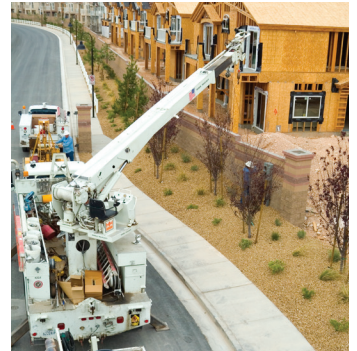


# CUSTOMER SERVICE



## Reliability and Power Quality

## How To Safeguard The Life And Reliable Operation Of Your Home Appliances And Business Equipment

### **Electricity powers our everyday lives.**

From specialized care equipment such as dialysis machines to everyday heating and cooling devices like air conditioners or furnaces and appliances, the impact of a power interruption on consumers can be significant.

NV Energy places the highest priority on providing safe and reliable electric energy to all customers. However, there are situations where disturbances beyond human control cause momentary disruptions or other power quality issues.

This Power Quality brochure outlines the power disturbances that happen in residential, industrial and commercial customers and how to protect against them.



## What Are The Different Types Of Power Disturbances I Can Experience?

There are several types of power disturbances that may affect your home or business. These may or may not impact you, depending on the magnitude, frequency and duration of the event, as well as the sensitivity of your electrical appliance or equipment.

If you have ever experienced any of the following, you may have a power quality concern:

### Residential customers:

- Upon arriving home, you see your digital clocks flashing
- Your personal computers shut down, lock up and/or restart
- Every time your air conditioner turns on, the lights flicker
- Frequent failures of home entertainment equipment, which you suspect to be caused by “power surges”
- The incandescent light bulbs in your home seem to require replacement more often than what you consider normal
- The ground-fault circuit-interrupter (GFCI) receptacle in your bathroom keeps tripping for no apparent reason
- Lights dim or blink

### Industrial and Commercial customers:

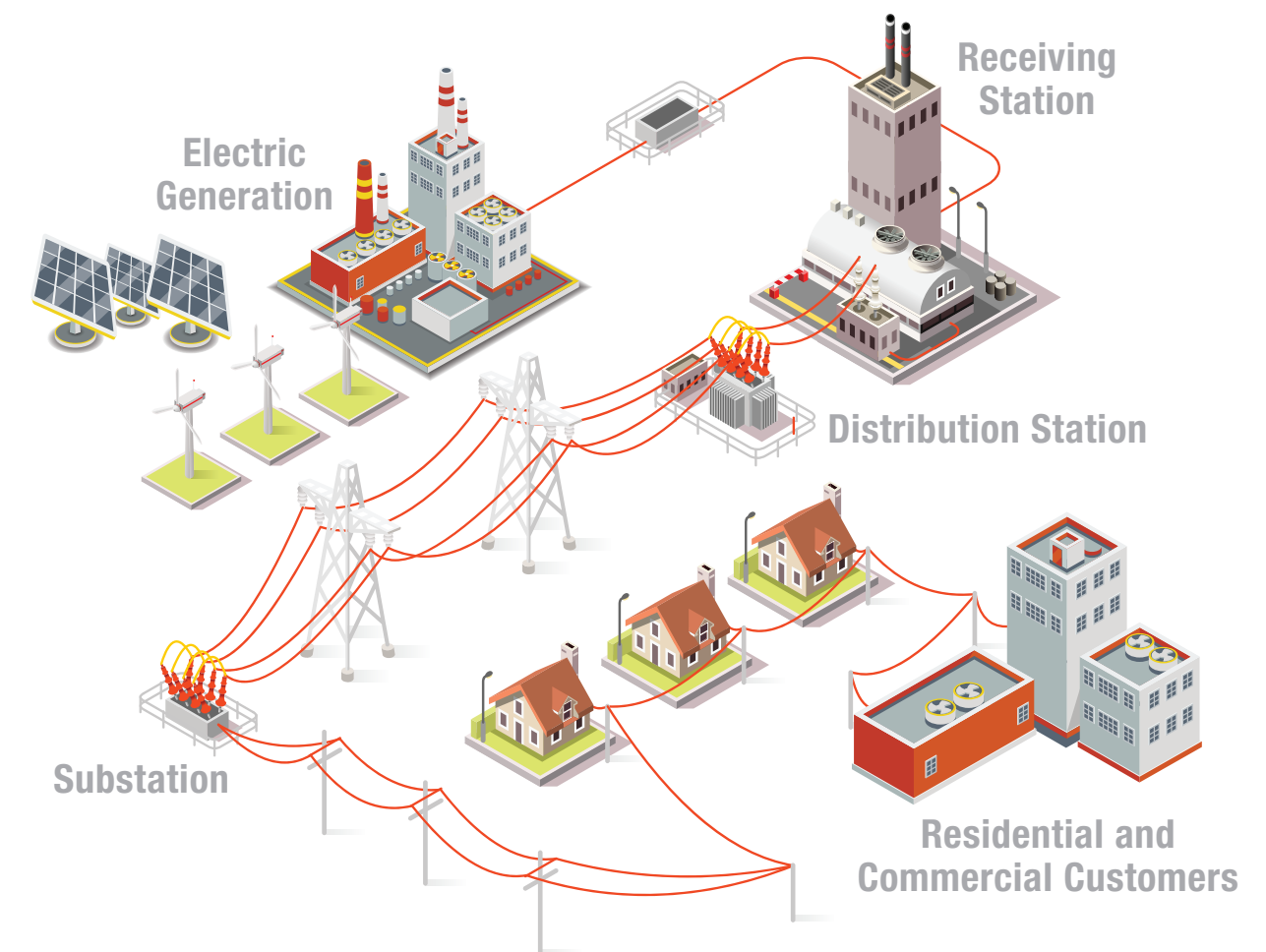
- The motors in your plant trip off-line when there is a “power blip”
- What you consider to be excessively frequent power interruptions are impairing production
- The chillers at your facility frequently trip off-line
- The variable frequency drives (VFD) in your facility trip off-line at the same time
- The operation of one piece of equipment appears to affect the operation of another
- Transformers and other equipment overheat without being overloaded

Events like these are possibly the result of either reliability or power quality related issues. These occurrences may be caused by conditions originating from the utility system, from within your home or facility, or even from the affected equipment itself.

## How Does NV Energy Deliver Electricity?

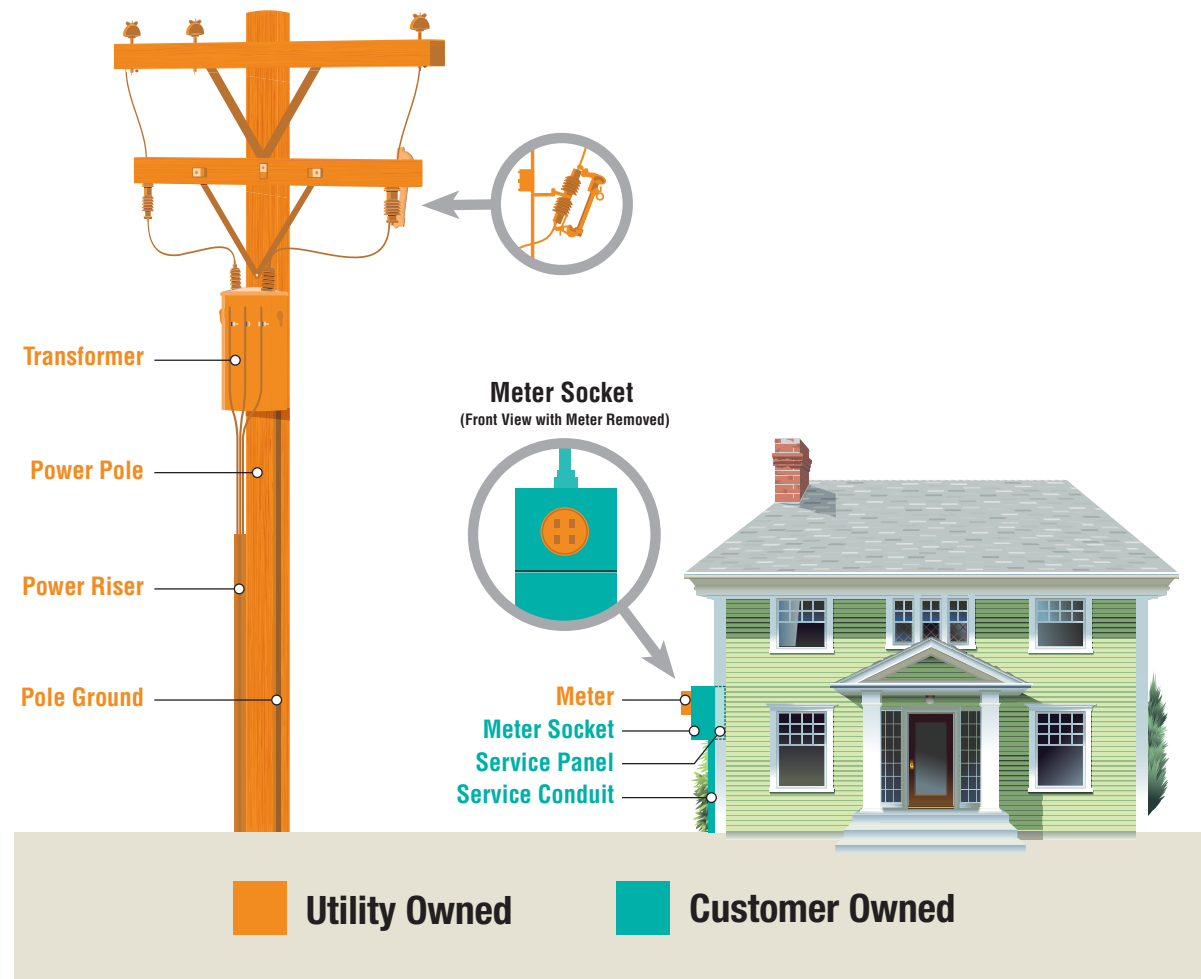
NV Energy operates an extensive, sophisticated generation, transmission and distribution power management system that supplies most of southern and northern Nevada with electricity. This system delivers a reliable supply of power that satisfies national voltage standards. Occasionally however, electric systems experience voltage disturbances from natural or man-made causes (e.g., lightning, wind, cars hitting power poles, etc.) that are impossible to predict or control. These disturbances can interfere with your appliances and even damage some of your more sensitive equipment such as computers. Fortunately, you can use devices to protect this equipment.

The electricity delivered to your home or business is typically generated by solar or wind facilities, or large centralized power plants as illustrated in the figure below. Power then travels over long distances via high voltage overhead transmission lines, which are interconnected in a grid or network configuration. From the overhead transmission lines system, power travels to distribution substations. From these substations, distribution lines, operating at lower voltage levels, disperse the power throughout cities and neighborhoods. For safety reasons, each power line is protected by a circuit breaker in the substation.



Electricity then travels from the distribution line through a service transformer located in close proximity to your home or business. Electricity enters the facility either through overhead or underground service entrance conductors (wires) which connect to the meter. NV Energy gathers meter information on a monthly basis and the information is reported to the billing department. Typically, ownership and responsibility of the service entrance conductors are transferred from NV Energy to the customer near the meter. The location where this transfer of ownership takes place is referred to as the point of service.

From the meter, or point of service, electricity flows along conductors to the main panel which contains the main breaker. The main breaker's (service panel) duty is to provide protection for the home or commercial/industrial facility. In homes, the distribution panel will also contain additional circuit breakers which provide protection for each individual branch circuit. These branch circuits deliver power for lights, appliances and electric outlets within the residence.



## Reliability And Power Quality

**RELIABILITY** refers to the continuity of electric delivery as described by the number and duration of power outages.

**POWER QUALITY** is characterized by electrical disturbances, such as momentary interruptions, voltage sags or swells, flickering lights, transients, harmonic distortion and electrical noise.

Experience on the NV Energy electric system indicates that a majority of electrical disturbances that cause poor power quality come from within a customer's facility. Powering on and off very large equipment, wiring errors, poorly specified or improperly serviced power conversion equipment, grounding loops and even normal daily operations can foster power quality issues that lead to production disturbances and lost data.

Severe weather, utility fault clearing, power line accidents and other external network issues like grid switching or power-factor correction capacitors represent the remaining twenty percent of power quality problems. These disturbances often generate spikes or power interruptions that can instantly damage equipment. Worst of all, these incidents are completely unpredictable and beyond anyone's control.

## NV Energy's Commitment To Reliability And Power Quality

NV Energy is committed to ensuring that the electricity powering your facility is of the highest reliability and quality, meeting or exceeding national standards.

NV Energy has a dedicated team of engineers and technicians that will provide technical analysis and assistance to those customers in need of practical solutions to their power quality and reliability issues. Through the careful application of sophisticated testing and monitoring equipment, NV Energy engineers and technicians will determine the quality of the power entering your facility and will perform measurement and testing up to NV Energy delivery points. Whether there are issues such as flickering lights, equipment tripping offline, total power loss without any apparent cause, or simply performing an electrical service check-up, the team's goal is to provide real-world recommendations as efficiently and effectively as possible. If you are still experiencing problems after NV Energy has verified the quality of the incoming power, you may need the services of a qualified power quality professional to perform an analysis of your facility.



To better understand your needs, the team meets in person at your residence or facility. This site visit ensures that the engineers and technicians assumptions including transformer and size are accurate. Often issues are discovered during the physical inspection that are key to providing effective recommendations.

To gather data on your electrical service, specialized high-speed monitors are utilized. In addition to the typical voltage, load current, and power measurements, these sophisticated devices provides the team with information showing the presence of transient voltage events that may last only a few milliseconds as well as power system harmonics including flow direction. Many other parameters are evaluated to provide an overall picture of the health of the electrical service.

A thorough report graphically showing voltage, current, harmonics, power factor and transients along with detailed explanations of current findings is provided. In addition, recommendations on mitigation techniques and measures that can help reduce electricity service down time are developed. In cases where it is determined a utility-side solution is appropriate, the recommendation will be described, actions to be taken identified, and a resolution time-frame provided.

## Types Of Electrical Disturbances

**INTERRUPTIONS** are a complete loss of power and can last a second or several hours. Equipment failure or damage to power lines from lightning, strong winds, falling tree branches, animal contact or car accidents can cause interruptions. These outages can affect the power to one home, one street or an entire neighborhood.

**MOMENTARY INTERRUPTIONS**, typically last between 0 to 5 minutes, are more frequent on overhead power lines depending on the length of the circuit to your home. Some circuits can cover more than 40 miles, and longer circuits result in greater exposure to power line damage, increasing the chance of interruptions. NV Energy has installed devices to mitigate interruptions or to minimize the duration of the interruption, clearing them within a few seconds. Momentary interruptions may cause a digital clock to blink though many new digital clocks come with battery backup, which helps to avoid a reset when there is an interruption. If you are working on a desktop computer, a momentary interruption may cause loss of data. This can be avoided by utilizing a UPS/battery backup, which can be purchased at a computer supply store.

**SUSTAINED INTERRUPTIONS** typically last more than 5 minutes to several hours. They happen less often on a typical urban circuit where most power lines are underground. In rural areas, electricity is typically transported through overhead lines that are exposed to wind, rain and snow. In rural areas, electric service interruptions are both more frequent and are of longer duration. Again, a UPS/battery backup helps protect you against a complete loss of power.

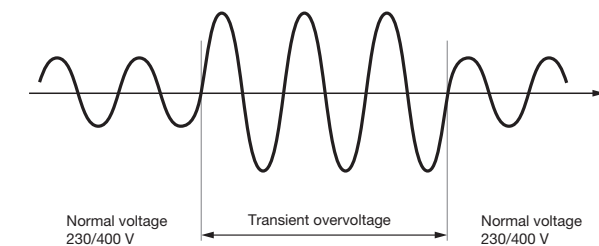
**PLANNED OUTAGES** are an interruption of service taken for maintenance work. NV Energy will inform you and your community in advance of such outages.

**UNEXPECTED OUTAGES** are a sudden interruption of service by bad weather, equipment failure, tree contact, vehicular impact, and other causes.

## Recognizing Electrical Disturbances, Understanding Their Impact, And Selecting The Correct Power Solution

### VOLTAGE TRANSIENTS

Voltage transients, also called spikes and impulses, are the result of sudden massive increases in voltage.



### EFFECTS:

Sensitive electronic equipment is most at risk from these disruptions. A voltage transient may cause system lock-up or failure, which can corrupt or lead to loss of valuable data.

### CAUSE:

Voltage transients can come from outside the facility through lightning strikes, power outages and utility grid switching. They can also originate inside the facility from short circuits, tripped breakers and the start-up of heavy equipment.

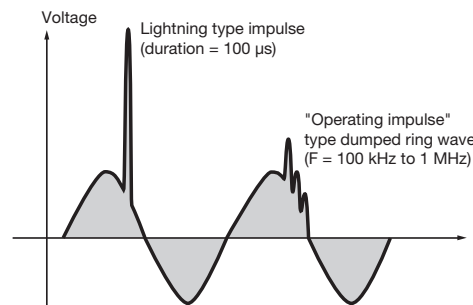
### SOLUTIONS:

Surge Protective Devices  
Power Conditioners  
Isolation Transformers



## VOLTAGE SURGE

A voltage surge, also referred to as an overvoltage or a line swell, is a temporary voltage level increase for durations from a half cycle to a few seconds. These disturbances can also last as long as several cycles.



### EFFECTS:

Surges and swells can lead to significant equipment and hardware damages.

### CAUSE:

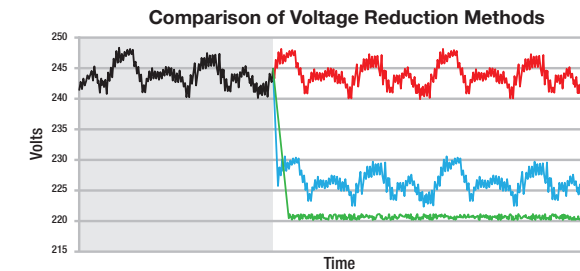
Voltage surges can be caused by large load shut-downs, such as switching off high-power electric motors and the normal cycling of HVAC systems. They can also be caused externally as loads are shed from the utility.

### SOLUTION:

UPS  
Power Conditioners  
Voltage Regulators

## BROWNOUTS

Brownouts, or voltage reductions, are conditions in which the supplied voltage level has been restricted below normal minimum levels for an extended period that may last days. Brownouts are extremely rare on the modern power grid.



### EFFECTS:

Brownouts can negatively impact the efficiency and lifespan of electrical equipment. They can also result in hardware crashes and occasional equipment failure.

### CAUSE:

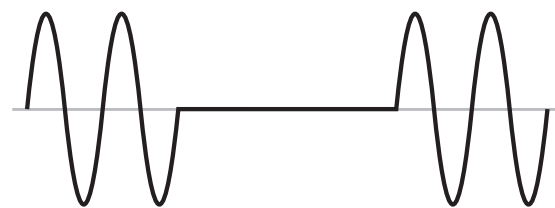
Overcapacity and other network issues can force utilities to intentionally create a brownout condition to compensate for high demand on the electrical power grid.

### SOLUTION:

Voltage Regulators

## POWER INTERRUPTIONS

Power interruptions are a complete loss of voltage for an extended time period.



### EFFECTS:

Power interruptions halt production and can decrease the lifespan of electrical equipment. The sudden nature of most power interruptions can also create hardware failures and crashes in PLCs and other computer-based equipment.

### CAUSE:

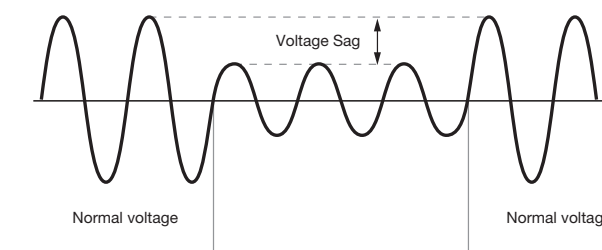
This total power disruption is typically created through an accident or equipment failure in the utility's generation or distribution network.

### SOLUTION:

UPS  
Generators

## VOLTAGE SAGS

Voltage sags, sometimes called undervoltage, are a temporary decrease in the voltage level.



### EFFECTS:

Similar to voltage reductions, repeated exposure to voltage sags can result in hardware failures and crashes in PLCs and other computerized equipment.

### CAUSE:

Voltage sags are a result of large load start-up and utility switching. While short-lived, these disturbances can reduce the efficiency and lifespan of electrical equipment.

### SOLUTION:

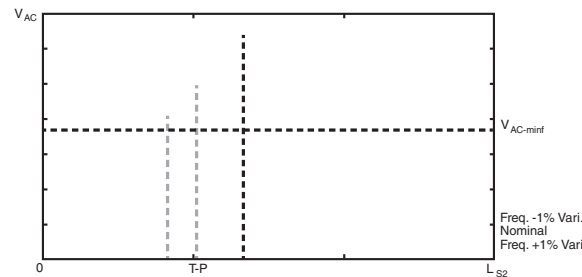
UPS  
Power Conditioners  
Voltage Regulators  
Power Supplies with sag immunity

## FREQUENCY VARIATIONS

While rare in utility power, frequency variations are most common with back-up power systems, such as standby generators.

### EFFECTS:

Frequency variations can cause system crashes and equipment damage, even ones that have UPS protection.



### CAUSE:

Frequency variations can exist if local power generation has poor speed regulations or through faults in the system. This disturbance can also be created by the disconnections of a large block or load or source of generation.

### SOLUTION:

Voltage Regulators  
Power Conditioners

## Power Reliability And Power Quality Are Who's Responsibility? *We All Are Responsible.*

### NV Energy's responsibilities:

- Provide service within Public Service Commission of Nevada guidelines under Rule No. 8 - Continuity Of Service. See appendix A for details.
- Provide steady-state voltage within prescribed parameters. See appendix B for details.

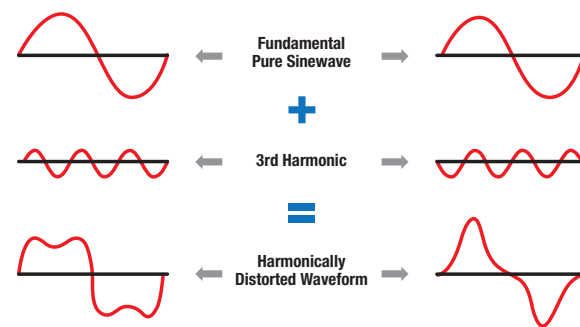
### Customer's responsibilities:

- Check that customer owned electrical facilities are in good operating condition, are sized correctly per the National Electric Code and are compatible with the needs of your equipment and systems.
- If your operations are sensitive to short-term power disturbances, purchase and install surge protection, voltage regulation, ride-through systems, etc. to limit the effect of these disturbances on your equipment.
- Regulate the injection of harmonics and radio/TV interference into the utility distribution system.

## What To Expect From Your NV Energy Delivery Service In Terms Of Power Reliability And Power Quality

## HARMONIC DISTORTION

Voltage distortion is created by multiples of the fundamental frequency (for example, 180 Hz in a 60 Hz system).



### CAUSE:

This sinewave distortion is typically generated by non-linear loads similar to switch mode power supplies used by personal computers, office equipment, variable frequency drives, solar inverters and solid-state electronics.

### SOLUTION:

Drive Isolation Transformers\*  
K-Rated Transformers  
UPS  
Power Conditioners

### EFFECTS:

Harmonics represent trouble for equipment throughout industrial facilities by overheating neutral conductors and transformers, tripping breakers, creating a high neutral current, reducing system capacities and even loosening electrical connectors.

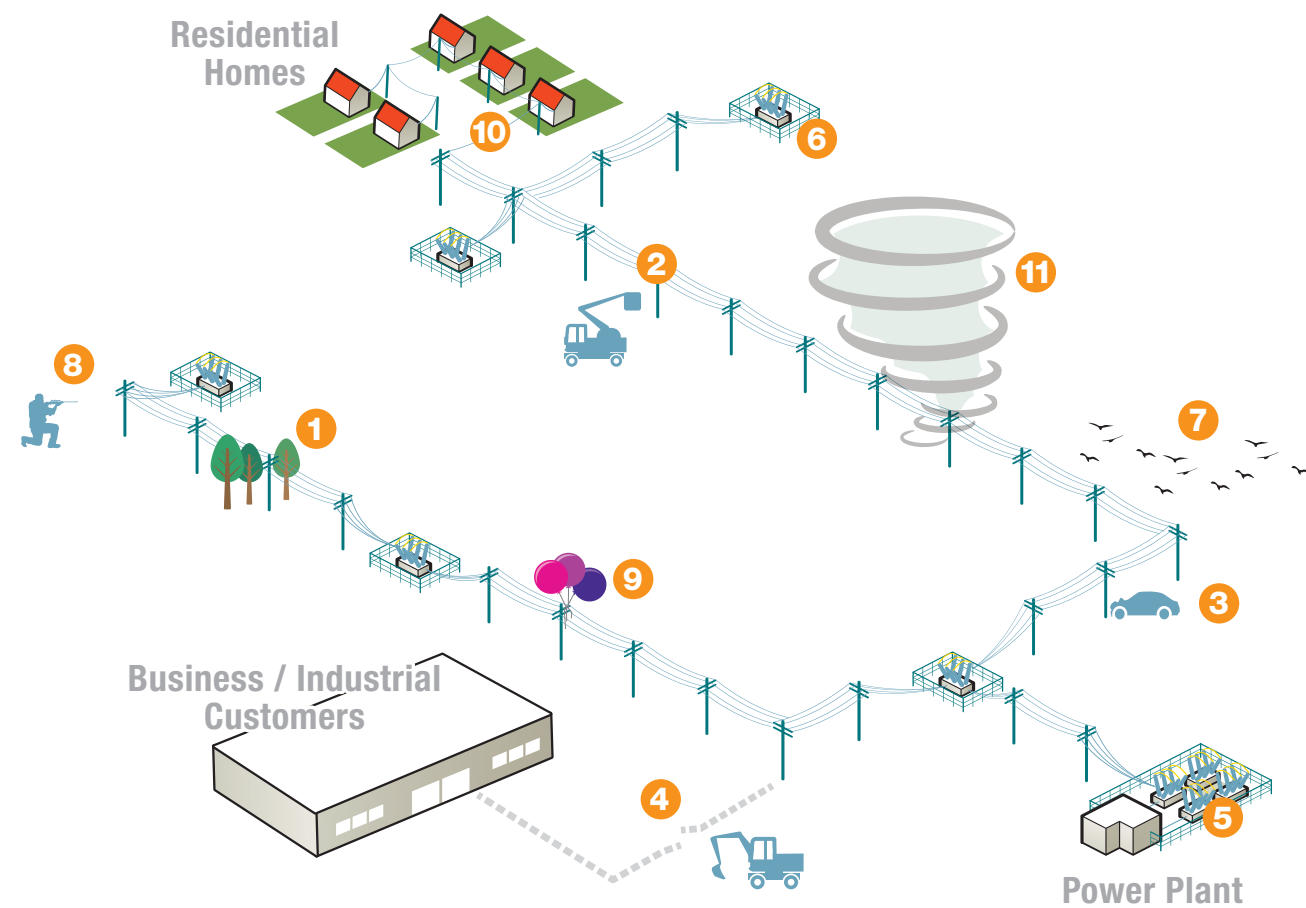
NV Energy is among the best in the nation in providing reliable power. But sometimes outages due to weather and environmental influences, equipment and normal operational conditions or other issues do occur, which can create both power quality and reliability disturbances.

NV Energy embraces a partnership approach with customers on power quality issues to provide the superior electrical service. Information sharing, cooperation and ongoing dialogue between NV Energy and you, and your electrical contractor or on-site electrician is key to successful power quality resolution. Each interested party has a different perspective and knowledge of certain factors that may not be known by the others. For example:

- NV Energy may have temporarily switched your facility or residence to an alternate circuit
- You may have added new equipment that is highly sensitive to voltage fluctuations or is inducing power quality issues
- Your electrician/electrical contractor may have revised the grounding scheme for a line of machine tools

Common sources of disturbances include the following and are illustrated in the figure below:

1. Trees and Vegetation
2. Overhead Conductor Down
3. Vehicular Impact
4. Dig-in on Underground Cable
5. Switching and Maintenance
6. Equipment failures
7. Birds and other wildlife
8. Vandalism
9. Mylar Balloons
10. Equipment Overload
11. Weather/Environmental Influences



## NV Energy Powering Up

Here are the typical activities we undertake to restore power as illustrated in the figure below:

1. Clear downed power lines and ensure they are safely de-energized.
2. Restore power to critical services and the greatest number of people as quickly as possible through High Voltage Transmission lines that keep hundreds of substations energized.
3. Restore power to Distribution Substations that convert high-voltage power to voltage levels for residential or commercial use.
4. Restore power to concentrated areas through distribution lines and tap lines. Distribution lines travel from the substations to neighborhoods and typically serve between 1,000 to 3,000 customers.
5. Restore power to tap lines that feed into pockets of 20 to 30 homes. Reroute power to restore as many customers as possible while making repairs.
6. Restore power to individual (typically suburban or rural) homes and businesses.

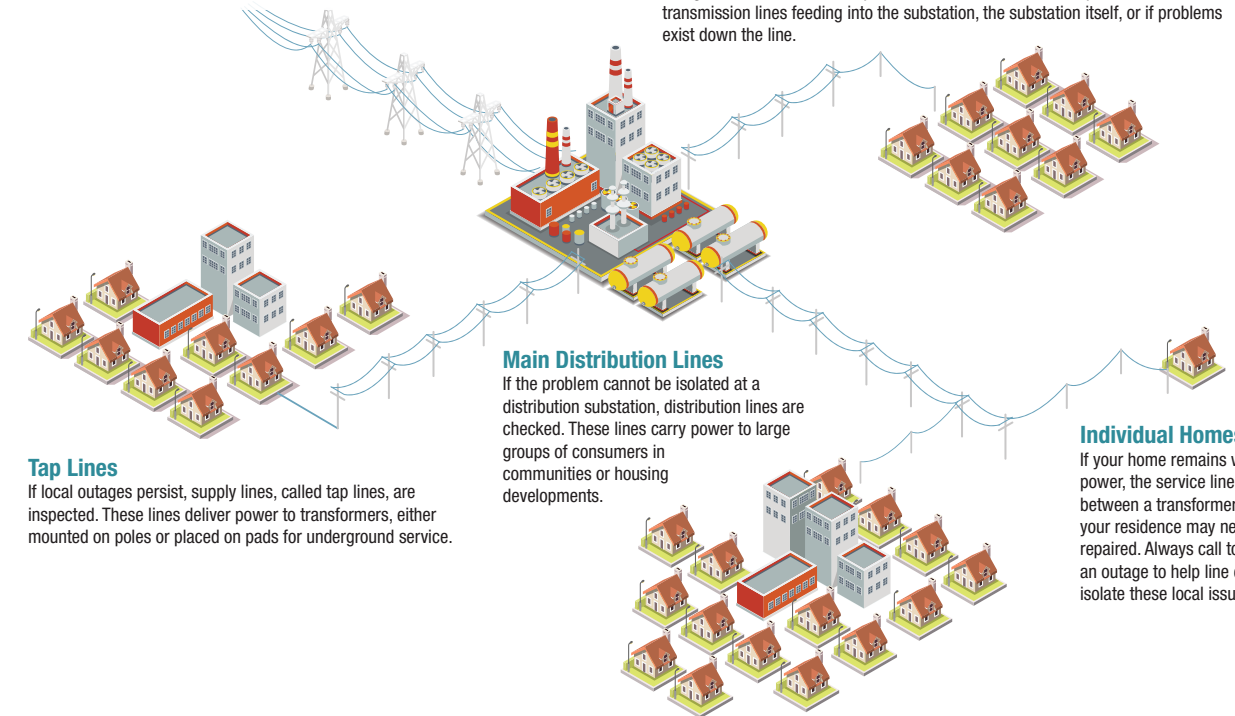
When an outage occurs, line crews work to pinpoint problems

### High-Voltage Transmission Lines

Transmission towers and cables that supply power to transmission substations (and thousands of customers) rarely fail, but when damage occurs, these facilities must be repaired before other parts of the system can operate.

### High-Voltage Transmission Lines

Each substation serves hundreds or thousands of customers. When a major outage occurs, line crews inspect substations to determine if problems stem from transmission lines feeding into the substation, the substation itself, or if problems exist down the line.



### Tap Lines

If local outages persist, supply lines, called tap lines, are inspected. These lines deliver power to transformers, either mounted on poles or placed on pads for underground service.

### Main Distribution Lines

If the problem cannot be isolated at a distribution substation, distribution lines are checked. These lines carry power to large groups of consumers in communities or housing developments.

### Individual Homes

If your home remains without power, the service line between a transformer and your residence may need to be repaired. Always call to report an outage to help line crews isolate these local issues.

NV Energy takes pride in maintaining a high level of reliability and ensuring a safe and stable energy supply while continually finding ways to improve the value for our customers.



## Contact Us

Please contact us whenever we can help you with power quality or any energy service issues.

Call your NV Energy representative or contact Main Customer Service with the following telephone numbers below:

### **Southern Nevada**

#### **Main Customer Service**

24 hours a day / 7 days per week  
(702) 402-5555  
CustomerService@nvenergy.com

#### **Para Servicio en Español (24/7)**

(702) 402-5554  
(800) 331-3103 - Toll Free  
711 - TTY Sensory Impaired

#### **Outage/Emergencies**

(702) 402-2900 - 24 hours a day  
(702) 402-4102 - Tree Trimming  
To request Tree Trimming, call  
(702) 402 - 5555

#### **Business Solutions Center**

Monday thru Friday • 7 a.m. to 6 p.m  
(702) 402-1000  
(866) 791-0345 - Toll Free  
BusinessServices@nvenergy.com

### **Northern Nevada**

#### **Main Customer Service**

24 hours a day / 7 days per week  
(775) 834-4444  
NevadaTeam@nvenergy.com

#### **Para Servicio en Español**

(775) 834-4700  
(800) 962-0399 - Toll Free  
711 - TTY Sensory Impaired

#### **Outage/Emergencies**

(775) 834-4100 - 24 hours a day  
(775) 834-5589 - Tree Trimming  
To request Tree Trimming, call  
(705) 834 - 4444

#### **Business Solutions Center**

Monday thru Friday • 7 a.m. to 6 p.m  
(775) 473-6998  
(877) 377-6387 - Toll Free  
BusinessServices@nvenergy.com

## Appendix A

The following summarizes certain key points related to power quality within the Public Utilities Commission of Nevada regulations that govern NV Energy.

### **Rule No. 8**

#### **CONTINUITY OF SERVICE**

##### **A. Shortage and Interruption**

The Utility will exercise reasonable diligence to furnish a continuous and sufficient supply of electricity to its Customers and to avoid any shortage or interruption of delivery thereof. It cannot, however, guarantee complete freedom from interruption.

The Utility will not be liable for interruptions or shortage of supply, nor for any loss or damage occasioned thereby, unless occasioned by negligence or wrongful act of the Utility.

##### **B. Temporary Suspension for Repairs**

The Utility will have the right to suspend service temporarily for the purpose of making necessary repairs or improvements to its system. When this becomes necessary, it will give to the Customers who may be affected as reasonable notice thereof as circumstances will permit, and will prosecute the work with reasonable diligence.

##### **C. Apportionment of Supply During Time of Shortage**

During times of shortage of supply, the Utility will apportion its available supply of electricity among its customers as directed by the Public Service Commission. In the absence of directions from the Commission it will apportion the supply in the manner that appears most equitable under conditions then prevailing.



## Appendix B

### Sustained Distribution Service Voltage Levels

NV Energy's distribution system should be planned, designed, and operated such that most service voltages are within Range A of ANSI C84.1-2011. The applicable voltage ranges are shown in Table 1 below.

**Table 1: NV Energy Sustained Distribution Service Voltage Ranges (in Volts) <sup>1</sup>**

Nominal Voltage	RANGE A		RANGE B	
	Minimum Voltage	Maximum Voltage	Minimum Voltage	Maximum Voltage
120	114	126	110	127
208	197	218	191	220
240	228	252	220	254
277	263	291	254	293
480	456	504	440	508
2400	2340	2520	2280	2540
4160	4050	4370	3950	4400
7200	7020	7560	6840	7620
12470	12160	13090	11850	13200
14400	14040	15120	13680	15240
19920	19420	20920	18930	21080
24940	24320	26190	23690	26400
34500	33640	36230	32780	36510

The following applies to the voltage ranges in Table 1:

- The limits in the table apply to Sustained Voltage levels and not to momentary voltage excursions that may result from such causes as switching operations, motor starting currents, and similar conditions.
- The occurrence of Service Voltages outside of Range A should be infrequent <sup>2</sup>.
- Range B includes voltages above and below Range A limits that necessarily result from practical design and operating conditions. Such voltages in Range B (those outside of Range A) will be limited in extent, frequency, and duration. Based upon the extent, frequency, or duration of the event(s), when they do occur, corrective measures may be undertaken within a reasonable time in order to strive to meet the Range A voltages listed in Table 1 above.

- It is the responsibility of the customer to insure their Utilization Equipment is designed and rated to give full satisfactory performance throughout all of Range A. Insofar as practicable, customer utilization equipment should be designed to give acceptable performance throughout all of Range B.
- Utilization Equipment does not generally operate directly at the voltages listed that are in excess of 7200 volts nominal. For service voltages in these ranges, it is assumed that the listed service voltage ranges will result in Utilization Equipment being served through additional transformers at voltages that are within acceptable voltage ranges.

<sup>1</sup> Voltage values taken directly from ANSI C84.1-2011, Table 1 – Standard nominal system voltages and voltage ranges.

<sup>2</sup> ANSI C84.1-2011 does not define what determines that voltages outside of Range A are infrequent.

