4.4.3 Environmental Control Facts

Computer systems are sensitive to environmental conditions. Environmental controls that can be implemented to protect computer systems include:

- Cool temperatures to protect hardware from being damaged by overheating.
- A humidity controlled environment to keep humidity above 50% to avoid electric shock.
- Moisture detectors to alert responsible individuals early and prevent water/flood damage from water pipes and sprinklers.
- Fire suppression controls to prevent damage from heat and smoke.

Infrastructure refers to the systems that support the site. Infrastructure components include AC power, heating, ventilation and air conditioning systems (HVAC), gas, and water. Of these systems, AC power can present the greatest challenge on a day-to-day basis. The table below identifies power conditions you should be familiar with:

Problem	Description
Surge/Spike	A *surge* or *spike* in power is a sudden rise in voltage. It can be caused by a lightning strike, a power plant coming online or going off-line, or even equipment inside the facility.
Sag/Dip	A *sag* or *dip* in power is a reduction in voltage for a short period of time (up to as long as a few seconds). Sources of sags or dips include chained power strips, faulty wiring, sudden power draws (such as when equipment is first turned on), and large inductive sources, such as an electric motor.
Brownout	A *brownout* is a reduction in voltage that lasts longer than a few seconds. A brownout is generally caused at the utility company during times of high power usage. The ANSI standard defines a brownout as an 8% drop between the power source and the voltage meter or a 3.5% drop between the voltage meter and the wall outlet.
Blackout	A *blackout* is a complete power failure. A blackout can have a variety of sources, such as downed power lines or failed transformers.
Fault	A *fault* is a momentary power outage that can have a variety of sources.
Transient	A *transient* is a fluctuation caused by line noise or disturbance.

The following table provides recommendations for preventing or correcting infrastructure problems.

Infrastructure System	Description
HVAC system	A well-maintained *heating, ventilating, and air conditioning* (HVAC) system is important for employee comfort and the protection of equipment. - HVAC controls the temperature and humidity of a building. - HVAC keeps temperatures cool for computer systems. - Computer systems and server rooms should be centrally located and have separate ducting for better controls. - Computer rooms/server rooms require full-time environmental controls. Recommendations for HVAC systems include: - Use *positive pressure* systems. Positive pressure systems protect the air quality in the facility by causing air to be forced out through doors, windows, and other openings. *Negative pressure* systems draw air in, potentially bringing in airborne particles such as dust, smoke from a fire, or contamination from a chemical leak. Positive pressure systems are more energy effective. - Protect filter air intakes. The air intakes are the source of air for the positive pressure system. Air intakes can be a target of sabotage or contaminated by toxic chemicals if an incident occurs in the surrounding area. - For electronic components, keep temperature between 70 and 74 degrees and humidity between 40% and 65%. - Ensure that appropriate personnel have access to shut off values for HVAC system in the event of an emergency.
AC Power	Power systems can help keep electrical service constant. The following types of protection are available to improve and protect your equipment for AC power issues: - *Surge protectors* protect against spikes that damage components. Many power strips have a built-in surge protector. - *Uninterruptible Power Supplies* (UPS) protect against under-voltage conditions of short duration (depending on battery life, 30 minutes or more). Most UPS systems include a line conditioner and a surge protector. - A *redundant power source* to ensure constant power. An example of a redundant power source is a backup generator or power from a secondary source in case one source fails. Backup generators require fuel to operate and can provide power to critical systems until the fuel is consumed. - *Line conditioners* (also known as power conditioners) are used to improve the quality of the power by providing one or more of the following: - Filters to remove noise

	▪ Temporary voltage regulators ▪ Surge protectors Line conditioners can be dedicated to a single computer, a server room, or an entire building. The order in which critical equipment should draw power is: ▪ UPS line conditioner ▪ UPS battery ▪ Backup generator
Water and Gas	Recommendations for water and gas focus mainly on the ability to turn them off in the event of a broken pipe, fire, or other type of an emergency. These recommendations are: ▪ Identify the location of a master shut off valve ▪ Identify the location of any secondary shut-off valves (using secondary shutoff valves minimizes the impact of the service loss) ▪ Ensure that the shut off valves work ▪ Mark shut off valves to increase visibility ▪ Ensure that appropriate personnel have access to shut off values for water and gas systems ▪ Secure shut off valves from general access In the event of water damage, take appropriate steps to protect equipment and the area from corrosion and mildew/mold. Mildew and mold can cause potential health hazards.

Interference is an environmental concern that should be addressed.

- *Electro-magnetic interference* (EMI) is caused by noise between the hot wire and the ground or neutral wires in a circuit. It can disrupt the signal in a data cable. Common causes of EMI are:
  - Motors
  - Heavy machinery
  - Lights
  - Electrical systems (for example, computer system)
- *Radio Frequency interference* (RFI) is the reception of high-frequency radio waves. Sources can include:
  - Microwave ovens
  - Wireless devices
  - Transmitting devices
  - Cellular phones
  - Florescent lighting

EMI shielding is the process of protecting computer systems from interference to prevent transmission problems and security concerns, such as eavesdropping. Methods to shield computer systems include:

- Surrounding a server room with a faraday cage to protect a system from RFI.
- Creating a TEMPEST (Transient Electromagnetic Pulse Emanating Surveillance Technology) environment or control zone to reduce electronic noise from devices.

A key consideration inside the building is the location of the data center. Recommendations for location choice include:

- Locate the data center as close as possible to the center of the building.
- Do not locate under water pipes or in any other area that might be subject to flooding or water damage.
- Make sure walls have a minimum fire rating of one hour and go all the way to the true ceiling.
- Reduce the number of inbound doors.
- Have small windows that a human cannot fit through.
- The data server room should be the most restricted area of the facility. Thus, it should be located in an area where security can be easily and thoroughly implemented.

Environmental Monitoring

Environmental conditions have a substantial impact on the reliability and life span of IT equipment. Environmental monitoring should be implemented in server rooms and data centers to ensure the proper function of environmental controls. The goal of environmental monitoring is to maintain environmental conditions and keep them as stable as possible.

Keep in mind the following regarding temperature:

- Heat reduces the life span and reliability of computer equipment.
- Fans and cooling systems on users' desktop, laptop, and notebook computers are usually adequate to keep those types of equipment sufficiently cool.

- Server rooms require special cooling systems due to the high concentration of equipment.
- The optimum temperature for computer equipment is 68 degrees Fahrenheit (20 Celsius).
- There is a variety of environment sensors and software available to monitor the temperature in server rooms and data centers.
- Environmental sensors and software can also help you identify hot spots.
- Temperature sensors are generally located one and a half to two feet above the floor and five to six feet above the floor throughout the room. A variation of more than 12 degrees between low-mounted and high-mounted sensors indicates a problem.

Air flow is an important factor in controlling temperature. Be aware that:

- Fans are a critical component in preventing hot spots in a computer room. There are two type of fans:
  - Fans inside the computer equipment.
  - Room fans, which circulate the air in the room.
- The air exchange rate for a computer room is much higher than for an office area.
  - An office area needs approximately two air changes per hour.
  - A server room needs between 20 and 30 air changes per hour.

Humidity is also an important consideration for server rooms.

- Humidity should be keep within a range of 40 to 65 percent.
  - Too much humidity results in condensation.
  - Too little humidity results in electrostatic discharge (ESD).
  - Depending on the naturally occurring humidity level of your area and the season, you may have to add humidity or use a de-humidifier.
- Avoid large, rapid changes in humidity. Keeping a narrow range of temperature in the computer room will help to avoid condensation.
- Many temperature sensors also monitor humidity.

Although sensors can keep you updated on specific temperature and humidity in the server room, you may want to consider implementing video monitoring. Being able to see what is happening in the server room can alert you to problems before the sensors register the change.

Hot and Cold Aisles

To ensure proper cooling, make sure server rooms have separate ducting or cooling systems from the rest of the building. The use of *hot* and *cold aisles* within the server rooms is an effective method for reducing the temperature of server rooms.

A *cold aisle* is created by having the front of the equipment face toward the center of the aisle. *Hot aisles* have the back of the equipment face the aisle. Air from the cooling system is forced into the cool aisles from underneath and exhausted through the hot aisles overhead. Typically, cold aisles face air conditioner output ducts and hot aisles face air conditioner return ducts. Best practices for hot aisle/cold aisle containment include:

- Install internal fans to bring air into or exhaust it out of individual units to act with, not against, the overall pattern of air flow in the center.
- Locate devices with side or top exhausts in their own part of the datacenter.
- Raise the floor 1.5 feet so that air being pushed by air conditioning equipment can pass through.
- Install automatic doors in the data center.

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