Dominion Energy®

Nuclear Media Guide

Information on Millstone Power Station
Waterford, Connecticut

In The Event of an Emergency at Dominion Energy's Millstone Power Station

Dominion Energy and the Connecticut Department of Emergency Services and Public Protection's Division of Emergency Management and Homeland Security will establish a Joint Information Center at:

360 Broad Street

Hartford, CT 06105

(See map next page)

All official announcements and news briefings about the emergency will be made at the Joint Information Center. Reporters are encouraged to come to the Joint Information Center.

Important Phone Numbers

Dominion Energy Millstone Public Affairs ....(860) 440-0132

Dominion Energy News Services .... (804) 771-6115

Connecticut Department of Emergency Services
and Public Protection.................. (860) 685-8541 or (860) 566-3180

U.S. Nuclear Regulatory Commission

NRC Public Affairs/Washington ....(301) 415-8200

Region I Public Information Office
King of Prussia, PA...(610) 337-5330

NRC Operations Center/Washington ....(301) 816-5100

NRC Public Affairs Website –
https://www.nrc.gov/about-nrc/public-affairs.html

Map/Directions to the State Emergency Operations and Joint Information Center

Hartford, CT

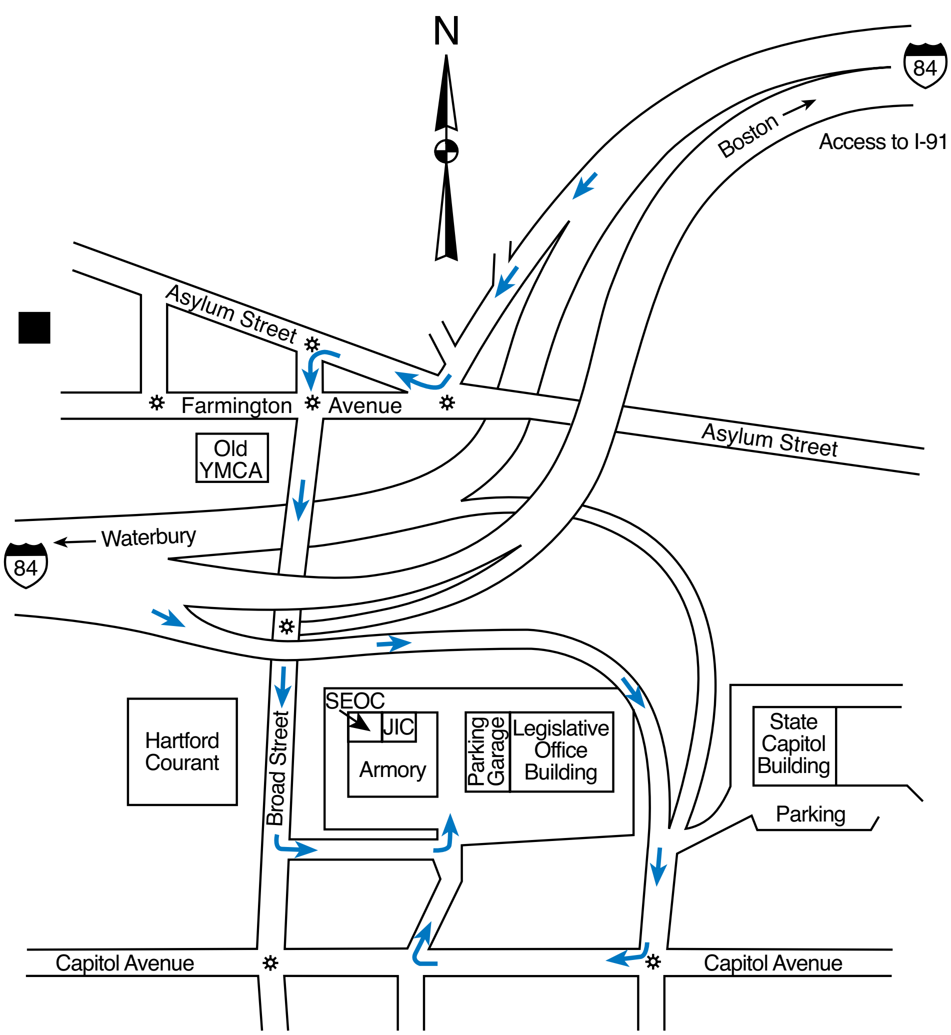
From I-91 North - In Hartford, take I-84 West; see below.

From I-91 South - In Hartford, take I-84 West; see below.

From I-84 West - Take Asylum Street exit. Turn right at end of exit. Take first left onto Broad Street (in front of old YMCA). Hartford Armory is on the left, across from the Hartford Courant.

From I-84 East - Take Capitol Avenue exit. Turn right at end of exit. Take first right into parking area. Hartford Armory is directly ahead of you on the left; parking garage is on the right.

NOTE: Enter at ground level on east side of building. Go straight down passageway to the end. Joint Information Center is on the right.



Note: ☼ are traffic lights

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Dominion Energy

Who We Are

Headquartered in Richmond, VA, Dominion Energy is one of the nation's largest producers and transporters of energy, with more than 7 million customers in 16 states who energize their homes and businesses with our electricity or natural gas.

Our company is built on a proud legacy of public service, innovation and community involvement. In addition to our core businesses, Dominion Energy and our thousands of employees invest in the communities where we live and work and by practicing responsible environmental stewardship wherever we operate.

Dominion Energy uses a variety of power stations to enhance our system's reliability. This guards against major problems that might be produced by economic, environmental, or technical problems that could arise in a single area.

Our nuclear stations have attracted international attention for their innovative programs, achievements and efficiency. In addition, we use renewable energy to produce electricity, including wind, solar, biomass fuels, and water that powers our hydroelectric generating facilities. Our fossil-fueled power stations primarily use natural gas to generate electricity, but coal and oil are also used.

Making Safe Nuclear Energy Safer

Building on the Nuclear Industry's Commitment to Safety and Preparedness

The nuclear energy industry's primary and constant goal is to make safe nuclear energy facilities even safer. A decades-long commitment to safety and continuous learning is reflected in the operational focus and safety culture at our facilities. Companies that operate 95 U.S. reactors review safety procedures continually and update their facilities and training programs with lessons learned from those reviews.

The industry has a commitment to safety because nuclear energy is a vital part of America's electricity portfolio. It helps achieve greater energy independence for America and produces affordable, reliable electricity for one of every five Americans. Safety is the foundation of a thriving nuclear energy industry in America and globally—with approximately 440 reactors producing electricity and 50 plants under construction.

After the March 11, 2011, earthquake and tsunami in Japan, the U.S. nuclear power industry is looking even more closely at ways to ensure safety is maintained in the face of extreme natural events. The U.S. industry and our global partners took immediate actions after the events in Japan, both to support the recovery of the Fukushima Daiichi reactors and to review critical safety systems at U.S. reactors. While we continue to monitor the situation closely and to learn from it, the nuclear energy industry in the United States has already implemented numerous measures to maintain and upgrade the already-high level of safety at nuclear energy facilities.

The nuclear energy industry unanimously approved an initiative to procure additional on-site portable equipment that will help ensure that every nuclear energy facility can respond safely to extreme events, no matter what the cause.

74% of the American public believes that nuclear plants operating in the United States are safe and secure.

- *Bisconti Research Inc/ Gfk Roper survey Feb. 17-19, 2012*

Companies that operate America's nuclear energy facilities have acquired or ordered more than 300 pieces of major equipment to supplement layer upon layer of safety at the nation's commercial reactors. At Millstone, this equipment is stored in a concrete dome that is built to withstand extreme events like earthquakes, tsunamis, and hurricanes.

The equipment ranges from diesel-driven pumps and electric generators to ventilation fans, hoses, fittings, cables and communications gear. It also includes support materials for emergency responders. The equipment will supplement emergency equipment acquired by the industry as a response to the Fukushima earthquake and tsunami, and after the 9/11 terrorist attacks to help facilities safely respond to large fires and explosions.

Proven Record Of Safety And Continuous Improvement

Nuclear energy facilities are designed and built to withstand the worst natural events ever recorded in the area near specific plant locations. U.S. facilities start out a step higher in design principles than in many other countries. In addition, the U.S. nuclear industry continues to boast one of the safest industrial working environments. Through rigorous training of plant workers and increased communication and cooperation between nuclear energy facilities and federal, state and local government officials, the nuclear industry is keeping the nation's 95 nuclear plants safe for their communities and the environment.

The industry is never satisfied with its past successes, though, and is committed to ongoing upgrades and enhancements that improve safety. The development of industry procedures and the U.S. regulatory system over time has resulted in a comprehensive safety approach that places the safety of America's reactors at a superior level. U.S. reactors have been upgraded continually since construction. This includes the replacement of components and parts on a regular schedule; the addition of equipment, such as special vents that will release hydrogen buildup in containment structures of some boiling water reactor designs; other enhanced safety systems after significant events; and additional portable backup safety equipment after 9/11 attacks.

America's nuclear energy facilities are well-protected against extreme events due to actions that the industry has taken over many years to strengthen plant designs, operational procedures and emergency preparedness. The industry has consistently updated nuclear plants through regulation or orders from the NRC or from lessons derived from operational or other events at nuclear power plants worldwide. The Three Mile Island accident in 1979 resulted in sweeping changes to the industry, including accredited reactor operator training, radiation protection, human factors engineering and emergency response planning. U.S. companies added emergency backup diesel generators as a result of a fire at the Browns Ferry plant in 1975 and modified U.S. plants and safety practices after the 1986 Chernobyl accident, even though that plant design is wholly different than U.S. and other Western designs.

The industry has updated procedural guidance for reactor operators to maintain critical safety when responding to operational events as well as extreme natural events that may be beyond the scale for which the plant was designed. This procedural regime includes:

- Emergency operating procedures developed in the 1980s after the Three Mile Island accident.

- Guidelines to manage severe accidents developed in the 1990s after the Chernobyl accident.

- Guidelines to manage the possibility of extensive damage developed after the 2001 terrorist attacks in New York, Washington, D.C., and Pennsylvania.

The men and women who operate America's nuclear energy facilities have full authority over the plants in emergency situations. Nuclear plant operators train regularly to implement special guidelines in the event of a severe accident. Reactor operators drill regularly on emergency scenarios and the drills are monitored to make sure that operators can implement emergency procedures effectively.

The U.S. industry has validated control room procedures for quicker operator response and companies give operators full control of reactor operation and related procedures during an emergency. This command and control structure enhances emergency response procedures.

America's nuclear energy facilities are **designed and built to withstand extreme natural forces**, such as hurricanes, tornadoes, flooding and earthquakes. These facilities also have safety margins for extreme events that will protect them against forces stronger than ever experienced in the areas where they are built. For example, design standards for withstanding earthquakes at California reactors are more robust than many even in the seismically active areas of Japan. Additional safety margin is the result of more robust plant design and construction than required by federal regulation, improved data or analysis methods, and plant modifications made over time at U.S. reactors.

The industry's independent regulator, the U.S. Nuclear Regulatory Commission (NRC), requires additional safety margin to account for any uncertainties and to ensure the plant can remain safe in the event that an accident and a severe natural phenomenon occur at the same time. The industry also is committed to planning for the unthinkable and protecting our workers and nearby residents against unlikely scenarios. The industry continually improves design standards, operational safety, personnel training, and emergency preparedness procedures to plan for extreme events to ensure the safety and security of our workers and nearby communities.

What sets the U.S. nuclear power industry apart from others, though, is its ability to continuously learn and implement improvements through its internal "watchdog" group, the Institute of Nuclear Power Operations (INPO). INPO was formed by the industry in 1979 to drive operational excellence—above and beyond NRC requirements. INPO promotes excellence in safety and reliability at U.S. nuclear plants by setting performance objectives, criteria and guidelines for nuclear plant operations, and by conducting regular evaluations of nuclear plants. Former Florida U.S. Senator Bob Graham, who chaired President Obama's Commission on the BP Deepwater Horizon Oil Spill and Offshore Drilling, said that the nuclear energy industry's safety regime at the Institute for Nuclear Power Operations should serve as a model for efforts to improve safety in offshore oil drilling.

The industry protects the public and its workers with state-of-the-art technology that layers precaution on top of precaution. For example, American nuclear power plants have four-feet-thick, steel-reinforced concrete containment buildings that surround the reactor and multiple backup cooling

"Our commission is urging the offshore oil and gas industry to follow in the path of other high-risk industries, such as nuclear power and chemical, which have established industry organizations to assure the highest standards of safety and complement effective governmental regulation."

- *Former Sen. Bob Graham, co-chair of the national commission on the Deepwater Horizon spill*

Layer upon layer of safety, security and emergency response capabilities protect America's nuclear energy facilities.

"I have always said that if there is an earthquake, I want to be in the control room at Comanche Peak."

- *Rep. Joe Barton, R-Texas May 2011*

systems and electrical power supplies that can function even during an emergency.

Constant training is a hallmark of the American nuclear energy industry, and training workers to respond in emergency situations is another important facet of industry preparedness. For example, before the NRC licenses an individual to operate or supervise operators of a nuclear power reactor, he or she must have several years of related experience and complete extensive classroom, simulator and on-the-job training. And training doesn't stop with the license. Reactor operators spend every fifth week training in a full-scale simulator that is the exact replica of each plant's control room. This is more continuous training than pilots and doctors.

The National Nuclear Accrediting Board reviews and accredits operator training programs under the auspices of INPO, and the NRC monitors its activities. No other nuclear energy program in the world has this level of specialized training for its operators.

Emergency response programs for nuclear energy facilities are the model for other industry and local government use. Federal law requires that nuclear energy companies create an on-site emergency response plan for their reactors and coordinate emergency preparedness plans with local, state and federal officials to protect the public. The NRC approves on-site plans, while approval of plans for protective actions for local residents, if needed, is coordinated between the NRC and the Federal Emergency Management Agency. These plans must be approved for a company to obtain and retain a reactor operating license from the NRC.

Put To The Test, U.S. Reactors Withstand Extreme Natural Forces

U.S. reactors have demonstrated they can withstand extreme natural events, such as earthquakes, hurricanes and extreme flooding.

- **Earthquakes:** In August 2011, Dominion Generation's North Anna nuclear energy facility declared an alert, the second lowest of the NRC's four-level emergency classification, due to a loss of off-site power following a 5.8 magnitude earthquake centered 11 miles from the facility. Both reactors shut down automatically from full power due to seismic motion as designed, and the emergency equipment functioned as designed to safely cool both reactors.

  Ground acceleration measured from the earthquake exceeded the plants' design parameters, but resulted in no significant damage to the facility. A detailed evaluation of the Aug. 23 event shows that it was less than one-third as strong as the ground acceleration for which the facility was designed and built.

- **Hurricanes:** Thanks to intense preparations and layer upon layer of safety systems, 24 reactors at 15 facilities from North Carolina to New England were fully prepared when Hurricane Irene struck the Eastern seaboard in August 2011.

  Operators of the East Coast nuclear energy facilities began preparations several days in advance of the storm, in compliance with the plants' comprehensive emergency preparedness plans and NRC guidelines. All withstood the storm intact and most continued to operate through the storm and provide power needed in the aftermath of the storm.

When Hurricane Katrina slammed into the Gulf Coast in 2005, the Waterford nuclear energy facility, just 20 miles from New Orleans, bore the brunt of the storm. The plant shut down safely, according to its guidelines, and relied on backup diesel generators for 4½ days to power safety systems until power from the grid was restored.

- **Flooding:** When the Missouri River rose to record flood levels, two reactors in Nebraska took extraordinary measures to remain safe. The Cooper Nuclear Station remained at full power and secure with all vital and safety systems dry and operable. The Fort Calhoun nuclear facility was already shut down for refueling and maintenance, and protective measures kept the plant safe despite floodwaters that surrounded the site.

U.S. Nuclear Industry Responds To Events In Japan

Even with this tangible evidence of preparedness and safety, the industry can and will add additional margins of safety by implementing lessons learned from the Fukushima accident.

The U.S. industry is learning lessons from the Fukushima Daiichi accident and will continue to do so. Nuclear plant operators globally are re-examining the baseline for safety and implementing lessons learned from Japan to enhance safety.

The NRC developed three tiers of actions for U.S. reactors, and the industry is working with the NRC to determine how we can implement those in an orderly fashion, with the priority focused on those changes that will provide the greatest safety benefit.

The U.S. industry has been supporting Japan in the recovery at Fukushima Daiichi. Companies that operate or service America's nuclear energy industry immediately deployed expertise, technology and materials to Japan to support Tokyo Electric Power Co. and the Japanese government. Meanwhile, U.S. operators immediately reviewed safety systems at their reactors and are continuing learning lessons to apply to the industry. The industry has a bias for action and is working constructively with the NRC to understand the lessons of the Japan accident and implement actions, where needed, that provides additional layers of safety and preparedness at U.S. reactors.

Within days of the Fukushima Daiichi accident, every electric company that operates a nuclear plant in America began a series of detailed inspections to validate safety and emergency response systems, personnel resources and programs.

Beginning March 15, 2011, four days after the earthquake and tsunami that threatened the Japanese nuclear plants, each U.S. company confirmed a high state of readiness to respond to both internal and external events at nuclear energy facilities. The companies also verified that procedures and capabilities exist to mitigate large events and maintain plant safety, including extended loss of AC power and flooding, and made changes where needed.

The industry installed additional backup systems at used fuel storage pools to ensure they are cooled and protected at all times. Used fuel storage pools are robust steel and concrete structures capable of maintaining cooling water levels and protecting used fuel rods even under the most extreme circumstances. If electrical power is interrupted for any reason, backup systems and procedures will ensure that cooling water is supplied to the pools. In addition, the industry immediately ensured that plant operating crews have regular, baseline information regarding water temperature and level in the fuel storage pools to ensure the ability to maintain cooling water supply to those pools in the event of a loss of power, well before it becomes a safety issue.

In addition, each nuclear power plant in the country is improving its ability to cope with a total loss of AC power by using portable equipment and ensuring the integrity of structures that surround the reactor. For example, containment vents play an important role in the overall safety strategy of some nuclear plant designs by preventing the potentially hazardous buildup of pressure from steam and gases inside the containment building that houses the reactor. A specially designed vent in the massive containment structure is designed to withstand extreme events by relieving primary containment pressure to a stack or other elevated release point. At Fukushima, had hydrogen buildup in the upper parts of the reactor building been released through such valves, explosions at the plant could have been avoided.

The industry also has assessed **reactor operator fundamentals and operator training programs** and found them to be effective.

Strict, Independent Government Oversight

The nuclear industry's ingrained culture of safety is reinforced by stringent and independent government regulation. Virtually every aspect of a nuclear energy facility is subject to government regulation and scrutiny — its design, where it is built, how it is built, how it is operated, how it handles used nuclear fuel, how it plans for emergencies and how it will be shut down at the end of its useful life.

In addition to evaluating and approving facility designs and inspecting nuclear energy facilities daily, the NRC licenses the professionals who operate a facility's reactor; inspects both daily operations and unusual events; penalizes any violations of federal regulations; investigates allegations of wrongdoing; and continuously assesses a plant's performance and safety.

- Independent NRC inspectors work at each nuclear energy facility and have unfettered access to plant data and employees.
- The inspectors have the authority to shut down nuclear energy facilities they believe are unsafe and to order changes in operations.
- Existing plants are subject to thorough reviews and approvals as part of the relicensing process.
- The regulatory system is transparent, with direct citizen involvement at every major milestone in establishing the design, selecting a location and granting a plant operating license.

NRC Task Force Recommendations

As an independent regulator, the NRC has required U.S. facilities to upgrade safety after significant global events, including Three Mile Island, Chernobyl and the 9/11 attacks. A 2011 analysis of the Fukushima event that the NRC provided to Congress confirms the safety of U.S. reactors and lays out the federal regulator's expectations for additional safety measures.

The industry and NRC generally are aligned on priority actions that should be taken at U.S. reactors. NRC's recommendations are grouped broadly in the following categories:

- Ensuring protection against extreme natural events.

- Enhancing mitigation measures for station blackout, hardened vents, hydrogen control and fuel pool cooling.
- Strengthening emergency preparedness.
- Clarifying the regulatory framework and improving agency efficiency.

The NRC report said: “a sequence of events like the Fukushima accident is unlikely to occur in the United States and some appropriate mitigation measures have been implemented, reducing the likelihood of core damage and radiological releases. … Continued operation and continued licensing activities do not pose an imminent risk to public health and safety.” Implementation of these recommendations without consideration of the safety benefit could divert attention and resources from those activities that are most important to enhancing safety.

Implementing New Safety Features

The U.S. industry is executing an integrated industry strategy to find and implement lessons learned and to ensure that no gaps exist in emergency response activities. The industry’s “Way Forward” strategy is a coordinated approach that integrates and coordinates all industry parties’ response to the Fukushima accident.

Supported by senior electric utility executives, reactor vendors and owners groups, NEI, INPO, and the Electric Power Research Institute formed the Fukushima Response Steering Committee to coordinate and oversee industry response activities. Activities being implemented in these specified areas of focus:

1. Maintain focus on excellence in existing plant performance.
2. Develop and issue lessons learned from Fukushima events.
3. Improve the effectiveness of U.S. industry response capability to global nuclear events.
4. Develop and implement a strategic communications plan.
5. Develop and implement the industry’s regulatory response.
6. Participate and coordinate with international organizations.
7. Provide technical support and research and development coordination.
8. Ensure accident response procedures provide steps for controlling, monitoring, and assessing radiation and communicating that information.

The U.S. industry, with cooperation from Tokyo Electric Power Co. and others in Japan, also developed the first comprehensive timeline of events at Fukushima Daiichi to inform the U.S. industry and regulatory response. The detailed report was delivered to U.S. industry, the NRC and members of Congress.

The report presents a chronology of activities at the Fukushima Daiichi station in the first four days after the earthquake and tsunami. INPO worked closely with Tokyo Electric Power Co. to develop the timeline. Information was compiled from the Japanese government, the International Atomic Energy Agency, and several Japanese nuclear and safety organizations. The U.S. nuclear energy industry has shared the report with the widest possible audience because it is important that all parties work from the same set of

“Even the most determined nuclear power critics cannot attack the impeccable safety record of nuclear power reactors under normal operating conditions.”

- *Progressive Policy Institute white paper December 2011* facts in determining the appropriate response. It is of paramount importance that we learn from it and take our facilities to even higher levels of safety and preparedness.

Industry Develops Strategy To Protect Against Extreme Events

The industry has developed a diverse, flexible approach to implementing post-Fukushima requirements that will achieve a greater safety benefit faster. The approach adds flexible coping capability that will provide a backup to permanently installed plant equipment that could be unavailable following severe or extreme natural phenomena or malevolent acts. This approach is integrated to implement the NRC's most significant recommendations and has been endorsed by the commission. The industry already exceeds baseline safety standards and FLEX will mitigate those scenarios that are beyond the plants' design parameters

The FLEX approach will include equipment such as additional pumps, generators, batteries and chargers that will be located in diverse locations throughout the plant site. The equipment will be commercial-grade, with program controls for equipment testing and maintenance, with results being subject to NRC oversight. The strategy is flexible in that it does not dictate that permanent equipment be installed, rather that the plant sites prepare portable equipment that could be used for any catastrophic event.

The FLEX concept is based on the industry's response to the events of 9/11, in which additional security precautions—such as portable generators, water pumps, hoses and batteries—were put in place to add layers of defense against unlikely events that are considered outside the scope of what a plant should be designed or regulated to withstand. The FLEX approach would provide multiple means of obtaining power and water needed to fulfill the key safety functions of reactor cooling, containment integrity and spent fuel pool cooling that would prevent damage to nuclear fuel.

Conclusion

The need for nuclear energy as part of America's energy mix is clear and our culture of safety and shared learning will make safe nuclear energy facilities even safer. Along with our support for the cleanup effort at Fukushima, the industry is taking additional actions to integrate what we have learned about the impact of extreme events on multiple reactors at nuclear energy facilities.

The FLEX approach provides multiple means of obtaining power and water needed to fulfill key safety functions.

The nuclear energy industry is focused on those actions that provide the greatest impact to safety, specifically maintaining electricity supply and reactor cooling capability. The industry is bound together by our shared responsibility for even safer operations, and we are committed to proposing solutions and innovations that support our common goal of safely producing clean electricity. The nuclear energy industry's primary and constant goal is to make safe nuclear energy facilities even safer. A decades-long commitment to safety and continuous learning is reflected in the operational focus and safety culture at our facilities. Companies that operate 95 U.S. reactors review safety procedures continually and update their facilities and training programs with lessons learned from those reviews.

The industry has a commitment to safety because nuclear energy is a vital part of America's electricity portfolio. It helps achieve greater energy independence for America and produces affordable, reliable electricity for one of every five Americans. Safety is the foundation of a thriving nuclear energy industry in America and globally—with more than 430 reactors producing electricity and 65 plants under construction.

After the March 11, 2011, earthquake and tsunami in Japan, the U.S. nuclear power industry is looking even more closely at ways to ensure safety is maintained in the face of extreme natural events. The U.S. industry and our global partners took immediate actions after the events in Japan, both to support the recovery of the Fukushima Daiichi reactors and to review critical safety systems at U.S. reactors. While we continue to monitor the situation closely and to learn from it, the nuclear energy industry in the United States is already implementing numerous measures to maintain and upgrade the already-high level of safety at nuclear energy facilities.

The nuclear energy industry in February 2012 unanimously approved an initiative to procure additional on-site portable equipment that will help ensure that every nuclear energy facility can respond safely to extreme events, no matter what the cause.

Companies that operate America's nuclear energy facilities have acquired more than 300 pieces of major equipment to supplement layer upon layer of safety at the nation's commercial reactors.

The equipment ranges from diesel-driven pumps and electric generators to ventilation fans, hoses, fittings, cables and communications gear. It also includes support materials for emergency responders.

Nuclear Power Plant Security

Key Facts

- The defense-in-depth philosophy used in the construction and operation of nuclear power plants provides high levels of protection for public health and safety.
- The U.S. Nuclear Regulatory Commission (NRC) holds nuclear power plants to the highest security standards of any American industry. The industry meets or exceeds these requirements in all areas. As a result, America's nuclear power plants are our nation's most protected and secure industrial assets. Well-armed and highly trained security forces protect every U.S. nuclear facility. These forces are routinely drilled and tested to ensure their readiness.
- Since Sept. 11, 2001, security provisions at nuclear power plants have been strengthened. The NRC has issued new security requirements for nuclear plant sites, and all U.S. plants have met these requirements.
- As part of 2005 comprehensive energy legislation, Congress required that the NRC officially increase security requirements. The bill also mandated background checks on nuclear power plant workers and allowed guards to use more advanced weaponry.
- The industry has added about 3,000 officers and upgraded physical security over the past four years. The industry has spent an additional $1.5 billion on security since September 2001.
- The industry coordinates with the NRC, Department of Homeland Security (DHS) and intelligence agencies on the assessment of potential threats and the specific actions by industry security forces in the event of a credible threat against a commercial nuclear facility.

- All commercial nuclear plants have emergency response procedures and contingency plans in the event of a plant accident or terrorist event. These procedures are evaluated every three years during extensive drills involving plant personnel and local police, fire and emergency management organizations. NRC and Federal Emergency Management Agency (FEMA) expert teams evaluate these drills.

Plant Security Meets All Federal Requirements

The nuclear energy industry is one of the few industries whose security program is regulated by the federal government. The NRC's requirements for nuclear power plant security are predicated on the need to protect the public from the possibility of exposure to radioactive releases caused by acts of sabotage. Intelligence information and incidents around the world are analyzed to ensure plant protection regulations are updated to reflect potential threats.

The NRC's security regulations are designed to ensure the industry's security force can protect against a range of threats. The threat against which the industry must defend is characterized as a suicidal, well-trained paramilitary force, armed with automatic weapons and explosives, and intent on forcing its way into a nuclear power plant to commit radiological sabotage. Such a force may have the assistance of an "insider," who could pass along information and help the attackers. The presumed goal of such an attack would be the release of radioactive material from the plant.

The NRC's "design basis threat" provides a foundation for developing defensive response strategies that cover a variety of situations. The NRC determines the design basis threat using technical studies and information received from intelligence experts and federal law enforcement agencies. It is reviewed by the agency twice a year.

Since Sept. 11, 2001, the NRC has twice raised the threat level against which nuclear plants must provide protection. In doing so, the NRC has assumed an increased number of possible attackers and weapons capabilities.

Congress also responded to public concern over nuclear plant security by including in the Energy Policy Act of 2005 several provisions that increase security requirements or capabilities. As part of the bill, the NRC was directed to increase officially the scope of the design basis threat. It also requires plants to fingerprint and conduct background checks of their employees. The bill also allowed the NRC to mandate certain advanced weaponry for plant guards. In addition, the bill increased federal penalties for sabotage and for bringing unauthorized weapons on to a nuclear power plant site.

Many industry security elements are considered "safeguards" information, which means they are controlled on a "need-to-know" basis. Clearly, plant protection capabilities and response strategy should be controlled and protected from public disclosure to avoid compromises that might benefit a potential adversary.

Defense-in-Depth Against Potential Threats

The FBI considers security forces and infrastructure at nuclear power plants formidable and considers nuclear power plants difficult to penetrate. In addition, the defense-in-depth features that protect the public from radiological hazard in the event of a reactor incident also protect the plant's fuel and related safety systems from attempted sabotage. The design of each plant emphasizes the reliability of plant systems, redundancy and diversity of key safety systems, and other safety features to prevent incidents that could pose a threat to public health and safety.

Steel-reinforced concrete containment structures protect the reactor. Redundant safety and reactor shutdown systems have been designed to withstand the impact of earthquakes, hurricanes, tornadoes and floods. Areas of the plant that house the reactor and used reactor fuel also would withstand the impact of a wide-body commercial aircraft, according to peer-reviewed analyses by the Electric Power Research Institute, a Palo Alto, California-based research organization. Plant personnel are trained in emergency procedures that would be used to keep the plant safe from a sabotage attempt.

A two-day national security exercise conducted by the Center for Strategic and International Studies (CSIS) in 2002 found that nuclear power plants would be less attractive targets to terrorist organizations because of the industry's robust security program. The exercise was designed to explore difficulties and reveal vulnerabilities that might arise if the nation were faced with a credible, but ambiguous, threat of a terrorist attack on American soil.

"Silent Vector" was developed and produced by CSIS in partnership with the ANSER Institute for Homeland Security and the Oklahoma City National Memorial Institute for the Prevention of Terrorism. Potential targets included refineries, large liquefied natural gas or liquefied petroleum gas storage operations, pipeline infrastructure, petroleum terminals, nuclear power plants, chemical operations, and dams.

CSIS President John Hamre said that nuclear power plants "are probably our best-defended targets. There is more security around nuclear power plants than anything else we've got. … One of the things that we have clearly found in this exercise is that this is an industry that has taken security pretty seriously for quite a long time, and its infrastructure, especially against these kinds of terrorist threats, is extremely good."

Security Increased Since Sept. 11, 2001

Immediately after the events of Sept. 11, 2001, security at every nuclear power plant was placed on its highest level of alert. Nuclear plant security now is consistent with DHS threat levels.

As a result, access to the plants is more strictly controlled, the defensive perimeters have been extended and reinforced, and security forces and capabilities have been augmented. Further, coordination with law enforcement, the intelligence community and the military has been enhanced. At some plants, these efforts have been supplemented by National Guard, U.S. Coast Guard, state police or other forces.

In 2002, the NRC formalized many of the enhancements to security that the industry already had implemented. The agency subsequently issued new requirements further restricting access authorization.

In 2003, the NRC issued rules limiting the working hours of security personnel and requiring increased training, including weapons proficiency. All plants met these requirements in 2004.

As a result of these mandates, each nuclear plant site has spent an average of nearly $70 million for physical improvements to improve security. In addition, the industry's total guard force was increased by approximately 60 percent.

Site Security Measures

All commercial nuclear plants have established extensive security measures. Plant operators and the NRC inspect these measures and test them in drills to uncover any weakness. Security measures include:

- Physical barriers and illuminated detection zones.
- Approximately 8,000 well-trained and well-equipped armed security officers at commercial nuclear plants who are on duty all day, every day.
- Surveillance and patrols of the perimeter fence.
- Intrusion detection aids (including several types of detection fields, closed-circuit television systems and alarm/alert devices).
- Bullet-resisting barriers to critical areas.
- A dedicated contingency response force.

All threats will be countered with dedicated, tactically trained, well-armed security officers who collectively determine the nature of a threat, assess its magnitude and take aggressive steps to deter the threat.

Controlled Access

Access to a nuclear power plant requires passage through a larger “owner-controlled area” surrounding the plant.

Access to an interior fenced area—the protected area, where the reactor building is located—is controlled by security officers and physical barriers. Vehicle barriers and/or other physical boundaries ensure the protected area of the plant cannot be breached by a direct vehicular assault or by detonation of a vehicle bomb. All vehicles, personnel and material entering the protected area first must be thoroughly inspected by security officers to ensure that no weapons, explosives or other such items are brought onto the plant site.

Access to the “protected area” of the plant is controlled through the use of physical barriers, intrusion detection equipment, closed-circuit surveillance equipment, a designated isolation zone and exterior lighting.

Access to the inner areas of the plant where vital equipment is located also is controlled through the use of physical barriers, locked and alarmed doors, and card-reader or hand geometry access control systems.

The barriers are substantial enough to effectively delay entry to allow for an effective armed response by plant security forces. Within the protected zone, access to all vital areas of the plant is even more secure. This access may be controlled by a security officer or provided by computer-controlled “key-card” access systems. Plant employees must have a documented need prior to gaining access to each vital area, and their movements are tracked by key-card access points throughout the vital area.

Reactor Operators Act in Concert With Security

Reactor operators train frequently to be sure they can respond to a range of unusual events. Plant operators have emergency procedures in place specifically for security situations, including automatic shutdown of the reactor in the event of an attack. Emergency planning and public notification systems support protection of public health and safety. The NRC periodically evaluates these plans during exercises or drills, which also may involve local police, fire and emergency management organizations.

Protecting Against An Insider Threat

All nuclear power plants have programs that reduce the potential for threats from plant personnel, or "insiders." These include authorization criteria for those allowed unescorted access to the plant's protected area and "fitness-for-duty" programs to deter drug and alcohol abuse.

Strong behavioral observation programs are in place requiring personnel to be trained to observe and report behavior that may be a potential threat to the normal operation of a nuclear power plant. In addition, many companies provide teamwork development programs that promote commitment and accountability in the work force.

Access Authorization

Before new nuclear plant employees or contractor employees are allowed unescorted access to the protected area, they must pass several evaluations and background checks to determine whether they are trustworthy and reliable. These include drug and alcohol screening, psychological evaluations, a check with former employers, education records, criminal histories (through the FBI) and credit histories.

Fitness-for-Duty Programs

Companies that operate nuclear power plants demand and ensure that personnel perform their duties in a safe, reliable and trustworthy manner, and are not under the influence of legal or illegal substances, or mentally or physically impaired from other causes, that would adversely hinder their ability to competently perform their duties. Employees who have unescorted access to the plant's protected area must maintain their fitness-for-duty. The NRC requires companies to conduct random drug and alcohol testing on their employees. At least half of all employees are tested annually.

Behavioral Observation

Employees with unescorted plant access are subject to continual behavioral observation programs. This observation is conducted by personnel who have been trained to do so. The purpose is to detect individual behavioral changes that, if left unattended, could lead to acts detrimental to public safety. Employees are offered counseling if they have job performance problems or exhibit unusual behavior. Similarly, anyone who appears to be under the influence of drugs or alcohol is immediately removed from the work area for evaluation.

Further Improvement Through Coordination

The nuclear energy industry recognizes that there is a theoretical possibility of an attack beyond the capabilities of plant security. In such cases, plant personnel would help respond in coordination with local, state and federal authorities. Nuclear plants are pursuing several different efforts to facilitate better coordination between the facilities and local, state and federal entities.

The nuclear energy industry is the first industrial sector to participate in the DHS Comprehensive Review Program. The comprehensive reviews examine every element of the critical infrastructure, including a thorough security assessment. DHS provides recommendations on additional measures that can be taken to protect against and mitigate possible terrorist attacks.

During these comprehensive reviews, a multidisciplinary team spends a week reviewing a site's vulnerabilities and security plans and also spends three to five days at the site interacting with security personnel, emergency planning and response staff, and state and local law enforcement and emergency responders.

The industry is fully committed to working with all levels of government to provide the best security possible to deter an attack and to respond forcefully and swiftly should one occur. The industry must always satisfy the security requirements imposed by the NRC. It is working constantly to improve security at nuclear plants through training, drills and exercises; implementation of new technology; and cooperation with government entities such as DHS, the FBI and local law enforcement.

Source: Nuclear Energy Institute

How Nuclear Power Is Generated

In a hydroelectric station, the weight of falling water is used to turn a turbine-generator to produce electricity. In a fossil fuel power station, coal, oil or gas burned in a furnace provides heat to change water to high-temperature steam. This intensely hot (about 1,050 degrees Fahrenheit) "energy-filled" steam drives the blades of a turbine, which spins a generator, producing electricity.

In a nuclear power station, the furnace is replaced by a reactor containing a core of nuclear fuel, primarily uranium. Splitting uranium atoms in the reactor produces heat, which is used to make the steam

There are four essential parts of a commercial reactor:

1. The core contains the fissionable uranium fuel in assemblies. Each assembly consists of a number of metal tubes (**fuel rods**) in which there are cylindrical ceramic pellets containing uranium. The assemblies are held in carefully designed geometric arrays by grid spacers. A typical reactor fuel core is cylindrically shaped, about 12 feet in diameter and 12 feet high.

2. The **control system** serves to regulate the rate of fission and, thereby, the rate of heat generation.

3. The **primary cooling system** carries heat away from the fuel assemblies to boil water in the steam generators.

4. **Additional** cooling systems and protection barriers.

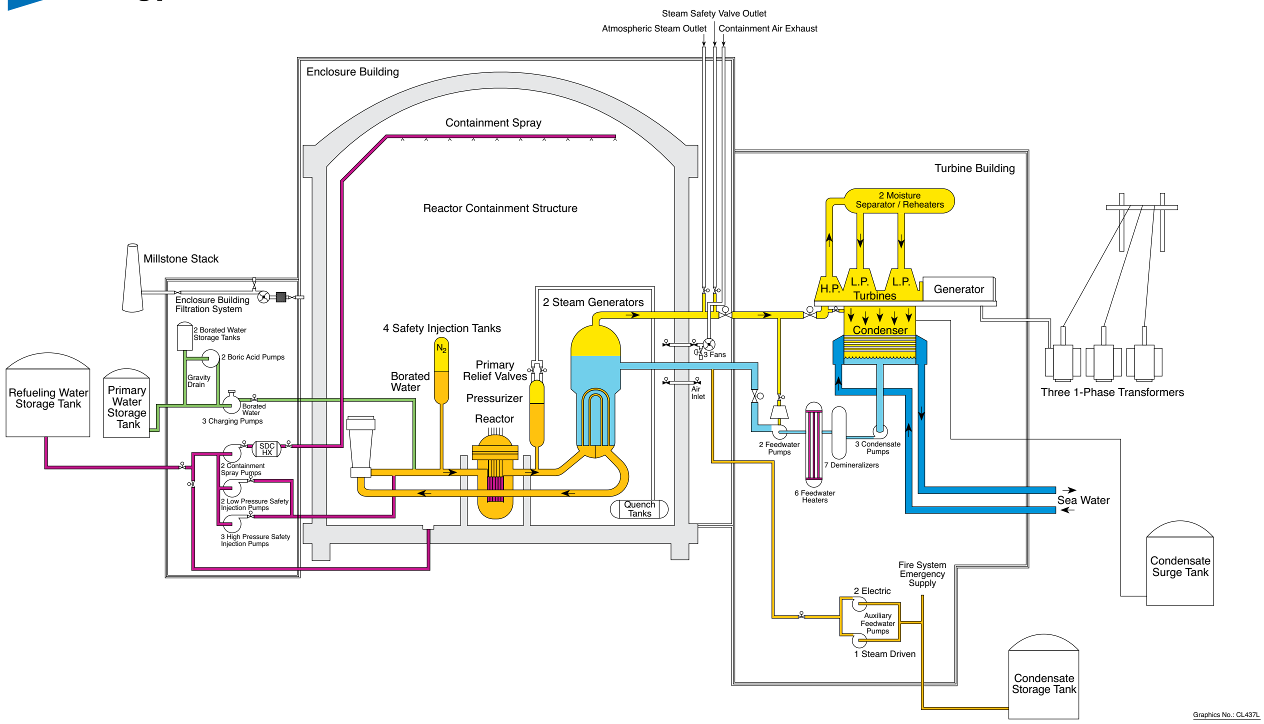
All operating commercial nuclear reactors in this country are of the water-cooled variety. Basically, they all work the same way. Water, in a closed cycle separate from the environment, flows through the reactor vessel and among the fuel rods and assemblies. This water carries away the heat that is a product of the fissioning of uranium atoms. The heat converts water to steam, which spins a turbine-generator, producing electricity.

Increasing or decreasing the rate of fission, and, thus, the amount of heat, is accomplished by two methods — inserting or removing control rods, and adjusting the amount of boron in the water. Both the control rods and boron act as fission moderators. A reactor operator can stop the fission process by fully inserting the control rods into the reactor.

The fission process in a commercial nuclear reactor can never "run away" and cause a nuclear explosion. The fuel design precludes such an occurrence. If primary cooling water is lost from the reactor system, it is possible that the fuel may melt and destroy itself, but it cannot cause a nuclear explosion.

Dominion Energy

Millstone II



Net Generating Capacity: .... 884 mwe

Cost: $424,400,000

Commercial Operation:.. December, 1975

Station Employees (Both Units):...1090

Reactor Manufacturer:....................................Combustion Engineering Inc.

Turbine Generator Manufacturer: ....General Electric Company

Engineer/Constructor:..Bechtel Corporation

Containment Walls (Thickness):..3.75 ft.

Steel Liner Thickness: ....1/4 inch

Height from base: ....176 ft.

Material:...Reinforced Concrete

Reactor Height:...42 ft.

Reactor Diameter: ....14 ft.

Steel Wall Thickness: ....4 3/8 – 8 5/8”

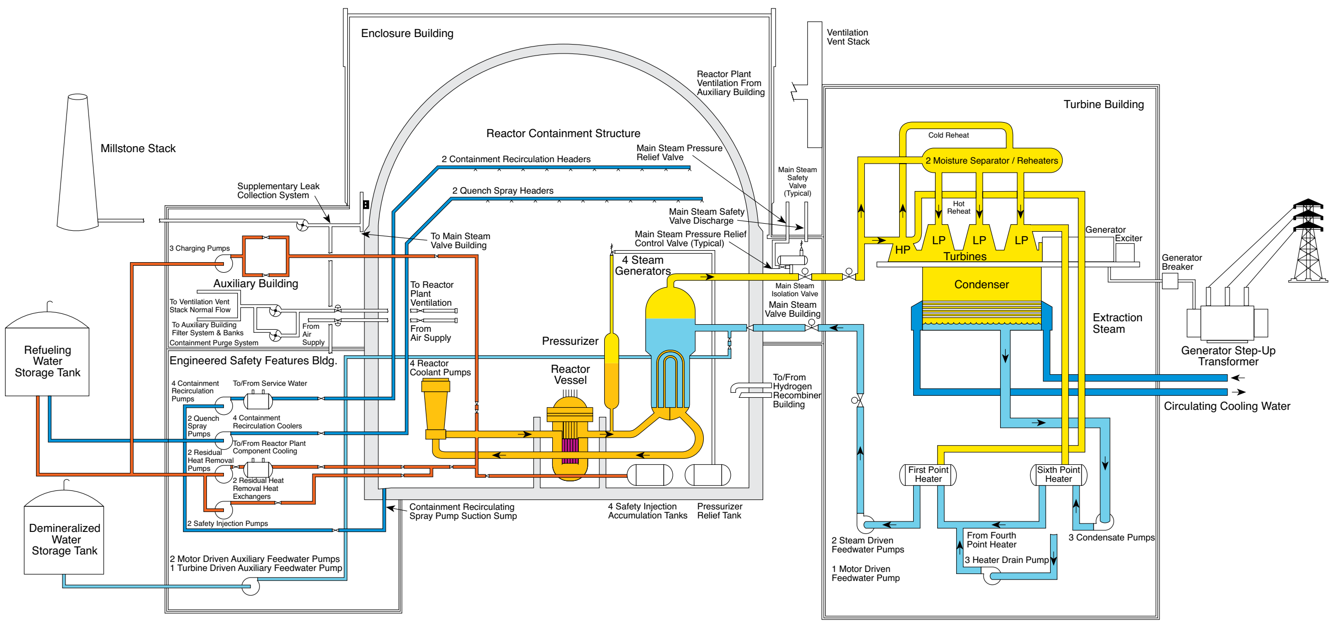
Number Fuel Assemblies in Reactor: 217

Operating Temperature:...572 degrees F

Operating Pressure: ....2,235 psig

Uranium Fuel: ....192,000 lbs.

Millstone III



Graphics No: CL438G

Net Generating Capacity: .... 1,227 mwe

Cost: $3,770,000,000

Commercial Operation:...April, 1986

Station Employees (Both Units):...1090

Reactor Manufacturer:......................................Westinghouse Electric Corp.

Turbine Generator Manufacturer: ....General Electric Company

Engineer/Constructor:............................Stone & Webster Engineering Corp.

Containment Walls (Thickness):..4.5 ft.

Steel Liner Thickness: ....3/8 – 1/2 “

Height from base: ....201 ft.

Material:...Reinforced Concrete

Reactor Height:..44.8 ft.

Reactor Diameter: ....14.4 ft.

Steel Wall Thickness: ....5 3/8”

Number Fuel Assemblies in Reactor: 193

Operating Temperature:..587 degrees F

Operating Pressure: .... 2,235 psig

Uranium Fuel: .... 222,645 lbs

Plant Components and Systems

Primary System

There are two closed coolant systems: the primary and the secondary. The primary system (also called the reactor coolant system) consists of water flowing through the reactor vessel to steam generators where heat is transferred to a second coolant loop, the secondary system. This secondary system water boils into steam, which flows to the turbine generator, produces electricity, is condensed back into liquid, and is returned to the steam generators.

Reactor Vessel

The reactor vessel, which houses the core of nuclear fuel assemblies, is made of carbon steel and is lined with stainless steel. It is cylindrical in shape and three to nine inches thick. The fuel assemblies are placed in the vessel in a precise geometric configuration designed to allow the fission process to take place and to efficiently utilize the fissile materials within the fuel.

The vessel also contains control rod assemblies made of a special neutron-absorbing alloy and enclosed in stainless steel. Under a wide range of circumstances, varying from a minor deviation from normal operating conditions to an emergency situation, the reactor will receive a signal to immediately shut down, known as a trip or scram. If such a signal is received, all the control rods are automatically inserted into the core and the reaction ceases immediately.

Reactor Control

Control of the reactor is accomplished primarily by the introduction of neutron absorbing materials in the reactor system. Boric acid, a neutron-absorbing chemical, is added to the water flowing through the reactor. The control rods are used primarily for startup and shutdown purposes. The role of the water itself in the fission process can also contribute to reactor control. Water, as the moderator, is a necessary part of the fission reaction. If the water is lost, the reaction automatically ceases. Even an increase in temperature, which makes the water less dense, can slow down the fission reaction.

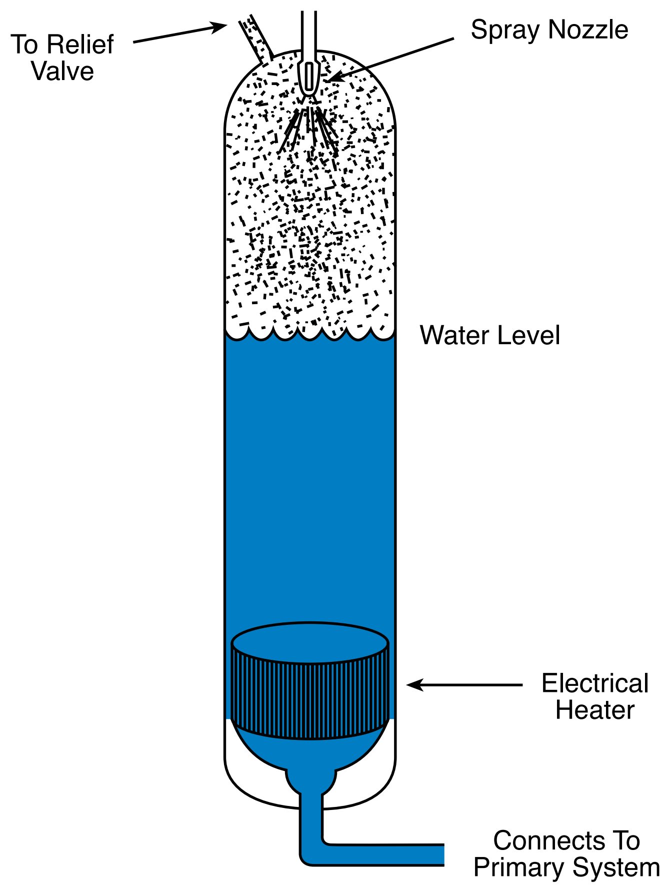
Reactor Protection

Nuclear plants are designed and operated for maximum efficiency; however, conditions, known as transients, such as equipment failures, operator error, or external factors (such as storms or loss of electrical power) may cause deviations from normal operating condition. To prevent these transients from affecting public safety, the plants are designed to automatically shut down whenever plant conditions exceed conservatively set operating boundaries. A deviation in power, pressure, temperature, water level, steam flow or coolant flow can cause an automatic shutdown, or trip. The reactor also can be tripped manually if an operator perceives a potentially unsafe condition or one that could damage plant equipment. A reactor trip is accomplished by rapidly inserting the control rods into the reactor core, which immediately stops the chain reaction.

Pressurizer

The primary (reactor) coolant system is kept under high pressure (approximately 2,235 pounds per square inch, or psi) to prevent boiling. This pressure is accomplished and controlled by a component called a pressurizer. Inside the pressurizer, electrical heaters heat the water to a higher temperature than the rest of the primary system, forming a large steam bubble in the top of the pressurizer. This is the only place that steam exists in the primary system, and it always remains in the pressurizer. System pressure can be reduced by sending water through spray nozzles in the top of the pressurizer, which cools the steam bubble and causes some of it to condense. The smaller steam bubble exerts less hydraulic force on the water, lowering system pressure.

Pressurizer



Steam Generator

The primary system water is heated to approximately 550 to 600 degrees Fahrenheit (F) as it flows through the reactor core. It then flows to steam generators where it transfers its heat to the secondary system.

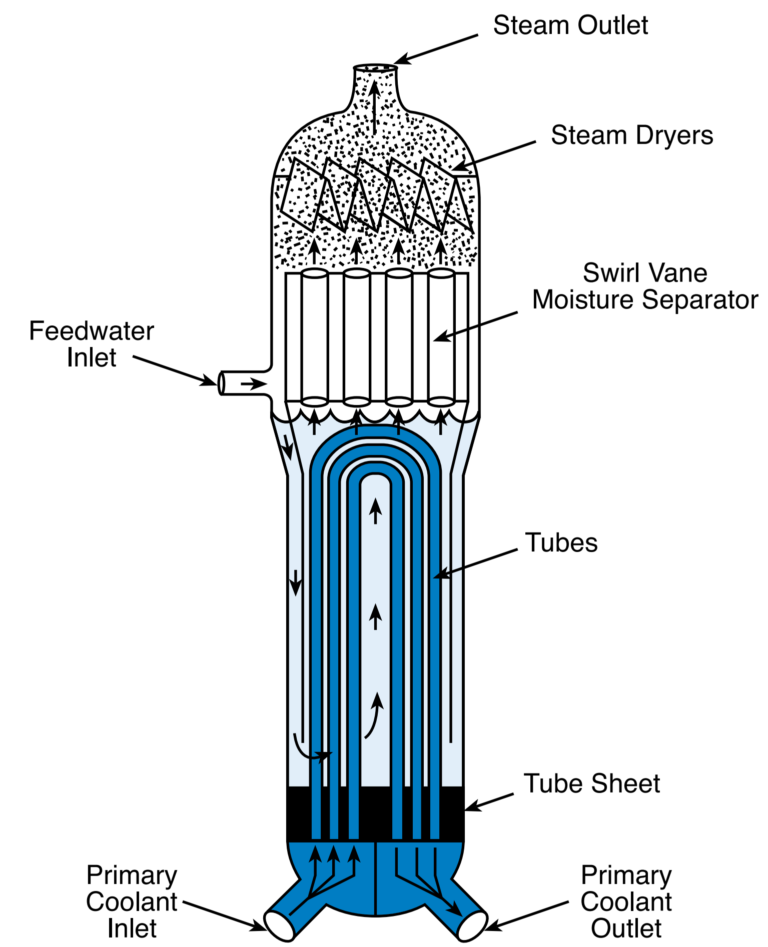
The steam generator is simply a heat exchanger between these two systems. Heated primary system water flows through thousands of U-shaped tubes in the steam generator, which serve as a boundary between the two systems. The heat is transferred through the tubes to the secondary system, which boils into steam.

The primary system water is then pumped back into the reactor vessel, approximately 50 to 60 degrees cooler than when it entered the steam generator.

The steam goes through moisture extraction devices, located in the upper area of the steam generator, which dry the steam. At this point, the steam

— at approximately 500 to 550 degrees F — is sufficiently dry to go to the turbine generator.

Steam Generator



Reactor Coolant Pumps

Primary system water that has gone through the steam generator is pumped back into the reactor vessel by reactor coolant pumps. These pumps are designed to pump large volumes of water.

Secondary System

Main Steam Isolation Valves

There is one set of main steam isolation valves (MSIVs), located in the main steam lines that close in the event of a high steam flow signal. Because the steam is not a part of the primary system the MSIVs do not serve any containment function; they simply prevent excess steam production in the steam generators.

Turbine Stop And Control Valves

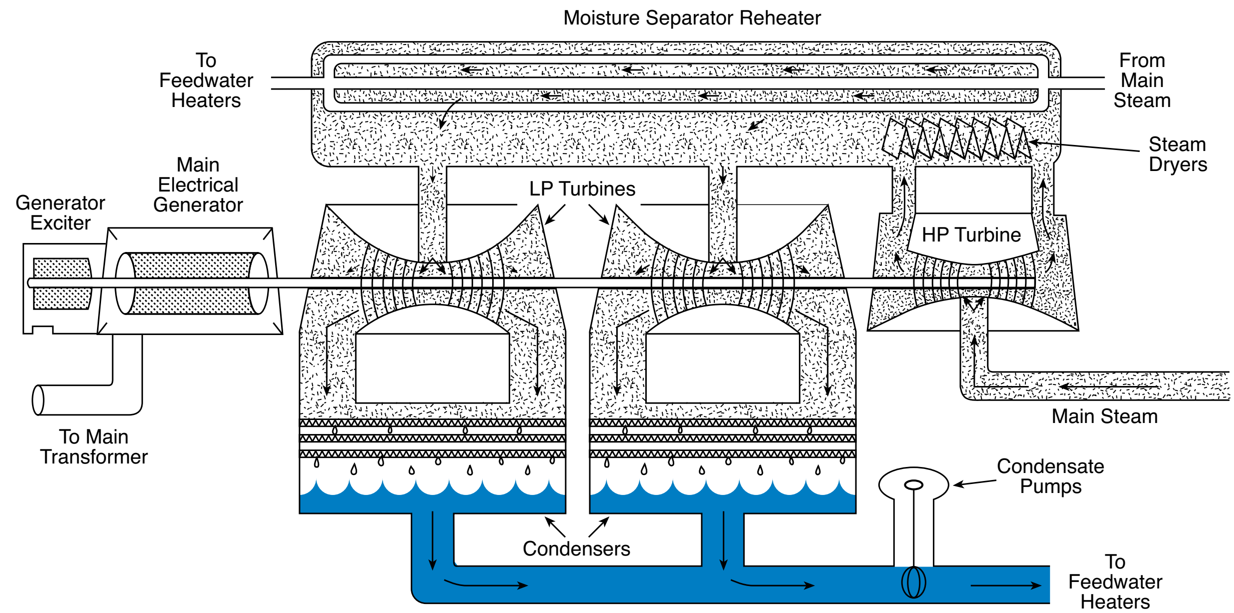
Steam entering the turbine building travels through two sets of valves prior to entering the turbine generator. The turbine stop valves are normally completely opened, but will close on a signal from a variety of systems. The purpose of these valves is to interrupt steam flow to the turbine to prevent it from over speeding when the generator stops generating electricity.

The turbine control valves are normally partially opened during operation. They throttle the steam flow to the turbine and control the steam flow to the turbine.

High-Pressure Turbine

Steam enters the high-pressure turbine casing and hits the blades of several successively larger sets of turbine blades, turning the shaft of the turbine-generator. During operation, the shaft spins at the rate of 1,800 revolutions per minute (RPM), in order to maintain the generator's electrical output at a constant frequency. By the time the steam hits the last stage of the high-pressure turbine, it has lost a great deal of its energy, and has begun to condense.

Turbine Generator



Moisture Separator-Reheater

Moist steam leaving the high-pressure turbine flows to the moisture separator reheater. The steam goes through moisture extraction devices that separate approximately 10 percent of the moisture from the steam. It is then reheated as it passes by hundreds of tubes carrying hot steam tapped off the main steam lines. At this point, the steam is sufficiently dry to go to the low-pressure turbines.

Low-Pressure Turbines

Steam leaving the moisture separator-reheater is sent to either two or three low-pressure turbines (Millstone 2 has two and Millstone 3 has three). It then passes through a series of turbine blades (usually seven or eight sets) attached to the turbine generator shaft, further contributing to the energy of the spinning turbine.

Combined intercept valves between the moisture separator reheater and the low-pressure turbines serve the same purpose as the turbine stop valves:

on the proper signal, they close to prevent steam in the moisture separator-reheater from overspeeding the turbine on a loss of electrical generator load.

By the time the steam has passed through the last set of blades, its useful energy has been converted to rotation of the turbines, and it is at a very low temperature (approximately 100 degrees F) and pressure (very close to a vacuum). It is able to remain in steam form at this temperature because of the extremely low pressure. At this point, the remaining task is to condense it back into liquid for reuse in the plant.

Condensers

Below each low-pressure turbine is a condenser containing thousands of long tubes, approximately 40 to 50 feet long and one inch in diameter. Cool water from an outside source flows inside these tubes, while steam exhausting from the turbines condenses on the outside of the tubes and drops to the bottom of the condenser. From there it will be recycled back into the plant. Millstone's outside source of cooling water is Long Island Sound.

Electrical Generator

The electrical generator, attached to the same shaft as the turbines, converts the mechanical energy of the spinning shaft to electrical energy. Inside the generator a large electromagnet spins inside huge coils of wire. The magnetic field moving across the coils of wire produces electricity in the coils. This electricity, with a voltage of approximately 24,000 volts, travels to the main transformer where it is converted to approximately 345,000 volts, suitable for transmission across long distances.

The amount of electricity produced is controlled by the strength of the magnetic field: the stronger the magnetic field, the more electricity is produced. The magnetic field strength is controlled by an adjustable electrical device called the generator exciter. When electricity is produced in the coils surrounding the electromagnet, it produces a magnetic field of its own. The interaction of these two magnetic fields provides a very strong resistance to rotation of the turbine-generator shaft, which is why high-pressure steam is necessary. If the generator suddenly stops producing electricity, this resistance disappears and, if the flow of steam to the turbines continued, an acceleration of the turbine, or over speed, would result. This condition is prevented by an automatic closure of the turbine stop valves and the combined intercept valves.

Condensate And Feedwater

The overall function of the Condensate and Feedwater Systems is to return the condensed steam from the condensers back to the boiling device or steam generators. This water, known as feed and condensate, is purified and reheated prior to being recycled.

Condensate Pumps

The condensate pumps take water from the condensers and pump it into a series of feedwater heaters.

Feedwater Heaters

Condensate goes through a series of five or six feedwater heaters before being sent back to the steam generators to be reboiled. Each heater heats the water to a slightly higher temperature than the previous one. These heaters are similar in configuration to steam generators in that they have

U-shaped tubes inside a shell. The condensate flows inside the tubes and is heated by steam outside the tubes, which has been tapped off various stages of the turbine.

By the time the water goes through the last feed water heater, it has been heated to more than 400 degrees F. The preheating of this water greatly increases the overall efficiency of the plant.

Feedwater Pumps

Feedwater pumps send the preheated water back for reboiling in the steam generators. These pumps operate at high pressure and enable the feedwater to overcome the steam pressure in the boiling device.

Feedwater Regulating Valves

The feedwater regulating valves control the flow of feedwater back to the boiling device, enabling operators to maintain a balance between feedwater flow and steam production.

Circulating Water System

The circulating water system pumps cool water from an outside source into the condensers to condense steam. Water is pumped from an intake structure located on the source of water, through tubes in the condensers, and back to the outside water source, somewhat warmer than when it entered the plant.

At Millstone, Long Island Sound is the outside source. After the water flows through the condenser tubes, it flows into what was once the Millstone granite quarry and then into the Sound.

Circulating Water Screens

Because sea water can carry debris that could clog the condenser tubes, the intakes are equipped with devices to clear debris from the water. Trash racks at the intake entrance prevent large debris, such as floating logs and large seaweed, from entering the plant. These racks are cleaned regularly.

Traveling screens filter smaller items, such as seaweed, fish and shellfish. The screens are made of wire mesh with 1/4 to 3/8 inch opening. When enough debris has accumulated on the screens, the screens are cleaned from behind by a pressure spray system.

Circulating Water Pumps

Large circulating water pumps, located in the intake structure, pump cooling water through the condensers in the plant. Millstone 2 has two condensers with four pumps. Millstone 3 has three condensers with six pumps.

Thermal Discharge

The circulating water discharged from the plant has been warmed by the process of condensing the steam. The temperature increase varies between the plants and is dependent upon power output, but is generally in the range of 20 to 40 degrees F. Because warm water has a potential for environmental impact, biological studies have been and continue to be conducted at the plants.

Studies at Millstone have demonstrated minimal environmental impact. Because of its location near the mouth of Long Island Sound, the tidal flow past Millstone is approximately thirty times greater than the flow through the two units. A measurable impact has been detected only in certain seaweed populations directly adjacent to the discharge.

Shutdown Cooling System

When a reactor shuts down, the fuel retains a significant amount of heat even though the fission reaction itself has been stopped. The fuel also generates additional heat through the decay of fission products. Although the heat output is a small percentage of that of normal operating conditions, it is sufficient to require a means of heat removal. During a non-emergency shutdown, the reactor will be placed in either hot-standby or cold-shutdown, depending on the expected duration and the work to be done during the outage.

In hot-standby, the fission reaction is stopped by the insertion of control rods, but the reactor system is maintained at close to normal operating temperature and pressure by removing decay heat at the rate at which it is produced. This allows the plant to resume operation by restarting the fission process without the need to go through a lengthy system heat-up.

When the plant is going to be out of service for several days, or when it is shutting down for refueling, it will be taken to cold shutdown. Heat is removed more quickly than it is being produced, and the temperature of the reactor system is reduced to less than 200 degrees F and 200 psi. This allows for inspection and maintenance of system components.

Shutdown Cooling

Steam bypasses the turbine generator and goes directly to the condensers. This water is returned to the steam generators by the feedwater pumps. Additional cooling, however, is provided by initiating the auxiliary feedwater system. This system takes cool water from a large storage tank and pumps it into the steam generators. The water boils in the steam generators and is then sent to the condenser or vented to the atmosphere. Because this water is coming from the secondary side of the steam generators, it is not radioactive.

If the plant is to taken to cold shutdown, the Residual Heat Removal (RHR) system is initiated when the primary system reaches 300 degrees F. Pumps in the RHR system take water from the primary system, cool it by sending through heat exchangers, and return the cooler water to the primary system. The pumps in this system are also used in the Low-Pressure Safety Injection (LPSI) systems, described later in this section.

Emergency Systems

Some safety systems are designed to provide additional water to the reactor in the event of a loss of its regular supply of coolant water. The objective of the Emergency Core Cooling System (ECCS) is to keep the core covered with water during the entire duration of the event. This prevents significant damage from overheating of the uranium pellets, as well as to the metal fuel cladding that contains them.

Some safety systems and components are designed to provide a physical barrier to the release of radioactivity to the public regardless of conditions inside the plant. These are: 1) the containment building; 2) the reactor coolant system boundary; and 3) the fuel rod cladding, collectively referred to as the three fission product barriers.

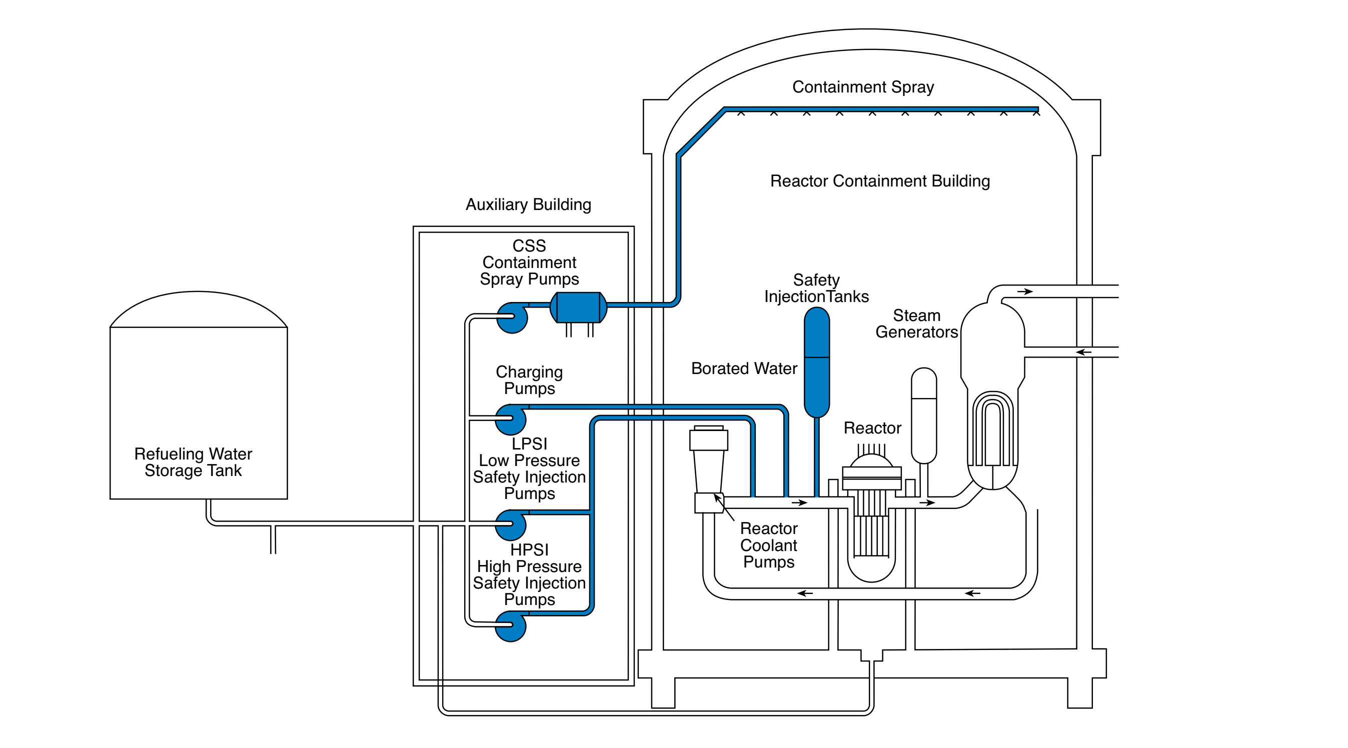
Still other safety systems are designed to reduce/clean up the level of radioactivity in the event it is released to the reactor containment building system or leaks from it. These are the containment sprays, containment air recirculation, standby gas treatment systems, and enclosure building filtration system.

Emergency Core Cooling System

The ECCS provides a backup water supply to the core in the event of a variety of Loss of Coolant Accidents (LOCAs) ranging from a small-break LOCA, in which a small pipe break exists but system pressure remains relatively high, to a large-break LOCA, in which a large pipe break causes a rapid loss of water and
system pressure.

The components of the ECCS, like other safety systems, are redundant; that is, any component necessary to keep the core covered under any set of conditions has a backup. This is consistent with the "single failure criteria" design philosophy of the U.S. Nuclear Regulatory Commission (NRC) and the nuclear industry. This philosophy ensures that the public will not be endangered by the failure of a single piece of equipment necessary to mitigate the consequences of an accident.

Emergency Core Cooling System



The function of the ECCS in a PWR is to keep the core covered with water in the event of a LOCA. The reactor at a PWR would "trip" on a number of signals received as the result of a LOCA of any size, and various components of the ECCS would initiate. The systems of the ECCS all draw water with a high boron concentration designed to prevent the fission process from resuming.

Among the components of the ECCS are the charging pumps, high- pressure safety injection, low pressure safety injection, containment spray, water recirculation and accumulator tanks.

Charging Pumps

In the event of a very small leak in the primary system of a PWR, the charging pumps (part of the plant's Chemical and Volume Control System) would supply makeup water to the system. These pumps are capable of injecting water at normal operating pressure, and will supply sufficient water to compensate for any leak too small to depressurize the system to the operating pressure of the high pressure safety injection system (HPSI), described below.

High Pressure Safety Injection System (HPSI)

HPSI is designed to keep the core covered in the event of a small to intermediate break LOCA during which some primary system pressure is maintained and water loss is intermediate. HPSI consists of two pumps that pump borated water from a large refueling water storage tank (RWST), located outside the reactor building, into the reactor vessel. Its operating range varies from plant to plant, but is generally in the range of 600 to 1,700 psi.

Low pressure Safety Injection System (LPSI)

The LPSI system is designed to provide large volumes of water to the core during a large break LOCA in which the primary system is rapidly depressurized and more water is being lost than can be replaced by the HPSI system. It operates at approximately 600 psi or less, and pumps thousands of gallons of water per minute from the RWST into the reactor vessel.

Containment Spray System (CSS)

In the event of a LOCA, steam pressure in containment will increase, and the containment spray system may initiate. Pumps in this system will also take water from the RWST, and spray it into the containment atmosphere. The purpose of this system is to cool and condense steam in the containment, thus lowering pressure within the building. It also would remove some radioactive fission products from the containment atmosphere.

Water Recirculation

The HPSI, LPSI and containment spray systems described above all use the RWST as their primary source of water. Obviously, this tank could eventually be depleted. At that point, or at any point within the emergency operating procedures, these systems can be aligned to take water that has accumulated on the floor of the containment and recycle it though heat exchangers. Thus these systems have a virtually inexhaustible supply of water.

Safety Injection or Accumulator Tanks

PWRs are equipped with safety injection tanks designed to cover the core during the early stages of a large break LOCA. These tanks contain borated water under a pressure of 225 to 650 psi. If primary system pressure drops below that level, the tanks automatically flood the core with thousands of gallons of water without the need for any pumps or other equipment.

Physical Barriers

Fuel Cladding

The fuel rods that contain the uranium pellets provide a barrier to fission product release. These rods, made of either stainless steel or a high-quality zirconium alloy, are pressurized with helium and sealed prior to being placed in the reactor. The cladding, usually about 0.025 inches thick, retains fission products produced on the outside surface of the pellets.

Reactor Coolant System

The reactor coolant system acts as the second barrier to a fission product release. It consists of the reactor vessel itself and associated piping and equipment. The vessel is a high-quality carbon steel container, three to nine inches thick.

In a PWR, the entire primary coolant system is considered part of this barrier.

Containment

The containment building is the final barrier designed to prevent the release of radioactivity from the reactor coolant system to the environment under both normal and the most severe emergency conditions. Therefore, all systems and components that could potentially release large amounts of radioactivity are housed in the containment structure.

Some PWRs, including Millstone 2 and 3, also have an enclosure building around the primary containment to contain any leakage from the primary containment and treat it before release to the environment.

The containments are designed to withstand not only the internal forces generated by a severe accident, but also external forces, such as a tornado, hurricane, plane crash or earthquake.

Electrical Transmission

Electricity coming from the main electrical generator is at a relatively low voltage (approximately 24,000 volts), but with a high current. This current cannot be carried by normal transmission lines without damaging the lines. Thus, it must be transformed to a form more suitable for distribution before leaving the station. The power is carried from the generator to the main transformer through a large hollow conducting pipe rather than transmission lines. This pipe, called the isolated phase bus (or isophase bus, for short), is enclosed within another pipe, and is air-cooled both inside and out to prevent damage to the conductor.

In the transformer yard, electricity from the isophase bus enters the main transformer, where it is transformed from 24,000 volts up to 345,000 volts. At this voltage, the current is low enough to be transmitted via transmission lines, and transmission losses are minimized. The main transformer is cooled by oil, which is itself cooled by a massive array of air fans.

Station Power

Before the electricity enters the main transformer, a small percentage of it is “tapped off” by the normal station service transformer (NSST), where it is transformed from 24,000 volts to a lower voltage. This voltage varies from plant to plant, but is generally in the range of 4,000 to 7,000 volts.

The NSST is the source of electricity for plant equipment when the plant is in a normal operating mode (i.e., the generator is producing electricity). The plant uses approximately four to five percent of the electricity produced by the generator.

If the generator is not producing electricity, plant components get their power from the transmission grid, either through the main transformer and NSST or through the reserve station service transformer (RSST). This transformer takes electricity from the transmission grid and transforms it to 4,000 to 7,000 volts, suitable for "in-house" use.

Emergency Power

If both the NSST and the RSST are ever unavailable, each plant has two redundant onsite sources of backup power to provide all the AC power necessary to handle emergency conditions. Either of the two onsite sources is capable of independently operating the plant's emergency systems. Millstone 2 and 3 have two diesel generators each.

Loss of Normal Power

Loss of Normal Power is the unlikely condition during which all normal off-site and emergency on-site AC power sources are unavailable. Even under these conditions, the plant still has the capability of cooling down. Power to the controls necessary to operate equipment would be provided by the station's DC batteries.

Cooling is provided with the help of a phenomenon called "natural circulation." It makes use of the principle that warm water rises and cool water falls. Water heated in the reactor automatically flows upward to the steam generators. Heat is taken away by the secondary system water in the steam generator. The cooled water flows back downward to the reactor vessel.

In order to maintain the cooling process, however, the water on the secondary side of the steam generators, which boils as it draws heat away from the primary system, must be replenished. This is accomplished by using a steam-driven auxiliary feedwater pump, which takes water from the condensate storage tank and pumps it into the steam generators. Because this pump is driven by steam rather than electricity, it can operate as long as sufficient heat is being produced in the reactor to generate steam.

Control Room

All plant equipment is monitored and operated from the control room — the "nerve center" of the plant. Operators in the control room constantly monitor plant conditions, respond to changes in system parameters and, if necessary, will undertake actions to bring plant conditions under control.

The control building itself, because it is considered part of the emergency system, is capable of withstanding a severe earthquake.

The atmosphere of the control room is carefully controlled, and if a condition existed which made the air outside the control room unsafe, the control room would automatically be isolated. This would ensure that operators could remain in the room to bring any emergency situation under control.

Control Room Operators

Operators at commercial nuclear plants come from a variety of technical backgrounds. The majority have Navy nuclear submarine service and have already received intensive training in all areas of reactor operations, or a college background in engineering.

After joining Dominion, a candidate undergoes intensive training before becoming a licensed commercial nuclear plant operator. He or she begins as a Plant Equipment Operator (PEO), performing various hands on tasks around the plant under the direction of the control room. In addition to on-the-job training, the PEO receives classroom training in plant systems, theory of operation and other related subjects.

After one to two years, some PEOs are selected for the license training program to become a licensed reactor operator. This program includes more than 1,000 hours of instruction of plant systems design and operation. It typically involves 70 weeks of classroom instruction in topics such as reactor theory, thermal hydraulics and nuclear physics; training on a computer simulator, which provides an exact working replica of the control room, plus 13 weeks of on-the-job training under the direct supervision of a licensed reactor operator.

The National Nuclear Accrediting Board reviews and accredits operator training programs under the auspices of the Institute of Nuclear Power Operations (INPO) and its activities are monitored by the NRC. Applicants must undergo a physical examination and be certified physically and mentally fit to be an operator. If the NRC determines that the applicant's qualifications and physical condition are acceptable, the applicant is scheduled to take the NRC licensing examination.

The examination process begins with a written exam covering reactor theory, thermodynamics, and mechanical components. The site-specific examination consists of a written examination covering the nuclear power plant system, procedures, and administrative requirements, and an operating test that includes a plant walk-through and a performance demonstration on the facility licensee's power plant simulator.

The operator's and senior operator's licenses are only valid to operate the facility on which the applicant was trained and tested. All licensed operators are required to participate in their facility licensee's drug and alcohol testing programs.

Operator licenses expire six years after the date of issuance or upon termination of employment with the facility licensee. The renewal process requires the applicant to provide written evidence of experience under the existing license. The NRC will renew the license if, on the basis of the application and certifications, it determines that the applicant continues to meet the regulatory requirements.

Emergency Preparedness

Millstone Station, the Connecticut Department of Emergency Services and Public Protection, Division of Emergency Management and Homeland Security (DEMHS), and the communities surrounding Millstone Station have developed comprehensive plans for responding to nuclear power plant emergencies. The objectives of these plans are to:

- Assess plant conditions.
- Provide a support organization for bringing plant conditions under control and into recovery.
- Provide procedures and means for notification of federal, state, and local officials.
- Provide procedures for protecting the health and safety of the public by initiating necessary protective actions.
- Provide procedures and means for alert and notification of the public of protective action recommendations.

In the event of a nuclear plant emergency, Millstone is responsible for determining its cause, assessing and classifying the severity of potential consequences, notifying government officials, and initiating actions to return the plant to a stable condition.

State and local officials are responsible for notifying the public and initiating actions, if necessary, to protect the health and safety of the public. These protective actions could include establishing access control of an affected area, controls of food, water, milk and livestock and sheltering or evacuation of the population in an affected area.

Types Of Accidents

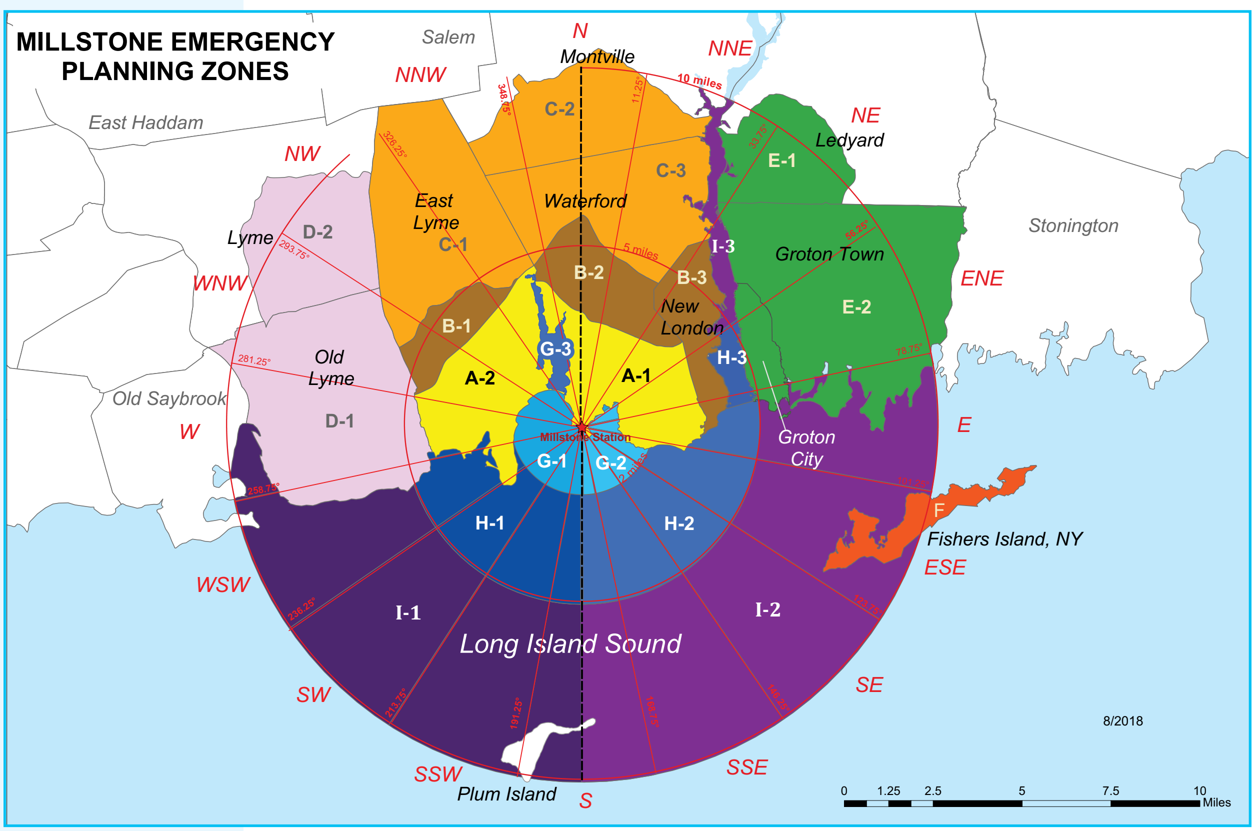
Nuclear power plants are equipped with systems that will protect the public under a variety of accident conditions. During design of the plant, a spectrum of postulated accident scenarios are analyzed, and the plant is fitted with redundant safety systems to prevent significant core damage and a large release of radioactivity under those conditions. These accidents range from low probability (1 in 10,000 per reactor per year) occurrences, such as a large pipe break Loss of Coolant Accident (LOCA), to a higher probability, but low consequence, occurrence such as an unplanned release of small amounts of radioactivity.

There are accidents whose probability of occurrence range from 1 in 10,000 per reactor per year to 1 in 10,000,000 per reactor per year and lower (plant lifetime is greater than 40 years with license extensions). These are called severe core damage accidents in which sequences of multiple, successive failures beyond the plant's design basis are postulated. These accidents result in damages ranging from damage to fuel cladding to core melting. The final line of defense for these types of low probability events would be the Emergency Plan.

Emergency Planning Zones

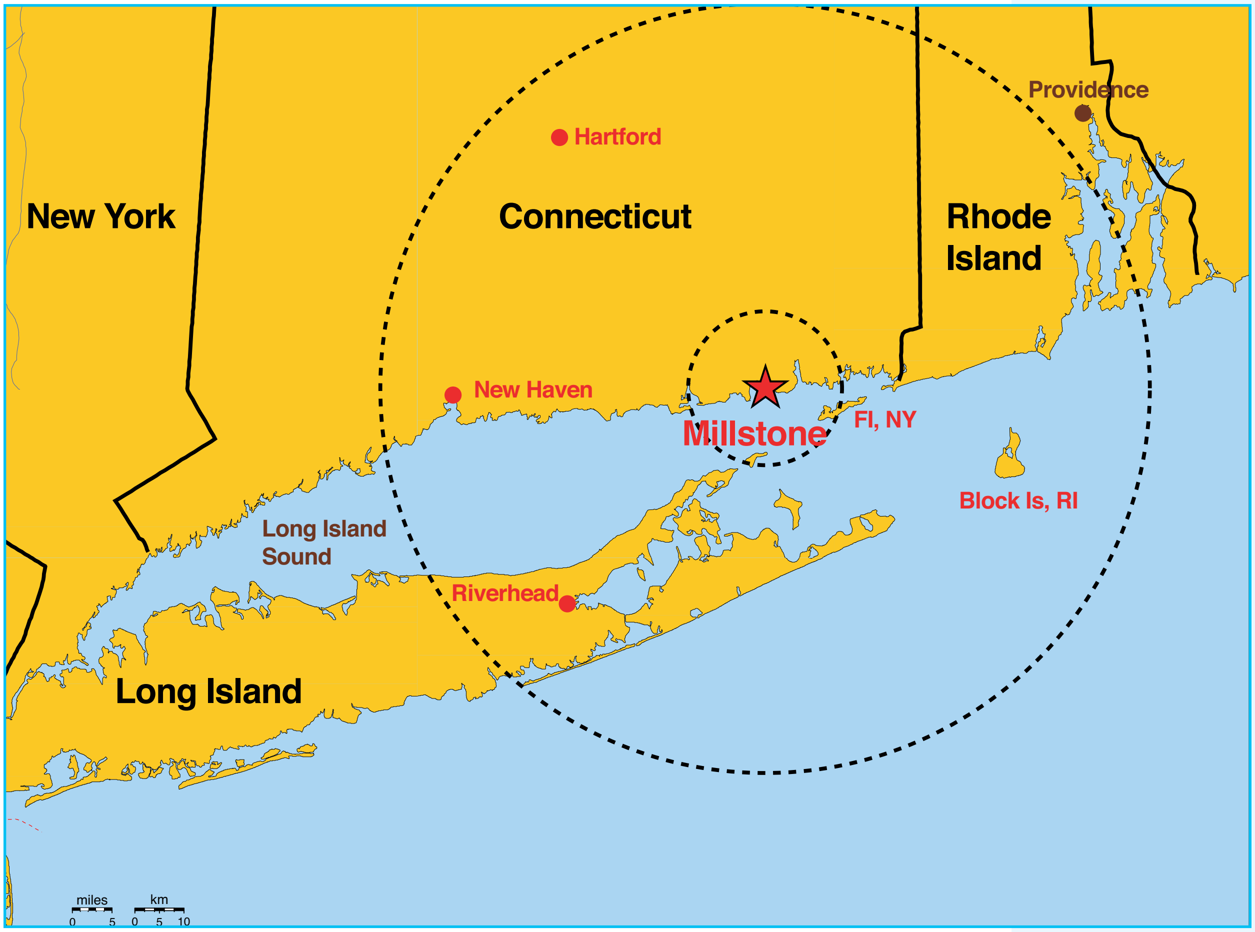
Communities located within approximately 10 miles of a nuclear power plant comprise the Plume Exposure Pathway Zone (EPZ). The U.S. Nuclear Regulatory Commission (NRC) considers the 10-mile EPZ as the area, including waterways, that could be affected by direct exposure to radiation in the event of a serious plant accident.

10-Mile Millstone Station
Emergency Planning Zone Map



Additionally, communities within 50 miles of the plant make up the Ingestion Exposure Pathway Zone (IPZ). This is an area designated by the NRC as having the potential for exposure from ingestion of contaminated food or water.

50-Mile Millstone Station
Emergency Planning Zone Map



Incident Classification Levels

Nuclear plant operators will classify an incident according to a specific set of guidelines based upon plant conditions and potential off-site consequences. These guidelines, known as Emergency Action Levels (EALs), are specific to each nuclear unit and provide the information needed to determine the appropriate emergency classification level.

The emergency classification levels are prescribed by the NRC in conjunction with the Department of Homeland Security and the U.S. Environmental Protection Agency (EPA). The four emergency classification levels are:

Unusual Event

An Unusual Event is the lowest of the four NRC emergency classification levels. It involves a minor problem at the plant and may result in a very small radiological release. The nuclear station, state and local emergency response organizations would not be activated and no protective actions for the public are required.

Alert

An Alert is the second lowest of the four NRC emergency classification levels and involves a relatively minor event. A small release of radioactivity could occur. The nuclear station's emergency response organization would be activated. State and local response organizations would be monitoring the situation closely and key personnel would be activated or placed on standby. Usually, no protective actions are required.

Site Area Emergency

A Site Area Emergency is the second highest of the four NRC emergency classification levels and involves a relatively serious problem at the plant. A small radioactive release is possible, however, the consequences would be limited to the plant's site boundary. The nuclear station, state and local emergency response organizations would be activated. Precautionary protective actions may be required for protection of the public such as monitoring food, water, milk and considering placing milk animals on stored feed.

General Emergency

A General Emergency is the most serious of the four NRC emergency classification levels. It could involve serious damage to the plant's safety systems and may result in the release of radioactive materials to an area beyond the plant's boundaries. Protective actions for the public would be required.

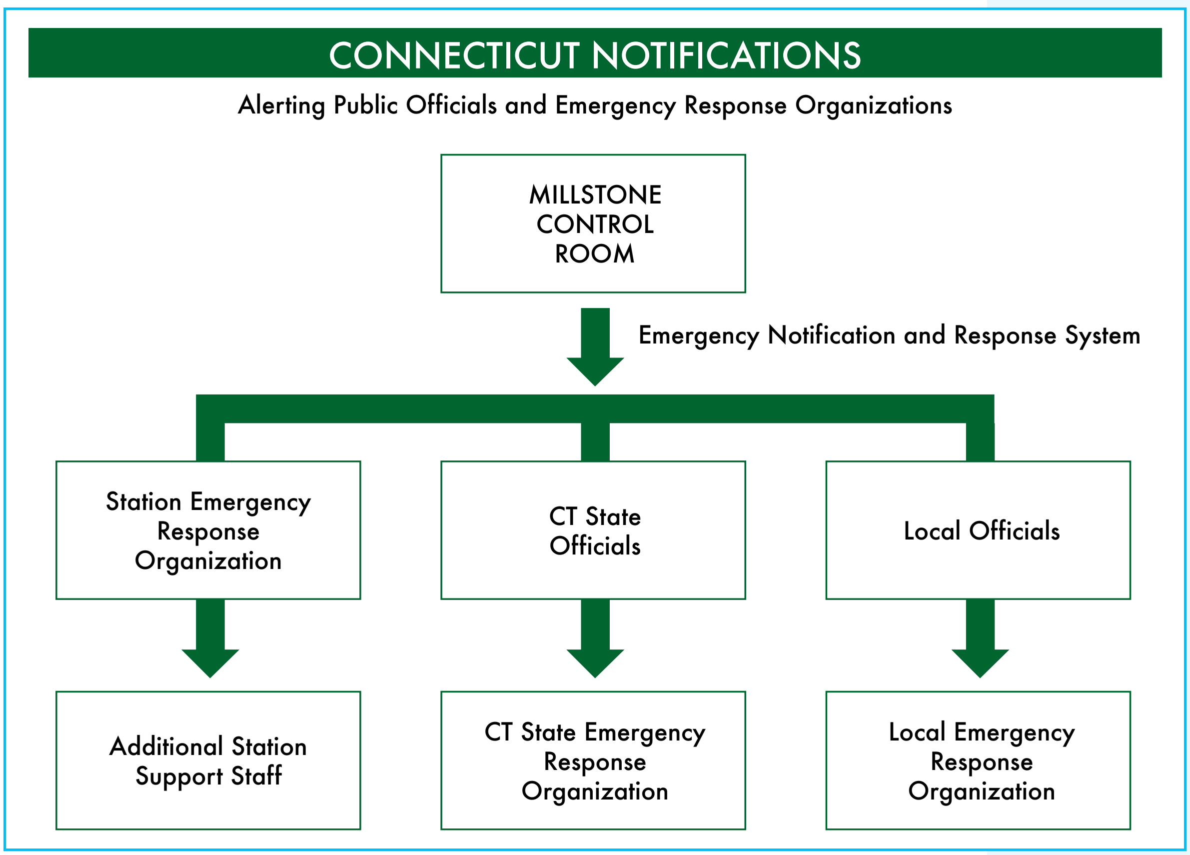
Notification System

Within 15 minutes after classifying an incident, the Millstone Power Station must notify designated government officials. In Connecticut, this prompt notification is made to Connecticut and New York state officials and local officials (within the 10-mile EPZ) via an electronic mass notification system with message receipt confirmation. Redundant phone, text, e-mail and FAX capabilities support the notification effort.

When an emergency is recognized and classified, assigned nuclear station, state, and local emergency responders are notified. Millstone members of the Station Emergency Response Organizations (SERO) are notified by an electronic mass notification system.

If the emergency is classified as an UNUSUAL EVENT, on-site personnel and resources are sufficient to respond; therefore, plant, state, and local emergency response organizations are usually not activated. However, if the emergency is classified as an ALERT, the plant SERO is activated. State and local officials are not required to activate their emergency response organizations at the ALERT classification, but may do so if they choose. All station, state, and local emergency responders are activated at the SITE AREA EMERGENCY and GENERAL EMERGENCY classifications.

Public Alerting System (PAS)



Sirens alert the public to tune to their local Emergency Alert System (EAS) radio or television stations for emergency information. In the event protective actions must be taken details will be available on those news outlets. All residents of the EPZ towns receive the *Millstone Safety Planning Information for Neighbors of Millstone Power Station* each year which has detailed instructions about what to do when sirens are activated.

The sirens can be operated in a number of different modes:

- The alert signal is a steady tone lasting for three minutes, indicating a natural or man-made disaster, such as severe weather, chemical accidents, floods, or nuclear power plant accident
- A long wavering tone signals an enemy attack
- A short wavering tone signals a fire
- A public address mode allows for voice announcements over a limited distance from a central control station located in each community

Some communities that use the sirens for fire and other emergency notifications test the sirens on a routine basis.

In the event a siren fails, each community has the ability to notify those individuals through route alerting. Route alerting is when a public safety vehicle is dispatched to the area affected and provides the warning information through a public address system.

Emergency Alert System (EAS)

The EAS is operated by each state's emergency management office in cooperation with selected radio and television stations. If an emergency results in an activation of the siren system, residents can tune in to a local participating EAS radio or television station for further details and instructions. Individual communities can also activate local sirens and EAS stations in the event of a local emergency.

Emergency Information

Media Emergency Information

In the event of an emergency, the media is a critical component for providing information and instructions to the public. A joint Millstone and state Media Center will be established to provide timely, accurate and coordinated information in a setting designed to accommodate media needs. Briefings and news conferences will be held, as needed, and contact information will be provided for inquiries from media representatives unable to be present at the Joint Information Center (JIC). News releases will also be developed, as necessary, and distributed to media outlets. (Directions to the JIC at the Hartford Armory are provided on page iii.)

Public Emergency Information

Information and instructions concerning nuclear power plant emergencies are made available to the public on an ongoing basis. An emergency information planning book, containing background information and emergency instructions, is mailed to all residents and businesses in those same EPZ communities on a periodic basis. Social media outlets (like Twitter) may be used by the State of Connecticut and local officials to direct the public to more detailed safety information. Many EPZ towns post preparedness information on their web sites.

Brochures or signs providing emergency information and instructions for visitors are also available at parks, beaches, and other recreation areas throughout the nuclear site's 10-mile EPZ. In addition, brochures containing emergency information and instructions for farmers, food processors, and

http://www.ct.gov/demhs

http://twitter.com/#!/ctdemhs

food distributors located in the Ingestion Pathway (50-mile) Zone (IPZ) are available to the agricultural community.

Public Protective Actions

Following activation of the emergency response organizations, state and local officials will issue appropriate public protective action directives. Depending on the nature of the incident, these could include:

- Monitor and Prepare – monitor news reports and check your emergency kits.
- Precautionary closing of schools, beaches, and other recreational facilities
- Taking shelter
- Access Control
- Evacuation
- Food, water, milk and livestock feed control
- Ingestion of Potassium Iodide

In the event of an emergency, the initial precautionary action for the Plume Exposure (10-mile) Pathway would likely be the closing of schools, beaches, parks and forests. These actions may be taken at an ALERT or SITE AREA EMERGENCY classification level if there were indications that plant conditions could deteriorate further.

In the event of a GENERAL EMERGENCY classification, protective actions would be directed for the public in potentially affected areas. Protective action directives could include evacuation and/or the sheltering of the public within a predetermined planning area of an approximate 2-mile, 5-mile, or 10-mile radius. Food water, milk and livestock feed control protective actions are planned within the ingestion pathway zone (50-mile) IPZ. These are relatively longer-term actions taken after the Plume phase EPZ actions are accomplished.

If an evacuation is necessary, Community Reception Centers (CRCs) in host communities will be available to receive members of the public who require temporary shelter, relocation with family or friends, or other assistance. CRCs are staffed with trained workers/volunteers who can also screen evacuees, pets, and emergency service workers for radiological contamination and provide decontamination if needed. The host communities and their designated reception centers are located outside the Plume Exposure Pathway EPZ for Millstone Power Station.

Precautionary dismissals for schools may precede public evacuation in many towns where schools fall within the 10-mile EPZ.

Community Reception Centers

EPZ Community	Host Community	Reception Center
East Lyme, CT	New Haven, CT	Southern CT State University
Fishers Island, NY	Windham, CT	Windham High School
Groton City, CT	Norwich, CT	Norwich Technical High School
Groton Town, CT	Norwich, CT	Norwich Technical High School
Ledyard, CT	Storrs, CT	University of Connecticut
Lyme, CT	New Haven, CT	Southern CT State University
Montville, CT	East Hartford, CT	East Hartford High School
New London, CT	Windham, CT	Windham High School
Old Lyme, CT	New Haven, CT	Southern CT State University
Waterford, CT	East Hartford, CT	East Hartford High School

Host Communities are located more than 15 miles from the power station.

Emergency Response Facilities

Millstone Control Rooms

Each nuclear unit has a Control Room, where plant conditions are monitored and controlled and where corrective actions would be taken to return the plant to a safe and stable condition in an emergency. The Control Room is the source of key communications to other on-site and off-site emergency response personnel and facilities, including transmitting plant data, incident reports and long- and short-term corrective actions. All nuclear station Control Rooms are shielded and have controlled ventilation systems so that they can remain habitable even in the event of a significant release of radioactive material. They are located immediately adjacent to their respective plants.

Millstone Emergency Operations Facility (EOF)

The nuclear station's EOF is the primary center for the management of the station's emergency response, coordination of radiological and environmental assessments, and exchange of information among the station, state, and federal emergency response organizations. The EOF contains communication links to on-site data and off-site organizations. EOF functions include linking Dominion to the state Emergency Operations Centers and the Media Center, deploying off-site radiological field teams, collating field team data, performing off-site dose assessment functions, and providing protective action recommendations to the State.

Millstone's EOF is located in Norwich, Connecticut, approximately 20 miles north of the station.

Millstone Technical Support Center (TSC)

Millstone Station's TSC is an emergency operations work center where designated engineering and technical personnel can analyze plant conditions to predict trends and devise appropriate corrective actions. The TSC's facilities provide data to evaluate station conditions so corrective actions can be developed to mitigate the event. There is also a technical reference library with drawings, procedures and systems descriptions. The TSC is located in a dedicated building near the Unit 3 turbine building.

Millstone Operational Support Center (OSC)

Millstone's OSC is the assembly point for support personnel who perform on-site assessment, repair, and search and rescue tasks in an emergency. The OSC also provides a staging area for personnel who are deployed into on-site areas. At Millstone, the affected unit OSC manager and assistants are located in the TSC building.

State Emergency Operations Center (SEOC)

The State EOC houses the off-site emergency response organization. The SEOC will be staffed by key state, federal and other agencies required for a radiological emergency (emergency management, environmental protection, public health, state police, transportation, etc.) Overall coordination is provided by state emergency management officials. Regional emergency management offices in the state provide direct contact with local agencies and implement state EOC directives.

The State EOC is located in the Governor William A. O'Neil State Armory at 360 Broad Street, Hartford. There are 5 DEMHS Regional Offices located in Bridgeport, Middletown, Hartford, Colchester and Waterbury. These Regional Offices serve as a single direct point of contact for the jurisdictions they serve on all administrative and emergency matters. If needed, DEMHS maintains an Alternate EOC located at 269 Maxim Road, Hartford.

Local Community Emergency Operations Centers

Each community within the 10-mile EPZ has its own Emergency Operations Center. Each local EOC is a communication point within each community, as well as a link with adjacent communities and the state. Each local chief executive, working with state and regional emergency officials, can direct protective actions for the community. Besides functioning as a briefing location for agency heads and emergency workers, the local EOC serves as a resource allocation facility and provides a central location where community officials can track emergency events and weather conditions.

Joint Information Center (JIC)

In order for Dominion Energy and the State of Connecticut to meet its commitment to provide timely and accurate information, a joint state and Millstone Information Center will be activated in the event of any potentially significant emergency (usually an ALERT classification or higher) that occurs at Millstone. The JIC is the central coordination point where information about an emergency and the emergency response will be released to representatives of the news media.

The Joint Information Center is co-located with the state EOC, at the Governor William A. O'Neil State Armory at 360 Broad Street, Hartford, Connecticut. Directions to the Joint Media Center are provided on page iii of this manual.

Millstone Station Emergency Response Organization (SERO)

Millstone's emergency response organization is designed to support and complement the station on-shift organization. In addition, the Station Emergency Response Organization (SERO) interfaces with state and federal officials and provides information to the media. The goal of the site emergency organization is to activate within 60 minutes of emergency notification, with somewhat more time allowed for activation of the Media Center located at some distance from the plant site.

In the initial few minutes after classification of an emergency, the Shift Manager in the plant's Control Room assumes the duties of director of the emergency response until the Emergency Operations Facility is activated and the duties are assumed by a SERO emergency director.

The SERO emergency director is responsible for coordinating all emergency operations at the affected station, including classification, mitigation of the incident, and corporate communications. At Millstone the SERO emergency director is known as the Director of the Station Emergency Operations (DSEO).

Major functions of the SERO include:

- Implementing emergency operations procedures
- Providing technical support to recommend corrective actions
- Coordinating on-site radiation protection, sampling and dose assessment
- Performing off-site dose assessments
- Providing on-site resource needs, including manpower, equipment and supplies
- Maintaining site security
- Providing information to the public via the media

State Emergency Response Organization

The Governor of Connecticut is responsible for directing the actions of all of the respective state agencies. The governor may direct state agencies to assist communities in order to ensure an adequate response to a radiological incident and protection of public health and safety.

The Connecticut Department of Emergency Services and Public Protection, Division of Emergency Management and Homeland Security (DEMHS) operates the State's EOC. DEMHS directs the activities of participating state agencies in an emergency and coordinates services, materials, and support to towns to ensure implementation of protective actions. DEMHS is responsible for initiating Emergency Alert System (EAS) broadcast notifications. These notices are intended to ·prompt the public to seek additional information from radio and television outlets. Emergency information will also be available on the DEMHS website and social media platforms as described on pages 43 through 44. DEMHS also partners with the United Way 2-1-1 information center to handle inquiries from the general public. This agency will be able to answer questions about incidents at Millstone. Language translations services and support for individuals with visual and hearing impairments are also available.

Numerous other state agencies may be involved with the emergency response, such as public safety, health services, agriculture, transportation, consumer protection, etc. For example, the Department of Energy and Environmental Protection (DEEP) provides emergency responses ranging from determining radiological impact to recommending protective actions. Whereas the Department of Transportation and the Connecticut State

Police provide traffic control and assistance with evacuations. The State Radiological Emergency Response Plan (RERP) and its appendices contain written procedures for each participating agency.

Local Emergency Response Organizations

Chief Elected or Appointed Officials ("Chief Executive Officer") are responsible for ensuring the safety and welfare of the people of that jurisdiction. Specifically, the Chief Executive Officer provides strategic guidance and resources during preparedness, response and recovery efforts. Emergency management, including preparation and training for effective response, is a core obligation of local leaders. The local Emergency Management Director (EMD) works with the Chief Executive Officer, appointed officials and first responders to ensure that there are unified objectives with regard to the municipality's emergency plans and activities. The local EMD is assisted by, and coordinates the efforts of, employees in departments and agencies that perform emergency management functions. Department and agency heads collaborate with the local EMD during development of the Local Emergency Operations Plan, and provide key response resources. Participation in the planning process ensures that specific capabilities (e.g., fire fighting, law enforcement, emergency medical services, public works, social services, environmental and natural resources agencies) are integrated into a workable plan to safeguard the community.

Federal Support Agencies

Other federal, state, local and private agencies may provide support in the event of a nuclear power plant emergency. The U.S. Nuclear Regulatory Commission (NRC) monitors nuclear plants, does an independent assessment of the emergency situation and offers regulatory guidance. The Department of Homeland Security through FEMA provides support to state emergency management agencies and, along with the NRC and Department of Energy (DOE), coordinates the activities of all federal agencies responding per the National Response Framework, Radiological Incident Annex.

Examples of other agencies that may assist in the emergency response include the U.S. Coast Guard, who provides access control and limited public notification along coastal waterways; AMTRAK, who directs train traffic in affected areas; the Institute of Nuclear Power Operations (INPO), who can acquire support and resources from other utilities as requested by Dominion Energy; and the American Red Cross, who assists in social services through local and state agencies.

Previous Alerts At Millstone Power Station

July 26, 1991

Millstone Power Station Unit 2

A power supply failed which rendered all control room annunciators unavailable for more than 15 minutes. As a result, an Alert was declared. The unit continued to operate at 100 percent reactor power throughout the event. Additional Operations personnel were stationed at the control panels to monitor conditions until the annunciators could be restored. No radiation was released. No one was injured.

April 17, 2005

Millstone Power Station Unit 3

During an automatic shutdown, one main steam line safety valve failed to close as it should have. As a result, an Alert was declared. Operators responded to these conditions, stabilized the unit in hot standby and began a cooldown. Once the unit entered hot shutdown, the Alert was terminated. No radiation was released. No one was injured.

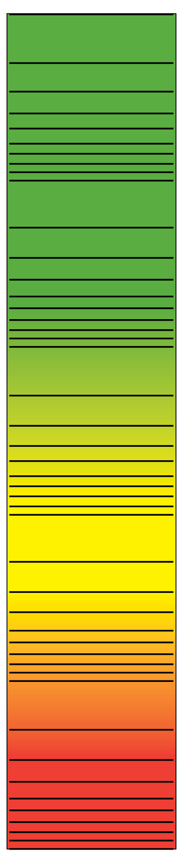
November 4, 2015

Millstone Power Station Unit 3

One of Unit 3's emergency diesel generators was taken out of service for planned maintenance. The maintenance activity included running the generator at full power to make adjustments. During this run, a fire was observed between the exhaust manifold and the turbo chargers. The fire was smothered by personnel on scene using a fire resistant blanket. The fire brigade responded and declared the fire out. The Shift Manager declared an alert due to damage to safe shutdown equipment. No radioactive material was released. No one was injured. Unit 3 remained at 100% power throughout the event.

More Information

Biological Effects of Acute Whole Body Radiation Exposure



Type of Exposure	Millirems	Rems	Biological Effects
Chest x-ray	10	.01	Currently, the amount of low-level radiation a person receives can be measured but cannot be related to the effects on the body. Because this data is inconclusive the effects of low-level radiation are assumed to be directly related to the total amount received.
Dental x-ray (2)	80	.08	
	100	.10	
Gastrointestinal tract x-ray	210	.21	
	1,000	1	100 cases of cancer per million persons exposed.
Lifetime dose from natural background radiation of 125 millirems per year.	9,000		
	10,000	10	No effect on normal life span.
	25,000	25	Radiation effects detectable only by laboratory examination: decrease in white blood cells, platelets . . . if background information is available to prior to exposure.
	50,000	50	Possible radiation sickness: headache, dizziness, malaise, nausea, vomiting, diarrhea, decrease in blood pressure, irritability and insomnia.
	100,000	100	Possible radiation sickness; little or no life shortening
	250,000	250	Acute radiation sickness, few or no deaths and significant life shortening. Radiation sickness includes vomiting, diarrhea, loss of hair, nausea, hemorrhaging, fever, loss of appetite and general malaise. Recovery (if no complications) in about three months.
	450,000	450	Half of those exposed will die within 30 days. Recovery, with some permanent impairment, of the other 50%.
	1,000,000	1,000	Death within 30 days.

What is Radiation?

Radiation is the emission of wave of energy or subatomic particles.

All matter is made up of atoms. The basic components of atoms are neutrons and protons, which together form the nucleus of the atom, and electrons which circle the nucleus.

In a stable material, the atom may combine chemically with other substances, but it does not throw off particles or waves of energy.

But atoms are stable only if the number of neutrons and protons in the core are in a certain ratio. If they vary from that ratio because of the presence of extra neutrons, they are called "isotopes." Chemically, their characteristics are the same as other atoms, but if the ratio of neutrons to protons varies too far, the atom is unstable and emits radiation to regain stability. Such atoms are called "radioisotopes" or "nuclides."

Many radioisotopes occur in nature. Such elements are commonly found in rocks, soil, building material and food. The sun, an atomic furnace, is another major source of radiation for people on earth, more so for those who are protected by only a thin layer of atmosphere, like people in airplanes or living at high altitudes. These sources of radiation are responsible for a natural background level of radiation that almost everyone is exposed to.

Other sources of radiation are man-made. For most people, the most common sources are X-rays used for medical purposes. In addition, since World Was II mankind has been able to split certain large atoms to produce heat or a blast, leaving unstable daughter-atoms, called fission products. Another method has been to add neutrons to previously stable atoms, producing radioisotopes.

Three forms of radiation emitted from radioisotopes and most likely to be present in a radiation accident are alpha particles, beta particles, and gamma rays.

Alpha particles are thrown off from the nucleus of the atom. An alpha particle consists of two neutrons and two protons. Outside the body, radioisotopes that emit alpha particles are a very small hazard, since the particles will not penetrate more than a few inches of air, and will not penetrate the skin. However, if an alpha emitter lodges in the lung or the gastrointestinal tract (through inhalation or swallowing) it would intensively irradiate a small area of tissue, perhaps for years. Such an internal dose can cause tissue death or cancer.

Alpha emitters are not likely to be present in a reactor accident, but could be released in incidents involving the transportation of radioactive materials. The primary hazard is if an alpha emitter is ingested or inhaled.

Beta particles are like electrons. They can travel several yards in air, and penetrate up to a third of an inch of skin, which in sufficient doses can cause a symptom similar to sunburn. The primary hazard is if a beta emitter is ingested or inhaled.

Gamma rays are waves of energy – like visible light or X-rays, but at a different wavelength from either – that are given off when electrons change their orbits and give up energy. Gamma rays can be blocked only by lead, brick, stone or soil. Gamma emitters, therefore, are a problem through both external irradiation and internal dose.

How is Radiation Measured?

In the United States, the most common unit of radiation is the roentgen, a measure of the ionization of atoms in the air. Because different types of radiation have different biological effectiveness, a second measure is commonly used to estimate the radiation dose, called the rem, for roentgen equivalent man. For gamma radiation, our main concern, roentgen and rem are the same.

Outside the United States, the International System of radiation measurements uses a unit called a sievert. For gamma radiation, a sievert equals 100 rem. As in the system used in the United States, the term is often modified by the prefix “milli-,” which means one-thousandth.

How Does Equipment Measure Radiation?

This equipment is of two types, mechanical and electronic. The first is called a self-reading dosimeter. It can be read instantly by the emergency worker in the field, and gives an indication of the external gamma exposure. It is about the size of a pen, but has a slightly larger circumference. It is worn clipped to the shirt pocket. The self-reading dosimeters commonly available are in the ranges of 0-200 millirem, 0-5 rem, and 0-20 rem.

If dosimeters of more than one range are available, emergency workers may carry one of each. If exposed, the low-range dosimeter would register first, but would become less useful if the total exposure was above 200 milliroentgen. On the other hand, if total exposure was under 200 milliroentgen, it would be difficult to read such a small amount on the 0-5 roentgen scale of the higher range dosimeter.

To read the dosimeter, wearers simply look through it, holding the end with the clip up to the eye. The other end is pointed at a light source, like an overhead light. The wearer will see the scale and the hairline indicator. Emergency workers are periodically asked to check their dosimeters and record the readings for future reference - to track their total exposure.

The electronic dosimeter is a box about the size of a pocket pager. It is worn clipped to a lanyard worn around the neck so that it is near the center of the chest. Emergency workers are instructed on how to read the digital displays and track their exposure.

Both the electronic dosimeter and the self-reading mechanical dosimeter measure radiation cumulatively, as an odometer measures miles, showing total exposure. Some models also measure the rate of exposure, or the number of roentgens absorbed per hour. Emergency workers report these exposures to their supervisor and can be recalled from the field as per state and federal guidance.

What Is the Effect of a Radiation Dose?

Radiation effects are divided by scientists into two categories: Acute, meaning within 60 days, and latent, meaning longer-term.

Acute effects result from high doses. They include hair loss, nausea, anorexia, hemorrhage, susceptibility to infections and death. Because of data from bomb tests and the Hiroshima and Nagasaki explosions, the doses needed to produce these effects are well known to scientists. But tolerance to high doses differs from person to person.

Our knowledge would require the study of large numbers of people exposed to small doses, and such data do not exist. As a result, most of the estimates of the effects of low-level exposure are extrapolations of the effects of higher-level doses. Scientists disagree about how the extrapolations should be made, however, so that the government standards listed here must be considered estimates, not certainties. The information here is derived from the December 1989 report of the Committee on Biological Effects of Ionizing Radiation, an advisory panel of the National Academy of Sciences.

For long-term cases of cancer, scientists use as a rule of thumb an estimate that each 10,000 person rem of exposure produces four to eight additional fatal cases of cancer. The lower number would be expected for exposures incurred over months or years; the higher number, for doses absorbed in hours or days.

For example, if 10,000 people were exposed to 1 rem each over a few days, scientists would expect that about eight of them would die from cancer as a result of the radiation dose, along with the 2,000 who would be expected to die of cancer unrelated to the radiation.

If the cancer rate were raised by that exposure from 2,000 to 2,008, experts say, it would not be possible to pick out the eight cases that were caused by radiation.

If the group of 10,000 were exposed to 2 rem each, scientists would expect 2,016 cases, and if each got 3 rem, raising the dose to 30,000 person/rem, the radiation would raise the number of cases by 24, to 2,024.

This calculation is sometimes used, with confusing results, to predict a fraction of a cancer death from certain release of radiation.

Radiation is also believed to cause genetic changes, resulting in disorders in future generations. As with cancer, the figures are estimates.

One rem to the population before conception (to sperm of the father or ova of the mother) is expected to produce between 5 and 75 additional serious genetic disorders per 1 million live births. This is in addition to the usual incidence of genetic disorders, or 90,000 per 1 million live births.

In men this effect can be limited somewhat by waiting for regeneration of sperm before procreation.

The following table is meant to put radiation doses into context:

2.5 millirem	Cosmic radiation dose to a passenger flying from New York to Los Angeles, one way
10 millirem	One chest X-ray
10 millirem	Average annual dose to U.S. residents from consumer products, 25 millirem: Limit set by the Environmental Protection Agency for what members of the public living near nuclear plants should be exposed to each year in routine, accident-free operation. (The actual average exposure is under 1 millirem.)
27 millirem	Average annual radiation dose to residents of the United States from cosmic rays
28 millirem	Average annual dose to residents of the United States from rocks and soil

60-80 millirem	Average annual cosmic radiation dose to residents of the Rocky Mountain states, where the atmosphere is thinner
83 millirem	Theoretical maximum possible dose to a member of the public at the Three Mile Island accident. The estimate is based on the cumulative dose recorded by an offsite dosimeter half a mile east-northeast of the site. The estimate assumes that an individual remained outdoors at that location continuously from March 28 until April 7, 1979.
100 millirem	average annual dose to residents of the United States from man-made sources, mainly medical uses but also including past bomb tests, nuclear plants, airport security machines and television sets.
160 millirem	Annual dose to the average airline flight crew, from cosmic radiation
200 millirem	Average annual dose from radon gas
300 millirem	Total average dose to residents of the United States, from natural and man-made sources
500 millirem	Limit set by the Federal Radiation Council for an individual member of the public from all sources of radiation, excluding medical radiation and natural background, per year
620 millirem	Average annual dose of radiation in the United State of America from natural and man made sources.
900 millirem	Lower gastrointestinal tract X-ray series
1-5 rem	Under the “Protective Action Guidelines” established by the Environmental Protection Agency, public officials should take emergency action when the dose to the public in a nuclear accident is anticipated to reach this range. Officials might wait until the top of the range was reached if weather or other factors made evacuation difficult.
3 rem	Limit set by most utilities for annual exposure of workers to radiation
5 rem	Exposure limit set by Nuclear Regulatory Commission for nuclear workers for a calendar year
25 rem	Guideline set by the EPA for maximum exposure of firefighters, police officers and other emergency workers in a reactor accident, engaged in nonlife saving activities. These exposures are meant to be once-in-a-lifetime events.
75 rem	EPA guidelines for firefighters, police officers and others engaged in lifesaving work
50-200 rem	(Assuming dose is distributed over the whole body): Mild, transient radiation sickness, including nausea and vomiting. Death in less the 5 percent of those exposed.
200-450 rem	More severe radiation sickness, with hair loss and infection due to depressed white blood cell counts. Half of those exposed to 450 rem will die within 60 days

450-600 rem	Severe radiation sickness. Hemorrhage, pneumonia, enteritis. All those exposed to 600 rem will die within 30 days

To put this in perspective, the lethal dose of 600 rem is more than 7,000 times larger than the theoretical dose at Three Mile Island (.083 rem vs. 600 rem): the dose sufficient to kill half those exposed, 450 rem, is more than 5,000 time the theoretical dose at Three Mile Island.

The Center for Disease Control (CDC) has also developed a Radiation Hazard Scale designed as a tool to convey risk to the public. The Radiation Hazard Scale can be found using the following link: https://www.cdc.gov/nceh/radiation/emergencies/radiationhazardscale.htm

Protective Measures

The simplest is potassium iodide tablets, which protect the thyroid gland, one of the parts of the body most vulnerable to radiation.

One of the products of a nuclear reactor is Iodine 131, a radioactive chemical the body treats just as it would handle ordinary iodine, a useful element. If Iodine 131 is inhaled, the body will concentrate the substance, just as it would ordinary iodine, in the thyroid gland, which will then be intensively irradiated.

Potassium iodide, also know by its chemical abbreviation, KI, prevents this by saturating the thyroid gland with stable iodine. The drug is classified by the Food and Drug Administration as “safe and effective” for this purpose, and for use in a radiation emergency it is a nonprescription drug.

In 2020, the state of Connecticut re-distributed new KI tablets to schools, businesses and towns within the EPZ. Residents in those towns can obtain KI at most town halls, fire stations and police departments. In an emergency, KI will be available at Community Reception Centers outside of the EPZ. Dosing information is packaged with the tablets and available on line at: https://emergency.cdc.gov/radiation/ki.asp Potassium iodide protects only the thyroid. It has no protective value for other organs of the body, and does not protect against other radioisotopes or against external exposure. KI should only be given to pets under the supervision of a veterinarian. KI may harm your pet if not dosed correctly.

In a radiation emergency, you can also think of distance, time and shielding as protective measures. Distance means not getting too close to a spill of radioactive material or other source of radiation. Time means that if you are in an area where your dosimeter indicates radiation is present, don’t stay longer than you have to. If the dose rate is very low – say, a few millirem per hour – you may be able to spend a few minutes conducting interviews or taking photos. Shielding is provided by taking shelter in a concrete or masonry building, the kind that used to carry “civil defense shelter” placards. If the exchange of air with the outside is slow, such a building can cut your dose rate dramatically. Wood-frame buildings will not provide the same shielding value.

Price-Anderson Nuclear Insurance

Price-Anderson nuclear insurance was established as federal law in September 1957 – well before the first commercial nuclear plant began operating.

Its primary purposes, then and now, have been to further the development of a vital source of electrical energy and to protect the public financially against injury or damage from a nuclear power accident.

Over the past four decades, this innovative legislation has served well its dual goals. It has also evolved and changed, improving economic safeguards for the public while turning over financial responsibility to a mature nuclear industry.

What are the key features of Price-Anderson?

In case of a nuclear power incident where the public is or could have been exposed to radioactive materials, the Price-Anderson Act ensures that a large sum of money will be available to compensate any member of the public who suffers a loss. Price-Anderson also puts a limit on the nuclear industry's liability for each of these incidents. At the same time, it guarantees that the federal government will review the need for compensation beyond this amount.

Thus, Price-Anderson balances the benefits of public protection against a predictable level of financial exposure for industry.

Does Price-Anderson cover only accidents at nuclear power plants?

No. The public also is eligible for compensation for accidents that occur during the transportation of nuclear fuel to, or nuclear waste from, the reactor as well as during their storage at the plant.

Does the public get any other benefits from Price-Anderson?

Price-Anderson eliminates many of the delays and problems that plaintiffs experience in ordinary tort actions to recover for damages or injuries. For example, no matter who is responsible for an accident, Price-Anderson channels financial liability to the utility industry.

In case of a serious nuclear accident involving substantial off-site contamination and damage – an "extraordinary nuclear occurrence" – utilities are required to waive certain defenses, thus making it easier for plaintiffs to recover. Furthermore, a Federal statute of limitations is invoked that supersedes often shorter state statutes. For these reasons, Price-Anderson often is called "no fault" insurance.

How well did Price-Anderson work at Three Mile Island?

Price-Anderson worked as intended. Within 24 hours after Pennsylvania Governor Richard Thornburgh advised a precautionary evacuation, nuclear insurance pools had opened a claims office in nearby Harrisburg to disburse emergency assistance.

What about dealing with non-emergency claims?

These procedures also worked well at TMI. In September 1981, a class action settlement was approved by the courts, establishing an economic injury fund of $20 million as well as a $5 million public health fund. For suits pending, valid claims most likely will be adequately covered within the limits of Price-Anderson.

If an accident exceeds the current limit on liability, will the public be able to recover fully?

Congress never intended that the limitation on liability act as a bar to further recovery. The explicit language of Price-Anderson requires Congress to consider further compensation.

But isn't it true that, except for Price-Anderson, a member of the public would be able to recover fully?

Not necessarily. Unlimited liability for the utility responsible for a nuclear accident does not guarantee full recovery – it simply means recovery up to the level of resources a utility might have available. Even the largest utilities, however, would have difficulty raising more than a few hundreds of millions of dollars compared to the $7.8 billion available under Price-Anderson.

Is Price-Anderson a subsidy to the nuclear industry?

If "subsidy" is defined as a payout of taxpayer funds by the federal government, then the answer on Price-Anderson is "no." The federal government never has paid out a penny in claims to the public. Moreover, the government has collected fees from the utilities. Accordingly, the federal government has been a net beneficiary under Price-Anderson.

Doesn't Price-Anderson provide an unprecedented break to one particular section of the economy; i.e., the nuclear utilities?

No. In a nation the size of ours and in an economy so complex and rapidly changing, government, for example, operates insurance-type mechanisms for crops, floods, banks, savings and loans, home mortgages, Social Security, Medicare, crime and maritime losses. Moreover, a number of laws provide for a limitation on liability, including oil spills, bankruptcy, worker's compensation as well as medical malpractice and even the liability parents have for acts by their children. In this context, the benefits of Price-Anderson are hardly "unprecedented."

Is Price-Anderson a disincentive to safety?

No. With or without Price-Anderson, a utility company's first and foremost objective is to ensure that its nuclear power plants are safe and reliable, to avoid any undue risk to the general public, its employees – and its own financial viability.

Why should homeowners be precluded from buying nuclear insurance protection?

For the benefit of the public, insurance companies have channeled all nuclear liability insurance capacity through the nuclear insurance pools to the nuclear industry.

Thus, not only are there the resources of insurers made available to protect the public, but large sums also are committed by reactor operators.

Through this approach – rather than spreading insurance coverage and its costs among individual owners of homes, cars and businesses – the public is protected by coverage paid for by the nuclear industry.

Do the nuclear insurance pools cover injury or damage caused by sabotage or terrorist acts?

The nuclear insurance pools have made very clear that their coverage does include injury or damage caused by dispersal of nuclear material from reactors, even if caused by sabotage or terrorists acts. The policies do not cover injury or damage if the sabotage or terrorists acts were related to war, insurrection or civil upheaval.

Also, if nuclear material is stolen and removed from an insured facility and subsequently used to threaten or cause harm to the public, injury or damage would not be covered by the pools. Compensation to the public for the results of such terrorist activity is clearly outside the scope of a system that compensates from private resources.

Glossary of Nuclear Terms

Acute Exposure
Radiation exposure received within 24 hours or a short period of time

Airborne Radioactivity
Radioactive material, in the form of particles or gases, dispersed in the air

ALARA (As Low As Reasonably Achievable)
The concept of keeping station personnel dose received to a minimum.

Alpha Radiation
An easily-shielded, positively charged particle emitted from the nucleus of a radioactive atom

Anti-Cs (Anti-contamination Clothing)
Clothing worn to protect personnel from contamination. Also called Protective Clothing or PCs.

Background Radiation
Radiation from sources such as naturally-occurring radioactive materials in the earth, air and water, and cosmic rays

Beta Radiation
A charged particle, similar to an electron, which generally is considered as exposure to the skin

Burnup (Nuclear)
A measure of nuclear reactor fuel consumption, usually expressed as megawatt-days thermal per metric ton of fuel exposed

Chain Reaction
A self-sustaining series of fissions in which additional fission is initiated by a neutron from a previous fission. This process is the basis for the operation of all nuclear reactors.

Chronic Exposure
Radiation exposure received over a long period of time

Code of Federal Regulations (CFR)
Rules established by the federal government relating to specific areas (i.e., radiation protection, station emergency plan, etc.)

Commited Dose Equivalent (CDE) or Commited Effective Dose Equivalent (CEDE)
Dose received from radioactive material in the body

Contaminated Area
An area in the station where loose surface contamination equals or exceeds station limits.

Contamination
Radioactive material in any place where it is not desired

Curie
A unit used for measuring radioactivity (2.2 x 1012 dpm)

Decay
The nucleus of an unstable atom changing to a stable state

Deep Dose Equivalent
Dose received from sources outside the body

Direct Reading Dosimeter (DRM)
Device used to record the amount of dose received

Disintegrations per Minute (DPM)
The number of radioactive decay events occurring in one minute

Dose
A measurement of an individual's exposure to ionizing radiation

Dose Rate
The amount of dose received per unit of time

Dosimeter of Legal Record
A device such as a Thermoluminescent Dosimeter (TLD) or Optically Stimulated Luminescent Dosimeter (OSLD)

Dosimetry
Devices that indicate the amount of dose received

Fission
The process of splitting atoms, which produces energy

Frisker
An instrument used to check personnel or equipment for contamination

Gamma Radiation
Radiation in the form of an energy wave, which will penetrate through the body

Half-life
The time required for a radioactive substance to decay to one-half of its original activity

High Radiation Area
An area in the station where the dose to a major portion of the body could exceed 100 millirem in any one hour. Areas that exceed 1,000 millirem/hour must be locked and require additional controls for entry.

Hot Spot
A localized source of radiation producing dose rates much higher than the general area

Ionizing Radiation
Energy in the form of waves and particles emitted from unstable atoms

Man-rem
The unit used to express the total dose to a group of workers

Maximum Permissible Concentration (MPC)
The amount of radioactive material allowed in air or water which, if taken into the body over an occupational lifetime of 50 years, would result in a dose that would not present an appreciable risk when compared to other industrial hazards

Net Plutonium
That plutonium which is recoverable after the irradiated fuel assemblies have been chemically processed

Neutron Radiation
An uncharged particle, emitted from nuclear fuel during fission

Nuclear Radiation
Energy or particles with energy emitted from an unstable nucleus as it decays

NUREG
Reports issued by or for the NRC for information purposes

Personnel Decontamination Area (PDA)
The area where contaminated individuals receive aid in decontaminating affected areas of their bodies

Plutonium (Pu)
A heavy, fissionable, radioactive, metallic element with atomic number 94.

It is produced as a by-product of the fission reaction in a uranium fueled nuclear reactor and can be recovered for future use.

Protected Area
The area within the double fence at the station

Protective Clothing (PCs)
Another term for anti-Cs

Rad
A unit of absorbed dose

Radiation
A form of energy (e.g., light, heat, ionizing radiation)

Radiation Area
An area in the station where the dose to a major portion of the body could exceed 5 millirem in any one hour or 100 millirem in five consecutive days

Radiation Work Permit (RWP)
A form describing radiological conditions, hazards and requirements for work or access into the Radiological Control Area

Radioactive Material
A substance that emits radiation

Radiological Control Area (RCA)
An area which requires an RWP for access

Regulatory Guides (Reg Guides)
Guidelines which represent the NRC's view of a specific topic

Roentgen
A measurement of X or gamma radiation in air

Roentgen Equivalent Man (REM)
A unit of dose measuring biological effects from radiation

Self-reading Dosimeter (SRD)
A device which may be read directly by an individual to provide an estimate of the dose received

Smear
A piece of paper or cloth used to sample for loose surface contamination

Step-off Pad
An exit point from a contaminated area designed to control the spread of contamination

Thermoluminescent Dosimeter (TLD)
A device used to record the amount of dose received

Total Effective Dose Equivalent (TEDE)
The sum of a person's internal and external dose

Unrestricted Area
An area where access is not controlled for the purposes of radiological protection

Uranium (U)
A heavy naturally radioactive, metallic element with atomic number 92. The two principle naturally occurring isotopes are uranium 235 and uranium 238. Uranium 235 is the principle fissionable material in the reactor core. However, uranium 238 is also important because it absorbs neutrons to produce a radioactive isotope which subsequently decays to plutonium 239, an isotope which is also fissionable by thermal neutrons.

Whole Body Counter
An instrument used to measure radioactive material inside the body

Glossary of Electricity Terms

Base Load Station

A generating station which is normally operated to take all or part of the base load of a system and which, consequently, operates essentially at a constant output

Capability

The maximum load which a generating unit, generating station, or other electrical apparatus can carry under specified conditions for a given period of time, without exceeding approved limits of temperature and stress

Capability Margin

The difference between net system capability and system maximum load requirements (peak load). It is the margin of capability available to provide for scheduled maintenance, emergency outages, system operating requirements, and unforeseen loads. On a regional or national basis, it is the difference between aggregate net system capability of the various systems in the region or nation and the sum of system maximum (peak) loads without allowance for time diversity between the loads of the several systems. However, within a region, account is taken of diversity between peak loads of systems that are operated as a closely coordinated group.

Capacity

The load for which a generating unit, generating station, or other electrical apparatus is rated either by the user or by the manufacturer. See also Name Plate Rating.

Capacity Factor

The ratio of the average load on a machine or equipment for the period of time considered to the capacity rating of the machine or equipment

Commercial and Industrial

A customer, sales, and revenue classification covering energy supplied for commercial and industrial purposes, except that supplied under special contracts or agreements or service classifications applicable only to municipalities or divisions or agencies of Federal or state governments or to railroads and railways. Usually subdivided into Commercial and Industrial or into Small Light and Power and Large Light and Power. Most companies classify such customers as Commercial or Industrial using the Standard Industrial Classification or predominant kWh use as yardsticks; others still classify as Industrial all customers whose demands or annual use exceeds some specified limit. These limits are generally based on a utility's rate schedules.

Degree-day

A unit measuring the extent to which the outdoor mean (average of maximum and minimum) daily dry-bulb temperature falls below (in the case of heating) or rises above (in the case of cooling) an assumed base. The base is normally taken as 65 degrees F for heating and for cooling unless otherwise designated. One degree-day is counted for each degree of deficiency below (for heating) or excess over (for cooling) the assumed base, for each calendar day on which such deficiency or excess occurs.

Demand

The rate at which electric energy is delivered to or by a system, part of a system, or a piece of equipment expressed in kilowatts, kilovoltamperes or other suitable unit at a given instant or averaged over any designated period of time. The primary source of “Demand” is the power-consuming equipment of the customers. See Load.

Design Voltage

The nominal voltage for which a line or piece of equipment is designed. This is a reference level of voltage for identification and not necessarily the precise level at which it operates.

Distribution

The act or process of distributing electric energy from convenient points on the transmission or bulk power system to the consumers. Also a functional classification relating to that portion of utility plant used for the purpose of delivering electric energy from convenient points on the transmission system to the consumers, or to expenses relating to the operation and maintenance of distribution plant.

Distribution Line

One or more circuits of a distribution system on the same line of poles or supporting structures, operating at relatively low voltage as compared with transmission lines

Diversity

That characteristic of variety of electric loads whereby individual maximum demands usually occur at different time. Diversity among customer’s loads results in diversity among the loads of distribution transformers, feeders, and substations, as well as between entire systems.

Frequency

The number of cycle through which an alternating current passes per second. Frequency has been generally standardized in the United States electric utility industry at 60 cycles per second (60 hertz).

Generating Station (Generating Plant or Power Plant)

A station at which are located prime movers, electric generators, and auxiliary equipment for converting mechanical, chemical, and/or nuclear energy into electric energy

Heat Rate

A measure of generating station thermal efficiency, generally expressed in Btu per net kilowatthour. It is computed by dividing the total Btu content of fuel burned for electric generation by the resulting net kilowatthour generation.

Investor-owned Electric Utilities

Those electric utilities organized as taxpaying businesses usually financed by the sale of securities in the free market, and whose properties are managed by representative regularly elected by their shareholders. Investor-owned electric utilities, which may be owned by an individual proprietor or a small group of people, are usually corporations owned by the general public.

Kilowatt (kW)

1,000 watts (defined herein)

Kilowatthour (kWh)

The basic unit of electric energy equal to one kilowatt of power supplied to or taken from an electric circuit steadily for one hour

Load

The amount of electric power delivered or required at any specified point or points on a system. Load originates primarily at the power consuming equipment of the customers. See Demand.

Load Factor

The ratio of the average load in kilowatts supplied during a designated period to the peak or maximum load in kilowatts occurring in that period. Load factor, in percent, also may be derived by multiplying the kilowatthours in the period by 100 and dividing by the product of the maximum demand in kilowatts and the number of hours in the period.

Load-frequency Control

The regulation of the power output of electric generators within a prescribed area in response to changes in system frequency, tie-line loading, or the relation of these to each other, so as to maintain the scheduled system frequency and/or the established interchange with other areas within predetermined limits

Megawatt (mW)

1,000 kilowatts

Name Plate Rating

The full-load continuous rating of a generator, prime mover or other electrical equipment under specified conditions as designated by the manufacturer. It is usually indicated on a name plate attached mechanically to the individual machine or device. The name plate rating of a steam electric turbine-generator set is the guaranteed continuous output in kilowatts of kVA and power factor at generator terminals when the turbine is cleaned and operating under specified throttle steam pressure and temperature, specified reheat temperature, specified exhaust pressure, and with full extraction from all extraction openings.

Network

A system of transmission or distribution lines so cross-connected and operated as to permit multiple power supply to any principal point on it

Peak Load Station

A generating station which is normally operated to provide power during maximum load periods.

Power Pool

A power pool is two or more interconnected electric systems planned and operated to supply power in the most reliable and economical manner for their combined load requirements and maintenance program

Pumped Storage

An arrangement whereby additional electric power may be generated during peak load periods by hydraulic means using water pumped into a storage reservoir during off peak periods

Service Area

Territory in which a utility system is required or has the right to supply electric service to ultimate customers

Summer Peak

The greatest load on an electric system during any prescribe demand interval in the summer (or cooling) season, usually between June 1 and September 30

Transformer

An electromagnetic device for change the voltage of alternating-current electricity

Transmission

The act or process of transporting electric energy in bulk from a source or sources of supply to other principal parts of the system or to other utility systems. Also a functional classification relating to that portion of utility plant used for the purpose of transmitting electric energy in bulk to other principal parts of the system or to other utility systems, or to expenses relating to the operation and maintenance of transmission plant.

Turbine-generator

A rotary-type unit consisting of a turbine and an electric generator

Watt

The electrical unit of power or rate of doing work. The rate of energy transfer equivalent to one ampere flowing under a pressure of one volt at unity power factor. It is analogous to horsepower or foot-pounds per minute of mechanical power. One horsepower is equivalent to approximately 746 watts.

Winter Peak

The greatest load on an electric system during any prescribed demand interval in the winter or heating season, usually between December 1 of a calendar year and March 31 of the next calendar year

Notes

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