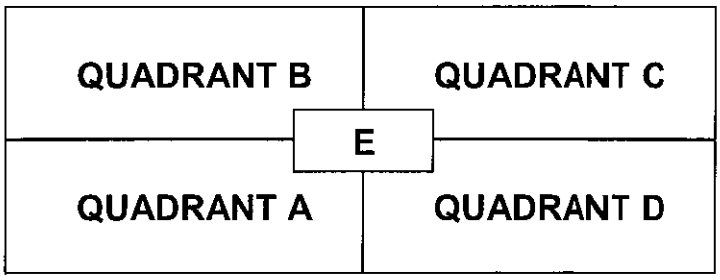
CASE 2 – IF NO NUMBERS ARE KNOWN, FILL IN USE SMALL NUMBERS

STRUCTURE I.D. MARKING (continued)

It is also important to identify locations within a single structure. The address side of the structure shall be defined as SIDE A. Other sides of the structure shall be assigned alphabetically in a clockwise manner from SIDE A.



The interior of the structure will be divided into QUADRANTS. The quadrants shall be identified ALPHABETICALLY in a clockwise manner starting from where the SIDE A and SIDE B perimeter meet. The center core, where all four quadrants meet will be identified as Quadrant E (i.e., central core lobby, etc.).



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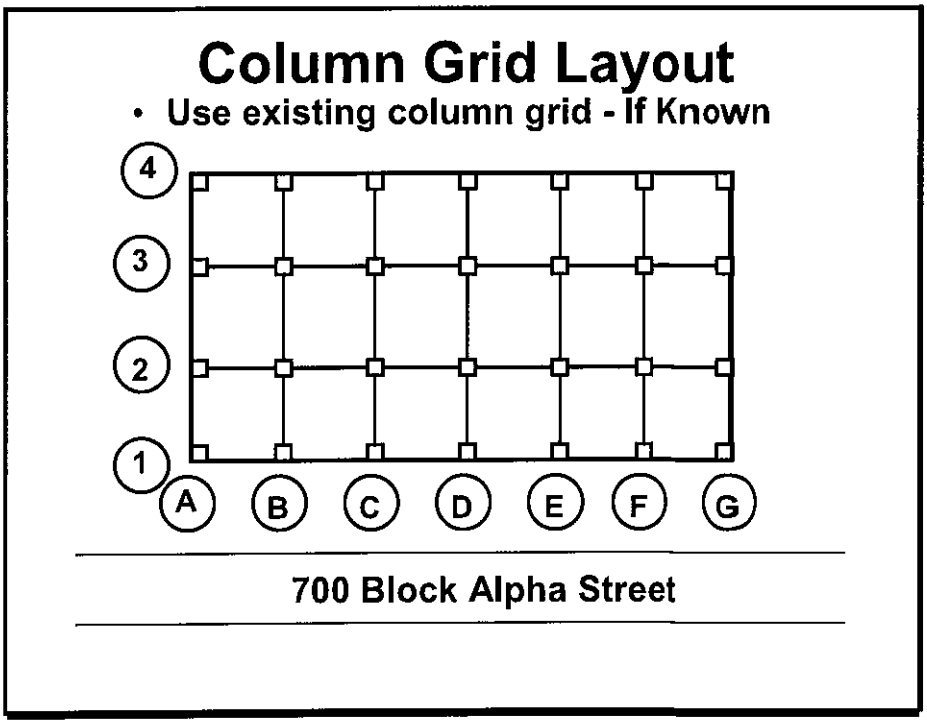
700 BLOCK ALPHA STREET

STRUCTURE I.D. MARKING (continued)

Multi-story buildings must have each floor clearly identified. If not clearly discernable, the floors should be numbered as referenced from the exterior. The Grade (or Street) Level Floor would be designated Floor 1 and, moving upward the Second Floor would be Floor 2, etc. Conversely, the First Floor below Grade (or Street) level would be B-1, the Second B-2, etc. For buildings where the street slopes, all at the incident must be informed as to which level will be called the First Floor.

If a structure contains a grid of structural columns, they should be marked with 2' high, orange letters/numbers to further identify enclosed areas. If plans are available, use the existing numbering system. If plans are not available, **Letter** the columns across the **Long Side** (Side A in this Example) starting from the left, and **Number** the columns along the **Short Side** (Side B in this example) starting from the front, Side A. The story level should be added to each marked Column, and be placed below the Column Locator Mark. Example: "FL-2" = Floor 2.



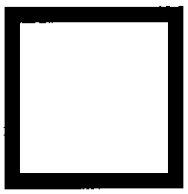
STRUCTURE/HAZARDS EVALUATION MARKING

- The Structures Spec (or other appropriate TF member) will outline a 2' X 2' square box at any entrance accessible for entry into any compromised structure. Paint sticks, lumber crayons or aerosol spray-paint cans (International Orange color) will be used for this marking system. Peel & Stick labels or stiff paper placards may be used to avoid paint damage. (See example on Page 1-25)
- Materials and methods used for marking shall be coordinated with FEMA IST as well as local Authority Having Jurisdiction, in order to avoid confusion with search and other marking.
- It is important that an effort is made to mark all normal entry points (Side A if possible) to a building under evaluation to ensure that Task Force personnel approaching the building can identify that it has been evaluated.
- The specific markings will be made inside the box to indicate the condition of the structure **at the time of the assessment.** Any identified hazards will be indicated, outside of the box, on the right side. (Placards have space below the box for comments on hazards)
- Normally the marking (or placards) would, also, be made immediately adjacent to the entry point identified as lowest risk. An arrow will be placed next to the box indicating the direction of the lowest risk entrance if the Structure/Hazards Evaluation Marking must be made somewhat remote from this entrance.
- All Task Force personnel must be aware of the possibility of, and look for other Structure/Hazards Evaluation markings made on the interior of the building.
- As each subsequent assessment is performed throughout the course of the mission, a new TIME, DATE, and TASK FORCE ID entry will be made below the previous entry, or a completely new marking made if the original information is now incorrect.

US&R STRUCTURES SPECIALIST FOG
DISASTER SITE REFERENCE DATA

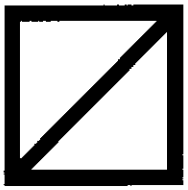
STRUCTURE/HAZARDS EVALUATION MARKING

The depiction of the various markings is as follows:

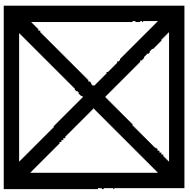


Low Risk for US&R Operations, with low probability of further collapse. Victims could be trapped by contents, or building could be completely pancaked or soft 1st story.

1



Medium Risk for US&R Ops, and structure is significantly damaged. May need shoring, bracing, removal, and/or monitoring of hazards. The structure may be partly collapsed.



High Risk for US&R Ops, and may be subject to sudden collapse. Remote search operations may proceed at significant risk. If rescue operations are undertaken, significant and time-consuming mitigation should be done.

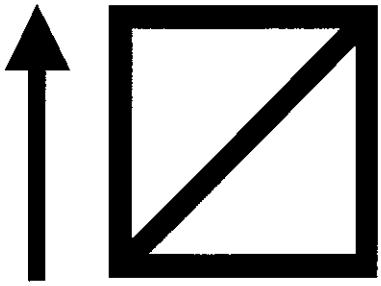
Arrow located next to a marking box indicates the direction to the lowest risk entrance to the structure, should the marking box need to be made remote from the indicated entrance.

HM

Indicates that a Hazardous Material condition exists in or adjacent to the structure. Personnel may be in jeopardy. Consideration for operations should be made in conjunction with the Hazardous Materials Specialist. Type of hazard may also be noted.

STRUCTURE/HAZARDS EVALUATION MARKING (cont.)

The TIME, DATE, and TF ID, are noted outside the box at the right-hand side. This info is made with paint stick or lumber crayon. The paper (or cardboard), stick-on placards may need to be attached using duct tape to assure their positioning.



7/15/91 1310 hrs.
HM - natural gas
OR-TF1

This example is for a Medium Risk building, and the arrow indicates the direction to the lowest risk entry (possibly a window, upper floor, etc.). Assessment was made on July 15, 1991, at 1:10 PM. There is an indication of natural gas in the structure. The evaluation was made by the #1 TF from the State of Oregon.

It should be understood that this building would not be entered until the Hazmat (natural gas) had been mitigated. When that mitigation is performed, this mark should be altered by a placing a line thru the HM and adding the time and TF who performed the mitigation. An entirely new mark could also be added when the mitigation is done, or after any change in conditions such as an aftershock. To indicate changed conditions when using labels or placards, one may cross-out the hazard if mitigated or just replace the label/placard if appropriate.

Marking boxes may also be placed in each of the specific areas within the structure (i.e., rooms, hallways, stairwells, etc.) to denote hazardous conditions in separate parts of the building.

It should also be noted that the Structure/Hazards Mark might not be made in many situations, such as:

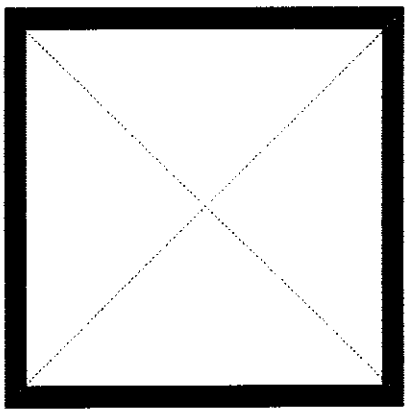
- Structures when StS are present at all times during the incident.
- Following hurricanes for very simple structures.

STRUCTURE/HAZARDS PLACARD

Should be printed on adhesive backed, 8.5" x 11" heavy white paper, Rite-on Rain paper, or light cardboard. Cut in half to obtain two placards.

1

White color was selected to avoid being confused with the Green – Yellow – Red Placards that are placed during Safety Evaluation of Structures by non-US&R Engineers.



Structural / Hazard Evaluation

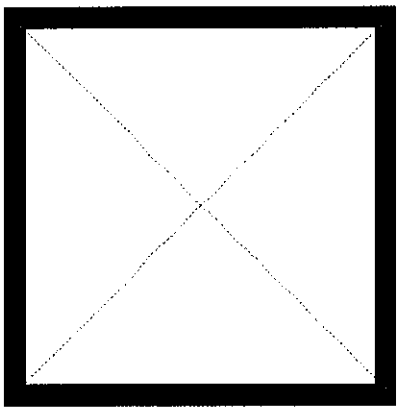
DATE	TIME	TF
HAZARDS:		

☐ **LR** — **Low Risk** for US&R Ops. Low probability of further collapse. Victims could be trapped by contents, or building could be completely pancaked or soft 1st story

☒ **MR** — **Medium Risk** for US&R Ops. Structure is significantly damaged. May need shoring, bracing, removal, and/or monitoring of hazards. The structure may be partly collapsed.

☒ **XR** — **High Risk** for US&R Ops. May be subject to sudden collapse. Remote search operations may proceed at significant risk. If Rescue Ops are undertaken, significant and time-consuming mitigation should be done

Should the marking box need to be made remote from the indicated entrance, place an arrow next to the box to indicate the direction to the lowest risk entrance to structure.



Structural / Hazard Evaluation

DATE	TIME	TF
HAZARDS:		

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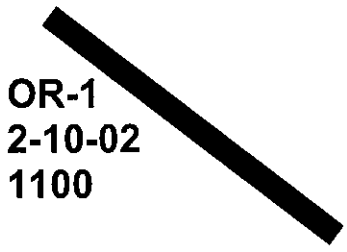
Should the marking box need to be made remote from the indicated entrance, place an arrow next to the box to indicate the direction to the lowest risk entrance to structure.

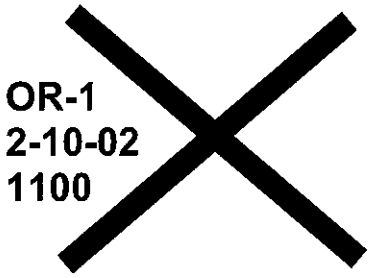
SEARCH ASSESSMENT MARKING

A separate and distinct marking system is necessary to denote information relating to the victim location determinations in the areas searched. This separate Search Assessment marking system is designed to be used in conjunction with the Structure and Hazards Evaluation marking system. The Canine Search Specialists, Technical Search Specialists, and/or Search Team Manager (or any other Task Force member performing the search function) will draw an "X" that is 2' X 2' in size with International Orange paint stick, lumber crayon or color spray paint **(note that K9 may be adversely effected by the Fumes from Spray Paint).** This X will be constructed in two operations - one slash drawn upon entry into the structure (or room, hallway, etc.) and a second crossing slash drawn upon exit.



Single slash drawn upon entry to a structure or area indicates search operations are currently in progress. Upon entering a building or a separate wing of a large building, add the Search Team I.D., Date and Time (24hr) of entry. (Next to main entry)

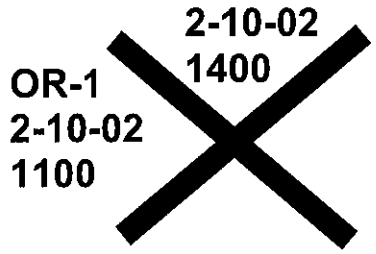
Note: OR-1 is used instead of OR-TF1 to save time. Also 1100 is used to abbreviate 1100hrs



Crossing slash is drawn as personnel exit from the structure or area.

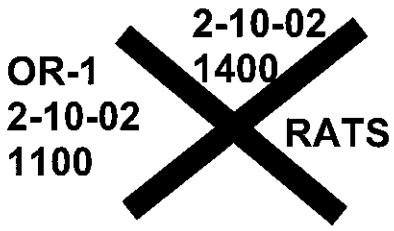
Distinct markings will be made inside the remaining quadrants of the X to clearly denote the search status and findings at the time of this assessment. The marks will be made with carpenter chalk or lumber crayon. The following illustrations define the Search Assessment marks:

SEARCH ASSESSMENT MARKING (continued)

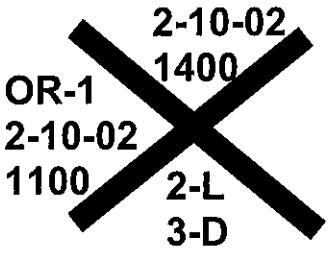


AFTER EXITING & DRAWING the 2nd SLASH, add the following INFO:

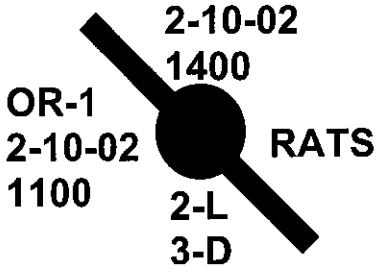
TOP QUADRANT - Time and date that the Search Team personnel left the structure.



RIGHT QUADRANT - Personal hazards.



BOTTOM QUADRANT - Number of live and dead victims still inside the structure. ["0" = no victims]



When the Recon Team leaves a structure **WITHOUT** completing the Search (aftershock, end of shift, etc), then the second slash **WILL NOT** be made. A **Solid Circle** is drawn at the mid-length of the First Slash, and Date/Time of Exit, Personal Hazards, & Victim Info will be filled in. Also indication of Quadrants or Floors completed should be added in a **BOX** below the X, or if the Bldg **HAS NOT** been entered (as in Hurricanes) mark **No Entry** in the **BOX.**

F = Floors
Q = Quadrants
or
No Entry

SEARCH ASSESSMENT MARKING (continued)

In most cases, extemporaneous information will not be conveyed using the marking system. This type of communication will usually take place as a result of face-to-face meetings between Search, Rescue, and other components of the Task Force.

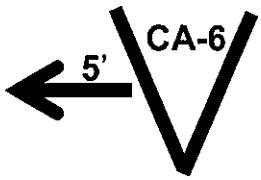
Search Markings should be made at each area within a structure, such as rooms, voids, etc, but only information related to the results of the search will be marked upon exiting each space (No Time or TF designation).

- An adhesive-backed search mark placard has been approved for use in incidents like Hurricanes and large earthquakes where many structures are involved. All FEMA Task Forces have been supplied with the graphic to be used in creating the stick-on search marks, which should be printed on orange paper. See Library, Disasterengineer.org

VICTIM LOCATION MARKING SYSTEM

- During the search function it is necessary to identify the location of potential and known victims.
- The amount and type of debris in the area may completely cover or obstruct the location of any victim.
- The victim location marks are made by the search team or others aiding the search and rescue operations whenever a known or potential victim is located and not immediately removed.
- The victim location marking symbols should be made with orange spray paint (using line marking or "downward" spray can) or orange crayon.
- The following illustrates the marking system:

VICTIM LOCATION MARKING SYSTEM (cont.)



Make a large (2' x 2') "V" w/orange paint near the location of the known or **potential** victim. Mark the name of the search team as shown.
An arrow may need to be painted next to "V" pointing towards the victims location is not immediately near where the "V" is painted. Show distance on arrow.

1

Paint a circle around the "V" when a potential victim has been **Confirmed to be alive** either visually, vocally, or by hearing sounds that would indicate a high probability of a victim. If more than one confirmed live victim, mark total number under the "V".

Paint a horizontal line through the middle of the "V" when a **Confirmed** victim is determined to be **deceased**. If more than one confirmed deceased victim, mark the total number under the "V". Use both live and deceased victim marking symbols when a combination of live and deceased victims are determined to be in the same location.

Paint an "X" through the **Confirmed** victim symbol after **all victims** have been removed from the specific location identified by the marking.

- Paint new victim symbols next to additional victims that are later located near where the original victim(s) were removed. (assuming original symbol has been "X"ed out).

FEMA US&R SHORING SYMBOLS

These symbols were developed by the FEMA US&R Structures Sub-group, and should be used to map locations of US&R Shoring

- Tee Shore

- Double T Shore

- Vertical Shore (V-3 = 3 posts, V-2 = 2 posts)

- Laced Post Shore
  (at Plywood Laced Post use PLP in box)

- Cribbing

- Raker Shore
  - Place vertical side of triangle against wall
  - Each triangle represents one Raker
  - Rakers should be installed groups of two or larger

- Horizontal Shore
  (H - 3 = 3 struts, H - 2 = 2 struts)

- Window or Door Shore (W or D)

Name_____

FEMA MARKING SYSTEM PERFORMANCE CHECKLIST

Action:

1. Team designated leader/spokesperson	Yes	No
2. Orientation of building properly completed	Yes	No
3. Structural assessment for scenario	Yes	No
4. Search markings complete and accurate	Yes	No
5. Victim location markings properly applied	Yes	No

Other Actions Observed

_____
_____
_____
_____
_____
_____

Instructor(s)_____Date_____

Module 5: Water Emergencies

Objectives

When completed, you will better be able to:

- Recognize hazards of working around water
- Select proper PPE for working around water hazards
- Identify risk management approaches
- Identify low risk water rescue options
- Identify basic principles of using throw bags

Content for this module can be found in the Water Emergencies PowerPoint and Handout (PowerPoint notes pages). This module also includes two optional hands-on Exercises – Water Safety PPE and Using Throw Bags – found below. The PPE Exercise includes a PowerPoint, PFD Handout, and a Performance Checklist. The Throw Bag Exercise materials include Steps (2-pages) and a Performance Checklist.

Water Emergencies

1

More Dangerous Than You Think

- Working around water is inherently hazardous work
- Working around *moving* water is even worse
- On a given day, workers have a 1:1112 chance of accidental drowning
- Greater odds to kill you than by firearms, fire, or electrical shock

2

The Force of Water

Current Velocity	Pressure on Legs	Pressure on Body	Pressure on Swamped boat
3 MPH	16.8	33.6	138
6 MPH	67.2	134	672
9 MPH	269	358	2688

3

Working Around Moving Water: Rules to Live By

- ***Know your limitations!!!***
- ***NO FIRE HELMETS***
- ***ALWAYS*** wear a PFD when within 10' of moving water
- Have the right tools for the job
- Be proactive: anticipate potential problems
- Self first, then coworkers, then others
- Keep things simple
- Have a Plan B
- ***NEVER*** put your feet down
- Never tie a rope to a would be rescuer
- Have backup downstream

4

First Steps

- Is this a rescue or a recovery?
- Where/who do I call for help?
- Determine time/location victim was last seen
- Obtain witness statements
- ***DON'T GET YOURSELF KILLED***

5

What We Are Doing Today…

- **DOES NOT** make you a swift water rescuer!!!!
- We are addressing self rescue and low risk techniques only:

("reach" and "throw")

6

Our Water Rescue Options

- **Self Rescue**
- **"Talk" Rescue**
- **Reach**
- **Throw**

7

Option 1: Self Rescue

- If you are working around moving water, you should be trained in self rescue techniques
- You must be dressed for the dance
- Prevention is better than reaction

8

Remember the Ten Foot Rule

- All persons working within ten feet of the water ***must*** wear a PFD
- Anyone whose location (ie: top of a steep bank) puts them at risk of going into the water ***must*** wear a PFD

9

Our Immediate Objective

- **Get back to shore as quickly as possible**
- DO NOT attempt to stand up while in the water
- DO NOT attempt to keep yourself from going down-current by pushing off the bottom
- Both invite foot entrapments which may be impossible to escape

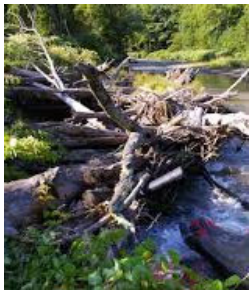
10

Get On Your Back!

- Get on your back
- Keep feet down-current
- Toes above water
- Keep knees slightly bent
- Steer yourself using your arms
- Use backstroke to slow momentum
- Fend of rocks and solid obstacles with your feet

11

Strainers



- Any object that allows water to pass through but will hinder or stop a solid object (like a person)
- Strainers may be either naturally occurring (fallen trees) or manmade

12

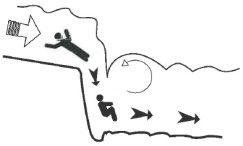
Strainers

- *Avoid* if at all possible
- If unavoidable, flip onto your front
- Swim towards the strainer *Head First*
- Attempt to push yourself OVER the strainer

13

Drops

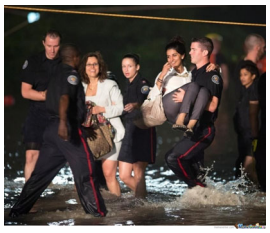
- Avoid if at all possible
- High risk of hydraulics
- Pull feet under buttocks to form a ball
- Brace for impact
- Attempt to “wash” or “swim” out from under the hydraulic



14

“Talk” Rescue

- Used to verbally coax victims to a safe area
- Challenges:
  - Panic
  - Normal survival behaviors
  - Instinctive drowning responses



15

Reach Rescue

- Extending an object from the shore to a person in the water
- Branch
- Ladder
- Webbing
- Pike pole
- Lightweight ladder
- Inflated fire hose

16

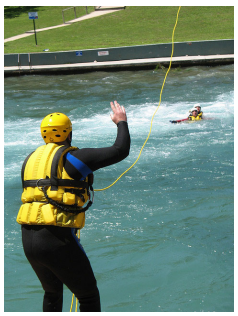
Throw Rescues

- Probably responsible for more shore based rescues than any other method
- Low cost
- Fairly simple to master

17

Considerations

- Watch for overhead obstructions
- Have a knife
- Do not tie yourself to the rope
- Hang onto the rope when you throw it
- Only one person throws at a time
- Practice



18

The Basic Procedure

- Establish contact with victim: Yell “ROPE”
- “Lead” the victim: aim either slightly down current or slightly up current from victim
- Throw OVER the victim if possible, with the rope landing across their shoulders or chest
- Prepare to be shock loaded

19

Two Methods

Underhand Throw

- Generally easiest and most accurate
- Can be used to throw rope bags or coils
- Can be complex if thrower is standing in water over knee deep
- Tendency is to throw high and short

Overhand Throw

- Good for short distance throws
- Accuracy requires practice
- Entanglement in overhead hazards more common
- Tendency is to throw low and short

20

Catching a Line

- Face down-current
- Angle body about 45 degrees to the current
- Grab the rope, not the bag
- ***DO NOT*** **WRAP OR TIE THE ROPE AROUND YOURSELF OR ANY PART OF YOUR BODY**

21

Catching a Line

- Swim towards the rope
- Keep your feet up
- Pull rope to your chest
- Roll onto your back
- Place rope over shoulder opposite the bank

22

Second Throws

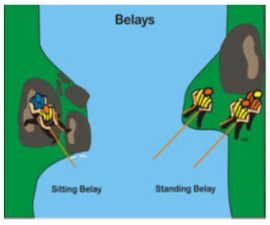
- Quickly retrieve line
- Coil in Butterfly loops OR loops of gradually increasing size
- Separate coil in half
- Re-throw
- Maintain control of “standing” end of rope at all times

23

Belays

- Keep your center of gravity low
- DO NOT wrap the rope around your hand
- Use your body, another person or a stationary object to increase friction
- Consider sitting hip belay

Image credit Robert Kauffman



24

Vector Pulls

- Used to pull victim to bank quickly or when current is holding the victim away from the bank
- Attach a second line or webbing sling to deployed rope
- Walk downstream and pull the victim towards the bank
- The “Crossreach” device or Wild Water Snag Plate can also be used with this technique

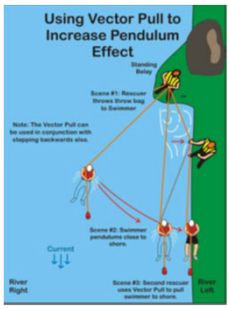


Image Credit Robert Kauffman

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Closing Comments

- We hope we NEVER have to use what we just discussed
- We cant rely on luck
- We must have a plan to help ourselves and our coworkers
- We have to practice

26

Questions??

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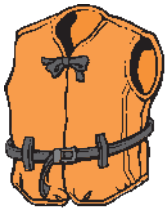
TYPES OF PERSONAL FLOTATION DEVICES



Type I

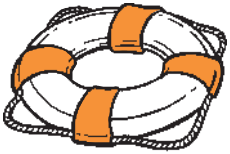
A Type I PFD is an approved device designed to turn an unconscious person in the water from a face downward position to a vertical or slightly backward position, and to have more than 20 pounds of buoyancy.

Type II

A Type II PFD is an approved device designed to turn an unconscious person in the water from a face downward position to a vertical or slightly backward position, and to have more than 15.5 pounds of buoyancy.

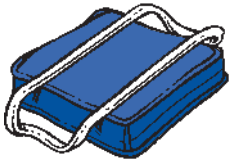
Type III

A Type III PFD is an approved device designed to have more than 15.5 pounds of buoyancy. While the Type III PFD has the same buoyancy as the Type II PFD, it has less turning ability. It does, however, allow greater wearing comfort and is particularly useful when water skiing, sailing, hunting, or engaged in other water sports.



Type IV

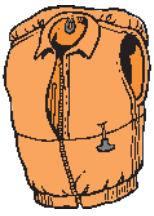
A Type IV PFD is an approved device designed to be thrown to a person in the water. It is not designed to be worn. It is designed to have at least 16.5 pounds of buoyancy. The most common Type IV PFD is a buoyant cushion. A ring buoy is also a Type IV PFD.



All Type I, II, and III PFDs must be U.S. Coast Guard approved, in good and serviceable condition, readily accessible, and of appropriate size for the wearer. Type IV PFDs must be U. S. Coast Guard approved, in good and serviceable condition, and immediately available.

Type V

A Type V PFD must be Coast Guard approved. It is a restricted device that is acceptable only when the wearer is engaged in the activity for which the device is intended. Some restricted PFDs must be worn to be acceptable. Always check the label of a restricted PFD; the label will show the water sports for which the PFD is authorized and will list all other restrictions.



Name_____

Selecting and Using a Personal Flotation Device Checklist

	Yes	No
Pre-Use Inspection - PFD inspected for:		
• Deformed, weakened or missing hardware		
• Deterioration of structural components		
• Rips, tear or open seams		
• Deterioration or loss of buoyant material		
• Date of manufacture (10 years or less)		
Fitting/Sizing		
• Proper PFD selected based upon chest size not weight		
• All straps loosened before PFD is donned		
• All straps appropriately secured, starting at waist		
• Instructor or colleague pulls PFD up at shoulders to assess fit		
Quick Release Assembly (if applicable)		
Demonstrates proper reaving and use of quick release buckle		

Instructor/Observer_____ Date_____

WATER RESCUE THROW RESCUE STEPS

October 2009

RESCUE TRAINING

Rescue Daily Quick Drills - Easy Access to Training Topics

Steps for Deploying a Throw Bag

References:
Delmar Water Levels I and II, pages 64

NFPA 1006, 2008 JPRs
11.1.6, 11.1.7

Step 1 – Loosen draw string at the top of the bag. Grab the looped end found on the top of the rope within the bag.

Step 2 – While holding the looped end, throw the bag in a underhand softball pitch fashion.

NORTH CAROLINA DEPARTMENT OF INSURANCE
OSFM
OFFICE OF STATE FIRE MARSHAL

WATER RESCUE THROW RESCUE STEPS

Rescue Daily Quick Drills - Easy Access to Training Topics

Steps for Deploying a Throw Bag

Step 3 – Try to throw the bag beyond the victim's location.

Step 4 – Once the victim has the rope, back away from the edge of the water to avoid falling in and pull in the victim.

Name: _____

Using a Throw Bag Performance Checklist

	Yes	No
Describe Optimal Positioning to Use Throw Bag		
• Downstream		
• Secure location where rescuer can brace against pull from victim		
Inspect Throw Bag Prior to Deployment		
• Drawstring fully opened		
• Rope stored in bag to assure effective deployment		
• Carabineers and other metal objects removed		
Extend Rope and Establishes Contact with Victim		
Aim, Then Deploy Bag using Overhand or Underhand Throw		
Secure Rope for Safe Belay		
Recover and Properly Restuff Rope Into Bag		

Instructor/Observer_____ Date_____

Closing and Evaluation

Thank you for participating in this program. You should now be better able to:

- Recognize hazards encountered in a post storm environment
- Identify how to protect yourself from hazards in a post storm environment
- Define terms and concepts used frequently in a post storm environment
- Implement a FEMA Marking System
- Describe water rescue techniques

This is an opportunity to ask any questions you may have, or to discuss how the knowledge and skills learned can be used at work.

Finally, we ask that you take 10 minutes to complete the program evaluation forms. These are important for improving the program. We take your comments seriously and make changes in content and exercises based on participant feedback. Your comments are anonymous.

We hope to see you at another Midwest Consortium program in the future.