Duke Energy Nuclear Media Guide

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This Media Guide is intended to serve as a reference for Duke Energy’s nuclear facilities. Additionally, this guide provides an overview of nuclear generation, the benefits of nuclear power, safety and security, emergency planning, nuclear physics, used nuclear fuel, radiation and other topics.

Duke Energy is committed to the safe operation of its nuclear fleet. Our goal is to protect the health and safety of our neighbors, employees and the environment as well as provide accurate information to the news media and public.

You can reach Duke Energy 24 hours a day through our Media Line: 800-559-3853 (DUKE).

This Media Guide provides information that can help you when covering Duke Energy’s nuclear fleet or the nuclear industry. We recognize the challenges of covering news related to nuclear energy, and we appreciate your important role in providing timely and accurate information to the public.

Should an actual emergency occur at any of our nuclear stations, you can reach Duke Energy for information by calling 800-559-3853. If needed, a media center would be opened based on the location of the affected station:

- Brunswick Media Center located at 1623 Village Road NE, Leland, N.C.
- Catawba Media Center in O.J. Miller Auditorium at the Energy Center located at 526 S. Church St., Charlotte, N.C.
- Harris Media Center in the N.C. Regional Headquarters located at 411 Fayetteville St., Raleigh, N.C.
- McGuire Media Center in O.J. Miller Auditorium at the Energy Center located at 526 S. Church St., Charlotte, N.C.
- Oconee Media Center located at 664 Issaqueena Trail, Central, S.C.
- Robinson Media Center located at 1755 Mechanicsville Road, Florence, S.C.

Thank you for taking time to review the Duke Energy Nuclear Media Guide. If you have any questions about Duke Energy’s nuclear fleet or the nuclear industry, please contact us.
Headquartered in Charlotte, N.C., Duke Energy Corporation is the largest electric power holding company in the United States, supplying and delivering energy to approximately 7.4 million U.S. electric and 1.5 million gas distribution customers. A Fortune 125 company, Duke Energy is traded on the New York Stock Exchange under the symbol DUK.

Duke Energy operates 11 nuclear units at six sites in the Carolinas. The combined generating capability of these facilities is approximately 10,719 megawatts. Duke Energy’s nuclear fleet generates approximately half of the electricity provided to its customers in the Carolinas, with production costs among the lowest in the nation.

The mission of Duke Energy’s Nuclear Generation organization is to produce electricity safely, reliably and cost-efficiently with an overriding value of protecting public health and safety. Our stations are designed, built and operated for safety and security, with multiple barriers and redundant safety systems to protect the public, station workers and the environment.

Nuclear energy has been a part of Duke Energy’s diverse fuel mix for more than 40 years, setting industry benchmarks for safety, reliability and efficiency. The Harris Nuclear Plant, McGuire Nuclear Station and Oconee Nuclear Station feature energy education centers, which serve as strong links between the stations and neighboring communities.

**Duke Energy Nuclear Facilities:**

<table>
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<tr>
<th>Plant</th>
<th>Capacity</th>
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<td>Brunswick Nuclear Plant</td>
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<td>Catawba Nuclear Station</td>
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<td>McGuire Nuclear Station</td>
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<td>1973</td>
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<tr>
<td>Robinson Nuclear Plant</td>
<td>741 megawatts</td>
<td>Hartsville, S.C.</td>
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</tbody>
</table>
News Media Contacts

Duke Energy and Nuclear Site Media Relations Contact Information

- Duke Energy 24-Hour Media Line: 800-559-3853 (DUKE)
- Brunswick Site Representative: 910-457-2900
- Catawba Site Representative: 800-777-0006, option 1
- Harris Site Representative: 919-362-2160
- McGuire Site Representative: 800-777-0003, option 1
- Oconee Site Representative: 800-777-1004, option 1
- Robinson Site Representative: 843-857-5291

Media Centers - Activated to Support Events

- Brunswick Media Center
  1623 Village Road NE
  Leland, NC 28451

- Duke Energy Catawba/McGuire Media Center
  526 S. Church St.
  Charlotte, NC 28202-1904

- Duke Energy Harris Media Center
  160 Rush St.
  Raleigh, NC 27603

- Duke Energy Oconee Media Center
  664 Issaqueena Trail
  Central, SC 29630-4434

- Duke Energy Robinson Media Center
  1755 Mechanicsville Road
  Florence, SC 29501

*Media outlets will be informed if these facilities are activated following an emergency declaration at a Duke Energy nuclear station. If activated, the media should call Duke Energy’s 24-hour media line: 800-559-3853 (DUKE).*

Federal, State and Local Agencies

Federal agencies:

- Nuclear Regulatory Commission
  [www.nrc.gov](http://www.nrc.gov)
  Public Affairs, Region II, Atlanta, Ga.
  404-997-4000 or 800-577-8510 (business hours)
  301-816-5100 (after hours, call the Operations Center in Rockville, MD)

- Federal Emergency Management Agency (FEMA)
  [www.fema.gov](http://www.fema.gov)
  770-220-5226 (news media)
  770-220-5200 (24 hours)
State agencies:

- North Carolina Division of Emergency Management: [www.ncem.org](http://www.ncem.org) 919-733-3300; 800-858-0368
- North Carolina Department of Health and Human Services: [www.ncdhhs.gov](http://www.ncdhhs.gov) 919-855-4800; 800-662-7030
- South Carolina Emergency Management Division: [www.scemd.org](http://www.scemd.org) 803-737-8500
- South Carolina Department of Health and Environmental Control: [www.scdhec.gov](http://www.scdhec.gov) 803-898-3432

Local Emergency Management Agencies

Brunswick Nuclear Plant
- [Brunswick County Emergency Management](#) 910-253-5383
- [New Hanover County Emergency Management](#) 910-798-6800

Catawba Nuclear Station
- [York County Emergency Management](#) 803-326-2300 (24 hours)
- 803-818-5212 (Clover, Lake Wylie and Bethel)
- [Charlotte-Mecklenburg County Emergency Management](#) 704-336-2412 (business hours)
- 704-336-2441 (after hours)
- [Gaston County Emergency Management](#) 704-866-3350 (business hours)
- 704-866-3300 (after hours)

Harris Nuclear Plant
- [Chatham County Emergency Management](#) 919-542-2911
- [Harnett County Emergency Management](#) 910-893-7580 (business hours)
- 910-893-9111 (after hours - Sheriff)
- [Lee County Office Of Emergency Management](#) 919-718-4670 (business hours)
- 919-775-5531 (after hours - Sheriff)
- 919-775-8268 (after hours - Sanford Police)
- [Wake County Emergency Management](#) 919-856-6480

McGuire Nuclear Station
- [Charlotte-Mecklenburg County Emergency Management](#) 704-336-2412 (business hours)
- 704-336-2441 (after hours)
- [Gaston County Emergency Management](#) 704-866-3350 (business hours)
- 704-866-3300 (after hours)
- [Iredell County Emergency Management](#) 704-878-5353 (business hours)
- 704-878-3039 (after hours)
- [Lincoln County Emergency Management](#) 704-738-8660 (business hours)
- 704-735-8202 (after hours)
- [Catawba County Emergency Services](#) 828-465-8230 (business hours)
- 828-464-3112 (after hours)

Oconee Nuclear Station
- [Oconee County Emergency Management](#) 864-638-4200
Pickens County Emergency Management
864-898-5945 (business hours)
864-898-5500 (after hours)
Robinson Nuclear Plant

Chesterfield County Office of Emergency Management
843-623-3362

Darlington County Emergency Management
843-398-4450

Florence County Emergency Management
843-665-7255

Lee County Emergency Management
803-484-5274

Industry Organizations

Nuclear Energy Institute (NEI)
www.nei.org
202-739-8000

American Nuclear Society (ANS)
www.ans.org
800-323-3044

Electric Power Research Institute (EPRI)
www.epri.com
800-313-3774
Visiting a Duke Energy Nuclear Facility

To request a nuclear site visit, call Duke Energy's media line at 800-559-3853 (DUKE). The appropriate media contact will call you for more details regarding the business purpose for the visit and will submit the request to site staff for consideration. Requests for visits to nuclear stations must go through a stringent review and approval process and generally cannot be approved on short notice.

If you would like to request video (B-roll) or a photo opportunity at a Duke Energy facility, please contact Duke Energy’s 24-hour media line at 800-559-3853 (DUKE).

**Duke Energy Nuclear Energy Education Centers**

Duke Energy provides energy education centers at three of its nuclear stations. The Energy and Environmental Center at Harris, the EnergyExplorium at McGuire and the World of Energy at Oconee serve as strong links between the stations and their communities. Each year, thousands of people visit these facilities to learn more about nuclear power and Duke Energy.

The three centers feature hands-on educational exhibits and resources for anyone interested in learning more about electricity and the benefits of nuclear power. In addition to educational opportunities, the EnergyExplorium and World of Energy feature a nature trail, picnic facility and butterfly garden. These facilities also regularly host free, family-friendly events.

All activities are free at the education centers.

**Energy and Environmental Center at Harris Nuclear Plant**

Phone: 984-229-6261  
Email: harris.plant@duke-energy.com  
Address: 3932 New Hill Holleman Road  
New Hill, NC 27562  
Hours: Individual and group visits are arranged by appointment only and are scheduled Monday through Friday, 9 a.m. to 5 p.m.

**EnergyExplorium at McGuire Nuclear Station**

Phone: 800-777-0003  
Email: energyexplorium@duke-energy.com  
Address: 13339 Hagers Ferry Road  
Huntersville, NC 28078  
Hours: Individual and group visits are arranged by appointment only and are scheduled Monday through Friday, 9 a.m. to 5 p.m.

**World of Energy at Oconee Nuclear Station**

Phone: 800-777-1004  
Email: worldofenergy@duke-energy.com  
Address: 7812 Rochester Highway  
Seneca, SC 29672  
Hours: Monday through Friday, 9 a.m. to 5 p.m. Reservations recommended for group visits.  
Closed: Saturday, Sunday and some holidays

**Nuclear Information Center (NIC)**

Please take a moment to visit the NIC, Duke Energy’s nuclear blog. The NIC features stories about nuclear plant operations, industry news, environmental stewardship, nuclear energy careers, community volunteerism, emergency planning and more.

**Web Address:** nuclear.duke-energy.com

*Images of Energy and Environmental Center, EnergyExplorium, World of Energy*
Duke Energy is committed to the safe, secure operation of its nuclear stations. A combination of well-trained personnel, physical barriers, advanced surveillance equipment, diverse and redundant safety systems and many other features ensure the safe operation of these stations. Beyond these safeguards, each station has detailed plans for handling emergencies, no matter how unlikely. These plans are closely coordinated and practiced with county, state and federal officials on a regular basis.

Neighbors living within the 10-mile emergency planning zone (EPZ) around nuclear stations receive emergency planning information annually in the form of a calendar, brochure or other documents mailed to their homes. In addition, nuclear informational brochures are shared with local schools and businesses/organizations such as hotels, motels, marinas and post offices that come in contact with “transient” populations. Media outlets around our nuclear stations receive information regarding our operations. Additional emergency planning information can be found on Duke Energy’s website at: https://www.duke-energy.com/safety-and-preparedness/nuclear-safety.

Duke Energy is responsible for managing any problem at its nuclear stations and would immediately notify federal, state and local authorities per its plan and procedures. These officials would then notify the public if any action is necessary.

**Emergency Classifications**

The NRC has established four classifications to describe a nuclear emergency. Duke Energy would contact federal, state and local authorities based on these classifications:

**Unusual Event**

This is the least serious of the four emergency classifications. It means there is a potential security concern or a minor operational or potential operational problem at the plant. There is no danger to the public and no public action is needed.

**Alert**

This is an operational or security event that could reduce the level of safety at the plant. There is no danger to the public. State, county and Duke Energy officials would prepare their emergency response centers and be ready to respond to the event and share information with the public.

**Site Area Emergency**

This event could involve a security incident or a major problem with plant systems that may reduce the level of safety at the plant. Any radioactive release beyond the site boundary would not be expected to exceed Environmental Protection Agency (EPA) guidelines. Emergency sirens may sound alerting the public to listen to their local emergency alert radio or television stations for information and instructions.

**General Emergency**

This is the most serious security or operational event that could occur at the plant. There may be a release of radiation associated with the event that may exceed EPA guidelines. State and county officials would take action to protect the public. Sirens may sound. Local radio and television stations would provide instructions to people living in the affected areas. Those affected may be told to stay inside, shelter in place, evacuate and/or take potassium iodide (KI).

Additional information on nuclear emergency response can be found at the NRC Website: www.nrc.gov/about-nrc/emerg-preparedness.html
Key Emergency Planning Terms

Public Protective Actions

In the unlikely event of a nuclear station incident, the public may be instructed to shelter (i.e., stay indoors), evacuate or take potassium iodide (KI). Current nuclear emergency planning programs are built on the premise that evacuation is the preferred protective action. County and state emergency management officials are responsible for making public protective action decisions and providing information to the public, no matter the type of emergency.

Warning Sirens

Emergency warning sirens are located throughout each nuclear station’s EPZ. Duke Energy installed the sirens after consultation with county emergency management officials. To ensure the sirens operate properly, they are tested in various ways on a weekly and quarterly basis. Testing is part of a formal maintenance program and requires no public action. Full sounding, three-minute test dates are noted in annual emergency planning brochures/calendars mailed to EPZ residents.

Warning sirens are for outdoor notification and only sounded at the direction of county/state emergency officials. If a siren sounds repeatedly, the public should listen to a local radio or television station to hear emergency information. Hearing a siren does not mean anyone should evacuate. The emergency information carried on the radio and television will provide what actions, if any, the public should take.

Potassium Iodide (KI)

KI is a non-prescription drug similar to iodized table salt. KI may prevent the thyroid gland from absorbing radioactive iodine and is one protective action that state or county officials may recommend during a nuclear emergency. KI is available to residents living within 10 miles of a nuclear station through county health departments.

KI should only be taken at the direction of state and county public health officials. Emergency information on the radio and television will advise the public when and how long to take KI, if it is needed.

For more KI information, visit:
- https://emergency.cdc.gov/radiation/ki.asp
- www.scdhec.gov/HomeAndEnvironment/DisasterPreparedness/RadiationNuclearSafety/PotassiumIodide
The two-unit Brunswick Nuclear Plant is located approximately two miles north of Southport, N.C. This was the first nuclear power plant built in North Carolina. Unit 2 began commercial operation in 1975 and unit 1 in 1977.

Brunswick Nuclear Plant has a total generating capacity of 1,870 megawatts, enough electricity to power more than 1 million homes.

Duke Energy nuclear power plants operate at a very high level of safety and security every day. Brunswick was designed and built with redundant safety systems and multiple barriers to protect the public, plant workers and the environment.

**Brunswick Nuclear Plant Quick Facts**

- **Owner:** Duke Energy
- **Operator:** Duke Energy
- **Location:** Southport, N.C.
- **Plant capacity:** 1,870 megawatts
- **Number of units:** 2
- **Groundbreaking:** 1970
- **Commercial operation:** unit 1 – 1977; unit 2 – 1975
- **Reactor type:** boiling water reactor
- **Fuel:** uranium dioxide
Catawba Nuclear Station is located on Lake Wylie in York County, S.C. Lake Wylie, created in 1904, is the oldest lake on the Catawba River and provides cooling water for both Catawba Nuclear Station and Allen Steam Station.


Duke Energy nuclear power plants operate at a very high level of safety and security every day. Catawba Nuclear Station was designed and built with redundant safety systems and multiple barriers to protect the public, plant workers and the environment.

**Catawba Nuclear Station Quick Facts**

- Owners:
  - Unit 1: 61.5 percent owned by North Carolina Electric Membership Corporation; 38.5 percent by Duke Energy
  - Unit 2: 75 percent owned by North Carolina Municipal Power Agency Number One; 25 percent by Piedmont Municipal Power Agency
- Operator: Duke Energy
- Location: York County, S.C.
- Station capacity: 2,310 megawatts
- Number of units: 2
- Groundbreaking: 1974
- Commercial operation: unit 1 – 1985; unit 2 – 1986
- Reactor type: pressurized water reactor
- Fuel: uranium dioxide
Harris Nuclear Plant

The single-unit Harris Nuclear Plant is located in New Hill, N.C. It is approximately 22 miles southwest of Raleigh, N.C.

Harris Nuclear Plant has a total generating capacity of 928 megawatts and began commercial operation in 1987. It can generate enough electricity to power more than a million homes.

Duke Energy nuclear power plants operate at a very high level of safety and security every day. Harris was designed and built with redundant safety systems and multiple barriers to protect the public, plant workers and the environment.

**Harris Nuclear Plant Quick Facts**

- Owner: Duke Energy
- Operator: Duke Energy
- Location: New Hill, N.C.
- Plant capacity: 928 megawatts
- Number of units: 1
- Groundbreaking: 1978
- Commercial operation: unit 1 – 1987
- Reactor type: pressurized water reactor
- Fuel: uranium dioxide
McGuire Nuclear Station

McGuire Nuclear Station is located on Lake Norman in Mecklenburg County, N.C. Lake Norman — the state’s largest manmade lake — was built by Duke Energy in 1963 by damming the Catawba River with Cowans Ford Hydroelectric Station. The lake provides cooling water for both McGuire Nuclear Station and Marshall Steam Station.

Unit 1 at McGuire Nuclear Station began commercial operation in 1981, followed by unit 2 in 1984.

Duke Energy nuclear power plants operate at a very high level of safety and security every day. McGuire was designed and built with redundant safety systems and multiple barriers to protect the public, plant workers and the environment.

**McGuire Nuclear Station Quick Facts**

- **Owner:** Duke Energy
- **Operator:** Duke Energy
- **Location:** Mecklenburg County, N.C.
- **Station capacity:** 2,316 megawatts
- **Number of units:** 2
- **Groundbreaking:** 1971
- **Commercial operation:** unit 1 – 1981; unit 2 – 1984
- **Reactor type:** pressurized water reactor
- **Fuel:** uranium dioxide
Oconee Nuclear Station is located on Lake Keowee in Oconee County, S.C., eight miles north of Seneca, S.C. Unit 1 began commercial operation in 1973, followed by units 2 and 3 in 1974.

Since it began operating, Oconee has safely and reliably generated more than 500 million megawatt-hours of electricity — the first nuclear plant in the United States to achieve this milestone. Oconee is one of the nation’s largest nuclear stations with a generating capacity of approximately 2.6 million kilowatts. This is enough electricity to power 1.9 million homes.

Oconee earned the distinction of being the second nuclear station in the country to have its licenses renewed by the Nuclear Regulatory Commission (NRC) for an additional 20 years. All U.S. reactors are initially licensed by the NRC for 40 years.

Duke Energy nuclear power plants operate at a very high level of safety and security every day. Oconee was designed and built with redundant safety systems and multiple barriers to protect the public, plant workers and the environment.

Oconee Nuclear Station Quick Facts

- Owner: Duke Energy
- Operator: Duke Energy
- Location: Oconee County, S.C.
- Station capacity: 2,554 megawatts
- Number of units: 3
- Groundbreaking: 1967
- Commercial operation: unit 1 – 1973; units 2 and 3 – 1974
- Reactor type: pressurized water reactor
- Fuel: uranium dioxide
The single-unit Robinson Nuclear Plant is located on Lake Robinson near Hartsville, S.C. The Robinson nuclear unit began commercial operation in 1971.

The 2,250-acre Lake Robinson was created by the company to provide cooling water for the nuclear unit.

Duke Energy nuclear power plants operate at a very high level of safety and security every day. Robinson was designed and built with redundant safety systems and multiple barriers to protect the public, plant workers and the environment.

**Robinson Nuclear Plant** Quick Facts

- Owner: Duke Energy
- Operator: Duke Energy
- Location: Hartsville, S.C.
- Plant capacity: 741 megawatts
- Number of units: 1
- Groundbreaking: 1967
- Commercial operation: 1971
- Reactor type: pressurized water reactor
- Fuel: uranium dioxide
Advantages of Nuclear Power

Nuclear power is a safe, reliable and clean source of energy — affordably generating approximately 20 percent of America’s electricity.

Today, 99 nuclear reactors operate in 30 states. Some states, such as South Carolina, generate more than 50 percent of its electricity from nuclear power. Duke Energy operates 11 nuclear units in two states — Brunswick in Southport, N.C.; Catawba in York, S.C.; Harris in New Hill, N.C.; McGuire in Huntersville, N.C.; Oconee in Seneca, S.C.; and Robinson in Hartsville, S.C.

Safety and security are the highest priority for Duke Energy’s nuclear fleet as well as the U.S. nuclear industry. Nuclear stations are designed, built and operated according to extensive safety and security requirements - strictly regulated by the NRC - to protect the public, station workers and the environment.

Nuclear stations can reliably generate large amounts of electricity around the clock to meet customer energy needs. In fact, nuclear power provides electricity to one in five businesses and homes in the U.S. Nuclear stations are also a low-cost provider of large-scale electricity 24 hours a day (baseload generation) for about 3.50 cents per kilowatt-hour.

Nuclear energy is one of the cleanest fuel sources, accounting for 62.4 percent of all emission-free electricity generated. Nuclear energy produces no carbon dioxide, sulfur dioxide or nitrogen oxide. Nuclear stations are important to a clean energy mix, providing a steady base to back up intermittent renewables like solar, hydro and wind power.

The U.S. Department of Energy predicts the U.S. will need 22 percent more electricity by 2040. To meet this increased demand, we will need to generate more electricity than we do today to produce food, to power factories and to drive productivity.

Coal, natural gas, hydroelectric, solar power, geothermal energy, wind power and biomass are important to the nation’s energy mix. However, we are unable to meet our energy needs around the clock with renewable energy sources only, making nuclear energy an attractive source of baseload generation.

Nuclear energy currently plays a key role in meeting our nation’s electricity needs and will continue to be an important energy source for the world in years to come.

Safety and Security of Nuclear Stations

Duke Energy, along with the U.S. nuclear industry, is committed to ensuring the safe, secure operation of our nation’s nuclear stations every day.

Nuclear Safety

Nuclear stations are among the safest and most secure facilities in the world. Industry organizations promote safety and excellence in the operation of commercial nuclear power plants. The NRC provides strong safety oversight and regulation of the industry, as well.

Nuclear stations are built to withstand a variety of external forces, including hurricanes, tornadoes, fires, floods and earthquakes. Nuclear stations are constructed to withstand earthquakes of the magnitude equivalent to or greater than the largest known earthquake for its geographic location.

The containment buildings that house the nuclear reactor are made of thick concrete. Nuclear stations also have numerous and diverse safety systems and physical barriers to prevent the release of radioactive materials and to protect the public, station workers and the environment.
A study conducted by the Electric Power Research Institute (EPRI) shows that reactor and fuel structures at U.S. nuclear stations would protect against a radiation release even if struck by a large commercial jetliner. A nuclear reactor is surrounded by a number of structures that would limit the effects of such an impact.

The effects of the March 2011 events in Japan caused the nuclear industry to look even closer at ways to further ensure that safety is maintained when faced with extreme natural events. While Duke Energy and the industry continue to monitor and learn from the situation, numerous measures have been put in place at nuclear plants to maintain and upgrade already high levels of safety.

**Nuclear Security**

Nuclear stations have numerous security features. Armed, well-trained security forces guard these stations 24 hours a day. Physical intrusion barriers consisting of concrete structures and razor wire fences, to name a few, surround the stations. Advanced surveillance equipment continually monitors areas surrounding the station.

Station access is tightly controlled by both security forces and sophisticated security systems, such as palm recognition screening and weapons and explosives detectors. Nuclear employees must pass stringent background investigations, psychological evaluations and drug and alcohol screenings. Employees and contractors are subject to continual monitoring and screening.

Our nuclear security programs are evaluated for effectiveness on a regular basis by both the company and the NRC. Duke Energy-operated nuclear stations meet all requirements set forth by the NRC and have performed well during security drills and tests. The company’s security training programs and facilities are among the best in the industry. We work closely with local, state and federal law enforcement agencies, federal security agencies and the intelligence community.

**Nuclear Power Generation**

Generation of electricity in a nuclear station is similar to a coal-fired steam station. The difference is the source of heat. Fissioning (splitting) of uranium atoms replaces the burning of coal as the source of heat. This heat is used to turn water into steam to drive turbine generators.

Duke Energy’s McGuire, Oconee, Catawba, Robinson and Harris nuclear plants are pressurized reactor designs. Brunswick is a boiling water reactor design.

**Pressurized Water Reactor**

Pressurized water reactors (also known as PWRs) keep water under pressure so that it heats, but does not boil. This heated water is circulated through tubes in steam generators. Water inside the steam generators circulates around these tubes and is heated into steam, which then turns the turbine generator. Water from the reactor and water that is turned into steam are in separate systems and do not mix.
How A Nuclear Pressurized Water Reactor Works

1. **The Fuel**
The fuel used in nuclear generation is uranium-235. It is manufactured as small pellets. A single pellet is less than an inch long, but produces the energy equivalent to burning a ton of coal. The pellets are placed end to end into fuel rods 12 feet long. Approximately 200 of these rods are grouped together into what is called a fuel assembly.

2. **Reactor**
Nuclear fission occurs when uranium atoms are split by particles known as neutrons. Uranium-235 atoms have a unique quality that causes them to break apart after colliding with a free neutron. Once a uranium-235 atom splits, neutrons are released that collide with other uranium-235 atoms. A chain reaction begins, and heat is released as a byproduct.

Control rods are inserted among the fuel assemblies to regulate or stop the fission process. These control rods absorb neutrons. When fully inserted among the fuel assemblies, nuclear fission stops. Withdrawing the control rods allows fission to occur.

3. **Pressurizer**
In a pressurized water reactor, the heat produced in the reactor is transferred to the first of three water systems: the primary (reactor) coolant, secondary coolant (steam supply) and condenser systems. The primary coolant is heated to more than 600 degrees Fahrenheit. A pressurizer keeps the primary coolant under pressure to prevent boiling.

4. **Steam Generator**
The hot, pressurized water from the reactor (primary coolant) passes through thousands of tubes in nearby steam generators. The outside of these tubes is surrounded by water from the secondary coolant system. The heat from the primary coolant is transferred to the secondary coolant system, which then turns into steam. The primary and secondary systems are closed systems. This means the water flowing through the reactor remains separate and does not mix with the water from the other system or the lake.

5. **Turbine**
Steam produced in the secondary coolant system is piped from the containment building into the turbine building to push the blades of a turbine. The turbine is connected to an electric generator by a long shaft. As the turbine blades spin, the shaft turns a magnet inside the generator to produce electricity.

6. **Condenser Coolant**
After spinning the turbines, the steam flows across condenser cooling system tubes. The steam is cooled, condensed back into water and returned to the steam generator to be used again and again.
7. **Lake Cooling or Cooling Towers**

At some nuclear stations, lake water flows through thousands of condenser tubes to cool steam back to water. Water from the condenser system is then discharged down a long canal (for cooling) and eventually enters the main part of the lake.

At other plants, the condenser cooling water is circulated through tall cooling towers to remove the extra heat it has absorbed. The water is pumped to the top of the cooling towers and is allowed to pour down through the structure. Natural-draft towers utilize the upward flow of air through the towers to cool the condenser water. In mechanical draft towers, several fans pull air inside to cool the condenser water. After it is cooled, the condenser water is pumped back into the turbine building to cool and condense the steam.

**How A Nuclear Boiling Water Reactor Works**

*Boiling Water Reactor Schematic*

Boiling Water Reactors (also known as BWRs) operate in a fashion similar to a PWR. Water in the reactor vessel is allowed to boil into steam to spin a turbine generator. A closed condenser water system cools this steam back into water so it can be pumped back to the reactor vessel. The nuclear fuel core is cooled in the process. Both units located at the Brunswick Nuclear Plant are boiling water reactors.

A BWR uses two separate water systems called "cycles." To begin, water is pumped through the reactor core where a controlled nuclear reaction releases heat. The water inside the reactor vessel boils into superheated steam. This steam is then directed against the turbine blades to make the turbine and electric generator spin at approximately 1,800 revolutions per minute (rpm), producing electricity.

After passing through the turbine, the steam passes through a condenser where it is cooled by water drawn from the Cape Fear River, converting it back to a liquid state. The water is then returned to the reactor where it is converted to steam again. The water from the reactor cycle never comes into direct contact with the plant’s other water systems and is contained within the reactor building and the turbine/generator building.

The cooling water exits the plant through a 5.5 mile-long canal. Pumps at the end of the canal pump the water 2,000 feet into the Atlantic Ocean. There, the rapid mixing and flushing action of the tides and currents quickly dissipate the heated water.

For more information about nuclear power, go to: [https://www.duke-energy.com/energy-education/how-energy-works/nuclear-power](https://www.duke-energy.com/energy-education/how-energy-works/nuclear-power).
**Used Nuclear Fuel**

**Storage**

Used nuclear fuel is a solid byproduct of the fission process used to generate electricity in nuclear stations. If all the used fuel produced in nearly 50 years of U.S. nuclear station operation was stacked end to end, it would cover a football field to a depth of less than 10 yards. Of this fuel, 95 percent could be recycled.

Duke Energy has 40 years of experience handling used nuclear fuel. Our employees are well-trained, environmentally conscious professionals who take pride in their work, including safely managing used fuel.

Duke Energy safely stores used nuclear fuel at its facilities in two ways — in steel-lined, concrete storage pools filled with water and in large, airtight steel canisters (dry cask storage). As with every other vital system at a nuclear station, the used-fuel pools and dry-storage canisters have numerous and redundant safety systems that ensure the fuel remains safe and secure.

The federal government has responsibility for permanently disposing of used nuclear fuel. Duke Energy continues to support the government's efforts to fulfill its obligation to accept and manage used nuclear fuel. Until a national repository or recycling is available, utilities will continue to safely and securely store used fuel at nuclear stations in storage pools or dry storage containers.

**Reprocessing (Recycling)**

Reprocessing (or recycling) used fuel is a method of chemically separating fuel constituents after the fuel is permanently removed from the reactor. Reprocessing reduces the volume of material requiring disposal.

Almost 95 percent of the material remaining in a used fuel assembly can be reused (uranium and plutonium) in new fuel assemblies. In considering the sustainability benefits alone, if the existing U.S. inventory of commercial used fuel in storage pools and dry storage casks were recycled, it would displace the need for millions of pounds of new uranium.

Used nuclear fuel recycling technology does exist, although not commercially in the U.S. For many years, a number of other countries (India, Japan, France, United Kingdom and Russia) have successfully used recycling to reduce the volume and content of used fuel. The pursuit of these advanced technologies in the U.S. does not relieve the federal government of its statutory responsibility to provide a disposal facility since recycling does not eliminate all used-fuel constituents.

**Radiation and Health**

Radiation is a natural part of our environment. It is not new or mysterious. We receive radiation from the sun, minerals in the earth, the food we eat and building materials in our houses. Even our bodies give off small amounts of radiation.

Exposure to extremely large amounts of radiation can be harmful. However, the amount of radiation given off in the normal operation of a nuclear station is very small - smaller, in fact, than the amount we would receive on a coast-to-coast airplane flight.

Some familiar sources of radiation are shown in the following table. Although radiation is invisible, it can be accurately measured. Radiation is measured in units called rem and millirem. The rem is a unit of measure that takes into account the effects different types of radiation have on the body. A millirem is 1/1000 of a rem.

<table>
<thead>
<tr>
<th>Radiation Source</th>
<th>Dose (millirem)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average annual radiation exposure from all sources</td>
<td>620</td>
</tr>
<tr>
<td>Natural background radiation (radon gas, cosmic, etc.)</td>
<td>310</td>
</tr>
<tr>
<td>Manmade sources:</td>
<td></td>
</tr>
<tr>
<td>• Medical sources (CT scans, X-rays, etc.)</td>
<td>298</td>
</tr>
<tr>
<td>• Consumer products (fertilizer, tobacco, smoke detectors, etc.)</td>
<td>12</td>
</tr>
<tr>
<td>• Living next to a nuclear power station</td>
<td>Less than 1</td>
</tr>
</tbody>
</table>

*NRC Website*
Nuclear Industry Lessons Learned

The U.S. nuclear industry relies on a program of continuous improvement based on ongoing lessons learned from worldwide operating experience to further enhance safety. In addition to the NRC's regulation, other industry organizations like the Nuclear Energy Institute, the World Association of Nuclear Operators and the Institute of Nuclear Power Operations, provide significant oversight to ensure the operational safety of nuclear stations worldwide.

Glossary of Nuclear Terms

Here are a few commonly used terms in the nuclear industry. Visit the NRC website (www.nrc.gov) for additional information.
Atom: The smallest particle of an element that cannot be divided or broken up by chemical means. It consists of a central core called a nucleus, which contains protons and neutrons. Electrons revolve around the nucleus.

Atomic Energy: Energy produced in the form of heat during the fission process in a nuclear reactor. When released in a sufficient and controlled quantity, this heat energy may be used to produce steam to run a conventional turbine generator to produce electrical power. Atomic energy is usually referred to as nuclear energy.

Background Radiation: Radiation from cosmic rays and radioactive material that naturally exists in soil, water and air is part of our environment. The amount of radiation a person gets is measured in millirems, and the average person in the U.S. receives about 620 millirem of radiation each year — about 50 percent from natural sources and the rest from manmade sources.

Boiling Water Reactor (BWR): In this reactor design, water flows upward through the core, where it is heated by fission and allowed to boil in the reactor vessel. The resulting steam drives turbine blades and a shaft connected to a generator to produce electrical power.

Capacity Factor: A measure of reliability, reflecting the amount of electricity a generating unit provides versus how much it could provide if operating at all times.

Combined Construction and Operating License (COL): A license that is issued by the NRC authorizing a licensee to construct and operate a nuclear station at a specific site in accordance with established laws and regulations. A COL is valid for 40 years, with the possibility of a 20-year renewal (for a total of 60 years).

Containment Building: The structure housing the nuclear reactor, pressurizer, reactor coolant pumps, steam generators and other associated piping and equipment. It is an airtight, steel-lined structure with heavily reinforced concrete walls several feet thick. It is designed to withstand tremendous physical forces.

Control Rods: Rods made of material that absorbs neutrons. When inserted into the nuclear fuel, the rods stop the fission process, thereby shutting down the reactor.

Cooling Tower: A large structure that serves as a heat exchanger to aid in the cooling of water used to cool exhaust steam leaving the turbines of a power plant. Cooling towers transfer this heat into the air, instead of into a body of water.

Core: The central portion of a nuclear reactor, which contains the fuel assemblies, moderator, neutron poisons, control rods and support structures. The reactor core is where fission takes place.

Fission: The splitting of atoms, which releases tremendous amounts of heat energy.

Fuel Rod: A long, slender, zirconium metal tube containing pellets of fissionable material, which provide fuel for nuclear reactors. Fuel rods are assembled into bundles called fuel assemblies, which are loaded individually into the reactor core.

Pressurized Water Reactor (PWR): The reactor heats water in a closed system that then transfers its heat to another closed system in the steam generators to produce steam to turn the turbine generator.

Radiation: Particles and/or energy given off by unstable atoms as they undergo radioactive decay to a stable state.

Reactor: A cylindrical, steel vessel that contains the core, control rods, coolant and structures that support the core.

Steam Generator: In a pressurized water reactor, it’s the large steel component where steam is produced. It is located inside the containment building.

Turbine Generator: A steam (or water) turbine directly coupled to an electrical generator. The two devices are often referred to as one unit.

Uranium: The fuel used in nuclear power reactors because of the ability of its atoms to undergo fission.