CHAPTER 11:
UTILITIES

For the most part, the utility systems that supply a structure consists of electricity, natural gas, and water. However, these may be found in numerous configurations, with a variety of different components. Few fires can be fought without shutting down one or more of these systems, whether this is accomplished by the fire department, the utility company, or a joint effort by both.

Electricity, natural gas, and water can hinder suppression or rescue efforts and threaten firefighters. Controlling utilities not only prevents further property damage, but provides safer conditions for personnel.

It is important that those who will handle utility control be familiar with utility hardware, as well as the inherent hazards of each type of service. The type, size, placement, and complexity of the utilities in a particular structure usually depend on the occupancy. Ladder companies should become aware of any unusual utility systems within their first dues during routine inspections and preplanning. It is their responsibility to learn to control these systems.

Utility control is not only a consideration at structure fires. It may be a part of any incident that involves electric, gas, and/or water service. Although utility control is generally thought of as being accomplished some time during the fire, various conditions may make it the first priority, for instance, when it is necessary to prevent further injuries or property loss. In fact, at some incidents, a utility service may be the origin of the fire or primary hazard.

Sound judgment is necessary to determine if the fire department has the expertise and tools to handle a particular utility; some utilities require complicated maneuvers to control. In these cases, the task should be left to the appropriate utility company.

ELECTRIC UTILITIES

Terms

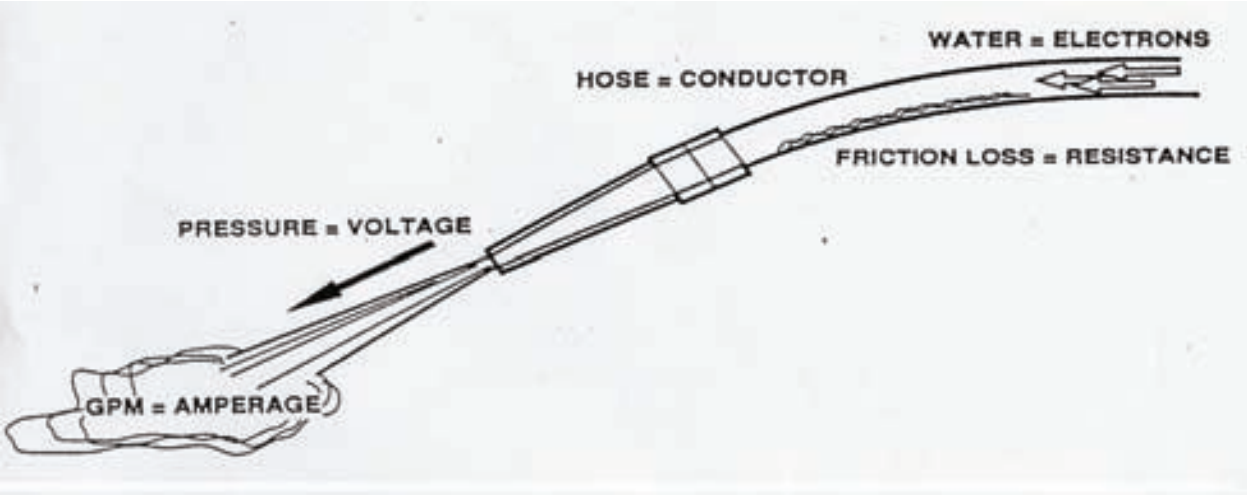
Amperage
Measures the quantity of electrons that are moving through a conductor in one second. The flow of electrons (amps) is comparable to the flow of water (gpm).

Conductors
These are the materials that allow movement of the electrons. A conductor is like the hose that carries the flow of water.

Electrons
The negatively charged particles in an atom are called electrons. Electrons can be compared to a drop of water in the hoseline.

Resistance
Refers to the quality of an electric circuit that resists the flow of current. Resistance is measure in ohms. Resistance is to electricity what friction loss is to water in a hoseline.

Voltage
This refers to the property of electricity that is responsible for moving electrons through a conductor. Voltage can be compared to pressure used to move the water through the hoseline.



Electrical Current Types

Alternating Current (AC)

a) Current flows in pulses at the rate of 60 cycles per minute
b) Used in all types of structures
c) Electrocution and burn hazard

Direct Current (DC)

a) Current flows continuously in one direction.
b) Used in automobiles, some commercial applications.
c) More commonly a burn hazard with low voltage.

Transmission of Electricity

Types of Electric Generating

THERMAL: Use the energy of heat to make electricity

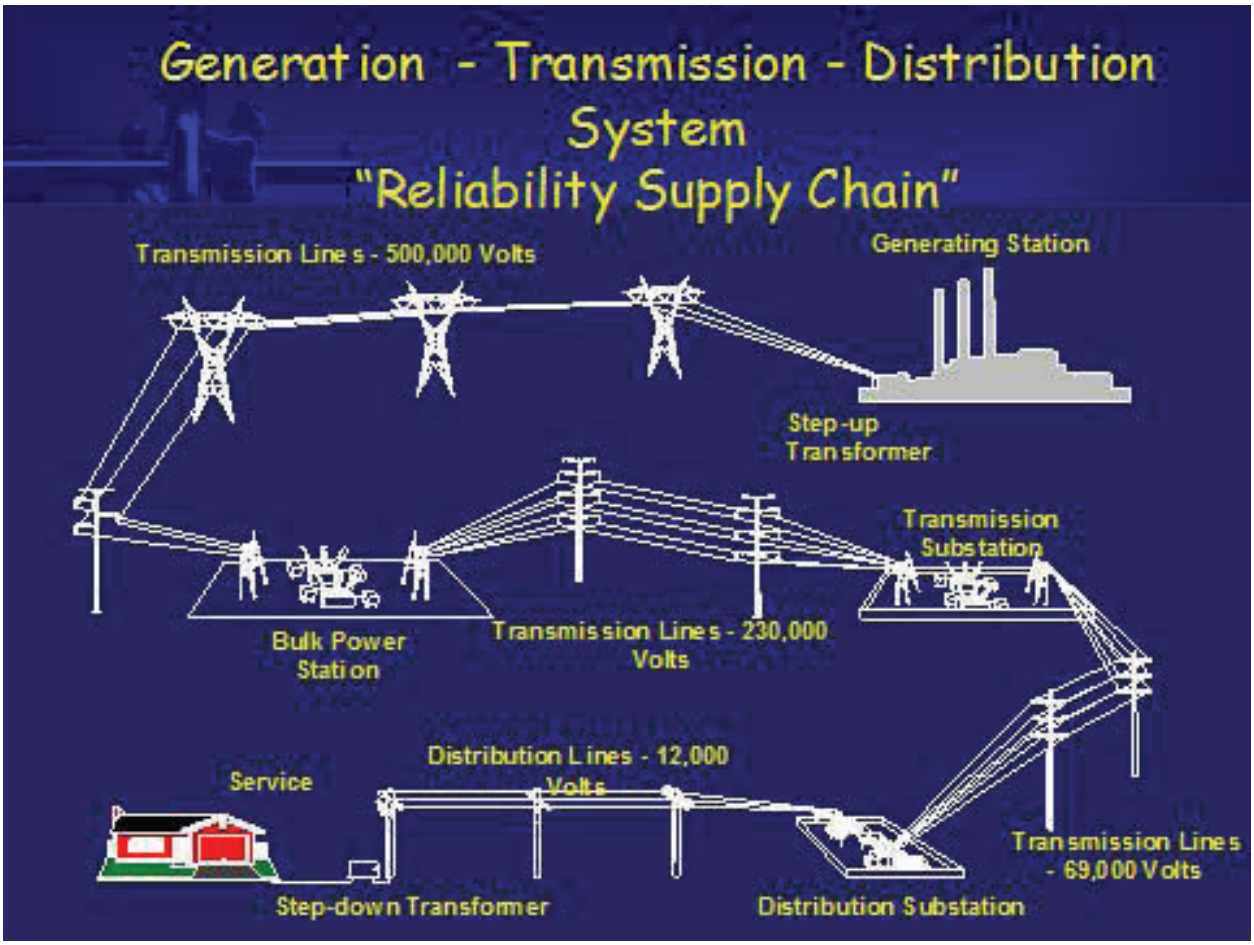
a) Fossil-fuels
b) Cogeneration
c) Nuclear

KINETIC: Use of water and wind to make electricity

a) Hydro-electric
b) Windmills

ALTERNATIVE: Use of fuel cells.

a) Photovoltaic devices (solar panels)
b) Geothermal plants
c) Fuel cells



The Supply Chain

Once electricity is generated, it is transmitted through power lines into a number of substation and electrical boxes. This process allows for electricity power to be "stepped-down" and distributed to homes. It is important for firefighters to understand the different types of electrical boxes and what dangers they pose.

IT IS IMPERATIVE THAT FIREFIGHTERS IDENTIFY ELECTRICAL BOXES AND HAVE APS OR SRP SECURE THEM BEFORE OPERATIONS BEGIN WHEN THE BOXES HAVE BEEN DAMAGED.

FIREFIGHTERS MUST BE AWARE OF WHAT PANELS CAN BE SECURED WHEN SHUTTING OFF POWER ON THE FIRE GROUND.

WHEN ELECTRIC BOXES AND LINES MALFUNCTION, THEY ATTEMPT TO RESET THE LINES AUTOMATICALLY, JUST BECAUSE THERE IS NO EVIDENCE THAT A LINE OR BOX MAY BE CHARGED, IT MAY RE-ENERGIZE

SUBSTATION INCIDENTS

Substations should NOT be entered unless the utility company is on scene and states it is safe to do so. Any electrical apparatus, transformer, or switch that has been involved should be considered property that is already lost. Efforts should be directed to protecting exposures.

Westwing Substation Fire, July 4, 2004

Substations are fenced, locked, and labeled. The utility company needs to be on scene before entering.

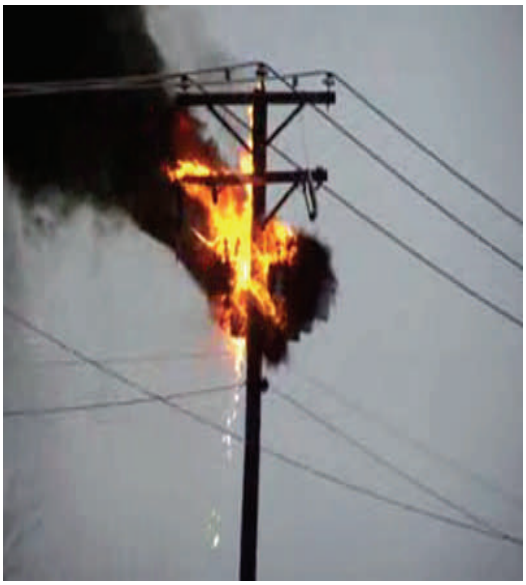
POWER LINES AND TRANSFORMER FIRES

DOWNED WIRES

- Request the utility company to respond.
- Should be assumed energized until the utility company on scene confirms they are not. Often downed wires may appear safe and not arc when contacting the ground.
- Located both ends of the downed lines.
- Secure the area and deny entry.
- Wires may unexpectedly re-energize at any time.
- A downed wire can energize anything that it touches (fences, poles, phone lines, etc).
- Traffic should be stopped with assistance from PD and all apparatus should stage at least 2 in tact utility poles away.
- If the lines are down on a vehicle, DO NOT TOUCH the vehicle until the utility company has secured the power.

POLE MOUNTED TRANSFORMER FIRES

- Request the utility company to respond.
- Place apparatus is a safe area away from, and out of reach of any hazards (including pole collapse).
- Clear the area**.**
- Be aware of explosion and arcing potential, electricity can arc up to approximately 15 feet away.
- Protect exposures.
- PCB hazards: smoke may be potentially fatal. Avoid and contain pools of oil around the transformer.



VEHICLE INTO POLE ACCIDENTS

Consider that anything touching the pole may be energized and request the utility company be dispatched immediately. If present, obtain the identification number on the effected pole. When approaching the vehicle, establish a hot zone of 10 feet from outside of the pole and vehicle.

If the occupants of the vehicle are conscious:

- Advise the patients that the utility company is nearby and to remain in the vehicle.
- If the occupant insists on getting out of the vehicle, they should be given explicit instructions and told not to come in contact with the vehicle and the ground at the same time.
- Once on the ground, small shuffling steps should be taken to move away from the involved vehicle.

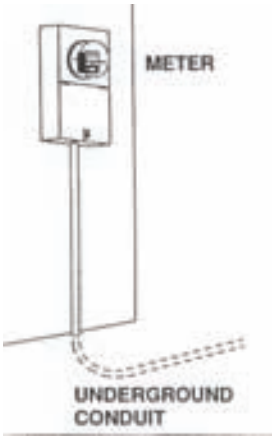
If the occupant is unconscious:

- Stay back until the utility company has confirmed there is no power to the pole.

Obtain the pole identification number if safe to do so.

RESIDENTIAL AND SMALL COMMERCIAL POWER

Underground



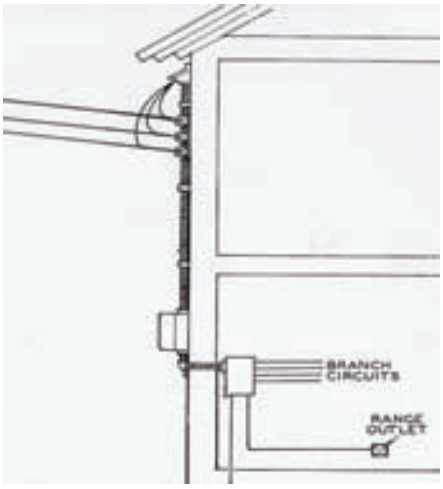
Overhead

Open Wire

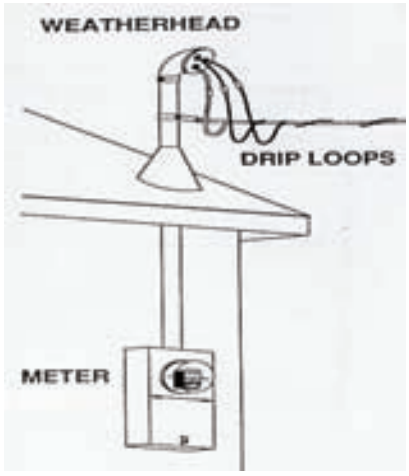
1) 2-3 wires 120 volts each
2) Anchored to building by insulators
3) Older buildings, usually not grounded

Triplex: 3 wires twisted together

1) Each insulated wire carries 120 volts
2) Bare wire is under tension and also serves as a secondary ground.



Overhead Open Wire



Overhead Triplex

RESIDENTIAL AND SMALL COMMERCIAL SHUT-OFFS

It is most common to find a residential or small commercial building shut-off on the exterior of the building. Although there are variations of different shut-offs, they are located near the meter. Pictured below are the most common shut-offs found on both underground and overhead wiring feeds.

COMMERCIAL & INDUSTRIAL POWER

Commercial and industrial occupancies have anywhere from 360-34,500 volts of power. If a company is assigned "secure utilities" in a commercial structure, this is methodical process and may take a significant amount of time to ensure that the structure has been secured properly. Often time there are more than one power disconnect and a complete 360° must be completed around the building. Many commercial structures also have a generator back up that must be secured to prevent the system from re-energizing (see the generator section in the chapter on how to secure).

Overhead Services

1) Open Wire
2) Triplex
3) Four-plex or Quadra-plex

Underground Services

1) Switching Cabinet
2) Transformer
3) Service Entrance Cabinet

COMMERCIAL AND INDUSTRIAL POWER SHUT-OFFS

Commercial buildings and strip malls have Service Entry Cabinets usually found in the back of the structure and marked “APS Meter” or “SRP Meter” which contain a variety of shut-off configurations and may be marked with individual zones or suite numbers. The main power disconnects are in the same panel of adjacent to the meter. In strip malls, the anchor store may have its own main and several sub-panels.

General Types of Disconnects

1) Fused pull-out
2) Circuit Breaker
3) External Lever
    A) Most common in commercial buildings
    B) Used to control single electric devices
    C) Will make a loud “pop” when turned off

APS Service Entrance Section Cabinet

SRP Service Entrance Section Cabinet

Various power shut-offs found in the Service Entrance Cabinets

Each separate occupancy will contain at least one sub-panel.

ELECTRICAL ROOMS

Many buildings, especially the anchor occupancy in a strip mall, will have an "Electric Room" with a utility company lock box. The Knox Box keys on the truck will not work on these exterior doors. There will be an interior door that is accessible with the Knox Box key. Although this door is safe to force open, it is more effective and provides better customer service to pick another door in the rear and open it with a key to access the interior door to the electrical room.

The inside of this electrical room will contain main shut-offs as well as subpanels. In this room it will be possible to shut off certain sections of the occupancy, while leaving certain zones on (i.e. coolers for food).

Main panels and subpanels inside of an Electrical Room. Most of these panels are well labeled to what each breaker controls.

MULTI-OCCUPANCY BUILDINGS

Apartment and hotel services are similar to commercial services in that voltages can vary from 240 to 34,500 volts. Each building contains a main with an external meter for each unit. Breaker switches will differ from structure to structure. Power to a multi-occupancy building may be secured by:

1) Securing the main to the entire building (this will secure power to the entire building)
2) Shutting off the individual unit or unit on the exterior meter (this will secure the individual unit)
3) Shutting off the subpanel located inside each individual unit (power can be isolated within the unit to a particular appliance)

Power into the building from an overhead line.

Power into the building from an underground line.

Main shut-off will secure the entire building.

Meter shut-off will secure the entire unit.

Subpanel located within the unit, has marked breakers

HIGH RISE POWER

Securing power in a high rise is a very complex assignment and needs to be pre-planned to be effective. It is important to SECURE AN RP early in the incident and assign them to the crew that is securing utilities. High rises may be set-up different, but have an "electrical room" that contains multiple shut-offs and subpanels, as well as controls for the generators. The electrical room may be on the first floor or in a basement. A high rise will have multiple "main shut-offs" for different floors or towers, as well as multiple generator that may need to be secured as well.

It is important to know that many high rise buildings such as hospitals also have critical areas of the structure that should not be shut off (surgery, life support systems, etc) and securing power needs to be a coordinated and joint effort.

HIGH RISE POWER

When securing high rise power, it is important that firefighters be aware of their surroundings and not randomly start flipping switches. Numerous transformers and/or switching cabinets may be in the vicinity of the electrical room. Firefighters must not touch any of these transformers or switching cabinets. If a transformer or switching cabinet is on fire, firefighters must stay out of the area and wait for the utility company to secure power.

Numerous transformers in the area of the electrical room of a high rise.

It is important to know what the switch that is being secured controls.

HIGH RISE POWER

The main power switch should be labeled appropriately.

Electrical power shut-offs may also be located inside of a Service Entrance Cabinet and have one of many types of disconnects. An exterior Service Entrance Cabinet is often seen in high rises that have added towers separate from the original build.

Smaller shut-offs may secure individual floors or sections of the high rise.

GENERATORS
All commercial generators generally operation in the same fashion. Industrial generators have some type of fuel supply (most often natural gas or diesel), which operates the generator head that provides electrical current. These generators are usually hardwired permanently into the building's electrical system.

When securing power, it is important to know that once the power is secured, a back-up generator may also need to be secured. There are two ways to prevent a generator from delivering power to the structure:

1) Shut off the generator
2) Shut off the breaker that feeds the building from the generator.

GENERATOR HOUSING
A generator most often has numerous doors in the housing so the generator completed access may be made to the generator when being serviced or repaired. The door that usually contains the shut-off switches will be in the door on the end of the cabinet opposite of the exhaust. The exhaust is on the end of the cabinet that has no baffles due to being soundproofed to help reduce the noise of the exhaust.

The exhaust end of the generator usually has no baffles and is soundproofed to keep noise levels down.

The door opposite of the exhaust usually contains the end of the generator with the shut-offs.

These doors are often locked, but can easily be forced open using the adz end of the Halligan Tool.

GENERATORS

SHUTTING OFF THE GENERATOR

Generator shut-offs

Push the “Emergency Stop” button

Turn the key to the “OFF” position

Flip the breaker to the “OFF” position.

GENERATORS

SECURING THE BREAKER

There are two types of generator breakers:

1) Automatic
2) Manual

AUTOMATIC

This system turns on automatically and feeds power to the building from the generator when the main power has an outage or has been turned off. This back-up power must be secured to ensure that back up power is not re-energizing the system.

When the main power is out, the circuit from the main feed is automatically turned off and electricity from the generator automatically feeds into the building.

Main power feed.

The breaker is found in a Service Entrance Section box that is located in the vicinity of the generator and adjoined to a electrical box labeled for the generator.

In an automatic system, it is important that the back up power be secured to prevent the building from re-energizing, the breaker from the generator must be turned off to completely secure all the power. The breaker style will vary, but are located next to the generator box.

Note: Securing the back-up power breaker secures power from entering the building. The generator will still run (until manually shut-off), but will not supply power to the building once the breaker is off.

MANUAL

In a manual system, a sequence must be completed to turn the back-up power on to the main structure. Although firefighters do not need to secure the breaker of generator in this system, they must an ensure that the RP does not turn on the back-up power.

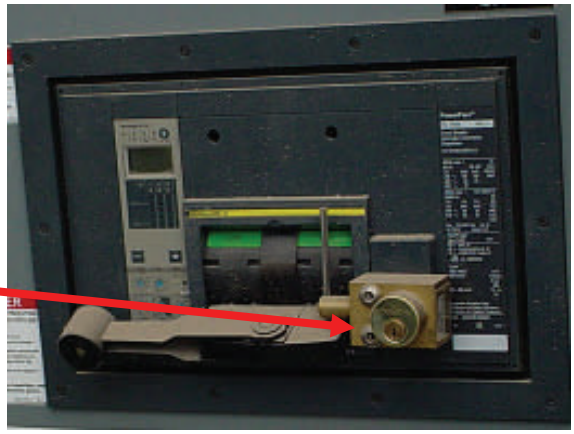
The sequence begins with opening the circuit to the main power feed. This will stop the main power from entering the building. Once the main power is secured, the key will release

Key is only released when main power is turned off.

Status of the main power feed:
Open = main power is off
Closed = main power is on.

Main power feed.

The circuit breaker for back-up power is locked in the off position. The only way to unlock it is using the key from the main feed. This prevents double feeding the building with both main and back up power. Once unlocked the breaker may be turned on.



Circuit breaker for back-up power

Note: In this system, the generator may automatically turn on, but will not give power to the building until the sequence is complete.

ELECTRICAL BOXES

Electrical boxes are everywhere. Some have enough electricity to instantly kill firefighters while others pose no danger at all. It is important that Ladder Companies become familiar with the most common types of boxes in their first due.

ELECTRICAL BOXES

SWITCHING CABINET

- Steps down electricity from distribution lines
- Feeds into a transformer
- Vegetable oil used to keep wires cool
- Nothing for firefighters to secure.
- Box comes in different shapes and sizes
- Some switching cabinets may be shut-off remotely by the utility company.
- IF THIS BOX HAS BEEN COMPROMISED, HAVE UTILITY COMPANY SECURE PRIOR TO TOUCHING THE BOX OR VEHICLE THAT STRUCK THE BOX.

APS Switching Cabinets have an identification number that begin with "SC"

ELECTRICAL BOXES

SRP SWITCHING CABINETS

SRP Switching Cabinets have an identification number that begin with "PD"

ELECTRICAL BOXES

APS TRANSFORMERS

- Steps down electricity from switching cabinets
- Feeds into service entrance section or breaker panel.
- Vegetable oil used to keep wires cool
- Nothing for firefighters to secure.
- Box comes in different shapes and sizes
- Box has a slight “buzzing” sound to it.
- IF THIS BOX HAS BEEN COMPROMISED, HAVE UTILITY COMPANY SECURE PRIOR TO TOUCHING THE BOX OR VEHICLE THAT STRUCK THE BOX.

APS Transformers have an identification number that begin with “TX”

ELECTRICAL BOXES

SRP TRANSFORMERS

SRP Transformers have an identification number that begin with “P”

ELECTRICAL BOXES

TRAFFIC SIGNAL CONTROL CABINET

In the valley, traffic signal control cabinet set-ups vary. Although they are set-up different, they have similar characteristics and they ALL pose a serious danger if a vehicle has struck them. They are fed with high voltage and the meter is either mounted on the cabinet or on a separate box nearby. Some cities have a battery back up pack in a cabinet next to the traffic signal cabinet. If the system has a battery back-up, both the electric and back-up system need to be secured. If a traffic cabinet is struck and still in contact with the vehicle, the power needs to be secured by the utility company or city traffic department before contact is made with the vehi-

Traffic signal control cabinet with the meter attached to the cabinet.

Traffic signal cabinet with the meter in a separate location (within 20 feet).

Traffic signal cabinet with a battery back-up. The size of the battery cabinet differs from city to city.

ELECTRICAL BOXES

COMMUNICATIONS CABINET

Quest and Cox are the two main communication cabinets that firefighters will come across. Most often, Quest boxes are green in color while Cox boxes are tan. Quest shares a joint trench with APS, and when a line below ground has been compromised, firefighters must take precaution to ensure the wires are not arcing. While most smaller communication boxes do not pose an electrical threat, main communication boxes with cooling systems do contain an electrical hazard. These cooled boxes often have a meter attached to, or in the vicinity of the cabinet.

The communication cabinets pictured to the right (not including the transformer) do not contain a voltage danger. These boxes are found within neighborhoods and along city streets. If involved in an accident, rescue efforts do not need to be prolonged.

Communication boxes with a meter in the vicinity of the cabinet or attached to the cabinet contain voltage. Many of these systems also have battery back up systems that also contain a cooling system

ELECTRIC VAULTS

Utility companies often put transformers and other electrical components in an underground vault. These vaults have a usually have a small entrance and are considered a “confined space” by OSHA. Its is important that firefighters do not enter this space or flow water into the vault during fire conditions.

HVAC SYSTEMS
Heating Ventilating and Air Condition (HVAC) Systems are broken down into 2 categories:

- Split Systems
- Package Systems

When dispatched to a fire with a light haze and/or a electrical burning odor, be suspect of a motor in the *air handler* that has burned up.

How An Air Conditioner Works
The majority of today's homes and smaller commercial air conditioning systems circulate a compressed gas refrigerant into a closed "split" system to cool the inside air. The refrigerant has to be re-cooled and condensed and outside air is most often used to accomplish this. The term "split" means that the components are divided into inside and outside portions as opposed to be located together in a "package" unit.

The refrigerants, commonly known as "Freon" (a registered trademark of DuPont), helps cool the inside air. In a "forced air" system, an internal blower/air handler circulates the cooled air through the ductwork. An outside fan pulls air across the external parts of the system to cool and condense the refrigerant.

Split System
(outside condensing unit & air handler in the attic)

Package System
(both the condensing unit & air handler are housed together)

SPLIT A/C SYSTEM

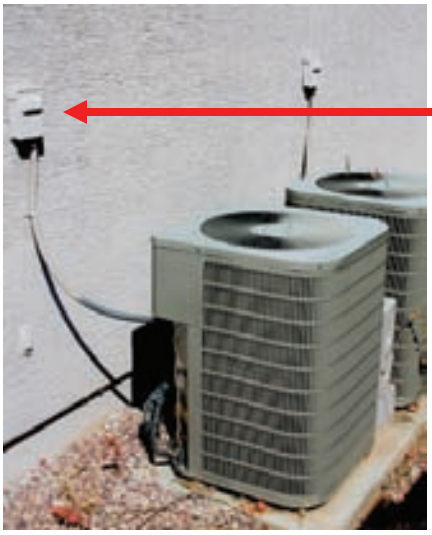
A split air conditioning system has 2 main components that firefighters may need to secure

1) Condenser
2) Air Handler

CONDENSER

The condenser in a split system is located in a different area than the air handler. The condenser has a compressor that that is used to convert gas to a liquid and back again. The fan on top of this unit is uses outside air to cool the compressor.

If this system fails, it will not be responsible for smoke inside of the structure. There are multiple ways to secure power to the condenser unit.



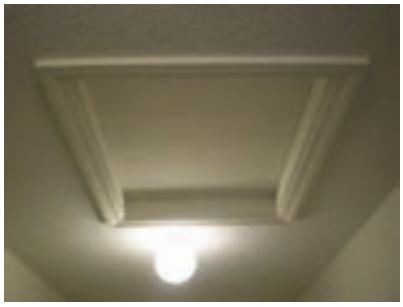
To secure power to the condensing unit, a pull fuse is located near the unit. Grab the fuse by the handle and pull straight out. Some commercial units may have a lever breaker to secure the condensing unit.

The condenser may also be secured by going to the circuit breaker and turning off the A/C breaker. If there are unmarked fuses, flip all "dual pole breakers", meaning two breakers attached. This will also secure all other utilities that are 220v, but will ensure that the A/C unit is secured as well. <u>Flipping the A/C breakers will secure the entire A/C system.</u>

AIR HANDLER

Air handlers are located in the attic next to the attic access scuttle. The air handler is responsible for drawing in air, blowing/pulling it over the cold (or hot) coils, and pushing it through the ductwork. Air is moved by a direct drive motor attached to a "squirrel cage." If the motor burns out, it will create smoke inside the structure and a possible electrical burning smell. Firefighters must secure the power to the air handler or complete A/C system before removing the panel on the air handler to see if the motor has failed. To remove the panel, a 5/16" or 1/4" nut driver must be used. There are several ways to secure power to the air handler.

The air handler will be located in the attic near the attic access scuttle.



Air handler suspended by the trusses. The panel that the "squirrel cage" and motor are behind are opposite of the Freon lines.

SECURING THE AIR HANDLER

Depending on code, the air handler may be hardwired and posses different breakers to shut off power to the air handler.

If not hardwired, pull the plug out that goes to the air handler.

Flip/pull the breaker or fuse. This is usually mounted to a truss and has conduit coming in, and going to the handler. Failure of the motor may cause the breaker to trip.

Flip the breaker at the main panel.

INSIDE THE AIR HANDLER

Once the panel is removed, the firefighter will be able to have a full visual of the internal parts of the air handler. The firefighter MUST SECURE THE POWER to the A/C unit or air handler BEFORE the panel is removed.

Components of the air handler after the panel has been removed.

This motor often burns up and creates smoke in the house. It could also be caused by inadequate air intake from dirty air filters. Dirty air filters or air filters that may appear to be "sucking in" may be a sign of a burned out air handler motor.

A capacitor may also fail causing smoke and a burning electrical odor. These capacitors are filled with oil and may create an oil spot underneath of they fail.

The "squirrel cage" in encased in metal and pulls/ pushes air over the coils and through the ductwork. The motor may be located above or below the "squirrel cage" and it may be vertical or horizontal. This unit will push smoke from the burned out motor throughout the ductwork and into the structure.

PACKAGE A/C SYSTEM

Packaged units are typically installed outdoors on the roof of a commercial structure or residence. They utilize all the same components as a split system, but come with everything packaged in one unit.

If there is light smoke in a structure, firefighters should be suspect of a burned out motor or belt and ladder companies should check these packaged units once the roof is made. Packaged units also draw 10-25% of the air used from the outside atmosphere. This will allow smoke that may be from another source on the roof to be pushed through the ductwork and enter the structure.

Removing the panel on a packaged system will also take a 5/16" or 1/4" nut driver. Firefighters MUST SECURE THE POWER BEFORE REMOVING THE PANEL TO THE PACKAGE SYSTEM.

SECURING POWER TO A PACKAGE SYSTEM

The most efficient way for a ladder company to secure the A/C unit is to turn off the breaker mounted to the unit itself. Turning the breaker off will secure power to that individual unit only.

Once the electrical room is located, each A/C unit will also have a "dual pole breaker." It will be difficult for the company securing the A/C unit to determine which unit is being isolated making this a less effective way to secure the unit that is attempting to be isolated.

INSIDE THE PACKAGE UNIT

A package system has a belt driven motor. The belt is attached to the motor and a drive on the “squirrel cage,” which is enclosed in metal.

It is common for a motor to burn out or a belt to be worn out. Both will cause the system to push smoke into the ductwork and into the structure.

A capacitor may also fail causing smoke and a burning electrical odor. These capacitors are filled with oil and may create an oil spot underneath of they fail.

An external air intake opens up to the atmosphere and accounts for 10-25% of the air pushed into the building. Odors and/or smoke also may be drawn into this intake and pushed into the building through ductwork.

PHOTOVOLTAIC DEVICES (PV)/SOLAR PANELS

Solar electric or photovoltaic (PV) panels being installed on homes and businesses all over the Valley. These devices pose an electrical hazard as well as added dead load to a roof that may not be designed for the added weight of these systems. Ladder companies assigned to securing utilities and operating on the roof must be familiar with these systems to conduct a safe and effective operation.

TYPES OF PHOTOVOLTAIC SYSTEMS

1) Thermal panels (heat water)
2) Photovoltaic panels (generate electricity)

THERMAL PANELS

The main hazard with a thermal panel system used to heat water is the additional dead load weight added to the roof. The heated water in these panels may be up to 180°F, but there is not reason to open the panels that contain water. Securing the power and water system to the structure will eliminate the pressure in these water heating systems.

Many swimming pools will utilize a thermal heating source as well to heat the pool and are constructed out of PVC pipe. These systems are light in weight and pose no danger to roof opera-

Thermal heating panels. Water is stored in the panels and adds a significant dead load.

Pool heating panels are lightweight and water is carried in PVC pipe. These systems don't pose a hazard for firefighters.

PHOTOVOLTAIC PANELS/SOLAR PANELS

Photovoltaic systems are used to turn solar energy into electricity. These systems are tied directly into the electric meter and have separate shut-offs from normal electric utilities. Solar panels pose the following hazards to firefighters:

1) Early collapse
2) Electrical shock
3) Electrical burns
4) Toxic inhalation hazards

<u>It is imperative the firefighters properly secure solar panels in addition to normal utilities before operating around these systems.</u>

PV systems have three primary components:

1) Modules
2) Inverters
3) Conduit

MODULES

Solar panel modules are comprised of silicone cells wired together and enclosed in an aluminum frame. These modules add dead weight to the roof load and may cause early collapse under fire conditions. These modules produce DC power whenever the sunlight is hitting them. These modules will not provide any power at night, and the only way to prevent them from creating DC power during the day, is to cover the all the panels of the system completely opaque material, blue tarps or black plastic will not work.

Covering the panel with a tarp is the only way to prevent the solar panel to producing DC current. The panel will not produce DC in the dark.

PHOTOVOLTAIC PANELS/SOLAR PANELS

INVERTERS & DISCONNECTS

Since the modules produce DC power, they are tied into an inverter that converts the DC voltage to AC current, which feeds the electricity directly back into the main power of the structure. The shut-off to the solar panel inverter is located next to the main meter, and should be properly labeled. FIREFIGHTERS SECURING UTILITIES MUST SECURE BOTH THE MAIN POWER AND THE POWER TO THE SOLAR PANEL.

A Photovoltaic system should be properly labeled and have a separate shut-off from the main breaker of the structure.

A label mounted to the panel of the main meter.

A separate panel for the photovoltaic system. Simply pull the lever to the “off” position to shut-off the inverter.

ROOF OPERATIONS

When ventilating a roof with a PV device, it is important to recognize the presence of the system during ventilation size-up. These systems may contribute to early and rapid collapse. Ventilation should not occur on trusses of which the system is mounted on. These systems are strong, but should not be stepped on as they are very slippery.

It is also important that ladder crews watch what they are cutting. Since the conduit should always be considered energized, they should not be cut. The conduit is often painted the same color as the house and may be difficult to see under fire conditions. This conduit also poses a trip hazards for ladder crews operating on the roof.

TACTICAL CONSIDERATIONS

- Emergency Traffic: advise command/interior of the presence and location of the photovoltaic device.
- Secure both the main panel AND the inverter to the PV panel.
- During the night, light towers will NOT produce enough light for the modules to produce DC power.
- DC power is generated with sunlight, the only way to stop that process is to cover all panels in their entirety with an opaque material.
- Stay away from the modules and conduit during roof operations. Don't break, remove, or walk on the panel.
- Expect early collapse from the added weight.

LIGHT RAIL

The light rail system in the Valley has the most high tech safety features in the industry today. Power from APS or SRP enters into a Traction Power Substation (TPSS) as AC power. Inverters inside of the TPSS convert the this into DC power which is split into opposite charges and sent to the Overhead Contact System (OCS). For the Light Rail Vehicle to operate, it must be in contact with the rails as well as a large metal arm extending from the top of the Light Rail Vehicle (Pantograph) to the OCS.

Pantograph in contact with the Overhead Contact System (OCS) wires.

Although there are many safeties built into the system, firefighters must know what to look for and ensure that there is no electrical hazard when operating on an incident involving a light rail vehicle. REQUEST AND SECURE AN RP THROUGH DISPATCH WHEN OPERATING ON AN INCIDENT INVOLVING A LIGHT RAIL COMPONENT. Significant hazards may be present when:

- Any light rail vehicle has a derailment (wheels off of the track while the pantograph is still engaged with the overhead wires).
- A fire on or near the light rail vehicle, overhead contact wires or traction power substation.
- Pantograph tangled in the overhead contact wires.
- Damage involving the top of the light rail vehicle or overhead wires.
- Moving light rail vehicles.

Pantograph

A complete circuit is made when the Pantograph is in contact with the OCS. There are two ways to retract the Pantograph. Generally, this will be lowered by the Metro operator if necessary.

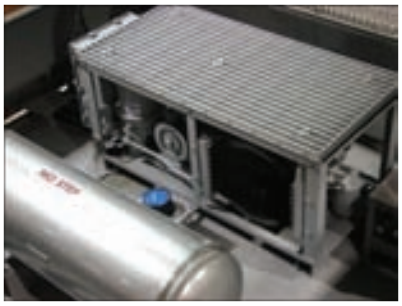
The Pantograph is normally raised and lowered by a push button.

Manual crank, the crank is stored in a locker in the center of the Light Rail Vehicle.

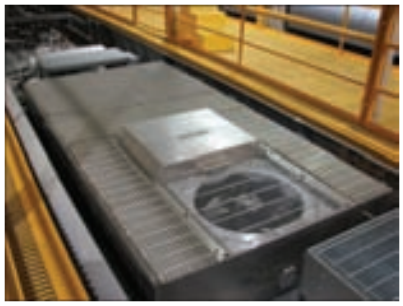
LIGHT RAIL

ROOF MOUNTED EQUIPMENT

The equipment mounted on the roof will be secured when the Light Rail Vehicle is shut-off using the emergency shut-off button located in the front of the Light Rail Vehicle.



Main reservoir and air compressor



HVAC unit

Propulsion inverter unit

EMERGENCY ACCESS

Once the power has been secured to the Light Rail Vehicle, the doors may be manually released from the exterior of the vehicle and are located next to the front left door at each end.

LIGHT RAIL

TRACTION POWER SUBSTATION (TPSS)
These substations are fed direct AC power from either APS or SRP. They are located every mile and contain 12,500 volts of AC in and 750 volts of DC out into the rails and OCS and contain 2000-6000 AMPs.

Power to the OCS can be removed using the Emergency Trip Switch (ETS) located in the Knox Box outside of the TPSS.

CRITICAL FACTORS

- The pantograph should be lowered by the operator if possible.
- If the Light Rail Vehicle is derailed and the Pantograph is touch the OCS, it should be considered energized and there is a SIGNIFICANT RISK FOR ELECTROCUTION.
- If the top of the Light Rail Vehicle is damaged or the wires are down, there is a SIGNIFICANT RISK FOR ELECTROCUTION.
- Secure the Light Rail Vehicle by removing the key.
- Ensure that other Light Rail Vehicles are not operating.
- Water use should not be used until power has been confirmed to be secured by the utility company

DE-ENERGIZE
- Step 1: Coordinate with the Operator to shut down power.
- Step 2: ETS at the TPSS Knox Box.
- Step 3: Hot Stick (done by utility company or Metro RP)

GAS UTILITES

Natural gas is the product of nature's action on organic material over millions of years. It is a common source of heat in buildings due to its convenience, abundance, and relatively low cost. Many structures in the Valley have natural gas delivered to the property, via underground service pipes.

Firefighters respond to natural gas incidents every day. This product is considered safe, due to its relatively small window of flammability. However, if we refuse to give it the proper attention, it will take advantage of our complacency. We must train ourselves to be vigilant, and on the alert, for situations that can injure or kill firefighters and/or the public that we serve.

PROPERTIES OF NATURAL GAS

Pure natural gas is completely odorless. For the purpose of leak detection, odorant is added so that as little as one-percent of natural gas in the air can be detected. The common odorant is a Mercapitan/Thiophane mix, which is used in solution of one pint per million cubic feet of gas. Natural gas is non-toxic and is not considered hazardous when inhaled in limited concentrations. However, in quantities large enough to displace oxygen, asphyxiation can occur.

Natural gas is lighter than air, which results in escaping natural gas rising and rapidly dissipating. This is a distinct safety advantage over heavier fuels such as butane and propane, which are heavier than air; and when escaping, it will collect in low areas. Escaping natural gas can be hazardous when trapped by confined spaces such as structures, hollow walls, etc. Natural gas also has an ignition temperature of 1100 degrees, and has a flammable range between 4 and 14 percent.

TRANSMISSION AND STORAGE

Most natural gas is initially distributed through over 30,000 miles of transmission lines from Texas, Kansas, New Mexico, Oklahoma, and the Rocky Mountain area. Transmission lines maintain pressures up to 1000 psi and use pressure booster compressor stations, at specific intervals, to maintain appropriate flow and pressures. To compensate for fluctuating demands, gas companies can maintain underground or above ground storage facilities. Natural gas is generally distributed by a combination of transmission lines and distribution mains. Transmission lines bring natural gas into Arizona and vary in diameter from 12 to 36 inches. Natural gas is then distributed to Southwest Gas customers by distribution mains. The gas is carried by service lines, as medium pressure, which normally does not exceed 60 psi. At the service meter (Meter Set Assembly), the pressure is reduced to a low pressure (approximately 1/4 psi.). Distribution mains are generally polyethylene and account for a high percentage of the mains in use today. Older existing distribution mains are made of steel or copper, but are rare to find. Polyethylene mains are color coded to identify the pipe as transporting natural gas. These pipes are yellow, which is the national color code for newer installations. Older installations of plastic pipe can be pink (salmon beige), or orange in color. Polyethylene will have a wire running the length of the pipe, for locating plastic gas lines, below ground. Above ground gas lines must be made of steel and cannot be plastic. Distribution mains are normally located underneath city streets, parallel to curbs, under grassy parkways, between the curb and sidewalk, and occasionally in alleys.

REGULATORY STATIONS

Regulatory stations are utilized to bring down the pressure of gas in a line. These stations are a very common and are usually found on the near the street with concrete filled metal poles surrounding them for protection. These systems make a "hissing" sound which is normal operations. Frequently, people will call in a gas leak because of this sound. These systems have two shut-off valves, but it is recommended that Southwest Gas is on-scene before securing the system unless it is necessary to effect a rescue.

When the valve is inline, it is open. The shut-off is larger than a residential meter, and a crescent or pipe wrench must be used.

METER SET ASSEMBLIES (MSA's)

Natural gas is distributed from a distribution main to the customer by a service line. Service lines run from distribution mains to structures, via an outside riser, where pressure regulators and meters are located. The pressure inside a customer line (inside the structure) is low pressure (approximately 1/4 psi) and is regulated and measured by a regulator and gas meter. Gas companies refer to gas meters as Meter Set Assemblies (MSA's). MSA's can be separated in the following categories:

- Residential
- Commercial
- Multiple Gas Meter

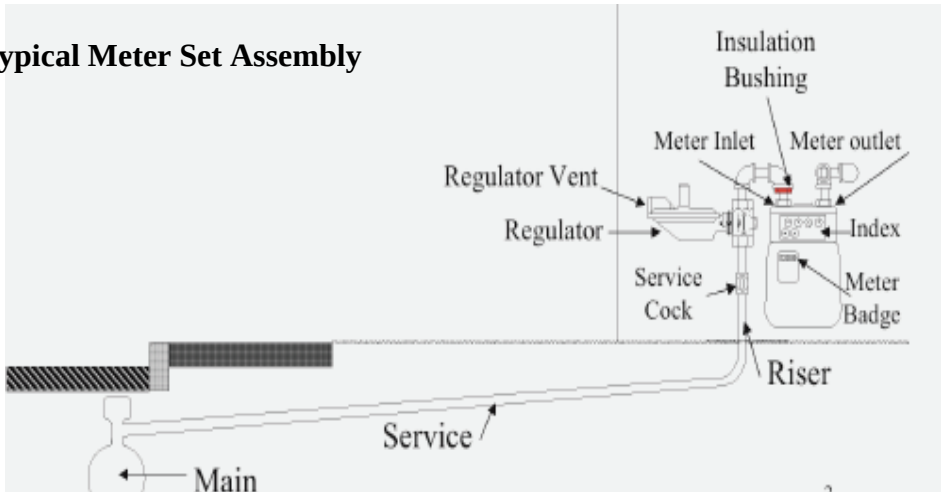
RESIDENTIAL METER SET ASSEMBLIES

The basic MSA consists of piping, a shut-off valve, regulator, and gas meter. The pipe rising vertically from the ground, close to the exterior wall of a structure is called a riser. Tracing the riser up from the ground, the first fitting is the shutoff valve called a stopcock or service cock. This valve is usually of primary concern to the personnel responsible for shutting off the gas to a structure. The following are characteristics of a residential MSA.

- A ring on the stopcock valve indicates a branch service.
- A flat washer on the stopcock valve indicates that the service line is a plastic pipe inserted inside an older metal pipe.
- A band on the stopcock valve indicates the service line is plastic.
- Next, up the riser, is a flat circular device called a "regulator" that reduces medium gas pressure (up to 60 psi) to a relatively low level of approximately 1/4 psi.
- Next are pipes and fittings, leading to the gas meter. The meter measures the amount of gas that is used. After the meter, gas flows through pipes and fittings into the structure.

TO SECURE GAS TO A HOUSE, CLOSE THE VALVE <u>BELOW THE REGULATOR.</u>

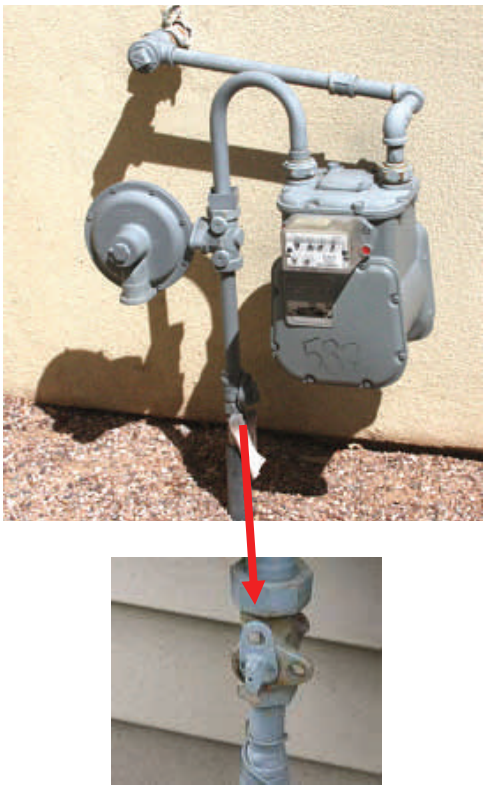
Typical Meter Set Assembly



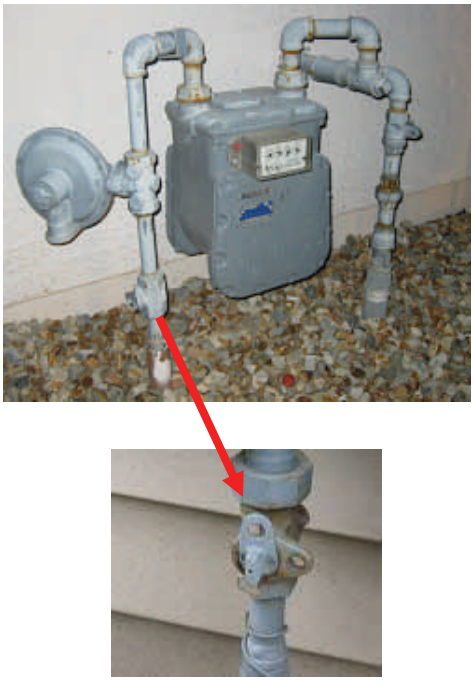
GAS UTILTIES

SECURING A RESIDENTIAL MSA

When the valve is inline, it is open. The shut-off is larger than a residential meter, and a crescent or pipe wrench must be used.



Occasionally, meters will have a “T” with service going into the house and underground service going to a pool or BBQ. The valve under the regulator must be shut off to secure the home. Shutting off the valve under the “T” will only isolate that appliance.



INDUSTRIAL METER SET ASSEMBLIES

Industrial MSA's are similar to, and larger than, residential MSA's due to the increased flow of gas (volume) that is necessary for commercial/industrial applications. Industrial MSA's can be characterized by any of the following features:

- A curb valve and curb valve extension handle can be utilized to control the flow of gas in the service main.
- Industrial shut-off valves, known as Nordstrom valves, are used for high pressure applications. They are larger than standard shut-off valves, and may require more effect and larger tools to shut off the flow of gas. Some industrial installations have gate valves with wheel handles that may be turned clockwise to close.
- Industrial applications that are high pressure can use two regulators in series to regulate the gas pressure. A rotary meter is used, instead of a conventional MSA, to regulate the high pressure and handle quick surges.
- Industrial MSA’s are physically larger than MSA’s used in residential applications.

.

Shut-offs will be the first from the ground prior to the regulator.

MULTIPLE METER SET ASSEMBLIES

Multiple housing units such as apartments, or commercial occupancies are often equipped with multiple MSA's, which provide a master stopcock and a separate meter and stopcock for each unit. Past the riser, and master stopcock, is a horizontal header that feeds multiple stopcocks and MSAs. Master stopcocks shut off the entire building and individual meters/stopcocks can control the flow of gas to individual occupancies in one structure. Southwest Gas is required to identify the individual MSA's, as to which unit or building they serve. If the identification has worn away, notify Southwest Gas to have the meters properly marked.

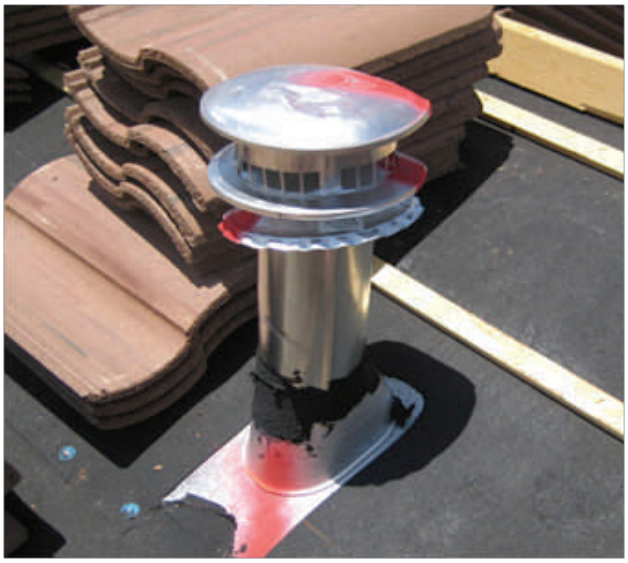
BRANCH SERVICE

In some commercial areas, multiple structures may be commonly serviced by a single service pipe called a standard service main. A metal ring identifies this branch service. The occupancy that is further from the supply main is a standard service, and the other occupancies are branch services. All MSA's that are served from the branch main will be identified by a ring at the stopcock.

VENT PIPES

Ladder companies must pay particularly close attention to gas vent pipes during building size up. The presence of a gas vent pipe will tell crews that the structure has gas service, but it will also give an idea of the layout of the house. Appliances commonly that run on gas are:

- Furnace
- Hot water heater
- Range
- Fireplace



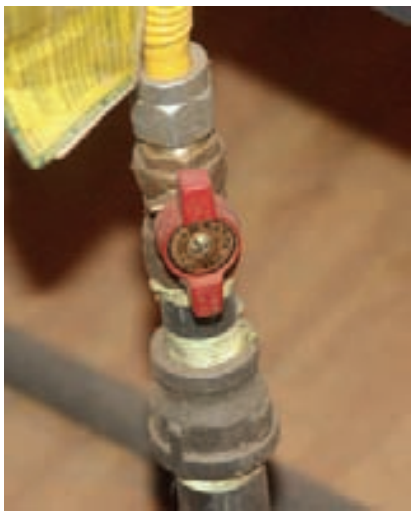
Gas appliances have a pipe with a spark arrestor on top. With a quick glance of the roof, firefighters can determine if a house has gas service, as well as use it to help determine the layout of the house.

Gas vent pipes were read to help determine what location to cut the ventilation hole the started in a kitchen. Notice the vent pipe near the vent hole that was part of the gas range. The hot water heater vent pipe is near the load bearing wall of the garage in this picture.

GAS UTILITIES

APPLIANCE SHUT OFFS

Each gas appliance, both residential and commercial has its own shut off that may be secured by a 1/4 turn.



WATER UTILITIES

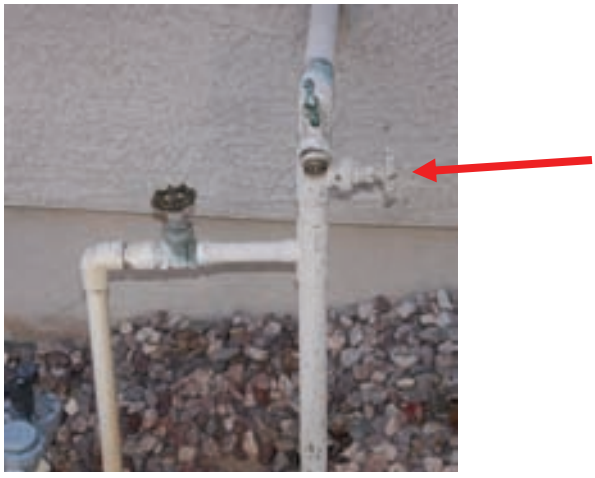
Although water covers about two thirds of the earth's surface, it is still necessary to deliver water to residential, commercial, and industrial customers to sustain the common necessities of life. Unfortunately, the presence of fires, building collapse, and common problems such as broken water pipes and activated sprinklers often result in the need to quickly control the flow of water. It is the uncontrolled flow of water that often requires the action of fire service personnel to abate this type of hazard in a timely and professional manner.

RESIDENTIAL

Securing water to a house may be achieved in two different ways:

1) At the meter
2) At the service line going into the home

Water service can be completely secured at the water meter. Inline is on, perpendicular to the line is shut off.



The main going into the house may be shut off my turning the wheel to the right. Notice that the yard sprinkler system has to be shut off additionally in the system due to the location of the connection.

WATER UTILITIES

COMMERCIAL SHUT OFFS

When securing water to a commercial building, it is best to have an RP present. A commercial property may have numerous water valves. In strip malls, it is common to have a main back-flow valve with multiple meters located near vacuum breakers.

Backflow valve. This supplies a commercial building or entire strip mall. It should only be secured by the water company. It has two OS&Y valves with a backflow valve between them.

The vacuum breaker may have a protective cage over it. There will be a meter next to the vacuum breaker where the water to the unit may be secured. Each lid should be marked or in the

Water service can be completely secured at the water meter. Inline is on, perpendicular to the line is shut off.

WATER UTILITIES

FIRE SPRINKLERS

Sprinkler systems should be shut off as soon as the fire is under control to avoid unnecessary water damage. The sprinkler system should be returned to service and fused heads replaced with the same type and style. Extra sprinkler heads are normally found on the premises and all engine and truck companies should carry a supply of extra heads. Someone should be directed to find the sprinkler shut-off, stopping the flow of water to the system. The system usually has a drain valve to the outside. At the same time personnel should be trying to stop the flow at the fused head.

Ladder Companies carry sprinkler kits to help stop the flow of water when isolated to a sprinkler head leak. These kits should include:

- Sprinkler head shut-offs
- Wrenches
- Sprinkler wedges
- Plumber Teflon tape

WATER UTILTIES

FIRE SPRINKLERS

Fire sprinklers are categorized in two types:

1) Residential
2) Commercial

RESIDENTIAL FIRE SPRINKLERS

Residential fire sprinklers are common in rural areas or large square footage homes. They are also fire code for most cities where a house is being utilized as a care home or day care.

Residential sprinkler risers are most often found in the garage. The system must be shut off at the street meter and the valve shown above is to drain the system. Extra sprinkler heads are located in the riser cabinet. A water gong or bell will be visible from the exterior of the home.

A residential sprinkler will have to be shut at this valve. This allows the water of the house to be secured without having to disable the sprinklers.

WATER UTILITIES

COMMERCIAL FIRE SPRINKLERS

Commercial fire sprinklers are found in a riser room or on the exterior of the building. They are most often fed by a backflow valve near the street that is separate from the service water. The FDC is tied into the sprinkler system and the FDC may actually be attached to the backflow valve.

Backflow valves may have the FDC attached or in separate area and feeds into the riser. It is recommended to secure the sprinklers at the riser, but closing an OS&Y valve will also stop water flow.

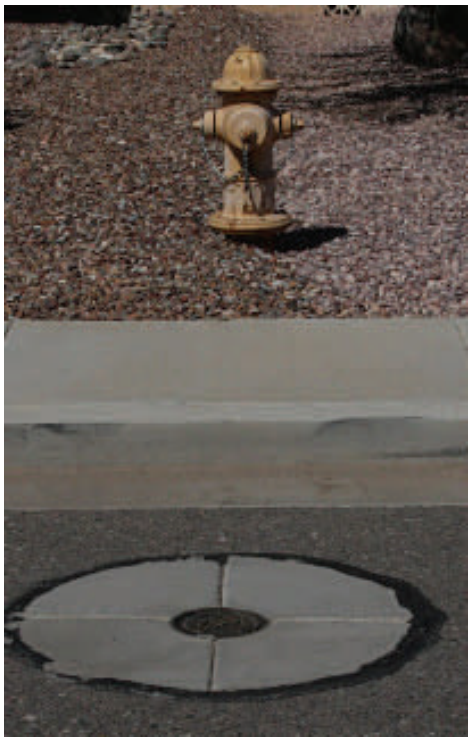
Flow indicator inline with the riser to show that the valve is open.

Closing either valve will stop water flow. The valve is turned to the right until it closes. The water flow indicator runs perpendicular to the riser when it is shut and inline when open.

WATER UTILITIES

FIRE HYDRANTS

Most cities in the Valley require that each individual fire hydrant has its own street valve that may be shut off with a T-wrench water shut off tool. This valve is usually located within 10 feet and often inline with the steamer cap.



To secure water to the individual fire hydrant, use a T-wrench shut off tool and turn to the right until the water flow stops.

WATER UTILITIES

INDIVIDUAL SHUT-OFFS

Firefighters frequently get dispatched to homes and businesses to "check flooding." Although firefighters can secure that water main, it is better customer service to isolate the water problem, so the customer has water supply to the rest of their structure.

Shut-offs for hot and/or cold water are located under each sink. There may even be a separate shut off for refrigerator ice makers and dish-washers.

A separate shut off valve may be located behind the toilet.

If it can be determined that the water leak is on the hot water side, and other methods (closing hot water valves under the sink), do not stop the flow of water, you can shut the cold water supply to the water heater. Shutting this valve will shut off all hot water to the structure but will leave the cold water supply in service.

Laundry rooms have a hot and cold shut off to the washing machine. Plastic lines to sinks, dish-washers and washing machines have a tendency to break or disconnect from the fitting because they are cooled and heated repeatedly over time.