
Westinghouse
Why *not*
in my backyard?
nuclear energy facts

Why *not* in my backyard?

Public concern over, and support for, nuclear energy has waxed and waned over the past half century. Concerns amplified as a result of the Three Mile Island, Chernobyl and Japan accidents. But as understanding of the causes of those accidents became clearer and more widespread, and as the governments established more defined oversight and utilities better defined their own self-oversight, acceptance of nuclear energy has improved dramatically

> "... acceptance of nuclear energy has improved dramatically."

Even so, nuclear energy production still carries a certain uncomfortable mystique for many - fission and radiation do not easily lend themselves to tangible visualization and comprehension. Too many people still imagine that if a nuclear power plant is nearby, they will be exposed to higher levels of radiation and they are troubled by worries of a nuclear accident. But how factual is all of this?

Radiation

What is normal and what is not?

Radiation is energy radiated in the form of waves, particles or bundles of energy called photons – the same photons are radiated from the sun. Without it, we would have no life on Earth. Radiation comes from the building block of matter: atoms. Some atoms remain the same forever, others decay and release their excess internal energy – what we call radiation or radiated energy.

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From above, we receive much radiation from our fusion-generated sun. From below, radon gas seeps from the Earth's crust and is present in the air we breathe. Radiation also emanates from rocks and soil as uranium breaks down naturally. It also comes from other sources. We live with greatly varying degrees of background radiation, depending on where we are located. In the U.S. people living in the northwest region of Washington state receive about 240 millirem per year, on average, from natural and man-made sources, whereas residents in the state's northeast region receive doses of about 1,700 millirem per year, most of it from radon that occurs naturally in the rock and soil.[1]

Radiation and Nuclear Power

If there is a nuclear power plant near your business or home, how much radiation are you really being exposed to?

The amount of radiation emitted from a nuclear power plant is typically less than one millirem per year, far less than the amount allowed by Federal law, which is five millirems per year, and far less than that to which we are exposed to naturally. Workers inside of nuclear power plants are limited to the amount of radiation to which they are exposed and are monitored for safety.

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Safety Precautions in Nuclear Power Plants

Nuclear power plants have many safety systems, including those for controlling the chain reaction of the fission process. Fuel rods are assembled into a structure that looks somewhat like a honeycomb. Additional rods, called control rods, are added. These rods are made of a material that absorbs neutrons so that the reactor can be slowed down or stopped.

To keep the reactor core from becoming too hot during nuclear fission, cooling water is used to flow around the core. Every nuclear power plant also has an emergency core cooling system that supplies additional cooling water to the core if the regular water supply fails.

To make sure no radiation from the fission process escapes, the entire core and water are sealed inside a large steel container called the reactor vessel. This is inside of a large, steel and concrete dome-shaped building, called the containment building. It's constructed to be strong enough to withstand earthquakes and tornados and also protects against any radiation escaping.

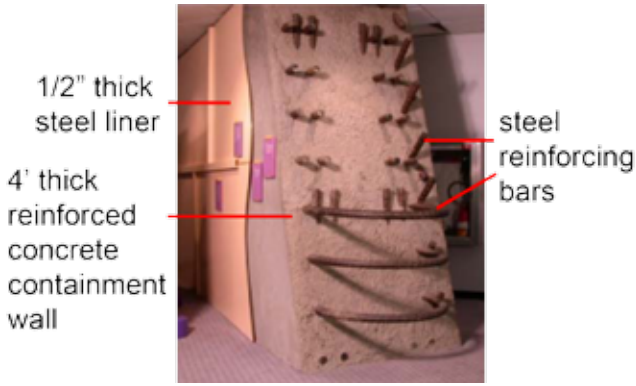
There are many other safety systems that exist in a nuclear power plant in case a system or part fails. Often, they are redundant, meaning there is more than one or that another safety system can take over if the first one fails. All of the nuclear plants in the Americas, Europe and Asia have these safety systems to prevent accidents and protect the public.

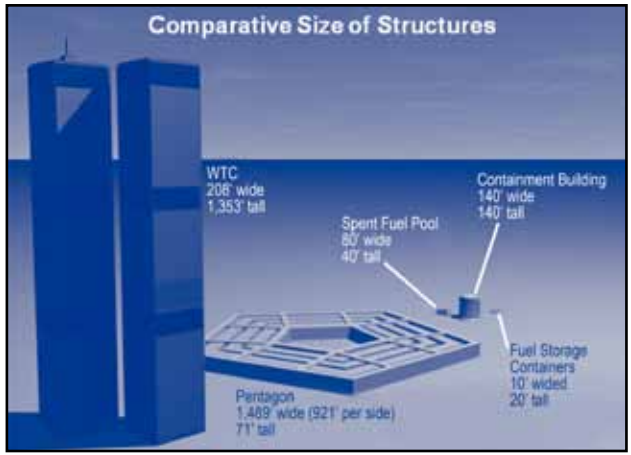
Terrorist Attacks

Protecting people from exposure to dangerous amounts of radiation has always been extremely important when nuclear power plants are designed and during their operation. The safety systems that are a part of all nuclear power plants and that have been designed to prevent nuclear accidents from occurring are excellent protection from external forces such as Mother Nature and potential terrorist attacks.

Here is some information to support this:

- *The typical construction of the power plant's containment wall contains a one-half inch thick steel liner on the outside and a four-foot reinforced concrete containment wall and steel reinforcing bars. (See top right photo)*
- *Since the 9/11 U.S. attack, special military forces are on guard at the plants 24 hours a day, seven days a week. There is also a restricted no-fly zone above the plants.*
- *In addition, the size of a nuclear power plant makes it an unlikely target. (See bottom right photo)*





A nuclear power plant is extremely safe, so why not in your backyard? It has robust containment; expanded and extensive security forces; a carefully screened workforce; fenced, barricaded and guarded areas; no-fly zones and is highly secured.

Environmental Effects

Specifically, nuclear power makes no contribution to global warming through the emission of carbon dioxide. Nuclear power also produces no notable sulfur oxides, nitrogen oxides or particulates. When nuclear power is produced, nothing is burned in a conventional sense. Heat is produced through nuclear fission, not oxidation. Nuclear power does produce spent fuels of roughly the same mass and volume as the fuel that the reactor takes in. These spent fuels are kept within the reactor's fuel assemblies; thus, unlike fossil fuels, which emit stack gasses to the ambient environment, solid wastes at nuclear power plants are contained throughout the generation process. No particulates or ash are emitted.

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Some people mistake the steam coming from cooling towers of a nuclear power plant to be a harmful substance or pollution, but it's not … it's just steam. Many other power plants have this same type of cooling tower.

Nuclear Energy: Past, Present and Future

While nuclear energy production has long proved itself to be very safe, especially when compared to other forms of energy production, three historical accidents in nuclear power plants come to mind for many when considering nuclear power: Three Mile Island, Chernobyl and Japan's Fukushima Daiichi.

Summary of severe accidents that occurred in fossil, hydro and nuclear energy chains in the period 1969-2000

	OECD			Non-OECD		
Energy chain	**Accidents**	**Fatalities**	**Fatalities/ GWey**	**Accidents**	**Fatalities**	**Fatalities/ GWey**
Coal	75	2259	0.157	1.044	18,017	0.597
Coal (China 1994-1999)				819	11,334	6.169
Coal (without China)				102	4831	0.597
Oil	165	3713	0.132	232	16,505	0.897
Natural Gas	90	1043	0.085	45	1000	0.111
LPG	59	1905	1.957	46	2016	14.896
Hydro	1	14	0.003	10	29,924	10.285
Nuclear	0	0	-	1	31*	0.048
Total	**390**	**8934**		**1480**	**72,324**	

* These are immediate fatalities only
GWey: Gigawatt-year of electric power
Source: Data provided to the OECD Nuclear Energy Agency by the Paul Scherrer Institute

Graphic recreated from World Nuclear News article "Risk statistics on energy" dated 03 September 2010.

At Three Mile Island, near Harrisburg, Pennsylvania, the 1979 accident was what is commonly referred to as a meltdown. This is when the fuel assembly (containing the fuel rods) melts. This can happen if the temperature inside of the reactor core, where the fuel rods are inserted and fission takes place, becomes hot enough to melt the steel of the rods and thus release more uranium and accelerate the fission in the reactor. At Three Mile Island, this occurred and about half the fuel in the core melted before enough cooling occurred to stop it. However, the worse prospect feared - an uncontrolled release of radiation to the environment - did not happen. Although design flaws, human errors and failure of some of the components in the systems[2] caused an accident, the design to protect the public from exposure worked. The melted fuel and radiation were contained - trapped inside of the steel reactor vessel inside of the containment. This was the worst accident of any nuclear reactor in the U.S. *(continued)*

Nuclear Energy: Past, Present and Future *(continued)*

At the Chernobyl Nuclear Power Plant, located on the Belarus-Ukraine border, an accident occurred in 1986 during a test. For the test, all of the safety systems had been shut down. Due to a combination of a serious flaw in the design, several human errors and the emergency safety systems being turned off, the nuclear reactor exploded due to a meltdown[3]. Part of the design flaws of the plant was that there was no containment building around the nuclear reactor vessel. Therefore, the explosion resulted in a large release of radiation into the environment. The Chernobyl plant was shut down. This type of design has never been used in the U.S.

On March 11, 2011, a devastating 9.0 magnitude earthquake and tsunami hit Northeastern Japan. The tsunami not only swept away everything in its path, including houses, cars and farm buildings, it also devastated the reactors at Japan's Fukushima Daiichi site.

As more is learned about the Japanese events, lessons learned will be applied to the existing fleet of plants. The U.S. nuclear energy industry, for example, has already started an assessment of the events in Japan and is taking steps to ensure that U.S. reactors can respond to extreme events that may challenge safe operation of the facilities. It is also important to realize that the existing fleet of operating nuclear plants are already highly safe, and that no industry takes safety more seriously than the commercial nuclear energy industry.

Next Generation and Today's New Nuclear Power Plants

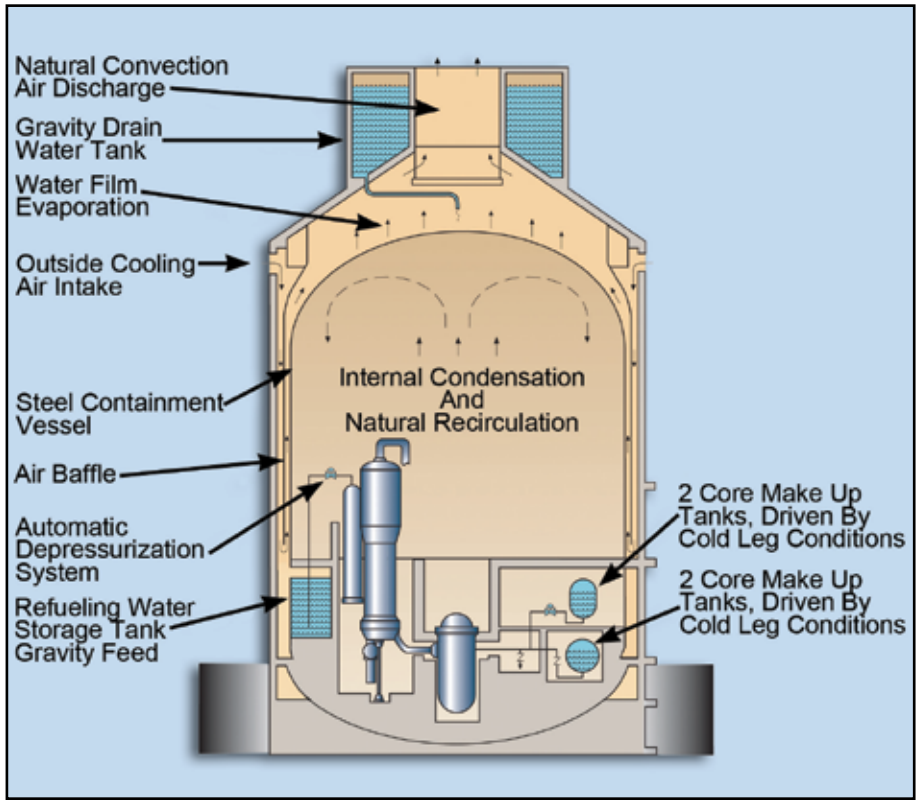
New nuclear power plant designs that have improved safety systems are being designed and built around the world.. Many of these newer plants incorporate passive safety systems. Today's plants are called Generation III+ plants and the Westinghouse AP1000® Nuclear Power Plant is the only Generation III+ plant to receive design certification from the U.S. Nuclear Regulatory Commission.

AP1000™

Westinghouse AP1000 Nuclear Power Plant

The AP1000 plant uses advanced passive safety systems. The systems are called passive because they use natural forces to work, without the need for human action. These safety systems will work even when there is no AC power available.

Additionally, the AP1000 plant is designed to mitigate a severe accident, such as core meltdown. If such an unlikely event were ever to occur at an AP1000 plant, an operator could flood the reactor cavity space immediately surrounding the reactor vessel with water and submerge the reactor vessel. The cooling would be sufficient to prevent molten core debris from melting the steel vessel wall and spilling into the containment.



What *could* be in my backyard?

A solar farm spread across 30 square miles produces essentially the same 1,000 megawatts of electricity generated by a single nuclear plant. Similarly, it would take 270 square miles of 50-story wind turbines, operating at 30 percent capacity, to generate 1,000 megawatts.

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For wind turbines to generate the 20 percent of U.S. electricity capacity provided by nuclear plants, an area the size of the state of West Virginia would be needed.

While such comparisons are not meant to diminish the importance of renewable energy sources, the reality is that many government policy makers and members of the general public are unaware of the facts. And while we all recognize that the best energy policy is one based on a mix of generation sources, the realities and limitations of renewables cannot support the goals of reducing global dependence on fossil fuels and reducing greenhouse gases nearly as effectively as nuclear power can.

Nuclear Energy Trivia

Relatively speaking, nuclear power plants are unsafe.

False: Nuclear energy is as safe as or safer than any other form of energy available. Nuclear power plants are designed and operated safely, with multiple backup safety systems, including automatic shutdowns.
Source: Nuclear Energy Institute (www.nei.org)

Accidents at Three Mile Island and Chernobyl led to significant improvements in nuclear plant safety.

True: All commercial nuclear power plants now have emergency response procedures in the event of an accident or security event. Among other actions, the industry established the Institute of Nuclear Power Operations (INPO) to promote excellence in operator training, and plant management and operation.
Source: Nuclear Energy Institute (www.nei.org)

There is no solution for the huge amounts of nuclear waste being generated.

False: All of the used nuclear fuel generated in every nuclear plant in the past 50 years would fill a football field to a depth of only 10 yards. 96 percent of this "waste" can be recycled.
Source: K.S. Krane, Introductory Nuclear Physics, John Wiley and Sons, 1987

Americans get most of their yearly radiation dose from nuclear power plants.

False: We are surrounded by naturally occurring radiation. Only 0.005 percent of the average American's yearly radiation dose comes from nuclear power; 100 times less than we get from coal, 200 times less than a cross-country flight and about the same as eating one banana per year.
Source: National Council on Radiation Protection and Measurements No. 92 and 95

A nuclear reactor is not the same as a nuclear bomb.

True: It is impossible for a nuclear reactor to explode like a nuclear weapon. Nuclear weapons contain very special materials in particular configurations, neither of which are present in a nuclear reactor.
Source: Nuclear Energy Institute (www.nei.org)

It is not safe to transport the radioactive materials.

False: Since 1971, there have been more than 20,000 shipments of used fuel and high-level wastes (over 80,000 tons) over many million kilometers. There has never been any accident in which a container with highly radioactive material has been breached or has leaked.
Source: World-Nuclear Association (www.world-nuclear.org)

The smoke coming out of the nuclear reactors is harmful.

False: That "smoke" isn't smoke at all. It is only hot water (steam) coming out of the nuclear cooling towers.
Source: EIA Energy Kids: //www.eia.doe.gov/kids/energy.cfm?page=nuclear_home-basics#top-container

Nuclear power plants create hundreds of high-paying jobs at the plants and in the surrounding communities.

True: A nuclear power plant creates up to 700 permanent jobs and pays 36 percent more than the average salaries in the local area. The plants also create an equivalent number of additional jobs in the local area to provide the goods and services to support the plant workforce.
Source: Just the Facts brochure, Nuclear Energy Institute (www.nei.org)

Nuclear power is very expensive.

False: Nuclear power has a lower production cost than coal or natural gas, so it helps reduce the price of electricity for consumers. Average electricity production costs at nuclear power plants have declined more than 30 percent in the past 10 years. This includes the cost of operating and maintaining the plant, purchasing nuclear fuel and managing the used fuel.
Source: Just the Facts brochure, Nuclear Energy Institute (www.nei.org)

Nuclear energy is bad for the environment.

False: Nuclear reactors emit no greenhouse gasses during operation. Over their full lifetimes, they result in comparable emissions to renewable forms of energy such as wind and solar. Also, nuclear energy requires less land use than most other forms of energy.
Source: P.J. Meier, "Life-Cycle Assessment of Electricity Generation Systems and Applications for Climate Change Policy Analysis," 2002

Half the world's people live in countries where new nuclear power reactors are planned or under construction.

True: Nuclear power capacity worldwide is increasing steadily, with over 50 reactors under construction in 13 countries. Most reactors that are on order or planned are in Asia, though there are major plans for new units in Europe, the United States and Russia. Today there are some 436 nuclear power reactors operating in 30 countries.
Source: World-Nuclear Association (www.world-nuclear.org)

Used nuclear fuel is deadly for 10,000 years.

False: Used nuclear fuel can be recycled to make new fuel and by-products. Most of the waste from this process will require a storage time of less than 300 years. Also, less than one percent is radioactive for 10,000 years. This portion is not much more radioactive than some things found in nature, and can be easily shielded to protect humans and wildlife.
Source: K.S. Krane, Introductory Nuclear Physics, John Wiley and Sons, 1987

The first U.S. town to be powered by nuclear energy was in Idaho.

True: The first U.S. town – Arco, Idaho, population 1,000 – was powered by nuclear energy from the experimental boiling water reactor BORAX III.
Source: Nuclear Energy Institute (www.nei.org)

A lot of people were injured and died at the Three Mile Island nuclear plant accident.

False: As the only U.S. reactor accident in history, damage was limited to the inside of the reactor, and no one was injured.
Source: Nuclear Energy Institute (www.nei.org)

If you removed all U.S. vehicles off the road it would reduce almost 650 million metric tons of carbon dioxide per year.

True: Nuclear-generated electricity avoids almost 650 million metric tons of carbon dioxide per year, which is the equivalent to taking these vehicles off the road.
Source: Nuclear Energy Institute (www.nei.org)

Nuclear energy has the smallest environmental impact of any clean-air electricity source.

True: A 1,000-megawatt wind farm would occupy 78 square miles. A 1,000-megawatt nuclear plant would occupy less than five percent of that area. A 1,000-megawatt power plant can meet the needs of a city the size of Boston or Seattle.
Source: Nuclear Energy Institute (www.nei.org)

An amount of nuclear fuel is the equivalent to the same amount of coal.

False: Nuclear fuel the size of a pencil eraser equals the energy of one ton of coal.
Source: World-Nuclear Association (www.world-nuclear.org)

One person could store their own nuclear energy waste in their refrigerator.

True: If all of an individual's electricity needs for a 70-year lifetime were supplied by nuclear generation, their 70 years of nuclear waste would weigh two pounds and fit into a soda can.
Source: "Clean Energy for California," Speech by Admiral Frank L. Bowman, president and chief executive officer of the Nuclear Energy Institute

To obtain copies of this booklet, e-mail rapalit@westinghouse.com

Resources used in this publication*:

1. *from http://www.ocrwm.doe.gov/factsheets/doeymp0403.shtml*
2. *from http://www.chernobyl.info/index.php?userhash=12588010&navID=10&lID=2*
3. *from http://www.nrc.gov/reading-rm/doc-collections/fact-sheets/3mile-isle.html*

**These website addresses were operable at the time of fact gathering. They are not maintained by Westinghouse.*

For more information about Westinghouse Electric Company and its community outreach program, N-Vision, contact Tracey Rapali at rapalit@westinghouse.com.

Why *not*?

The focus of the Westinghouse N-Vision Program is to educate our communities about the many benefits of nuclear energy.

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