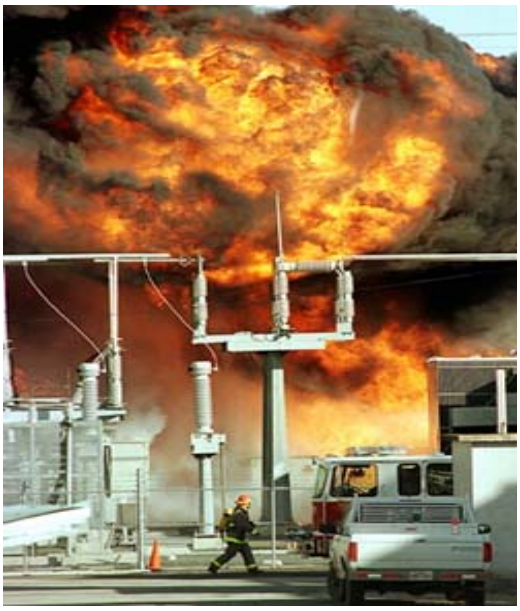

Does your organization have SOPs / SOGs for emergencies involving utility facilities?

Does your organization's training include utility safety for your first responders / other personnel?

Does your organization actively support damage prevention to utility facilities & other proactive programs to prevent utility accidents?

Utility Hazards (Electric & Natural gas) Considerations for SOP / SOG Development for Emergency Response

OVERVIEW – SOP / SOG DEVELOPMENT

This material was developed to aid emergency response organizations in developing or enhancing standard operating procedures ("SOPs") or standard operating guidance ("SOGs") relative to emergencies involving electric and natural gas facilities. This material is only focusing on a few aspects of SOPs/SOGs. SOPs can provide a valuable resource for emergency organizations / agencies in protecting themselves and others from harm. SOPs are not one fits all – they must be customized to the unique aspects, requirements, capabilities and resources of the emergency agency.

SOPs clearly outline what is expected and required of personnel during an emergency. They establish a standard course of action generic in nature that includes equipment placement, tactical operations, safety, command structure, responder expectations, coordination with other organizations, hazard assessment, and related considerations. SOPs are the procedural guidance for responding not the technical skills. This material provides considerations first responder organizations should evaluate when responding to emergencies that involve or could involve electric and / or natural gas facilities. While the material was prepared relative to electric and natural gas hazards and utility facility considerations, not all hazards or aspects of electric and natural gas utilities may have been considered.

It is strongly recommended that multiple resources and subject matter experts be used to develop your agencies SOPs. Some resources have been referenced in this document. It does not represent all of what is available. You should consult with your local utility and other operators of facilities in your jurisdiction for additional information and with other governmental, standard setting groups and other experts. SOPs are living documents that need to be reviewed and updated periodically.

Communication and coordination are key elements of any SOP. Always notify electric and gas utilities immediately whenever their facilities are involved in an incident - utilize their expertise. Some incidents will require that the electric and / or gas be shut off and for the first responders to wait for the utility to de-energize or shut off the gas. Never attempt to repair electric or gas facilities. You could jeopardize people and your own safety.

REFERENCES – SOP DEVELOPMENT

SOP and SOG are used interchangeable. SOPs are a means to convey important concepts, techniques, and considerations in a format readily useable by emergency personnel in their daily jobs. The following references can be helpful in developing or enhancing your organization's SOPs:

- FEMA – Developing Effective Standard Operating Procedures – For Fire and EMS
  - Wed link: www.usfa.**fema**.gov/downloads/pdf/publications/fa-197.pdf
- FEMA – NIMS National Incident Management System
  - Web link: http://www.fema.gov/emergency/nims/nims_compliance.shtm
- OSHA 1910.120 Hazard Awareness Training
  - Web link: http://www.osha.gov/Publications/osha3071.pdf
- Minnesota Fire, EMS Safety Center - Preparation of Fire Department Standard Operating Guidance (S.O.G.)
  - Web link: http://www.firecenter.mnscu.edu/Handbook/pubteammember.pdf
- NFPA 471 Recommended Practice for Responding to Hazardous Materials Incidents
- NFPA 472 Standard for Professional Competencies of Responders to Hazard Material Incidents
- NFPA 1500 Standard on Fire Department Occupational Safety and Health Program
- NWCG Training Working Team - Developing Standard Operating Procedures in Wildfire Management
  - Web link: http://www.fireleadership.gov/toolbox/documents/SOP_Workbook.pdf
- Alberta Fire Office - A Code of Practice for Fire Fighters –
  - Web link: **http://employment.alberta.ca/documents/WHS/WHS-PUB_fex003.pdf**
  - **http://employment.alberta.ca/whs/network/hstopics/explosives/index.asp**
  - **http://www.pseg.com/customer/town/damage/pdf/CodeofPracticeAlberta.pdf**
- Writing Effective Policies and Procedures by Nancy J. Campbell,
  - ISBN 0-8144-7960-X, 1998 AMACOM, American Management Association

Pre-Planning:

Standard Operating Procedures should include pre-planning and coordinating with utility facility owners for fixed facilities such as electric substations and natural gas metering and regulating stations. A modified ICS-200 form can be used to capture key aspects of the planning such as command post and staging locations. The pre-planning should include fire, police, emergency medical, emergency management and utility responders. The plan should be reviewed periodically for updating, to brief new responders and to ensure that the various organizations know their roles, expectations and command / coordination approach. A combined exercise and / or plan field walk-thru can aid emergency responder familiarity and identify potential issues. The command / coordination approach should be consistent with the principals and approach of the National Incident Management System.

General Electric Safe Distance Guidance Summary (Table E-1)

Emergency type / operation phase	Recommended emergency minimum safe approach distance	Recommended public minimum safe approach distance	Special Considerations
Initial assessment: Downed wire / utility pole fire / transmission line failure	300-feet (generally at least two full pole spans)	300-feet (generally at least two full pole spans)	Approach from opposite side of pole line. Look for any downed wires & other objects that could be energized such as guard rails, fences, or other wires. Keep the public at least 300-feet away from energized material.
Downed wire	30-feet (as safety permits)	300-feet (generally at least two full pole spans)	Emergency personnel may approach to within 30-feet if needed to advise accident victims of precautions to take to protect life provided it is safe to do so.
Pole fire	300-feet (generally at least two full pole spans)	300-feet (generally at least two full pole spans)	Approach from opposite side of pole line. Look for any downed wires & other objects that could be energized such as guard rails, fences, or other wires. Keep the public at least 300-feet away from energized material.
Substation emergency / fire	500-feet	1,000 feet	Approach upwind and away from overhead and underground electric facilities. Look for any downed wires & other objects that could be energized such as guard rails, fences, or other wires. Transformers and other equipment containing oil may BLEVE. Keep the public at least 1,000-feet away.
Manhole / vault electric fire	300-feet	1,000 feet	Approach upwind and away from overhead and underground electric facilities. Look for any downed wires & other objects that could be energized such as guard rails, fences, or other wires. Keep the public at least 1,000-feet away. Beware that nearby manholes (1,000 to 2,000 feet) and vaults may be impacted and explode. Underground transformers may BLEVE. Check nearby buildings for smoke and CO accumulation.
Wild-land fire near electric transmission lines	150-feet (generally three full tower heights away and upwind)	300-feet (generally at least one full tower span)	Fire near electric facilities can cause smoke and particle matter near very high voltage electric lines to act as a conductor causing electric to arc from very high voltage lines to the ground or nearby emergency personnel (within 100-feet). Keep the public at least 300-feet away and upwind.

ELECTRIC Hazards & Safety

Some information critical to developing SOPs for electric incidents will be reviewed in this section. The information is organized as follows:

- Background – this provides aspects of the utility system and general characteristics and properties of electricity;
- General precautions including Dos & Do Nots – this provides information on generic actions and considerations for electric emergency response SOPs;
- Specific types of electric emergencies – this provides recommended SOP categories and critical aspects to consider for various types of electric emergency categories;
- General consideration and precautions – this provides a strong recommendation to fully develop SOPs by considering all available information and aspects of the emergency including other related and non-related safety factors; and,
- References – this provides some limited reference sources to electric emergency response, examples of other SOPs, and some other aspects to consider. This reference information can be found at the end of the document.

Background

Electricity is delivered to end users through a distribution system of overhead and underground cables and conductors / wires. The voltage in these systems can range from 500,000 volts to 120 volts. Transformers can change higher voltage to lower voltage. Transformers can also change lower voltage to high voltage. Transformers are found on poles, in yards, in vaults, in parking lots, inside buildings and in substations / switch stations. Transformers usually contain oil and may contain a large amount of oil.

Properties of electricity
A silent killer
Is measured in voltage and current
Current can either be Alternating Current (AC) or Direct Current (DC)
Regardless of the voltage, it is always looking for a ground to go to- human or otherwise
Current travels through a number of mediums- wire, water, smoke, tools, and other
Faulty electric equipment can produce electrical arcs, explode / BLEVE
Conductor / wire covering is not insulation – it is a weather jacket that does not provide protection from electric shock

General precautions and Dos & Do Nots:

Safety precautions will depend on the specific situation and associated hazards. At times, the only action possible is to establish a hot zone and protect exposures until the electric supply can be shut off. Do not park emergency vehicles over manholes, catch basins, or other underground vaults, or on the same side as the utility poles, or under the utility lines. **Always size-up and assess the situation at least two full pole lengths or 300-feet away from the downed wire (see Table E-1).**

When responding to an electrical incident, always consider wire(s) as energized. Do not touch or come in close proximity to it. When raising ladders know where the overhead wires are and stay at least 30-feet clear. Remember that any object in contact with the wire could become energized including the ground.

Hazards associated with electricity may not be apparent. Look for signs when assessing the incident. Indications of electric involvement may be one or more of the following: arcing; an occasional buzzing sound; intense bright flashes; **or nothing at all -** just a conductor / wire hanging. Be alert to the location of overhead utilities, underground manholes and vaults, possible downed wires in contact with fences, trees, and / or other objects including the ground. A fire may also be associated with a downed wire or electric incident. A possible victim could also be an indication especially if they are located under / near utility lines. Be alert – look for down or hanging wires as you approach the scene. Always assume that the electric line is energized.

First responders have to use restraint, good judgment, and caution. The best action is to wait for the electric utility. There are times when you will not be able to attempt a rescue. Electricity can be deadly to first responders.

Emergency responders have been killed attempting to evaluate electrical incidents. By establishing SOPs and adhering to clear safety criteria, your organization will be able to protect first responders and the public.

Notify the electric utility as soon as possible and coordinate action with them.

As with any emergency the need to communicate in clear language, to collect information, and to coordinate action is critical. An incident command structure and communication guidelines consistent with FEMAs National Incident Management System can be helpful.

Electric Do Nots:

- Don't park emergency vehicles under or near overhead lines.
- Don't touch downed lines, even with gloves, sticks, or tools.
- Don't assume the electric utility has already been notified when you encounter downed lines.
- Don't allow aerial equipment or devices such as ladders, trucks to approach closer than 10 feet to overhead utility line(s) <50KV. (for voltages above 50 KV - 10-feet plus 0.4 inches for each 1\kV >50kV).
- Don't pull electric meters or cut electric service lines.
- Don't apply water or foam to burning electric equipment, as electricity can use the water stream as a path to find ground electrifying the water, engine, and personnel in contact with the water or engine.
- Don't enter electric substations or switch yards without permission from the electric utility.
- Don't enter underground vaults or manholes without permission from the electric utility.
- Don't risk your safety. Wait for the electric utility to de-energize and ensure the electric facilities, wires, and / or lines are safe before you enter the hot zone.
- Don't assume electric lines / wires are dead or de-energized.

Electric Dos:

- Notify the electric company immediately - utilize their expertise whenever there are downed lines or wires or electric equipment is involved.
- Treat all utility lines and wires as high voltage and energized.
- Look for overhead lines when arriving at emergency scenes, park opposite.
- Check for and avoid utility lines and wires on the ground, in trees, or on vehicles.
- Beware of step voltage / potential and keep at least 30 feet or more away from any downed lines / wires.
- Have occupants remain in vehicles that are in contact with downed lines until the "all clear" is provided by the electric utility.
- Instruct occupants of energized vehicles to jump clear and hop or shuffle away from their vehicles (remember step potential) if no other options are available
- When utility electric equipment is on fire, let it burn, protect exposures, and contact the electric utility. Be aware of a potential BLEVE if the electric equipment contains oil.
- Do use great caution, as electricity cannot be seen. All too often a mistake can be deadly. Always wait for the electric utility to de-energize the electric facilities.
- Always consider all electric lines and wires energized and unsafe until the electric utility verifies the line / wire to be safe.

Specific Types of Electric Emergencies

Pole and wires down:

For poles and wires down, remain at least 30 feet away. Anything **in contact or near** high voltage lines / wires can become energized including fences, trees, other utility lines (telephone, cable, etc.), and the ground. Think of a circle of safety around the area. Establish a clear hot zone. When in doubt about a safe distance, remain as far away as possible. Do not approach any downed poles or lines with any equipment or vehicles. Rubber boots and other rubber protection **will not protect you from electricity.** Coordination with the electric utility is extremely important and necessary.

First responders have to use restraint, good judgment, and caution. The best action is to wait for the electric utility. There are times when you will not be able to attempt a rescue. **Downed wires can be deadly to first responders.**
See Table E-1 for general guidance safe distances.

Vehicle hit pole with/without occupants in the vehicle:

If no one is in the vehicle or the vehicle occupants are dead and the vehicle is on fire with a downed wire, wait for the electric utility to arrive and the electric line is de-energized before attempting any action. Protect exposures and wait for the utility. If water is used to protect exposures, beware and prevent water run-off and flow from impacting the energized area.

If a downed wire is on a vehicle with occupants and the vehicle is not on fire, instruct the vehicle occupants to remain calm and in the vehicle. Even if the wire is sparking, have the occupants remaining the vehicle. You can instruct vehicle occupants on first aid actions while waiting for the electric utility. Keep the vehicle occupants informed. Keep at least 30 feet from the vehicle and downed wire – remember the circle of safety. If the vehicle is operational and the driver is conscious, you can instruct the driver to attempt to move the vehicle. Make sure that all personnel are at least 30 feet away from the vehicle and wire. Wire has a memory and can recoil when it is moved. Be careful of the wire recoiling. Ensure the vehicle is moved more than 30 feet from the downed wire before any occupants leaves the vehicle. The best approach is to wait for the electric utility to de-energize the wire and make the area safe.

If the vehicle is on fire with a downed wire and the vehicle occupants are **conscious**, instruct them to be calm. Use only dry chemical extinguishers if you must suppress the fire - **Use extreme caution**, a spotter, and remember the step potential. (Step potential is the electric potential difference of two points in contact with the ground such as your feet / boots. The greater the separation of your feet, the greater the potential and associated voltage and possible current.) Do not use water or foam, as these will conduct electricity and could kill first responders. Keep as far away as possible when using the dry chemical extinguisher – shuffle as you approach the vehicle – keep at least 30-feet away. Do not use a stream spray. If you are able to extinguish the fire, have the occupants remain in the vehicle, until the electric utility arrives and de-energizes the electric wire.

If the vehicle occupants must exit the vehicle, instruct them to exit the vehicle as follows and that they should wait until each person is in the clear before the next person leaves the vehicle and that they must follow your instructions or they could be injured. Inform them that the electric wire is energized and that they must do exactly as you instruct them. Briefly explain about the step potential and what your are going to have them do and then instruct them step by step through the process having them wait for the next instruction. Inform them that they must not touch the vehicle and ground at the same time. Have them open the vehicle door as wide as possible and stand on the doorsill. Instruct them to jump clear away, landing with both feet together while still standing and maintaining their balance. Once they are clear, they are to hop away from the vehicle till they are at least 30 feet from the vehicle. Remember the best approach is to have people stay in the vehicle until the electric utility de-energizes the wire.

If the vehicle is on fire with a downed wire and the vehicle occupants are **unconscious**, use only dry chemical extinguishers to attempt to suppress the fire - **Use extreme caution**, a spotter, and remember the step potential. (Step potential is the electric potential difference of two points in contact with the ground such as your feet / boots. The greater the separation of your feet - the greater the potential and associated voltage and possible current). Do not use water or foam, as these will conduct electricity and could kill first responders. Keep as far away as possible when using the dry chemical extinguisher (rate for electrical fires) – shuffle as you approach the vehicle - keep at least 30-feet away. Do not use a stream spray. Realize that you may not be able to affect a rescue without endangering yourself or other first responders. There could be circumstances and a point where a rescue should not be attempted or should be discontinued.

First responders have to use restraint, good judgment, and caution. The best action is to wait for the electric utility. There are times when you will not be able to attempt a rescue. Downed wires can be deadly to first responders.

Substation / Switch Station fire: (Do Not Enter!)

Realize that there is no need to attempt to extinguish fires involving electric equipment in substations or switch stations. Attempting to do so can be extremely dangerous and deadly. Remain at least 500 to 1000 feet away and upwind from any substation or switch station on fire. Beyond the electric hazards associated with the very high voltage, transformers and other electric equipment can contain large quantities of oil that could BLEVE. Large electric towers and other electric equipment could fail and fall or be projected from substation fires. Extreme caution is needed. Other hazardous materials such as asbestos, batteries and PCBs may also be encountered. Substations may have direct current (DC) energy from batteries as an emergency electric source of power. Typically 120-140 VDC comprised of at least 10 or more batteries. Electric equipment can explode causing manhole covers and other material to be projected. **Wait for the electric utility before taking any action near the substation.** Establish a hot zone and wait for the utility. Never enter a substation or switchyard without the permission and accompaniment of electric utility personnel. At times, an electric utility may make an area safe for firefighters / emergency responders inside a substation remain in that area as other areas may be energized. Make sure that all emergency personnel know which areas are safe and which areas are off bounds and unsafe to them. Stay with an electric utility safety guide while in the substation or switchyard. Coordination with the electric utility is extremely important and necessary. See Table E-1 for guidance.

Vault and manhole fire:

Realize that there is no need to attempt to extinguish fires involving electric equipment in vaults and manholes. Attempting to do so can be extremely dangerous and deadly. Remain at least 300 to 500 feet away and upwind from any vaults or manholes on fire. Nearby (1000 to 2000 feet) other manholes and vaults can become impacted and explode. Beyond the electric hazards associated with high voltage, transformers and other electric equipment in vaults and manholes can contain quantities of oil that could BLEVE. In addition, manholes and vaults maybe confined spaces and hazards associated with confined spaces need to be considered. Other hazardous materials such as asbestos and PCBs may also been encountered. Do not park near other vaults or manholes. Electric equipment can explode causing manhole covers and other material to be projected. Approach from an upwind direction, the electric fire could expand to other manholes and vaults as the electric wires heat and the electric short travels along the electric line. Keep the area clear. Establish a hot zone and wait for the electric utility. Never enter a manhole or vault without an "all clear – ok" from the electric utility. Coordination with the electric utility is extremely important and necessary.

Pole fire:

Beyond the cautions already mentioned, poles can have electric equipment on tops that contain oil. Poles on fire can become structurally unsound and fall. The best approach is to secure the area and wait for the electric utility. Protect exposures. Keep away from the pole and electric line. Park away from the pole line on the opposite side of the street **at least two full pole spans away** for the pole on fire. Do not use water or foam to extinguish the fire. Remember that the water stream will act as a conductor and could cause the water, hose, and engine to become energized and any person in contact / nearby could be killed. If water is used to protect exposures, beware and prevent water run-off and flow from impacting the energized area. See Table E-1 for guidance.

Wild-land fire and transmission lines:

Fire near electric facilities can cause smoke and particle matter near very high voltage electric lines to act as a conductor causing electric to arc from very high voltage lines to the ground or nearby firefighters / emergency responders (within 100-feet). These lines are found hanging from large electric towers. The intense heat of nearby fires may cause electric towers to become structurally unsound and fall. Keep emergency personnel and equipment at a safe distance of at least 150-feet or three full tower heights away and upwind.

Generators back-feed potential:

Conductors / wires disconnected from the power feed can become energized if a generator is used by customers or others that are connected to the power lines. A transformer can step up the voltage from 120 volts to high voltage. Always assume that downed conductors / wires are energized even if it appears that the wires are disconnected from the power feed. Wait for the electric utility to verify that the wires are de-energized.

NATURAL GAS Hazards & Safety

Some information critical to consider when developing SOPs for natural gas incidents will be review in this section. The information is organized as follows:

- Background – this provides aspects of the utility system and general characteristics and properties of natural gas,
- General Precautions including Dos & Do Nots – this provides information on generic actions and considerations for gas emergency response SOPs,
- Specific types of gas emergencies – this provides recommended SOP categories and critical aspects to consider for various types of gas emergency categories,
- General consideration and precautions – this provides a strong recommendation to fully develop SOPs by considering all available information and aspects of the emergency including other related and non-related safety factors, and
- References – this provides some limited reference sources to natural gas emergency response examples of other SOPs, and some other aspects to consider. This reference information can be found at the end of the document.

Background:

Natural gas is delivered to end users through a distribution system of pipes of varying pressures and sizes. The gas in transmission pipes can be 1200 to 300 psi. The pressure is lowered to 175 to $\frac{1}{4}$ psi and provided to end-users. Regulators and other pressure reducing equipment typically have a relief vent. This is a safety device that vents gas to the atmosphere preventing high-pressure gas from being released inside buildings. Natural gas pipes are made of various materials including steel, cast iron, copper, and plastic.

Properties of natural gas:

- Primarily comprised of methane (~95%)
- Odorless, colorless, and tasteless - an odorant is added as a warning signal
- Non-toxic – simple asphyxiant by creating an oxygen deficient atmosphere
- Vapor density of ~0.6 - **Lighter than air – it rises**
- Can migrate especially when trapped underground
- Ignition temperature 930°F and greater
- Lower flammability limit of 4 to 5 percent
- Upper flammability limit of 15 percent

General precautions and Dos & Do Nots:

Safety precautions will depend on the specific situation and associated hazards. At times the only action possible is to establish a hot zone and protect exposures until the gas supply can be shut off. Generally, when responding to gas odor, leak, or excavation damage to utility facility emergencies, always assume natural gas to be involved until an assessment is conducted. Approach the site upwind. Do not park emergency vehicles over manholes, catch basins, or other underground vaults. If one gas leak or a gas fire is found, be alert to other gas leaks. Multiple gas leaks are possible. Natural gas can migrate underground a considerable distance. Always evaluate the full extend of a gas leak when establishing a hot zone. Eliminate sources of ignition before investigating gas leaks. Know how to use your gas detection equipment and ensure that this equipment is properly calibrated according to the manufacturer's instructions. Also know what calibration gas is used and if a correction factor is needed for an accurate reading. Clear procedures and criteria should be established relative to readings obtained and actions to take. Generally, with any open air reading 1% or greater (20% of the LFL or LEL) all parties including emergency responders should evacuate. Even with lower readings there can be areas within in buildings that are in the explosive range. The odorant in the natural gas can be stripped or absorbed by some soils removing or comprising the olfactory detection of natural gas. A combustible gas detector is the only reliable method to detect for the presence of natural gas. The establishment of evacuation criteria for the safety of first responders is critical and needs to be reviewed periodically. Investigating a gas leak can be dangerous. Gas escaping into the atmosphere of an enclosed structure can create an explosive atmosphere. Emergency responders have been killed attempting to evaluate gas leaks. By establishing SOPs that limit the number responders evaluating gas leaks and limiting their goal to life safety only with clear gas detection reading action levels for everyone's safety, risk maybe limited. Control ignition sources. Using sound judgment with a clear understanding of the hazards should be part of the SOP and periodic training. The goal should be to protect life and establish a hot zone that protects the public. Other possible signs of a gas leak beyond the use of a combustible gas indicator may be one or more of the following: an odor like rotten eggs; a hissing sound, bubbling in water; dirt being blown up into the air; a discoloration / vapor cloud; localized frost on the ground in warm weather; vegetation that appears dead or dying, such as a brown area of grass, **or nothing at all**. The best approach is to use a calibrated combustible gas indicator.

Notify the gas utility as soon as possible and coordinate action with them.

As with any emergency the need to communicate in clear language, to collect information, and to coordinate action is critical. An incident command structure and communication guidelines consistent with FEMAs National Incident Management System can be helpful.

Natural gas Do Nots:

- Don't park over manhole or valve covers or storm drains or too close to structures.
- Don't park in front or downwind of emergency locations.
- Don't use open flames (flares, smoking, other sources).
- Don't operate any in-ground or underground valves.
- Don't operate doorbells, light switches or other electrical devices (pagers, cell phones, radios).
- Don't turn off venting relief valves – let the gas blow.
- Don't extinguish gas fires until fuel sources have been secured.
- Don't turn on gas valves.
- Don't shut off gas service to industrial facilities without knowledge of its effect.

Natural gas Dos:

- Notify the gas company immediately - utilize their expertise.
- Treat all gas leaks as potentially hazardous.
- When in doubt - Evacuate structures immediately.
- Look for multiple gas leaks even if the gas is burning when establishing the hot zone.
- Only shut off above-ground meter / service valves.
- Secure affected areas by doing a complete hazard assessment of the area.
- Evacuate the structures as necessary including surrounding structures.
    - Move evacuees and pedestrians to a safe distance beyond where potential debris would impact if the structure exploded.
- Always anticipate and expect an explosion to occur.
- Use **only** properly calibrated detection equipment.
- Establish clear first responder evacuation criteria. For example:
  if a 1% or greater open-air reading percent gas or a 20% or greater LEL reading is detected everyone, including first responders, are evacuated beyond the hot zone.
- Use calibrated combustible gas indicators according to the manufactory's instructions to evaluate the gas leak and establish the hot zone.
- Use only intrinsically safe communications and other electrically operated equipment. Turn all such equipment on before entering any structures or starting to evaluate the gas leak to establish the hot zone.

Specific Types of Natural Gas Emergencies

The specific types of natural gas emergency considerations described below provide additional precautions and considerations to the general precautions. The format and organization of your SOP will depend on your organization's approach. Whichever approach chosen, the various factors of the type of incident must be integrated into the SOP. The following hazards and considerations need to be considered and included.

Natural gas odor - inside:

Gas escaping inside a structure has the potential to create an explosive atmosphere. Caution and sound judgment should be used when conducting a gas leak investigation. The primary goal is to protect lives. Immediately evacuate people from buildings if gas is detected. Readings with a calibrated combustible gas indicator should follow the manufacturer's instructions. A background reading outside of the building should be taken. Readings should be taken at the entrance to all rooms. Closed doors should be cracked slightly to insert the probe and a reading obtained before opening the door. Opening a door or venting an atmosphere that is above the Upper Explosive Limit ("UEL") could cause an explosive atmosphere and subsequent explosion. Control ignition sources. Leave switches in their current position. Any change could cause an ignition source. Radios, pagers, cell phones, flashlights and other equipment that is **non-intrinsically safe should not be used** nor taken into potentially explosive atmospheres. All intrinsically safe equipment should be turned on prior to entering a gaseous atmosphere. If at any time a reading of 1% or greater open air percent gas (or 20% of the LEL) or the predetermined action level set by your organization is encountered, everyone including emergency responders should evacuate the building. If a small gas leak such as an unlit pilot light is found, continue to check the entire building for a second gas leak. There can be multiple gas leaks. Gas can migrate - check drains, basements and crawl-spaces. If gas is found to be migrating from outside the building, evacuate the building and check the surrounding buildings. Evacuate surrounding buildings around the buildings found with natural gas leaking. **Never pull the electric meter** in an attempt to de-energize the building. Evacuate the buildings and wait for the gas utility. Buildings found with natural gas leaking can be vented provided that the gas level readings are below the LEL. Do not vent buildings where the readings are above the UEL. For large buildings and industrial complexes, enlist the help of a person who knows the facility. The focus of your gas leak investigation is to determine what area to evacuate and to help in establishing a hot zone. If in doubt about what area to evacuate, evacuate a larger area and coordinate with the gas utility on modifying the hot zone later. Remember that gas can migrate and the situation will evolve over time especially as more gas escapes. A building clear of natural gas at one time may not be clear later.

Natural gas odor – outside:

When responding to gas odors outside, all neighboring buildings should be checked for leaking gas. If high readings of 4% or greater percent gas (or 80% of the LEL) are found outside near buildings, do not enter the building and evacuate the area. If gas is found venting from relief vents, do not attempt to stop the gas from venting. The odorant in the natural gas can be stripped or absorbed by some soils removing or comprising the olfactory detection of natural gas. A combustible gas detector is the only reliable method to detect for the presence of natural gas. Windy conditions can make the olfactory detection of natural gas difficult and variable.

Excavation damage:

Anytime a gas facility is damaged or suspected of being damaged, it is important to **check all surrounding buildings** as the gas pipe may have been pulled and come apart inside a structure. If it is a pressure gas service, an explosive atmosphere can be created quickly. There can also be multiple gas leaks. For example, the gas pipe is damaged in the excavation area and pulled out inside a structure. A gas fire may occur at the excavation area and the gas pipe could also be pulled out inside a structure. Ground collapse or excavation damage could occur with no outside gas leak and the gas pipe being pulled out inside a nearby structure. **All surrounding buildings and structures should be checked for leaking gas including those across the street.** The combustible gas indicator / meter should be used to check in each surrounding structures for leaking gas. Evacuate the area as needed. Keep people upwind and away from the leaking gas. Keep ignition sources away from leaking gas. Move people beyond where a structure explosion could injure them. Wait for the gas utility to control the gas. Do not attempt to stop the gas by plugging or attempting to repair the gas pipe. Gas leaking from plastic pipes can create a static charge that could become an ignition source. Multiple types of utility facilities could have been damaged including electric, water, or other pipelines. Beware of overhead electric lines in case the gas leak ignites.

Natural gas fire:

Do not attempt to extinguish a natural gas fire. Wait till the gas utility shuts off the gas source. Always investigate if a second gas leak is in the area. Check surrounding buildings for leaking gas. Remember there can be multiple gas leaks. Protect exposures. Use a fog spray.

Natural gas vehicles:

Know how to identify natural gas vehicles that use compressed natural gas. If a gas leak were to occur, it generally would dissipate quickly as natural gas is lighter than air.

Evacuation considerations:

When evacuating occupants from a structure, clearly instruct them to leave the building directly without operating any switches or ignition sources and have them move at least two buildings away from any affected structures and out of the hot zone. Remember that the hot zone should be established based on an assumption that the structures with leaking gas will explode. Ensure fire and emergency response equipment is outside the hot zone. The distance to evacuate will depend on the structure characteristics such as height, gas pressure and pipe size leaking, other flammable / explosive contents in and around the structure, building materials, and other factors. The focus of your gas leak investigation is to determine what area to evacuate and to help in establishing a hot zone. If in doubt about what area to evacuate, evacuate a larger area and coordinate with the gas utility on modifying the hot zone later. Clear action levels and criteria for combustible gas indicator readings should be established for the safety of first responders. Any readings above a predetermined level should require first responders to evacuate the structure. Remember that the readings can vary inside a structure with some areas of the structure being in or above the explosive range.

Electric and natural gas general considerations and precautions:

The information provided above is not complete. **You must use the references below and other references for a complete understanding of the issues above, hazard awareness, and for issues relevant to your operations not covered in this document.** If there are differences in any safety criteria or recommendations in the various references, chose the more protective standard or criteria.

First responder and life safety are always the first consideration. Expect and anticipate that natural gas can explode. Electricity is the silent killer. Establish your hot zone and evacuate surrounding structures accordingly. Anticipate multiple gas leaks and other potential hazards and damagers beyond natural gas and electricity. Coordinate action with the local utility / facility operator. Develop clear SOPs including advice from you local utility and mutual aid responders. Ensure a coordinated approach. Your SOPs should be integrated and coordinated with other responding first responders and mutual aid providers. Pre-planning and joint exercises are effective means to prepare.

Consideration of who arrives on scene first, and what actions are time critical such as evacuation, establishing a hot zone, and keeping the public and first responders safe is key. What equipment such initial first responders would need to carry out the most effective overall response should also be considered. This consideration should cross organizational groups and agencies. It is a team response that needs to be viewed in the whole and be well coordinated.

Use references and conduct periodic hazard assessments and SOP / SOG reviews based on lessons learned from exercises and incidents. Ensure that all personnel are familiar with and trained according to your agencies SOPs /SOGs. Establish periodic training and review periods for SOPs / SOGs. SOPs should be living documents that grow and are enhanced as your organization's experience and expertise grows.

REFERENCES: ELECTRIC, NATURAL GAS, & OTHER

The limited references below are a starting point to aid in developing and enhancing SOPs /SOGs for electric and natural gas emergencies. Networking with other emergency responders, agencies, and subject matter experts can greatly aid SOP development and enhancement. Others' incidents and their incident investigations are another good source of lessons learned. By periodically reviewing your SOPs in context of other incidents; reviewing other's SOPs; applying lessons learned from drills, pre-planning; joint exercises; and, conducting hazard analysis, your SOPs / SOGs will remain current and become a living document. This will enhance safety for your responders and the public as well as expand your organization's capabilities.

- FIREFIGHTER'S HANDBOOK – Addendum NEW JERSEY EDITION by Delmar Leaning (Text used by New Jersey for Fire Fighter I training program as 2006)
  - Section D Public Utilities, Propane and Carbon Monoxide Hazards

- Responding to Utility Emergencies – Michael Callan, Red Hat Publishing Company
  - www.redhatpub.com

- National Fire Protection Association ("NFPA")
  - NFPA 70 National Electric Code
  - NFPA 101 Life Safety Code
  - NFPA 471 Recommended Practice for Responding to Hazardous Material Incidents
  - NFPA 472 Standard for Professional Competence of Responders to Hazardous Material Incidents
  - NFPA 600 Standard on Industrial Fire Brigades
  - NFPA 1001 Standard for Fire Fighter Professional Qualifications
  - NFPA 1006 Standard for Rescue Technician Professional Qualifications
  - NFPA 1021 Standard for Fire Officer Professional Qualifications
  - NFPA 1041 Standard for Fire Service Instructor Professional Qualifications
  - NFPA 1051 Standard for Wildland Fire Fighter Professional Qualifications
  - NFPA 1061 Standard for Professional Qualification for Public Safety Telecommunicator
  - NFPA 1500 Standard on Fire Department Occupational Safety and Health
  - NFPA 1561 Standard on Emergency Services Incident Management System

- Pipeline Emergencies – Gregory G, Noll & Michael S. Hildebraand
  - www.pipelineemergencies.com

- U.S. Fire Administration
  - http://www.usfa.fema.gov/
  - http://www.usfa.dhs.gov/fireservice/research/safety/EMS_response_study.shtm

- Natural Gas Recognizing and Avoiding the Hazards: DVD–AEGIS Insurance
  http://www.aegislink.com/portal/resources/education_training/loss_control/training_safety_awareness_programs/03.do

- Electric Recognizing and Avoiding the Hazards: DVD–AEGIS Insurance Services
  http://www.aegislink.com/portal/resources/education_training/loss_control/training_safety_awareness_programs/03.do

- Natural Gas Accident Investigations:
  - www.ntsb.gov

- New Jersey One-Call
  - http://www.nj1-call.org/emergency_info.php

- National Institute for Occupational Safety and Health, CDC
  - http://www.bt.cdc.gov/planning/
  - http://www.osha.gov/SLTC/emergencypreparedness/index.html
  - http://www.cdc.gov/niosh/homepage.html
  - http://www.cdc.gov/niosh/docs/2004-144/chap5.html
  - http://www.cdc.gov/niosh/hid15.html

- Electric / Hybrid Vehicles
- http://www.state.nj.us/dca/dfs/prius.pdf

- NJ Firefighter Training S-130 (Wildfire) Student Workbook

- National Association of State Fire Marshals
  - http://www.firemarshals.org/
  - http://www.pipelineemergencies.com/
  - http://www.safepipelines.org/emergency/training_course.htm

- Public Service Electric and Gas Company
  - http://www.pseg.com/safety

NOTE: **Examples of SOGs and other information are contained on the CD with this document. These SOGs / documents are not being recommended and may not be complete and / or applicable to your organization. These documents and SOPs / SOGs are provided to aid your organization to develop and enhance your SOGs. Each organization must develop their own SOGs based on their specific circumstances, capabilities, and needs.**