Entergy Nuclear Issue Brief
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Emergency Readiness

How do systems, procedures, emergency planning and training keep the public safe?

In addition to stringent design and construction standards, Entergy and other nuclear operators conduct ongoing programs to ensure plant safety. These programs, which are evaluated by the Nuclear Regulatory Commission, include:

- Ongoing risk analysis and design enhancements to address natural and man-made risks.
- Extensive operator training in preparation for extreme conditions, along with drills and evaluations by the NRC.
- Emergency response plans aimed at protecting public health and safety, such as those put in place following Hurricane Katrina; these plans are regularly exercised in cooperation with local, state and federal agencies.

Emergency Power

Systems are designed with multiple contingent backup systems to provide greater safety margins in our ability to keep cooling water in the reactor and spent fuel pool.

Nuclear plants are required to have emergency AC power sources (diesel generators) to provide electricity to plant safety equipment upon loss of power from the electrical grid. The emergency power automatically starts upon a loss of offsite power to power up the electrical busses supplying power to the safety-related systems. Backup generators are tested regularly to ensure that they successfully start and accept electric loads. All sites have at least two independent separate trains of emergency electrical power. Additionally, there are battery-powered DC support systems for some emergency DC power to critical components.

Various emergency diesel generators at Entergy plants are located within hardened structures and at elevations designed to protect the emergency diesel generators from the sites' design basis environmental disasters, including hurricanes, tornadoes, earthquakes and flooding.

All sites have diesel fuel storage tanks with a capacity to supply fuel oil to the emergency diesel generators for at least 7 days. The storage tanks are underground, except for Waterford 3, Vermont Yankee and a portion of Indian Point's fuel supply. In all cases, the tanks are located in a structure designed for protection against the design basis environmental disasters, including hurricanes, tornadoes, earthquakes and flooding.

A nuclear plant can maintain a shutdown condition isolated from the bulk power transmission system indefinitely.

Emergency Procedures

In addition to stringent design and construction standards, Entergy and other nuclear operators conduct ongoing programs evaluated by the NRC to ensure plant safety. These include ongoing risk

analysis and design enhancements to address natural and man-made risks and extensive operator training and drills to prepare for extreme conditions.

All Entergy plants have Severe Accident Management Guidelines. The guidelines prescribe actions beyond normal emergency operating procedures and address severe challenges to the reactor core of the kind seen in Japan.

Federal law requires that energy companies develop and perform graded exercises of sophisticated emergency response plans to protect the public. The U.S. Nuclear Regulatory Commission reviews and approves these plans. In addition, the NRC coordinates approval of these plans with the Federal Emergency Management Agency, which has the lead federal role in emergency planning beyond the nuclear plant site. Every emergency operating procedure is reviewed every two years; drills happen at least quarterly throughout each year on a three-phase approach, enhancing plant capabilities beyond design basis threats. Drills are performed to coordinate firefighting and emergency response teams and include strategies associated with reactor and containment mitigation enhancements, such as filling and/or venting capabilities.

There is a focus on cross-connecting systems to supply water to the spent fuel pool by using a portable pump to provide make-up and/or spray capability.

The U.S. nuclear industry's hierarchy of procedures are designed with public safety in mind:

Normal system level operating instructions	Normal operating instructions for specific components, systems or functions
General operating procedures	Provides instructions for plant startup, shutdown and refueling operations
Alarm response procedures	Provides instructions in the event of equipment alarms
Abnormal operation procedures	Provides detailed instructions to respond to specific plant abnormal conditions
Emergency operating procedures	Provides instructions for maintaining adequate core cooling and protection of the reactor vessel and containment under a variety of prescribed emergency conditions
Radiological emergency response procedures	Provides instructions for plant staff to take actions to mitigate the consequences of an event that could lead to radioactive material release to the public. Provides instruction for making recommendations to state and local agencies to take action to protect the health of the public, including evacuation or sheltering. These procedures interface with contingency procedures to mitigate a loss of large areas of the plant and with state and local radiological emergency response procedures.
Severe accident guidelines	Provides instructions for containment of radioisotopes if adequate core cooling cannot be maintained. These procedures interface with procedures to mitigate a loss of large areas of the plant. They also provide guidance for conditions outside of the design basis.

Emergency Classifications
Nuclear Regulatory Commission guidelines for emergency classifications are based on their potential severity, ranging from "notification of unusual event" to "general emergency." Nuclear power plants have detailed guidelines for determining when to declare each of the event classifications.

- A **notification of unusual event**, the lowest classification, means that a minor plant event — either an operational event or security threat — has occurred, but no radiation release has occurred.
- An **alert** means that there is an actual or potential reduction in the plant's safety level, or a security event that could threaten site personnel or damage plant equipment.
- A **site area emergency** suggests a more serious event. Major safety equipment has either failed or is deemed likely to fail.
- A **general emergency** is the most serious event. In this instance, radiation may leak outside the plant and beyond the plant boundary.

Nuclear plant events of any type are not common. The United States, with 104 operating commercial nuclear reactors, had six alerts in 2010. The only site area emergency occurred in 2006. There has not been a general emergency since the Three Mile Island accident in 1979.

Under the U.S. Department of Homeland Security's National Response Plan, a nuclear plant security event classified at the alert level or higher is an incident of national significance. Federal resources may be made available to assist with emergency response if state and local resources are overwhelmed.

The Federal Radiological Preparedness Coordinating Committee — chaired by the director of the Department of Homeland Security sector-specific agency — coordinates all federal responsibilities for assisting state and local governments in radiological emergency planning and preparedness activities.

Emergency Planning
Each plant performs quarterly drills exercising emergency response teams in various failure scenarios. Drills ensure the plant personnel are prepared to respond to and classify many different events. In addition, the drills exercise the teams' ability to provide protective action recommendations to the state.

Emergency response plans have broad industry involvement, including at least 200 employees at each nuclear power plant. Local, state and NRC officials also have emergency response plans and participate in periodic exercises to demonstrate the integration of each organization's response.

All nuclear power plants must participate in federally evaluated, full-scale emergency exercises every two years. For each exercise, the utility creates a confidential emergency scenario for use by plant staff and local emergency response organizations, including local government officials, law enforcement, local hospitals and radiological monitoring teams. Post-exercise critiques by the federal agencies and exercise participants identify areas for correction in future exercises or improvements needed in the plans.

Several communities have used the structure of nuclear plant emergency plans to respond to other types of emergencies. For example, during the 2007 wildfires in California, county emergency officials drew on relationships and communications links they had established during their years of planning for nuclear-related events.

Emergency Evacuation
In the United States, a nuclear plant's emergency response plan must provide protective measures, such as sheltering and evacuation of communities within a 10-mile radius of the facility. Japan used a similar plan.

Populations within the 10-mile emergency planning zone of a nuclear plant are at greatest risk of exposure to radiation and radioactive materials, including radioactive iodine. Beyond 10 miles, the major risk of radioiodine exposure is from ingestion of contaminated foodstuffs, particularly milk products. Both the Environmental Protection Agency and the Food and Drug Administration have published guidance to protect consumers from contaminated foods within a 50-mile radius.

In 1978, a multi-agency federal task force determined that a 10-mile radius encompassing a nuclear power facility is an appropriate emergency planning zone in the event of a release of radioactive material from the reactor. The projected radiation doses that would result from most hypothetical reactor accidents would not be a threat to public health and safety beyond the 10-mile zone, the task force concluded.

In 2001 (post-9/11), the NRC issued new requirements and guidance that focus in part on emergency preparedness at plant sites in response to security threats. The industry implemented these measures, which address such issues as on-site sheltering and evacuation, public communications and emergency staffing in the specific context of a security breach.

Potassium iodide (or KI) tablet use was incorporated in 2001 to the NRC-revised emergency planning regulations for nuclear power reactors. It details the option for states to stockpile, recommend and distribute KI as a secondary protective measure for the public. KI would supplement evacuation and sheltering in the event of a nuclear reactor accident. If taken within several hours of exposure to radioactive iodine, KI can protect the thyroid gland. KI does not protect any other part of the body, nor does it protect against any other radioactive element.

Emergency Planning Zones
The emergency planning zone used for nuclear reactors in the United States was developed by a team of scientists from several branches of government including the Nuclear Regulatory Commission, the Environmental Protection Agency and the Federal Emergency Management Agency. The size of the EPZ is based on an assumption of a severe accident at a single nuclear power reactor, much like the accidents that are being experienced at any one of the reactors at Fukushima Daiichi in Japan. A severe accident is one in which there is substantial nuclear reactor fuel damage, including melting, loss of all barriers to contain the radioactive materials and release of those radioactive materials to the environment in very large quantities.

The size of the EPZ, a circle of about 10-mile radius, reflects the area beyond which doses would not be expected to exceed the protective action guidelines established by the U.S. Environmental Protection Agency.

A fundamental premise of the EPZ model is that it is the zone for which there are:
- Detailed plans for protection of public health and safety, including alerting and notification
- Field radiation monitoring
- Methods for instructing residents and visitors on how to know that an emergency condition exists and what actions may be required
- Methods for dissemination of public protective action directives by government officials
- Evacuation plans
- Facilities established for contamination monitoring and processing of members of the affected population

- Methods established for protecting transportation-dependent and institutionalized populations

All of these actions are pre-planned and documented for the 10-mile radius EPZ. Their implementation is practiced during drills and exercises. In addition, in the exceedingly unlikely event that conditions affect areas beyond the 10-mile EPZ, emergency planning provides for ad hoc actions as necessary to protect public health and safety. Decisions on whether to shelter or evacuate are made by state public safety officials, in consultation with local officials. While both the 10-mile emergency preparedness zone and 50-mile zone for monitoring the environment and food products were established, in an actual emergency, response directors would designate protective actions beyond these zones should conditions require.

Government Evacuation of U.S. Citizens Within 50 miles of the Japanese Reactors
The basis for the EPZ remains valid. In fact, other nations have their own EPZs for nuclear power reactor accidents that are based on similar severe accident considerations. Those EPZs are also about 10-miles in radius, and even less.

The NRC recommendations for U.S. citizens who might be within the 50-mile range of the Fukushima Daiichi reactors took into account the actual conditions in the area with respect to roads, communications and availability of supporting emergency services, as well as the uncertainties regarding the characterization and progression of the accident there. The government approach took into account uncertainties associated with the limited information on radiation exposure rates at and near the six-reactor Fukushima plant. The nuclear energy industry fully supports federal government actions to protect the health and safety of Americans in Japan in the aftermath of the Fukushima accident.

At U.S. nuclear power plants, detailed information regarding plant status and radiation exposure rates would be known to the Nuclear Regulatory Commission, state leaders and plant operators as an event progressed. This has been demonstrated in actual events and hundreds of emergency preparedness exercises at nuclear power plants.

While prudent for Americans in Japan for this situation, this action should not be interpreted as a standard for U.S. reactor emergency planning policy, specifically the use of a 50-mile zone.

Operator Training
Nuclear power plant operators are trained to ensure that the plant will achieve and maintain safe shutdown during a station blackout scenario – a loss of offsite power and loss of onsite emergency AC power. The training includes regular classroom work as well as plant-specific simulator exercises.

For NRC licensed operators (reactor operators and senior reactor operators), drills are run in a simulator, which mirrors the real control room. These drills evaluate how operators handle events like core overheating, electrical blackout, reactor trips and other emergencies.

Operators are trained to support and provide guidance on restoring and maintaining core cooling, containment integrity and spent fuel pool cooling under conditions associated with explosions, large area fires, aircraft attack and/or natural disasters.