APPENDIX D

NUCLEAR GLOSSARY

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NUCLEAR GLOSSARY

Absorber: Any material that stops ionizing radiation. Lead, concrete, and steel attenuate gamma rays. A thin sheet of paper or metal will stop or absorb alpha particles and most beta particles.

Accelerator: Device used to increase the energy of particles, which then collide with other particles. Major types are linear accelerators and circular accelerators. The name refers to the path taken by the accelerated particle.

Access Hatch: An airtight door system that preserves the pressure integrity of a reactor containment structure while allowing access to personnel and equipment.

Act: means the **Atomic Energy Act** of 1954 (68 Stat. 919) including any amendments thereto.

Activation: The process of making a radioisotope by bombarding a stable element with neutrons or protons.

Active Fuel Length: The end-to-end dimension of fuel material within a fuel element.

Activity: The rate of disintegration (transformation) or decay of radioactive material per unit time. The units of activity are the curie (Ci) and the becquerel (Bq).

Agreement State: A state that has signed an agreement with the Nuclear Regulatory Commission under which the state regulates the use of byproduct, source, and small quantities of special nuclear material in that state.

Air Sampling: The collection of samples to measure the radioactivity or to detect the presence of radioactive material, particulate matter, or chemical pollutants in the air.

Airborne Radioactivity Area: A room, enclosure, or area in which airborne radioactive materials, composed wholly or partly of licensed material, exist in concentrations that (1) exceed the derived air concentration limits or (2) would result in an individual present in the area without respiratory protection exceeding, during those hours, 0.6 percent of the annual limit on intake or 12 derived air concentration-hours

ALARA: Acronym for "as low as (is) reasonably achievable." Means making every reasonable effort to maintain exposures to ionizing radiation as far below the dose limits as practical, consistent with the purpose for which the licensed activity is undertaken, taking into account the state of technology, the economics of improvements in relation to state of technology, the economics of improvements in relation to benefits to the public health and safety, and other societal and socioeconomic considerations, and in relation to utilization of nuclear energy and licensed materials in the public interest.

Alpha Particle: A positively charged particle ejected spontaneously from the nuclei of some radioactive elements. It is identical to a helium nucleus that has a mass number of 4 and an electrostatic charge of +2. It has low penetrating power and a short range (a few centimeters in air). The most energetic alpha particle will generally

fail to penetrate the dead layers of cells covering the skin and can be easily stopped by a sheet of paper. Alpha particles are hazardous when an alpha-emitting isotope is inside the body.

Alternate ac Source: means an alternating current (ac) power source that is available to and located at or nearby a nuclear power plant and meets the following requirements:

1. Is connectable to but not normally connected to the offsite or onsite emergency ac power systems;
2. Has minimum potential for common mode failure with offsite power or the onsite emergency ac power sources;
3. Is available in a timely manner after the onset of station blackout; and
4. Has sufficient capacity and reliability for operation of all systems required for coping with station blackout and for the time required to bring and maintain the plant in safe shutdown (non-design basis accident).

Anion: A negatively charged ion.

Annihilation: Annihilation of particles is the disappearance of the mass energy of a particle and its corresponding antiparticle, and its appearance as another sort of energy (possibly including a spray of particles of total quantum number zero for each of the additive quantum numbers).

Annual Limit on Intake (ALI): The derived limit for the amount of radioactive material taken into the body of an adult worker by inhalation or ingestion in a year. ALI is the smaller value of intake of a given radionuclide in a year by the reference man that would result in a committed effective dose equivalent of 5 rems (0.05 sievert) or a committed dose equivalent of 50 rems (0.5 sievert) to any individual organ or tissue.

Anticipated Transient Without Scram (ATWS): ATWS is one of the "worst case" accidents, consideration of which frequently motivates the NRC to take regulatory action. The accident could happen if the system that provides a highly reliable means of shutting down the reactor (scram system) fails to work during a reactor event (anticipated transient). The types of events considered are those used for designing the plant.

Antineutrino: Antiparticle to the neutrino. See antiparticles.

Antiparticle: Particle having the same mass, spin, isospin as a particle, but having all additive quantum numbers opposite to those of its respective particle. Antiparticles have the opposite charge of its corresponding particle. Anti-baryons are antiparticles to baryons, anti-leptons are antiparticles to leptons, anti-quarks are antiparticles to quarks. The antiparticle for a particular particle, for example a neutrino, is denoted an antineutrino.

Assumptions (for IPEs, IPEEs, and PRAs): In the context of PRAs, assumptions are those parts of the mathematical models that the analyst expects will hold true for the range of solutions used for making decisions. Without assumptions, even the most powerful computers may not be able to provide useful solutions for the models.

Asymptotic Freedom: Quark-quark interactions weaken as the energy gets higher, or, equivalently, as the quarks approach one another.

Atom: The smallest particle of an element that cannot be divided or broken up by chemical means. It consists of a central core of protons and neutrons, called the nucleus. Electrons revolve in orbits in the region surrounding the nucleus

Atomic Energy: Energy released in nuclear reactions. Of particular interest is the energy released when a neutron initiates the breaking up or fissioning of an atom's nucleus into smaller pieces (fission) or when two nuclei are joined together under millions of degrees of heat (fusion). It is more correctly called nuclear energy.

Atomic Energy Commission: Federal agency created in 1946 to manage the development, use, and control of nuclear energy for military and civilian applications. Abolished by the Energy Reorganization Act of 1974 and succeeded by the Energy Research and Development Administration (now part of the U.S. Department of Energy) and the U.S. Nuclear Regulatory Commission.

Atomic Mass (sometimes mistakenly called atomic weight): The mass of a neutral atom. Its value in atomic mass units (u) is approximately equal to the sum of the number of protons and neutrons in the nucleus of the atom.

Atomic Mass Number: *A*, the total number of nucleons (protons and neutrons) found in a nucleus.

Atomic Mass Unit (amu or u): Unit of mass defined by the convention that the atom **Carbon 12, C_{12}** has a mass of exactly 12 u; the mass of 1 u is **1.67×10^{-27} kg.**

Atomic Number: *Z*, the total number of protons found in a nucleus.

Atomic Weapon: means any device utilizing atomic energy, exclusive of the means for transporting or propelling the device (where such means is a separable and divisible part of the device), the principal purpose of which is for use as, or for development of, a weapon, a weapon prototype, or a weapon test device.

Atomic Weight: for an element is defined as the average atomic weight of the isotopes of the element. The atomic weight for an element can be calculated by summing the products of the isotopic abundance of the isotope with the atomic mass of the isotope.

Atom Percent: is the percentage of the atoms of an element that are of a particular isotope. Atom percent is abbreviated as **a/o.**

Attenuation: The process by which the number of particles or photons entering a body of matter is reduced by absorption and scattered radiation.

Auxiliary Building: Building at a nuclear power plant, frequently located adjacent to the reactor containment structure,that houses most of the reactor auxiliary and safety systems, such as radioactive waste systems, chemical and volume control systems, and emergency cooling water systems.

Auxiliary Feed-water: Backup water supply used during nuclear plant startup and shutdown to supply water to the steam generators during accident conditions for removing decay heat from the reactor.

Average Planar Linear Heat Generation Rate (APLGHR): The average value of the linear heat generation rate of all the control rods at any given horizontal plane along a fuel bundle.

Background Radiation: The radiation found in the natural environment originating primarily from the naturally radioactive elements of Earth and from cosmic rays. The term may also mean radiation extraneous to an experiment.

Barrel (petroleum): A unit of volume equal to 42 U.S. gallons

Baryon: A massive composite hadron (made of three quarks) such as the proton or the neutron.

Baryon Number: Quantum number characteristic of baryons. Each baryon has a value of +1, while each anti-baryon has a value of -1.

Basic Component: means, for the purposes of **10-CFR 50.55(e)** :

1. When applied to nuclear power reactors, any plant structure, system, component, or part thereof necessary to assure

A. The integrity of the reactor coolant pressure boundary,

B. The capability to shut down the reactor and maintain it in a safe shutdown condition

C. The capability to prevent or mitigate the consequences of accidents which could result in potential offsite exposures comparable to those referred to in **10CFR 50.34(a)(1), § 50.67(b)(2),** or § **100.11.**

2. When applied to other types of facilities or portions of such facilities for which construction permits are issued under **10CFR § 50.23,** a component, structure, system or part thereof that is directly procured by the construction permit holder for the facility subject to the regulations of this part and in which a defect or failure to comply with any applicable regulation in this chapter, order, or license issued by the Commission could create a substantial safety hazard.

3. In all cases, **basic component** includes safety related design, analysis, inspection, testing, fabrication, replacement parts, or consulting services that are associated with the component hardware, whether these services are performed by the component supplier or other supplier.

Bayesian Estimation: A mathematical formulation, using Bayes' theorem, by which the likelihood of an event can be estimated taking explicit consideration of certain contextual features (such as amount of data, nature of decision, etc.).

Bayesian Prior: A way to express the context of a Bayesian estimation in which initial data are updated as new data become available.

Becquerel (Bq): Unit of activity in the International System–one disintegration per second; 1 Bq = 27 pCi. The unit of radioactive decay equal to 1 disintegration per second. 37 billion (3.7×10^{10}) becquerels = 1 curie (Ci).

Beta Particle (beta radiation, beta ray): An electron of either positive charge (e^+ or b+) or negative charge (e, e^- or b-) emitted by an atomic nucleus or neutron in the process of a transformation. Beta particles are more penetrating than alpha particles but less than gamma rays or x-rays. Electron capture is a form of beta decay.

A charged particle emitted from a nucleus during radioactive decay, with a mass equal to 1/1837 that of a proton. A negatively charged beta particle is identical to an electron. A positively charged beta particle is called a positron. Large amounts of beta radiation may cause skin burns, and beta emitters are harmful if they enter the body. Beta particles may be stopped by thin sheets of metal or plastic

Beyond Design-Basis Accidents: This term is used as a technical way to discuss accident sequences that are possible but were not fully considered in the design process because they were judged to be too unlikely. As the regulatory process strives to be as thorough as possible, "beyond design-basis" accident sequences are analyzed to fully understand the capability of a design.

Big Bang: Beginning of the universe; a transition from conditions of unimaginable density and temperature to conditions of lower density and temperature.

Binding Energy: The minimum energy required to separate a nucleus into its component neutrons and protons.

Bioassay: The determination of kinds, quantities, or concentrations and, in some cases, locations of radioactive material in the human body, whether by direct measurement (in vivo counting) or by analysis and evaluation of materials excreted or removed (in vitro) from the human body.

Bioenergy: Energy derived from biomass as electricity or heat, or combinations of heat and power; in the form of liquid or gaseous fuels, it is often referred to as biofuels

Biological Half-life: The time required for a biological system, such as that of a human, to eliminate, by natural processes, half of the amount of a substance (such as a radioactive material) that has entered it.

Biological Shield: A mass of absorbing material placed around a reactor or radioactive source to reduce the radiation to a level safe for humans.

Biomass: Any organic matter available on a renewable or a recurrent basis, including agricultural crops and residues, wood and wood residues, urban and animal residues, and aquatic plants.

Blackbody: An object that is a perfect emitter and absorber of radiation.

Blackbody Radiation: Radiation emitted by a blackbody (the intensity depends on temperature).

Black Hole: An object so dense that light cannot escape from it.

Boiling Water Reactor (BWR): A reactor in which water, used as both coolant and moderator, is allowed to boil in the core. The resulting steam can be used directly to drive a turbine and electrical generator, thereby producing electricity

Bone Seeker: A radioisotope that tends to accumulate in the bones when it is introduced into the body. An example is strontium-90, which behaves chemically like calcium

Boson: A particle having spin that is an integer multiple of **(h-bar)**.

Breeder: A reactor that produces more nuclear fuel than it consumes. A fertile material, such as uranium-238, when bombarded by neutrons, is transformed into a fissile material, such as plutonium-239, which can be used as fuel.

British Thermal Unit (Btu): One British thermal unit, or BTU, is the quantity of heat required to raise the temperature of one pound of water one degree Fahrenheit.

Byproduct Material: Byproduct material is:

1. Any radioactive material (except special nuclear material) yielded in, or made radioactive by, exposure to the radiation incident to the process of producing or using special nuclear material (as in a reactor);
2. The tailings or wastes produced by the extraction or concentration of uranium or thorium from ore

Calibration: The adjustment, as necessary, of a measuring device such that it responds within the required range and accuracy to known values of input.

Capability: The maximum load that a generating station can carry under specified conditions for a given period of time without exceeding approved limits of temperature and stress.

Capacity Factor (gross): The ratio of the gross electricity generated, for the time considered, to the energy that could have been generated at continuous full-power operation during the same period.

Capacity Factor (net): The ratio of the net electricity generated, for the time considered, to the energy that could have been generated at continuous full-power operation during the same period.

Carbon Dioxide (CO_2): A colorless, odorless, non-poisonous gas that is a normal part of the ambient air. Carbon dioxide is a product of fossil fuel combustion.

Cask: A heavily shielded container used to store and/or ship radioactive materials. Lead and steel are common materials used in the manufacture of casks.

Cation: A positively charged ion.

Certified Fuel Handler: means, for a nuclear power reactor facility, a non-licensed operator who has qualified in accordance with a fuel handler training program approved by the Commission.

Chain Reaction: A reaction that initiates its own repetition. In a fission chain reaction, a fissionable nucleus absorbs a neutron and fissions spontaneously, releasing additional neutrons. These, in turn, can be absorbed by other fissionable nuclei, releasing still more neutrons. A fission chain reaction is self-sustaining when the number of neutrons released in a given time equals or exceeds the number of neutrons lost by absorption in non-fissionable material or by escape from the system.

Charged Particle: An ion. An elementary particle carrying a positive or negative electric charge.

Chemical Recombination: Following an ionization event, the positively and negatively charged ion pairs may or may not realign themselves to form the same chemical substance they formed before ionization. Thus, chemical recombination could change the chemical composition of the material bombarded by ionizing radiation.

Cherenkov Radiation: Light emitted by particles that move through a medium in which the speed of light is slower than the speed of the particles.

Cladding: The thin-walled metal tube that forms the outer jacket of a nuclear fuel rod. It prevents corrosion of the fuel by the coolant and the release of fission products into the coolant. Aluminum, stainless steel, and zirconium alloys are common cladding materials.

Cleanup System: A system used for continuously filtering and de-mineralizing a reactor coolant system to reduce contamination levels and to minimize corrosion.

Climate Change: The change in weather patterns and surface temperatures that is at the center of the controversy concerning man's use of carbon based fuels for the generation of energy. Some groups of scientist are attempting to link the change in average temperature on the earth to the miniscule increases in greenhouse gas concentrations in the earth's atmosphere.

Coastdown: An action that permits the reactor power level to decrease gradually as the fuel in the core is depleted.

Cogeneration: The production of electrical energy and another form of useful energy (such as heat or steam) through the sequential use of energy.

Cold Shutdown: The term used to define a reactor coolant system at atmospheric pressure and at a temperature below 200 degrees Fahrenheit following a reactor cooldown.

Collective Dose: The sum of the individual doses received in a given period by a specified population from exposure to a specified source of radiation.

Combined Cycle: An electric generating technology in which electricity is produced from otherwise lost waste heat exiting from one or more gas (combustion) turbines. The exiting heat is routed to a conventional boiler or to a heat recovery steam generator for utilization by a steam turbine in the production of electricity. Such designs increase the efficiency of the electric generating unit.

Commission: means the **Nuclear Regulatory Commission** or its duly authorized representatives.

Committed dose equivalent: means the dose equivalent to organs or tissues of reference that will be received from an intake of radioactive material by an individual during the 50-year period following the intake.

Committed effective dose equivalent: is the sum of the products of the weighting factors applicable to each of the body organs or tissues that are irradiated and the committed dose equivalent to these organs or tissues. The committed dose equivalent for a given organ multiplied by a weighting factor.

Common defense and security: means the common defense and security of the United States.

Cost of Service Regulation: means the traditional system of rate regulation, or similar regulation, including "price cap" or "incentive" regulation, in which a rate regulatory authority generally allows an electric utility to charge its customers the reasonable and prudent costs of providing electricity services, including capital, operations, maintenance, fuel, decommissioning, and other costs required to provide such services.

Compact: A group of two or more states formed to dispose of low-level radioactive waste on a regional basis. Forty-two states have formed nine compacts.

Compound: A chemical combination of two or more elements combined in a fixed and definite proportion by weight.

Condensate: Water that has been produced by the cooling of steam in a condenser.

Condenser: A large heat exchanger designed to cool exhaust steam from a turbine below the boiling point so that it can be returned to the heat source as water. In a pressurized water reactor, the water is returned to the steam generator. In a boiling water reactor, it returns to the reactor core. The heat removed from the steam by the condenser is transferred to a circulating water system and is exhausted to the environment, either through a cooling tower or directly into a body of water.

Conservation Law: A relation asserting that a specific quantity is conserved. For example, conservation of energy, conservation of momentum, conservation of electron number. Conservation laws are connected to symmetries through Noether's theorem.

Construction Recapture: The maximum number of years that could be added to the license expiration date to recover the period from the construction permit to the date when the operating license was granted. A licensee is required to submit an application for such a change.

Construction or Constructing: means, for the purposes of **10-CFR-50.55(e**), the analysis, design, manufacture, fabrication, quality assurance, placement, erection, installation, modification, inspection, or testing of a facility or activity which is subject to the regulations in this part and consulting services related to the facility or activity that are safety related.

Containment Structure: A gaslight shell or other enclosure around a nuclear reactor to confine fission products that otherwise might be released to the atmosphere in the event of an accident.

Contamination: Undesired radioactive material that is deposited on the surface of or inside structures, areas, objects, or people.

Control Rod: A rod, plate, or tube containing a material such as hafnium, boron, etc., used to control the power of a nuclear reactor. By absorbing neutrons, a control rod prevents the neutrons from causing further fissions.

Controls: when used with respect to nuclear reactors means apparatus and mechanisms, the manipulation of which directly affects the reactivity or power level of the reactor.

When used with respect to any other facility means apparatus and mechanisms, the manipulation of which could affect the chemical, physical, metallurgical, or nuclear process of the facility in such a manner as to affect the protection of health and safety against radiation.

Control Room: The area in a nuclear power plant from which most of the plant power production and emergency safety equipment can be operated by remote control.

Controlled Area: At a nuclear facility, an area outside a restricted area but within the site boundary, access to which the licensee can limit for any reason.

Coolant: A substance circulated through a nuclear reactor to remove or transfer heat. The most commonly used coolant in the United States is water. Other coolants include heavy water, air, carbon dioxide, helium, liquid sodium, and a sodium-potassium alloy.

Cooldown: The gradual decrease in reactor fuel rod temperature caused by the removal of heat from the reactor coolant system after the reactor has been shutdown.

Cooling Tower: A heat exchanger designed to aid in the cooling of water that was used to cool exhaust steam exiting the turbines of a power plant. Cooling towers transfer exhaust heat into the air instead of into a body of water.

Core: The central portion of a nuclear reactor containing the fuel elements, moderator, neutron poisons, and support structures.

Core Damage Frequency: An expression of the likelihood that, given the way a reactor is designed and operated, an accident could cause the fuel in the reactor to be damaged.

Core Meltdown Accident: An event or sequence of events that result in the melting of part of the fuel in the reactor core.

Cosmic Radiation: Penetrating ionizing radiation, both particulate and electromagnetic, originating in outer space. Secondary cosmic rays, formed by interactions in the Earth's atmosphere, account for about 45 to 50 millirem of the 360 millirem background radiation that an average individual receives in a year.

Cost of Service Regulation: means the traditional system of rate regulation, or similar regulation, including "price cap" or "incentive" regulation, in which a rate regulatory authority generally allows an electric utility to charge its customers the reasonable and prudent costs of providing electricity services, including capital, operations, maintenance, fuel, decommissioning, and other costs required to provide such services.

Counter: A general designation applied to radiation detection instruments or survey meters that detect and measure radiation. The signal that announces an ionization event is called a count.

Criteria Pollutant: A pollutant determined to be hazardous to human health and regulated under the Environmental Protection Agency's (EPA) National Ambient Air Quality Standards. The 1970 amendments to the Clean Air Act require EPA to describe the health and welfare impacts of a pollutant as the "criteria" for inclusion in the regulatory regime.

Criticality: A term used in reactor physics to describe the state when the number of neutrons released by fission is exactly balanced by the neutrons being absorbed (by the fuel and poisons) and escaping the reactor core. A reactor is said to be "critical" when it achieves a self-sustaining nuclear chain reaction, as when the reactor is operating.

Critical Mass: The smallest mass of fissionable material that will support a self-sustaining chain reaction.

Critical Organ: That part of the body that is most susceptible to radiation damage under the specific conditions under consideration.

Cross-Section: The cross-section of a Nuclear Reaction denoted by the Greek letter σ is a measure of the probability of the occurrence of a particular reaction under prescribed conditions.

Crud: A colloquial term for corrosion and wear products (rust particles, etc.) that become radioactive (i.e., activated) when exposed to radiation. Because the activated deposits were first discovered at Chalk River, a Canadian nuclear plant, "crud" has been used as shorthand for Chalk River Unidentified Deposits.

Crude Oil: A mixture of hydrocarbons that exists in the liquid phase in natural underground reservoirs and remains liquid at atmospheric pressure after passing through surface separating facilities. Crude oil production is measured at the wellhead and includes lease condensate.

Cumulative Dose: The total dose resulting from repeated exposures of ionizing radiation to an occupationally exposed worker to the same portion of the body, or to the whole body, over time.

Curie (Ci): The basic unit used to describe the intensity of radioactivity in a sample of material. The curie is equal to 37 billion (3.7×10^{10}) disintegrations per second, which is approximately the activity of 1 gram of radium. A curie is also a quantity of any radionuclide that decays at a rate of 37 billion disintegrations per second. It is named for Marie and Pierre Curie, who discovered radium in 1898.

The original unit used to describe the intensity of radioactivity in a sample of material. One curie equals thirty-seven billion disintegrations per second, or approximately the radioactivity of one gram of radium. This unit is no longer recognized as part of the International System of units. It has been replaced by the becquerel.

Cyclotron: Circular accelerator in which the particle is bent in traveling through a magnetic field, and an oscillating potential difference causes the particles to gain energy.

Cyclotron Frequency: Frequency at which the electric field is switched in order to accelerate the particles in the cyclotron. The frequency is related to the mass and charge of the particle to be accelerated.

Daughter: A nuclide formed by the radioactive decay of a different (parent) nuclide.

Daughter Products: Isotopes that are formed by the radioactive decay of some other isotope. In the case of radium-226, for example, there are 10 successive daughter products, ending in the stable isotope lead-206.

Decay Heat: The heat produced by the decay of radioactive fission products after a reactor has been shut down.

Decay, Radioactive: The decrease in the amount of any radioactive material with the passage of time due to the spontaneous emission from the atomic nuclei of either alpha or beta particles, often accompanied by gamma radiation.

The change of one radioactive nuclide into a different nuclide by the spontaneous emission of radiation such as alpha, beta, or gamma rays, or by electron capture. The end product is a less energetic, more stable nucleus. Each decay process has a definite half-life.

Decay Rate: The ratio of activity to the number of radioactive atoms of a particular species.

Decay Time: The time required for a quantity to fall to ***1/e*** times the original value.

Declared Pregnant Woman: A woman who is an occupational radiation worker and has voluntarily informed her employer, in writing, of her pregnancy and the estimated date of conception

Decommission: means to remove a facility or site safely from service and reduce residual radioactivity to a level that permits:

1. Release of the property for unrestricted use and termination of the license;
2. Release of the property under restricted conditions and termination of the license.

Decommissioning: The process of closing down a facility followed by reducing residual radioactivity to a level that permits the release of the property for unrestricted

DECON: A method of decommissioning in which the equipment, structures, and portions of a facility and site containing radioactive contaminants are removed and safety buried in a low-level radioactive waste landfill or decontaminated to a level that permits the property to be released for unrestricted use shortly after cessation of operations.

Decontamination: The reduction or removal of contaminating radioactive material from a structure, area, object, or person. Decontamination may be accomplished by (1) treating the surface to remove or decrease the contamination, (2) letting the material stand so that the radioactivity is decreased as a result of natural radioactive decay, or (3) covering the contamination to shield or attenuate the radiation emitted

Deep-Dose Equivalent (DDE): The external whole-body exposure dose equivalent at a tissue depth of 1 cm (1000 mg/cm^2).

Defect: means, for the purposes of **10-CFR 50.55(e)**:

1. A deviation in a basic component delivered to a purchaser for use in a facility or activity subject to a construction permit under this part, if on the basis of an evaluation, the deviation could create a substantial safety hazard;
2. The installation, use, or operation of a basic component containing, a defect as defined in paragraph (1) of this definition;
3. A deviation in a portion of a facility subject to the construction permit of this part provided the deviation could, on the basis of an evaluation, create a substantial safety hazard.

Defense-in-depth: A design and operational philosophy with regard to nuclear facilities that calls for multiple layers of protection to prevent and mitigate accidents. It includes the use of controls, multiple physical barriers to prevent release of radiation, redundant and diverse key safety functions, and emergency response measures.

Density: The ratio of an object's mass to its volume.

Department and Department of Energy: means the Department of Energy established by the Department of Energy Organization Act (Pub. L. 95-91, 91 Stat. 565, 42 U.S.C. 7101 et seq.), to the extent that the department, or its duly authorized representatives, exercises functions formerly vested in the Atomic Energy Commission, its Chairman, members, officers and components and transferred to the U.S. Energy Research and Development Administration and to the Administrator thereof pursuant to sections 104 (b), (c) and (d) of the Energy Reorganization Act of 1974 (Pub. L. 93-438, 88 Stat. 1233 at 1237, 42 U.S.C. 5814) and retransferred to the Secretary of Energy pursuant to section 301(a) of the Department of Energy Organization Act (Pub. L. 95-91, 91 Stat. 565 at 577-578, 42 U.S.C. 7151).

Departure From Nuclear Boiling Ratio (DNBR): The ratio of the heat flux to cause departure from nucleate boiling to the actual local heat flux or a fuel rod.

Departure From Nucleate Boiling (DNB): The point at which the heat transfer from a fuel rod rapidly decreases due to the insulating effect of a steam blanket that forms on the rod surface when the temperature continues to increase.

Depleted Uranium: Uranium having a percentage of uranium-235 smaller than the 0.7 percent found in natural uranium. It is obtained from spent (used) fuel elements or as byproduct tails, or residues, from uranium isotope separation.

Derived Air Concentration (DAC): The concentration of radioactive material in air and the time of exposure to that radionuclide in hours. An NRC licensee may take 2000 hours to represent one ALI, equivalent to a committed effective dose equivalent of 5 rems (0.05 sievert).

Derived Air Concentration-Hour (DAC-hour): The product of the concentration of radioactive material in air (expressed as a fraction or multiple of the derived air concentration for each radionuclide) and the time of exposure to that radionuclide, in hours. A licensee may take 2,000 DAC-hours to represent one ALI, equivalent to a committed effective dose equivalent of 5 rem (0.05 Sv).

Design Bases: means that information which identifies the specific functions to be performed by a structure, system, or component of a facility, and the specific values or ranges of values chosen for controlling parameters as reference bounds for design. These values may be:

1. **r**estraints derived from generally accepted "state of the art" practices for achieving functional goals,

2. requirements derived from analysis (based on calculation and/or experiments) of the effects of a postulated accident for which a structure, system, or component must meet its functional goals.

Design-Basis Accident: A postulated accident that a nuclear facility must be designed and built to withstand without loss to the systems, structures, and components necessary to assure public health and safety.

Design-Basis Phenomena: Earthquakes, tornadoes, hurricanes, floods, etc., that a nuclear facility must be designed and built to withstand without loss of systems, structures, and components necessary to assure public health and safety.

Design-basis Threat: A profile of the type, composition, and capabilities of an adversary. The NRC and its licensees use the design-basis threat (DBT) as a basis for designing safeguards systems to protect against acts of radiological sabotage and to prevent the theft of special nuclear material. The DBT is described in detail in Title 10, Section 73.1(a), of the Code of Federal Regulations This term is applied to clearly identify for a licensee the expected capability of its facility to withstand a threat.

Detector: A material or device that is sensitive to radiation and can produce a response signal suitable for measurement or analysis. A radiation detection instrument.

Deterministic (probabilistic): Consistent with the principles of "determinism," which hold that specific causes completely and certainly determine effects of all sorts. As applied in nuclear technology, it generally deals with evaluating the safety of a nuclear power plant in terms of the consequences of a predetermined bounding subset of accident sequences. The term "probabilistic" is associated with an evaluation that explicitly accounts for the likelihood and consequences of possible accident sequences in an integrated fashion.

Deterministic Effect: The health effects of radiation, the severity of which varies with the dose and for which a threshold is believed to exist. Radiation-induced cataract formation is an example of a deterministic effect (also called a non-stochastic effect)

Deuterium: An isotope of hydrogen with one proton and one neutron in the nucleus.

Deuteron: The nucleus of deuterium. It contains one proton and one neutron. See also heavy water.

Deviation: means, for the purposes of **10 CFR-50.55(e)**, a departure from the technical or quality assurance requirements defined in procurement documents, safety analysis report, construction permit, or other documents provided for basic components installed in a facility subject to the regulations of this part.

Differential Pressure (dp or dP): The difference in pressure between two points of a system, such as between the inlet and outlet of a pump.

Director: means, for the purposes of **10 CFR-50.55(e)**, an individual, appointed or elected according to law, who is authorized to manage and direct the affairs of a corporation, partnership or other entity.

Discount Rate: The interest rate used to assess the value of future cost and revenue streams; an essential factor in assessing true returns from an investment in energy efficiency, as well as opportunity costs associated with not making that investment. In this report, we always use real discount rates that do not include inflation. To obtain the equivalent nominal discount rate including inflation, simply add the percentage annual inflation rate to the real discount rate

Discovery: means, for the purposes of**10 CFR-50.55(e),** the completion of the documentation first identifying the existence of a deviation or failure to comply potentially associated with a substantial safety hazard within the evaluation procedures discussed in **10 CFR-50.55(e)**.

Distillate Fuel Oil: The lighter fuel oils distilled off during the refining process. Included are products known as ASTM grades numbers 1 and 2 heating oils, diesel fuels, and number 4 fuel oil. The major uses of distillate fuel oils include heating, fuel for on- and off-highway diesel engines, and railroad diesel fuel.

Doppler Coefficient: Another name used for the fuel temperature coefficient of reactivity.

Dose: The absorbed dose, given in rads (or in SI units, grays), that represents the energy absorbed from the radiation in a gram of any material. Furthermore, the biological dose or dose equivalent, given in rem or sieverts, is a measure of the biological damage to living tissue from radiation exposure.

Dose Equivalent: The product of absorbed dose in tissue multiplied by a quality factor and then sometimes multiplied by other necessary modifying factors at the location of interest. It is expressed numerically in rems or sieverts

Dose Rate: The ionizing radiation dose delivered per unit time. For example, rem or sieverts per hour.

Dosimeter: A small portable instrument (such as a film badge or thermoluminescent or pocket dosimeter) for measuring and recording the total accumulated personal dose of ionizing radiation.

Dosimetry: The theory and application of the principles and techniques involved in the measurement and recording of ionizing radiation doses.

Drywell: The containment structure enclosing a boiling water reactor vessel and its recirculation system. The drywell provides both a pressure suppression system and a fission product barrier under accident conditions.

Earthquake, Operating Basis: An earthquake that could be expected to affect the reactor plant site, but for which the plant power production equipment is designed to remain functional without undue risk to public health and safety.

Effective Dose Equivalent: The sum of the products of the dose equivalent to the organ or tissue and the weighting factors applicable to each of the body organs or tissues that are irradiated.

Effective Half-life: The time required for the amount of a radioactive element deposited in a living organism to be diminished 50 percent as a result of the combined action of radioactive decay and biological elimination.

Efficiency, Plant: The percentage of the total energy content of a power plant's fuel that is converted into electricity. The remaining energy is lost to the environment as heat.

Elastic Scattering: In this interaction of radiation with matter. The impinging particle approaches the target and

Electrical Generator: An electromagnetic device that converts mechanical (rotational) energy into electrical energy.

Electric Dipole Moment: The product of charge and distance of separation for an electric dipole.

Electric Utility Restructuring: With some notable exceptions, the electric power industry historically has been composed primarily of investor-owned utilities. These utilities have been predominantly vertically integrated monopolies (combining electricity generation, transmission, and distribution), whose prices have been regulated by State and Federal government agencies. Restructuring the industry entails the introduction of competition into at least the generation phase of electricity production, with a corresponding decrease in regulatory control. Restructuring may also modify or eliminate other traditional aspects of investor-owned utilities, including their exclusive franchise to serve a given geographical area, assured rates of return, and vertical integration of the production process.

Electromagnetic Radiation: A traveling wave motion resulting from changing electric or magnetic fields. Familiar electromagnetic radiation range from x-rays (and gamma rays) of short wavelength, through the ultraviolet, visible, and infrared regions, to radar and radio waves of relatively long wavelength.

Electron: An elementary particle with a negative charge and a mass 1/1837 that of the proton. Electrons surround the positively charged nucleus and determine the chemical properties of the atom.

Electron-volt (eV): Energy unit used as the basis of measurement for atomic processes. One electron-volt is equal to the amount of energy gained by an electron dropping through a potential difference of one volt, which is 1.6 ´ 10-19 joules.

Electron Capture: A radioactive decay process in which an orbital electron is captured by and merges with the nucleus. The mass number is unchanged, but the atomic number is decreased by one.

Electroweak Interaction: A theory which unifies the electromagnetic and weak interactions.

Element: One of the 103 known chemical substances that cannot be broken down further without changing its chemical properties. Some examples include hydrogen, nitrogen, gold, lead, and uranium.

Emergency Classifications: Response by an offsite organization is required to protect local citizens near the site. A request for assistance from offsite emergency response organizations may be required.

Emergency Core Cooling Systems (ECCS): Reactor system components (pumps, valves, heat exchangers, tanks, and piping) that are specifically designed to remove residual heat from the reactor fuel rods should the normal core cooling system (reactor coolant system) fail.

Emergency Feedwater: Another name that may be used for auxiliary feed-water.

Energy: The capacity for doing work as measured by the capability of doing work (potential energy) or the conversion of this capability to motion (kinetic energy). Energy has several forms, some of which are easily convertible and can be changed to another form useful for work.

Energy Saving Performance Contract: An agreement with a third party in which the overall performance of installed energy conservation measures is guaranteed by that party.

Energy Services Company: A company which designs, procures, finances, installs, maintains, and guarantees the performance of energy conservation measures in an owner's facility or facilities.

ENTOMB: A method of decommissioning in which radioactive contaminants are encased in a structurally long-lived material, such as concrete. The entombment structure is appropriately maintained and continued surveillance is carried out until the radioactivity decays to a level permitting decommissioning and ultimate unrestricted release of the property.

Enthalpy: In thermodynamics the Quantity called enthalpy, denoted by **H** or **h** (for the specific enthalpy)

$$\mathbf{H = U + pV}\ .$$

Where **U** is the internal energy,

p is the internal pressure

V is the volume.

Enthalpy is a property of a gas or liquid and it's units in the British System are **Btu/lbm.**

Entropy: In thermodynamics the Quantity called entropy, denoted by **S** or **s** (for the specific entropy) is a measure of the amount of energy in a physical system not available to do work. As a physical system becomes more disordered, and its energy becomes more evenly distributed, that energy becomes less able to do work. The amount of entropy is often thought of as the amount of disorder in a system.

Environmental Qualification: A process for ensuring that equipment will be capable of withstanding the ambient conditions that could exist when the specific function to be performed by the equipment is actually called upon to be performed under accident conditions.

Ethanol: A denatured alcohol (**C_2H_5OH**) intended for motor gasoline blending.

Evaluation: means, for the purposes of **10-CFR-50.55(e**), the process of determining whether a particular deviation could create a substantial safety hazard or determining whether a failure to comply is associated with a substantial safety hazard.

Event Notification (EN) System: An internal NRC automated event tracking system used by the NRC Operations Center to track information on incoming notifications of the occurrence of significant material events that have or may affect public health and safety. Significant material events are reported to the NRC Operations Center by NRC licensees, staff of the Agreement States, other Federal agencies, and the public.

Excited State: The state of an atom or nucleus when it possesses more than its normal energy. Typically, the excess energy is released as a gamma ray.

Exclusion Area: The area surrounding the reactor where the reactor licensee has the authority to determine all activities, including exclusion or removal of personnel and property.

Excursion: A sudden, very rapid rise in the power level of a reactor caused by super-criticality. Excursions are usually quickly suppressed by the negative temperature coefficient, the fuel temperature coefficient or the void coefficient (depending upon reactor design), or by rapid insertion of control rods.

Exposure: Being exposed to ionizing radiation or to radioactive material.

External Radiation: Exposure to ionizing radiation when the radiation source is located outside the body.

Externalities: Benefits or costs, generated as a byproduct of an economic activity, that do not accrue to the parties involved in the activity.

Extremities: The hands, forearms, elbows, feet, knees, leg below the knees, and ankles. (Permissible radiation exposures in these regions are generally greater than in the whole body because they contain fewer blood forming organs and have smaller volumes for energy absorption.)

Fast Fission: Fission of a heavy atom (such as uranium-238) when it absorbs a high energy (fast) neutron. Most fissionable materials need thermal (slow) neutrons in order to fission.

Fast Neutron: A neutron with kinetic energy greater than its surroundings when released during fission.

Federal Government: funding for conversion means funds appropriated to the Department of Energy or to any other Federal Agency to pay directly to or to reimburse non-power reactor licensees for costs attendant to conversion.

Federal Licensee; means any NRC licensee, the obligations of which are guaranteed by and supported by the full faith and credit of the United States Government.

Feedwater: Water supplied to the reactor pressure vessel (in a BWR) or the steam generator (in a PWR) that removes heat from the reactor fuel rods by boiling and becoming steam.

Fermion: A particle having a spin that is an odd integer multiple of **(h-bar)**/2.

Fertile Material: A material, which is not itself fissile (fissionable by thermal neutrons), that can be converted into a fissile material by irradiation in a reactor. There are two basic fertile materials: uranium-238 and thorium-232. When these fertile materials capture neutrons, they are converted into fissile plutonium-239 and uranium-233, respectively.

Film Badge: Photographic film used for measurement of ionizing radiation exposure for personnel monitoring purposes. The film badge may contain two or three films of differing sensitivities, and it may also contain a filter that shields part of the film from certain types of radiation.

Fiscal Year: The 12-month period, from October 1 through September 30, used by the Federal Government in budget formulation and execution. The fiscal year is designated by the calendar year in which it ends.

Fissile Material: Although sometimes used as a synonym for fissionable material, this term has acquired a more restricted meaning. Namely, any material fissionable by thermal (slow) neutrons. The three primary fissile materials are uranium-233, uranium-235, and plutonium-239.

Fission (fissioning): The splitting of a nucleus into at least two other nuclei and the release of a relatively large amount of energy. Two or three neutrons are usually released during this type of transformation.

Fission Gases: Those fission products that exist in the gaseous state. In nuclear power reactors, this includes primarily the noble gases, such as krypton and xenon.

Fission Products: The nuclei (fission fragments) formed by the fission of heavy elements, plus the nuclide formed by the fission fragments' radioactive decay.

Fissile Nucleus: A nucleus that may fission after collision with a thermal (slow) neutron or that fissions spontaneously (by itself).

Fission: The splitting of a heavy nucleus into two roughly equal parts (which are nuclei of lower-mass elements), accompanied by the release of a relatively large amount of energy in the form of kinetic energy of the two parts and in the form of emission of neutrons and gamma rays.

Fission products: Nuclei formed by the fission of higher mass elements. They are of medium atomic mass and almost all are radioactive. Examples: ^{90}Sr, ^{137}Ce.

Fusion: A process whereby low mass nuclei combine to form a more massive nucleus plus one or move massive particles.

Fluorescent Lamps: Fluorescent lamps produce light by passing electricity through a gas, causing it to glow. The gas produces ultraviolet light; a phosphor coating on the inside of the lamp absorbs the ultraviolet light and produces visible light. Fluorescent lamps produce much less heat than incandescent lamps and are more energy efficient. Linear fluorescent lamps are used in long narrow fixtures designed for such lamps. Compact fluorescent light bulbs have been designed to replace incandescent light bulbs in table lamps, floodlights, and other fixtures.

Fissionable Material: Commonly used as a synonym for fissile material, the meaning of this term has been extended to include material that can be fissioned by fast neutrons, such as uranium-238.

Flux: A term applied to the amount of some type of particle (neutrons, alpha radiation, etc.) or energy (photons, heat, etc.) crossing a unit area per unit time. The unit of flux is the number of particles, energy, etc., per square centimeter per second.

Formula Quantity: Strategic special nuclear material in any combination in a quantity of 5000 grams or more computed by the formula, grams = (grams contained U-235) + 2.5 (grams U-233 + grams plutonium). This class of material is sometimes referred to as a Category I quantity of material

Fossil Fuel: Any naturally occurring organic fuel formed in the Earth's crust, such as petroleum, coal, and natural gas.

Fuel acceptable: to the Commission means that the fuel replacing the existing **Highly Enriched Uranium (HEU)** fuel in a specific non-power reactor

1. Meets the operating requirements of the existing license or, through appropriate **NRC** safety review and approval, can be used in a manner which protects public health and safety and promotes the common defense and security;
2. Meets the Commission's policy of limiting, to the maximum extent possible, the use of **HEU** fuel in that reactor.

Fuel Assembly: A cluster of fuel rods (or plates). Also called a fuel element. Many fuel assemblies make up a reactor core.

Fuel Cells: One or more cells capable of generating an electrical current by converting the chemical energy of a fuel directly into electrical energy. Fuel cells differ from conventional electrical cells in that the active materials such as fuel and oxygen are not contained within the cell but are supplied from outside.

Fuel Cycle: The series of steps involved in supplying fuel for nuclear power reactors. It can include mining, milling, isotopic enrichment, fabrication of fuel elements, use in a reactor, chemical reprocessing to recover the fissionable material remaining in the spent fuel, re-enrichment of the fuel material, re-fabrication into new fuel elements, and waste disposal.

Fuel Reprocessing: The processing of reactor fuel to separate the unused fissionable material from waste material.

Fuel Rod: A long, slender tube that holds fissionable material (fuel) for nuclear reactor use. Fuel rods are assembled into bundles called fuel elements or fuel assemblies, which are loaded individually into the reactor core.

Fuel Temperature Coefficient of Reactivity: The change in reactivity per degree change in the fuel temperature. The physical property of fuel pellet material (uranium-238) that causes the uranium to absorb more neutrons away from the fission process as fuel pellet temperature increases. This acts to stabilize power reactor operations. This coefficient is also known as the Doppler coefficient.

Full-time Equivalent: A measurement equal to one staff person working a full-time work schedule for one year.

Fusion Reaction: A reaction in which at least one heavier, more stable nucleus is produced from two lighter, less stable nuclei. Reactions of this type are responsible for enormous release of energy, as in the energy of stars, for example.

Gamma Radiation: High-energy, short wavelength, electromagnetic radiation emitted from the nucleus. Gamma radiation frequently accompanies alpha and beta emissions and always accompanies fission. Gamma rays are very penetrating and are best stopped or shielded by dense materials, such as lead or depleted uranium. Gamma rays are similar to x-rays.

Gamma Ray: A highly penetrating type of nuclear radiation, similar to x-radiation, except that it comes from within the nucleus of an atom, and, in general, has a shorter wavelength.

Gap: The space inside a reactor fuel rod that exists between the fuel pellet and the fuel rod cladding.

Gas Centrifuge: A uranium enrichment process that uses a large number of rotating cylinders in a series. These series of centrifuge machines, called trains, are interconnected to form cascades. In this process, **Uranium Hexafluoride, (UF_6)** gas is placed in a drum or cylinder and rotated at high speed. This rotation creates a strong gravitational field so that the heavier gas molecules (containing U-238) move

toward the outside of the cylinder and the lighter gas molecules (containing U-235) collect closer to the center. The stream that is slightly enriched in U-235 is withdrawn and fed into the next higher stage, while the slightly depleted stream is recycled back into the next lower stage. Significantly more U-235 enrichment can be obtained from a single unit gas centrifuge than from a single unit gaseous diffusion barrier

Gas-Cooled Reactor: A nuclear reactor in which a gas is the coolant.

Gaseous Diffusion Plant: A facility where uranium hexafluoride gas is filtered. Uranium-235 is separated from uranium-238, increasing the percentage of uranium-235 from 1 to about 3 percent. The process requires enormous amounts of electric power.

Gases: A substance possessing perfect molecular mobility and the property of indefinite expansion, as opposed to a solid or liquid; any such fluid or mixture of fluids other than air. Normally, these formless substances completely fill the space, and take the shape of, their container.

Gas-Turbine Electric Power Plant: A plant in which the prime mover is a gas turbine. A gas turbine typically consists of an axial-flow air compressor and one or more combustion chambers which liquid or gaseous fuel is burned. The hot gases expand to drive the generator and then are used to run the compressor.

Gauge Boson: Particle mediating an interaction. By exchange of the gauge particle, the interaction between two particles is accomplished.

Geiger Counter: A **Geiger-Müller** detector and measuring instrument. A radiation detection and measuring instrument. It consists of a gas-filled tube containing electrodes, between which there is an electrical voltage, but no current, flowing. When ionizing radiation passes through the tube, a short, intense pulse of current passes from the negative electrode to the positive electrode and is measured or counted. The number of pulses per second measures the intensity of the radiation field. It was named for Hans Geiger and W. Mueller, who invented it in the 1920s. It is sometimes called simply a Geiger counter or a G-M counter and is the most commonly used portable radiation instrument.

Generation (gross): The total amount of electric energy produced by a generating station as measured at the generator terminals

Generation (net): The gross amount of electric energy produced less the electric energy consumed at a generating station for station use.

Global Warming: Global warming is the increase in global temperatures that the earth has been experiencing this century. Gases that are thought by many to contribute to global warming through the greenhouse effect include carbon dioxide, methane, nitrous oxides, chlorofluorocarbons (CFCs), and halocarbons (the replacements for CFCs). Carbon dioxide emissions are primarily caused by the use of fossil fuels for energy.

Gluon: A gauge particle mediating the color strong interaction.

Gigawatt: One billion watts.

Gigawatthour: One billion watt-hours.

Government Agency: means any executive department, commission, independent establishment, corporation, wholly or partly owned by the United States of America which is an instrumentality of the United States, or any board, bureau, division, service, office, officer, authority, administration, or other establishment in the executive branch of the Government.

Graphite: A form of carbon, similar to that used in pencils, used as a moderator in some nuclear reactors.

Gray (Gy): The international system (SI) unit of absorbed dose. One gray is equal to an absorbed dose of 1 Joule/kilogram (one gray equals 100 rads)

Greenhouse Gas: Any gas that absorbs infrared radiation in the atmosphere.

Hadron: A strongly interacting particle.

Half-life: The time in which one half of the atoms of a particular radioactive substance disintegrate into another nuclear form. Measured half-lives vary from millionths of a second to billions of years. Also called physical or radiological half-life.

Half-life, Biological: The time required for the body to eliminate one half of the material taken in by natural biological means.

Half-life, Effective: The time required for a radionuclide contained in a biological system, such as a human or an animal, to reduce its activity by one-half as a combined result of radioactive decay and biological elimination.

Half-thickness: Any given absorber that will reduce the intensity of an original beam of ionizing radiation to one-half of its initial value.

Head, Reactor Vessel: The removable top section of a reactor pressure vessel. It is bolted in place during power operation and removed during refueling to permit access of fuel handling equipment to the core.

Health Physics: The science concerned with the recognition, evaluation, and control of health and environmental hazards that may arise from the use and application of ionizing radiation.

Heap Leach: A method of extracting uranium from ore using a leaching solution. Small ore pieces are placed in a heap on an impervious material (plastic, clay, asphalt) with perforated pipes under the heap. Acidic solution is then sprayed over the ore, dissolving the uranium. The solution in the pipes is collected and transferred to an ion-exchange system for concentration of the uranium.

Heat Exchanger: Any device that transfers heat from one fluid (liquid or gas) to another fluid or to the environment.

Heat Pump: A device that extracts available heat from one area (the heat source) and transfers it to another (the heat sink) to either heat or cool an interior space. Geothermal heat pumps can operate more efficiently than the standard air-source heat pumps, because during winter the ground does not get as cold as the outside air (and during the summer, it does not heat up as much).

Heat Sink: Anything that absorbs heat. It is usually part of the environment, such as the air, a river, or a lake.

Heatup: The rise in temperature of the reactor fuel rods resulting from an increase in the rate of fission in the core.

Heavy Water (D_2O): Water containing significantly more than the natural proportions (one in 6,500) of heavy hydrogen (**deuterium, D**) atoms to ordinary hydrogen atoms. Heavy water is used as a moderator in some reactors because it slows down neutrons effectively and also has a low probability of absorption of neutrons.

Heavy Water Moderated Reactor: A reactor that uses heavy water as its moderator. Heavy water is an excellent moderator and thus permits the use of un-enriched uranium as a fuel.

High-enriched Uranium: Uranium enriched to 20 percent or greater in the isotope uranium-235.

High-level Waste: Radioactive materials at the end of a useful life cycle that should be properly disposed of, including--

1. The highly radioactive material resulting from the reprocessing of spent nuclear fuel, including liquid waste directly in reprocessing and any solid material derived from such liquid waste that contains fission products in concentrations;
2. Irradiated reactor fuel; and
3. Other highly radioactive material that the Commission, consistent with existing law, determines by rule require permanent isolation.

High-level waste (HLW) is primarily in the form of spent fuel discharged from commercial nuclear power reactors. It also includes HLW from activities and a small quantity of reprocessed commercial HLW

High Radiation Area: Any area with dose rates greater than 100 millirems (1 millisievert) in one hour 30 centimeters from the source or from any surface through which the ionizing radiation penetrates. Areas at licensee facilities must be posted as "high radiation areas" and access into these areas is maintained under strict control.

Highly Enriched Uranium: (**HEU**) fuel means fuel in which the weight percent of U-235 in the uranium is 20% or greater. Target material, special instrumentation, or experimental devices using HEU are not included.

Historical Site Assessment: means the identification of potential, likely, or known sources of radioactive material and radioactive contamination based on existing or derived information for the purpose of classifying a facility or site, or parts thereof, as impacted or non-impacted.

Homolog (or homologs): Elements in the same periodic table group that tend to exhibit similar, but not identical, chemical properties.

Hormesis: Controversial theory which argues that there is a benefit to health, or decrease in biological damage from radiation as dose in increased (valid only for very small doses).

Hot: A colloquial term meaning highly radioactive.

Hot Spot: The region in a radiation/contamination area where the level of radiation/contamination is significantly greater than in neighboring regions in the area.

Hubble Constant: Ratio of outward speed of galaxies to their distances from Earth.

Impacted Areas: mean the areas with some reasonable potential for residual radioactivity in excess of natural background or fallout levels.

Incentive Regulation: means the system of rate regulation in which a rate regulatory authority establishes rates that an electric generator may charge its customers that are based on specified performance factors, in addition to cost-of-service factors.

Independent Power Producer: A wholesale electricity producer (other than a qualifying facility under the Public Utility Regulatory Policies Act of 1978), that is unaffiliated with franchised utilities. Unlike traditional utilities, IPPs do not possess transmission facilities that are essential to their customers and do not sell power in any retail service territory where they have a franchise.

Induced Radioactivity: Radioactivity that is created by bombarding a substance with neutrons in a reactor or with charged particles produced by particle accelerators.

Infrared Radiation: Electromagnetic radiation of longer wavelength than visible light.

In Situ Leach: A process using a leaching solution to extract uranium from underground ore bodies in place (in other words, in situ). The leaching agent, which contains an oxidant such as oxygen with sodium carbonate, is injected through wells into the ore body in a confined aquifer to dissolve the uranium. This solution is then pumped via other wells to the surface for processing.

In Vitro: From the Latin for "in glass," isolated from the living organism and artificially maintained, as in a test tube.

In Vivo: From the Latin for "in one that is living," occurring within the living.

Individual Plant Examination (IPE): As requested by the NRC in Generic Letter 88-20, “Individual Plant Examination for Severe Accident Vulnerabilities” (November 23,

1988), a risk analysis that considers the unique aspects of a particular nuclear power plant, identifying the specific vulnerabilities to severe accident of that plant.

Individual Plant Examination for External Events (IPEEE): While the "individual plant examination" takes into account events that could challenge the design from things that could go awry internally (in the sense that equipment might fail because components do not work as expected), the "individual plant examination for external events" considers challenges such as earthquakes, internal fires, and high winds.

Induced Radioactivity: Radioactivity that is created when stable substances are bombarded by ionizing radiation. For example, the stable isotope cobalt-59 becomes the radioactive isotope cobalt-60 under neutron bombardment.

Integrated Plant Evaluation: An evaluation that considers the plant as a whole rather than system by system.

Iodine Spiking Factor: The magnitude of a rapid, short-term increase in the appearance rate of radioiodine in the reactor coolant system. This increase is generally caused by a reactor transient that results in a rapid drop in reactor coolant system pressure relative to the fuel rod internal pressure.

Ion: **1**. An atom that has too many or too few electrons, causing it to have an electrical charge, and therefore, be chemically active.

2. An electron that is not associated (in orbit) with a nucleus.

Ion-exchange: A common method for concentrating uranium from a solution. The uranium solution is passed through a resin bed where the uranium-carbonate complex ions are transferred to the resin by exchange with a negative ion like chloride. After build-up of the uranium complex on the resin, the uranium is eluted with a salt solution and the uranium is precipitated in another process.

Ionization: The process of adding one or more electrons to, or removing one or more electrons from, atoms or molecules, thereby creating ions. High temperatures, electrical discharges, or nuclear radiations can cause ionization.

Ionization Chamber: An instrument that detects and measures ionizing radiation by measuring the electrical current that flows when radiation ionizes gas in a chamber, making the gas a conductor of electricity.

Ionizing Radiation: Any radiation capable of displacing electrons from atoms or molecules, thereby producing ions. Some examples are alpha, beta, gamma, x-rays, neutrons, and ultraviolet light. High doses of ionizing radiation may produce severe skin or tissue damage.

.**Irradiate:** To expose to some form of radiation.

Isomer: Nuclides with the same number of neutrons and protons in different states of excitation.

Isomeric Transition: A relatively long-lived radioactive decay in which a nucleus goes from a higher to a lower energy state. The mass number and the atomic number are unchanged.

isotope: Isotopes of a given element have the same atomic number (same number of protons in their nuclei) but different mass numbers (different number of neutrons in their nuclei). ^{238}U and ^{235}U are isotopes of uranium.

Any two or more forms of an element having identical or very closely related chemical properties and the same atomic number but different atomic weights or mass numbers.

Isotope Separation: The process of separating isotopes from one another, or changing their relative abundances, as by gaseous diffusion or electromagnetic separation. Isotope separation is a step in the isotopic enrichment process.

Isotopic Enrichment: A process by which the relative abundance of the isotopes of a given element are altered, thus producing a form of the element that has been enriched in one particular isotope and depleted in its other isotopic forms.

joule (J): Unit of energy, equivalent to the work done in lifting a one-newton weight a distance of one meter.

K-capture: The capture by an atom's nucleus of an electron from the innermost electron orbital (K-shell) surrounding the nucleus.

kelvin (K): Unit of temperature equal in size to the Celsius degree, but with the zero set by the absolute zero of temperature, -273.15°C. Ice freezes at 273 K, room temperature is about 293 K, and water boils at 373 K, at sea level. human body temperature is 310 K.

keV: One thousand electron-volts.

Kerosene: A petroleum distillate that is used in space heaters, cook stoves, and water heaters; it is suitable for use as an illuminant when burned in wick lamps

Kilo: A Greek prefix meaning "thousand" in the nomenclature of the metric system. This prefix multiplies a unit by 1000.

Kilovolt: The unit of electrical potential equal to 1000 volts.

Kilowatt (kW): One thousand watts of electricity (see Watt).

Kilowatthour (kWh): One thousand watthours.

Kinetic energy: The energy that a body possesses by virtue of its mass and velocity. Also called the energy of motion.

Lens Dose Equivalent: The external exposure dose equivalent to the lens of the eye at a tissue depth of 0.3 centimeters (300 mg/cm^2).

Lepton: A particle (such as the electron or neutrino) not subject to strong interactions.

Lepton Number: Additive quantum number defining leptons; the three lepton numbers are electron number, muon number, and tau number. These numbers remain the same in all reactions.

Lifetime: The mean life of a particle or radioactive nucleus. This is equivalent to the decay time.

Linac: Another name for a linear accelerator.

Linear Accelerator: Particle accelerator laid out in a straight line.

Lethal Dose (LD): The dose of radiation expected to cause death to 50 percent of an exposed population within 30 days (LD 50/30). Typically, the LD 50/30 is in the range from 400 to 450 rem (4 to 5 sieverts) received over a very short period.

Licensed Material: Source material, special nuclear material, or byproduct material received, possessed, used, transferred or disposed of under a general or specific license issued by the NRC.

Licensing Basis: The collection of documents or technical criteria that provides the basis upon which the NRC issues a license to possess radioactive materials, conduct operations involving emission of radiation, use special nuclear materials, or dispose of radioactive waste.

Light Truck: Two-axle, four-tire trucks with a gross vehicle weight less than 10,000 pounds.

Light Water: Ordinary water as distinguished from heavy water..

Light Water Reactor: A term used to describe reactors using ordinary water as coolant, including boiling water reactors (**BWR**s) and pressurized water reactors (**PWR**s), the most common types used in the United States.

Limiting Condition for Operation: The section of Technical Specifications that identifies the lowest functional capability or performance level of equipment required for safe operation of the facility.

Limiting Safety System Settings: Settings for automatic protective devices related to those variables having significant safety functions. Where a limiting safety system setting is specified for a variable on which a safety limit has been placed, the setting will ensure that automatic protective action will correct the abnormal situation before a safety limit is exceeded.

Linear Heat Generation Rate: The heat generation rate per unit length of fuel rod, commonly expressed in kilowatts per foot (kw/ft) of fuel rod.

Liquefied Natural Gas: Natural gas (primarily methane) that has been liquefied by reducing its temperature to -260□F at atmospheric pressure.

Liquefied Petroleum Gas: Ethane, ethylene, propane, propylene, normal butane, butylene, and isobutane produced at refineries or natural gas processing plants.

Loop: In a pressurized water reactor, the coolant flow path through piping from the reactor pressure vessel to the steam generator, to the reactor coolant pump, and back to the reactor pressure vessel. Large PWRs may have as many as four separate loops.

Loss of Coolant Accident (LOCA): Those postulated accidents that result in a loss of reactor coolant at a rate in excess of the capability of the reactor makeup system from breaks in the reactor coolant pressure boundary, up to and including a break equivalent in size to the double-ended rupture of the largest pipe of the reactor coolant system.

Low enriched uranium: (**LEU**) fuel means fuel in which the weight percent of U-235 in the uranium is less than 20%.

Low Population Zone (LPZ): An area of low population density often required around a nuclear installation before it's built. The number and density of residents is of concern in emergency planning so that certain protective measures (such as notification and instructions to residents) can be accomplished in a timely manner

Low-level Waste: A general term for a wide range of wastes having low levels of radioactivity. Industries; hospitals and medical, educational, or research institutions; private or government laboratories; and nuclear fuel cycle facilities (e.g., nuclear power reactors and fuel fabrication plants) that use radioactive materials generate low-level wastes as part of their normal operations. These wastes are generated in many physical and chemical forms and levels of contamination

Low-level radioactive wastes containing source, special nuclear, or byproduct material are acceptable for disposal in a land disposal facility. For the purposes of this definition, low-level waste has the same meaning as in the Low-Level Radioactive Waste Policy Act, that is, radioactive waste not classified as high-level radioactive waste, transuranic waste, spent nuclear fuel, or byproduct material as defined in section 11e.(2) of the Atomic Energy Act (uranium or thorium tailings and waste).

Major Decommissioning Activity: means, for a nuclear power reactor facility, any activity that results in permanent removal of major radioactive components, permanently modifies the structure of the containment, or results in dismantling components for shipment containing greater than class C waste in accordance with **10-CFR § 61.55**.

Major Radioactive Components: means, for a nuclear power reactor facility, the reactor vessel and internals, steam generators, pressurizers, large bore reactor coolant system piping, and other large components that are radioactive to a comparable degree.

Mass Energy: Energy a particle has by virtue of its mass (given by **$E = MC^2$**).

Mass Number: The total number of protons and neutrons in the nucleus**: A=Z+N.** This is also the total nucleon number of the nucleus.

Mass-energy Equation: The equation developed by Albert Einstein, which is usually given as **$E = mc^2$,** showing that, when the energy of a body changes by an amount E (no matter what form the energy takes), the mass (m) of the body will change by an amount equal to E/c^2. The factor c squared, the speed of light in a vacuum (3×10^8), may be regarded as the conversion factor relating units of mass and energy. The equation predicted the possibility of releasing enormous amounts of energy by the conversion of mass to energy. It is also called the Einstein equation.

Maximum Dependable Capacity (gross): In a nuclear power reactor, dependable main-unit gross generating capacity, winter or summer, whichever is smaller. The dependable capacity varies because the unit efficiency varies during the year due to temperature variations in cooling water. It is the gross electrical output as measured at the output terminals of the turbine generator during the most restrictive seasonal conditions (usually summer).

Maximum dependable capacity (net): In a nuclear power reactor, gross maximum dependable generating capacity less the normal station service loads.

Mega: A prefix that multiplies a basic unit by 1,000,000 (10 to the sixth power).

Megacurie: One million curies.

Megawatt (MW): One million watts.

Megawatt Hour (MWh): One million watt-hours.

Methanol: A light volatile alcohol (**CH_3OH**) used for motor gasoline blending.

Metric Ton: Approximately 2200 pounds in the English system of measurements. (Note: In the international system of measurements, 1 metric ton = 1000 kg.)

Micro: A prefix that divides a unit into one million parts (0.000001).

Microcurie: One millionth of a curie. That amount of radioactive material that disintegrates (decays) at the rate of 37 thousand atoms per second.

Milli: A prefix that divides a basic unit by 1000.

Millirem: One thousandth of a rem (0.001 rem).

Milliroentgen (mR): One thousandth of a roentgen (R). $1mR = 10^{-3}$ R = 0.001 R.

Mixed Oxide (MOX) Fuel: A mixture of uranium oxide and plutonium oxide used to fuel a reactor. Mixed oxide fuel is often called "MOX."

Moderator: A material, such as ordinary water, heavy water, or graphite that is used in a reactor to slow down high-velocity neutrons thus increasing the likelihood of fission.

Moderator Temperature Coefficient of Reactivity: As the moderator (water) increases in temperature, it becomes less dense and slows down fewer neutrons, which results in a negative change of reactivity. This negative temperature coefficient acts to stabilize atomic power reactor operations.

Molecule: A group of atoms held together by chemical forces. A molecule is the smallest unit of a compound that can exist by itself and retain its chemical properties.

Monitoring of Radiation: Periodic or continuous determination of the amount of ionizing radiation or radioactive contamination present in a region, as a safety measure, for the purpose of health or environmental protection. Monitoring is done for air, surface and ground water, soil and sediment, equipment surfaces, and personnel (for example, bioassay or alpha scans).

Meson: A particle (such as the pion) made of quark-antiquark pairs.

MeV: One million electron-volts.

Microwaves: Electromagnetic radiation with wavelength intermediate between radio wave and infrared radiation.

Multiwire Proportional Counter: Particle detector using changes in the current in wires due to the passage of ionizing particles nearby.

Muon: A charged lepton about 200 times more massive than an electron.

Muon Number: Additive quantum number characterizing muons and muon neutrinos

Nano: A prefix that divides a basic unit by one billion (10^{-9}).

Nanocurie: One billionth 10^{-9} of a curie.

Natural Circulation: The circulation of the coolant in the reactor coolant system without the use of the reactor coolant pumps. The circulation is due to the natural convection resulting from the different densities of relative cold and heated portions of the system.

Natural Gas: A mixture of hydrocarbons (principally methane) and small quantities of various non-hydrocarbons existing in the gaseous phase or in solution with crude oil in underground reservoirs.

Natural Uranium: Uranium as found in nature. It contains 0.7 percent uranium-235, 99.3 percent uranium-238, and a trace of uranium-234 by weight. In terms of the amount of radioactivity, it contains approximately 2.2 percent uranium-235, 48.6 percent uranium-238, and 49.2 percent uranium-234.

Net Summer Capability: The steady hourly output that generating equipment is expected to supply to system load exclusive of auxiliary power, as demonstrated by tests at the time of summer peak demand.

Neutrino: An electrically neutral particle with negligible mass. It is produced in processes such as beta decay and reactions that involve the weak force.

Neutron: One of the basic particles that make up a nucleus. A neutron and a proton have about the same mass, but the neutron has no electrical charge.

Neutron Capture: The reaction that occurs when a nucleus captures a neutron. The probability that a given material will capture a neutron is proportional to its neutron capture cross section and depends on the energy of the neutrons and the nature of the material.

Neutron Chain Reaction: A process in which some of the neutrons released in one fission event cause other fissions to occur. There are three types of chain reactions:

1. Non-sustaining--An average of less than one fission is produced by the neutrons released by each previous fission (reactor sub-criticality);
2. Sustaining--An average of exactly one fission is produced by the neutrons released by each previous fission (reactor criticality);
3. Multiplying--An average of more than one fission is produced by the neutrons released by previous fission (reactor super-criticality).

Neutron Flux: A measure of the intensity of neutron radiation in neutrons/cm^2-sec. It is the number of neutrons passing through 1 square centimeter of a given target in 1 second. Expressed as nv, where n = the number of neutrons per cubic centimeter and v = their velocity in centimeters per second.

Neutron Generation: The release, thermalization, and absorption of fission neutrons by a fissile material and the fission of that material producing a second generation of neutrons. In a typical nuclear power reactor system, there are about 40,000 generations of neutrons every second.

Neutron Leakage: Neutrons that escape from the vicinity of the fissionable material in a reactor core. Neutrons that leak out of the fuel region are no longer available to cause fission and must be absorbed by shielding placed around the reactor pressure vessel for that purpose.

Neutron Number: The total number of neutrons in the nucleus, N.

Neutron Source: Any material that emits neutrons, such as a mixture of radium and beryllium, that can be inserted into a reactor to ensure a neutron flux large enough to be distinguished from background to register on neutron detection equipment.

Neutron, Thermal: A neutron that has (by collision with other particles) reached an energy state equal to that of its surroundings, typically on the order of 0.025 eV (electron volts).

Nuclear Binding Energy: The energy that free nucleons give up in order to be bound inside a nucleus.

Nuclear Reactor: A device in which a fission chain reaction can be initiated, maintained, and controlled. Its essential components are fissionable fuel, moderator, shielding, control rods, and coolant.

Nucleon: A constituent of the nucleus; that is, a proton or a neutron.

Nucleus: The core of the atom, where most of its mass and all of its positive charge is concentrated. Except for ^{1}H, the nucleus consists of a combination of protons and neutrons.

Nuclide: Any species of atom that exists for a measurable length of time. A nuclide can be distinguished by its atomic mass, atomic number, and energy state.

Nitrogen Oxides (NOx): A product of combustion of fossil fuels whose production increases with the temperature of the process. It can become an air pollutant if concentrations are excessive.

Noble Gas: A gaseous chemical element that does not readily enter into chemical combination with other elements. An inert gas. Examples are helium, argon, krypton, xenon, and radon.

Non-Bypassable Charges: mean those charges imposed over an established time period by a Government authority that affected persons or entities are required to pay to cover costs associated with the decommissioning of a nuclear power plant. Such charges include, but are not limited to, wire charges, stranded cost charges, transition charges, exit fees, other similar charges, or the securitized proceeds of a revenue stream.

Non-impacted Areas: mean the areas with no reasonable potential for residual radioactivity in excess of natural background or fallout levels.

Non-power Reactor: means a research or test reactor licensed under **10-CFR §§ 50.21(c)** or **50.22** of this part for research and development.

Non-stochastic Effect: The health effects of radiation, the severity of which vary with the dose and for which a threshold is believed to exist. Radiation-induced cataract formation is an example of a non-stochastic effect (also called a deterministic effect)

Non-vital Plant Systems: Systems at a nuclear facility that may or may not be necessary for the operation of the facility (i.e., power production) but that would have little or no effect on public health and safety should they fail. These systems are not safety related.

Non-power Reactor: Reactors used for research, training, and test purposes, and for the production of radioisotopes for medical and industrial uses.

Notification: means the telephonic communication to the NRC Operations Center or written transmittal of information to the NRC Document Control Desk.

Not Applicable (NA): Specifies that a particular field is not applicable to the event.

Not Reported (NR): Specifies that information applicable to the particular field was not included in the event report.

Nozzle: As used in power water reactors and boiling water reactors, the interface (inlet and outlet) between reactor plant components (pressure vessel, coolant pumps, steam generators, etc.) and their associated piping systems.

NRC Operations Center: Rockville, Maryland, serves as the focal coordination point for communicating with NRC licensees, State agencies, and other Federal agencies about operating events in both the nuclear reactor and nuclear material industry. The Operations Center is staffed 24 hours a day by an NRC Headquarters Operations Officer (HOO), who is trained to receive, evaluate, and respond to events reported to the Operations Center.

Nuclear Electric Power: Electricity generated by an electric power plant whose turbines are driven by steam generated in a reactor by heat from the fissioning of nuclear fuel.

Nuclear Energy: The energy liberated by a nuclear reaction (fission or fusion) or by radioactive decay.

Nuclear Force: A powerful short-ranged attractive force that holds together the particles inside an atomic nucleus.

Nuclear Power Plant: An electrical generating facility using a nuclear reactor as its heat source to provide steam to a turbine generator.

Nuclear Reactor: means an apparatus, other than an atomic weapon, designed or used to sustain nuclear fission in a self-supporting chain reaction.

Nuclear Steam Supply System (NSSS): The reactor and the reactor coolant pumps (and steam generators for a pressurized water reactor) and associated piping in a nuclear power plant used to generate the steam needed to drive the turbine generator unit.

Nuclear Waste: A particular type of radioactive waste that is produced as part of the nuclear fuel cycle (i.e., those activities needed to produce nuclear fission, or splitting of the atom). These include extraction of uranium from ore, concentration of uranium, processing into nuclear fuel, and disposal of byproducts. Radioactive waste is a broader term that includes all waste that contains radioactivity. Residues from water treatment, contaminated equipment from oil drilling, and tailings from the processing of metals such as vanadium and copper also contain radioactivity but are not "nuclear waste" because they are produced outside of the nuclear fuel cycle. NRC generally regulates only those wastes produced in the nuclear fuel cycle (uranium mill tailings, depleted uranium, spent fuel rods, etc.).

Nucleon: Common name for a constituent particle of the atomic nucleus. At present, applied to protons and neutrons

Nucleus: The small, central, positively charged region of an atom. Except for the nucleus of ordinary hydrogen, which has only a proton, all atomic nuclei contain both protons and neutrons. The number of protons determines the total positive charge or atomic number. This number is the same for all the atomic nuclei of a given chemical element. The total number of neutrons and protons is called the mass number.

Nuclide: A general term referring to all known isotopes, both stable (279) and unstable (about 2,700), of the chemical elements.

Occupational Dose: The dose received by an individual in the course of employment in which the individual's assigned duties involve exposure to radiation or to radioactive material from licensed and unlicensed sources of radiation, whether in the possession of the licensee or other person. Occupational dose does not include dose received from background radiation, from any medical administration the individual has received, from exposure to individuals administered radioactive materials and released in accordance with NRC regulations, from voluntary participation in medical research programs, or as a member of the general public.

Operable: A system, subsystem, train, component, or device is operable or has operability when it is capable of performing its specified functions and when all necessary attendant instrumentation, controls, electrical power, cooling or seal water, lubrication, or other auxiliary equipment that are required for the system, subsystem, train, component, or device to perform its functions are also capable of performing their related support functions.

Operational mode: In a nuclear power reactor, an operational mode corresponds to any one inclusive combination of core reactivity condition, power level, and average reactor coolant temperature.

Orphan Source: See unwanted radioactive material

Oxygenates: Any substance which, when added to motor gasoline, increases the amount of oxygen in that motor gasoline blend.

Ozone: Three-atom oxygen compound (03) found in two layers of the Earth's atmosphere. One layer of beneficial ozone occurs at 7 to 18 miles above the surface and shields the Earth from ultraviolet light.

Several holes in this protective layer have been documented by scientists. Ozone also concentrates at the surface as a result of reactions between byproducts of fossil fuel combustion and sunlight, having harmful health effects.

Parent: A radionuclide that decays to another nuclide.

A radionuclide that upon radioactive decay or disintegration yields a specific nuclide (the daughter).

Particulates: Visible air pollutants consisting of particles appearing in smoke or mist.

Parts Per Million (ppm): Parts (molecules) of a substance contained in a million parts of another substance (e.g., water).

Pellet, Fuel: As used in pressurized water reactors and boiling water reactors, a pellet is a small cylinder approximately 3/8-inch in diameter and 5/8-inch in length, consisting of uranium fuel in a ceramic form--uranium dioxide, UO_2. Typical fuel pellet enrichments in nuclear power reactors range from 2.0 percent to 3.5 percent uranium-235.

Performance-based Regulation: Required results or outcome of performance rather than a prescriptive process, technique, or procedure.

Performance-based Regulatory Action: Licensee attainment of defined objectives and results without detailed direction from the NRC on how these results are to be obtained. (See the Communication Plan for Performance-Based Regulation by using accession number ML021120533 in ADAMS.)

Periodic Table: An arrangement of chemical elements in order of increasing atomic number. Elements of similar properties are placed one under the other, yielding groups or families of elements. Within each group, there is a variation of chemical and physical properties, but in general, there is a similarity of chemical behavior within each group.

Permanent Cessation of Operations: means, for a nuclear power reactor facility, a certification by a licensee to the NRC that it has permanently ceased or will permanently cease reactor operation(s), or a final legally effective order to permanently cease operation(s) has come into effect.

Permanent Fuel Removal: means, for a nuclear power reactor facility, a certification by the licensee to the NRC that it has permanently removed all fuel assemblies from the reactor vessel.

Person: means (1) any individual, corporation, partnership, firm, association, trust, estate, public or private institution, group, government agency other than the Commission or the Department, except that the Department shall be considered a person to the extent that its facilities are subject to the licensing and related regulatory authority of the Commission pursuant to section 202 of the Energy Reorganization Act of 1974, any State or any political subdivision of, or any political entity within a State, any foreign government or nation or any political subdivision of any such government or nation, or other entity; and (2) any legal successor, representative, agent, or agency of the foregoing.

Personnel Monitoring: The use of portable survey meters to determine the amount of radioactive contamination on individuals, or the use of dosimetry to determine an individual's occupational radiation dose.

Petroleum: A generic term applied to oil and oil products in all forms.

Photon: A quantum (or packet) of energy emitted in the form of electromagnetic radiation. Photons have momentum and energy, but no rest mass or electrical charge. Gamma rays and x-rays are examples of photons.

Photomultiplier: Commonly used device for detecting photons by converting them to an electrical signal.

Photovoltaic Cell: An electronic device consisting of layers of semiconductor materials fabricated to convert incident light directly into electricity (direct current).

Photovoltaic Module: An integrated assembly of interconnected photovoltaic cells designed to deliver a selected level of working voltage and suited for incorporation in photovoltaic power systems.

Pico: A prefix that divides a basic unit by one trillion (10^{-12}).

Picocurie: One trillionth (10^{-12}) of a curie.

Pig: A colloquial term describing a container (usually lead or depleted uranium) used to ship or store radioactive materials. The thick walls of this shielding device protect the person handling the container from radiation. Large containers used for spent fuel storage are commonly called casks.

Pile: A colloquial term describing the first nuclear reactors. They are called piles because the earliest reactors were "piles" of graphite and uranium blocks.

Pion: The least massive known spin-0 meson. The three charge states of the pion (negative, neutral and positive) are involved in the long-range force between the nucleons.

Planned Special Exposure: An infrequent exposure to radiation, separate from and in addition to the annual dose limits

Plausible Accidents: Postulated events that meet a probability test rather than the more challenging test represented by a design-basis event.

Plutonium (Pu): A heavy, radioactive, manmade metallic element with atomic number 94. Its most important isotope is fissile plutonium-239, which is produced by neutron irradiation of uranium-238. It exists in only trace amounts in nature.

Pocket Dosimeter: A small ionization detection instrument that indicates ionizing radiation exposure directly. An auxiliary charging device is usually necessary.

Poison, Neutron: In reactor physics, a material other than fissionable material in the vicinity of the reactor core that will absorb neutrons. The addition of poisons, such as control rods or boron, into the reactor is said to be an addition of negative reactivity.

Pool Reactor: A reactor in which the fuel elements are suspended in a pool of water that serves as the reflector, moderator, and coolant. Popularly called a "swimming pool reactor," it is used for research and training, not for electrical generation.

Positron: Particle equal in mass but opposite in charge to the electron. A positive electron.

Possession-only License: A form of license that allows possession but not operation.

Power Coefficient of Reactivity: The change in reactivity per percent change in power. The power coefficient is the summation of the moderator temperature coefficient of reactivity, the fuel temperature coefficient of reactivity, and the void coefficient of reactivity.

Power Defect: The total amount of reactivity added due to a given change in power. It can also be expressed as the integrated power coefficient over the range of the power change.

Power Reactor: A reactor designed to produce heat for electric generation (as distinguished from reactors used for research), for producing radiation or fissionable materials or for reactor component testing.

Preliminary Notification (PN): A brief summary report issued by the NRC staff to notify the Commission of the occurrence of a significant event that appears to have health and safety significance or major public or media interest. PNs are based on information provided by State radiation control program staff.

Pressure Vessel: A strong-walled container housing the core of most types of power reactors. It usually also contains the moderator, neutron reflector, thermal shield, and control rods.

Pressurized Water Reactor (PWR): A power reactor in which heat is transferred from the core to an exchanger by high temperature water kept under high pressure in the primary system. Steam is generated in a secondary circuit. Many reactors producing electric power are pressurized water reactors.

Pressurizer: A tank or vessel that acts as a head tank (or surge volume) to control the pressure in a pressurized water reactor.

Price-cap Regulation: means the system of rate regulation in which a rate regulatory authority establishes rates that an electric generator may charge its customers that are based on a specified maximum price of electricity.

Primary System: A term that may be used for referring to the reactor coolant system.

Probabilistic Risk Analysis: A systematic method for addressing the risk triplet as it relates to the performance of a complex system to understand likely outcomes, sensitivities, areas of importance, system interactions, and areas of uncertainty. The risk triplet is the set of three questions that the NRC uses to define “risk”:

1. What can go wrong?
2. How likely is it?
3. What are the consequences?

Procurement Document: means, for the purposes of § 50.55(e) of this chapter, a contract that defines the requirements which facilities or basic components must meet in order to be considered acceptable by the purchaser.

Produce: when used in relation to special nuclear material, means

1. To manufacture, make, produce, or refine special nuclear material
2. To separate special nuclear material from other substances in which such material may be contained; or
3. To make or to produce new special nuclear material.

Production Expense: Production expenses are a component of generation expenses that includes costs associated with operation, maintenance, and fuel.

Production facility: means:

1. Any nuclear reactor designed or used primarily for the formation of plutonium or uranium-233;
2. Any facility designed or used for the separation of the isotopes of plutonium, except laboratory scale facilities designed or used for experimental or analytical purposes only;
3. Any facility designed or used for the processing of irradiated materials containing special nuclear material, except
   - **A.** laboratory scale facilities designed or used for experimental or analytical purposes,
   - **B.** Facilities in which the only special nuclear materials contained in the irradiated material to be processed are uranium enriched in the isotope U-235 and plutonium produced by the irradiation, if the material processed contains not more than 106 grams of plutonium per gram of U-235 and has fission product activity not in excess of 0.25 millicuries of fission products per gram of U-235,
   - **C.** Facilities in which processing is conducted pursuant to a license issued under parts 30 and 70 of **10-CFR 50.55(e)**, or equivalent regulations of an Agreement State, for the receipt, possession, use, and transfer of irradiated special nuclear material, which authorizes the processing of the irradiated material on a batch basis for the separation of selected fission products and limits the process batch to not more than 100 grams of uranium enriched in the isotope 235 and not more than 15 grams of any other special nuclear material.

Proportional Counter: A radiation instrument in which an electronic detection system receives pulses that are proportional to the number of ions formed in a gas-filled tube by ionizing radiation.

Proprietary Information: Privately owned knowledge or data, such as that protected by a registered patent, copyright, or trademark.

Proton: One of the basic particles that makes up an atom. The proton is found in the nucleus and has a positive electrical charge equal to the negative charge of an electron and a mass similar to that of a neutron**:** a hydrogen nucleus.

Proton Number: The total number of protons in the nucleus, Z.

Primary Energy: The energy that is embodied in resources as they exist in nature (e.g., coal, crude oil, natural gas, or sunlight). For the most part, primary energy is transformed into electricity or fuels such as gasoline or charcoal. These, in turn, are referred to as secondary or site energy.

Propane: A normally gaseous straight-chain hydrocarbon (C3H8). It is a colorless paraffinic gas that is extracted from natural gas or refinery gas streams.

Public Dose: The dose received by a member of the public from exposure to radiation or to radioactive material released by a licensee, or to any other source of radiation under the control of a licensee. Public dose does not include occupational dose or doses received from background radiation, from any medical administration the individual has received, from exposure to individuals administered radioactive materials and released in accordance with 10 CFR 35.75, or from voluntary participation in medical research programs.

Quadrillion Btu (Quad): Equivalent to 10 to the 15th power Btu (1 quad = 1.055 x 10e18 joules).

Quality Factor: The factor by which the absorbed dose (rad or gray) is to be multiplied to obtain a quantity that expresses, on a common scale for all ionizing radiation, the biological damage (rem or sievert) to an exposed individual. It is used because some types of radiation, such as alpha particles, are more biologically damaging internally than other types.

Quantum Theory: The concept that energy is radiated intermittently in units of definite magnitude, called quanta, and absorbed in a like manner.

QCD: Quantum chromodynamics, the gauge theory describing the color strong interaction.

QED: Quantum electrodynamics, the gauge theory describing electromagnetism.

Quark: A strongly-interacting fermion that is a building block of hadronic matter. Quarks come in six flavors: up, down, charm, strange, top, bottom.

Rad (Radiation Absorbed Dose): The special unit for radiation absorbed dose, which is the amount of energy from any type of ionizing radiation (e.g., alpha, beta, gamma, neutrons, etc.) deposited in any medium (e.g., water, tissue, air). A dose of one rad means the absorption of 100 ergs (a small but measurable amount of energy) per gram of absorbing tissue (100 rad = 1 gray).

Radiation Area: Any area with radiation levels greater than 5 millirems (0.05 millisievert) in one hour at 30 centimeters from the source or from any surface through which the radiation penetrates.

Radiation Detection Instrument: A device that detects and displays the characteristics of ionizing radiation.

Radiation (Ionizing Radiation): Alpha particles, beta particles, gamma rays, x-rays, neutrons, high-speed electrons, high-speed protons, and other particles capable of producing ions. Radiation, as used in 10 CFR Part 20, does not include non-ionizing radiation, such as radio- or microwaves, or visible, infrared, or ultraviolet light (see also 10 CFR 20.1003).

Radiation, Nuclear: Particles (alpha, beta, neutrons) or photons (gamma) emitted from the nucleus of unstable radioactive atoms as a result of radioactive decay.

Radiation Shielding: Reduction of radiation by interposing a shield of absorbing material between any radioactive source and a person, work area, or radiation-sensitive device.

Radiation Sickness (Syndrome): The complex of symptoms characterizing the disease known as radiation injury, resulting from excessive exposure (greater than 200 rads or 2 gray) of the whole body (or large part) to ionizing radiation. The earliest of these symptoms are nausea, fatigue, vomiting, and diarrhea, which may be followed by loss of hair (epilation), hemorrhage, inflammation of the mouth and throat, and general loss of energy. In severe cases, where the radiation exposure has been approximately 1000 rad (10 gray) or more, death may occur within two to four weeks. Those who survive six weeks after the receipt of a single large dose of radiation to the whole body may generally be expected to recover.

Radiation Source: Usually a sealed source of radiation used in tele-therapy and industrial radiography, as a power source for batteries (as in use in space craft), or in various types of industrial gauges. Machines, such as accelerators and radioisotope generators, and natural radio-nuclides may be considered sources.

Radiation Standards: Exposure standards, permissible concentrations, rules for safe handling, regulations for transportation, regulations for industrial control of radiation, and control of radioactive material by legislative means.

Radiation Warning Symbol: An officially prescribed symbol (a magenta or black trefoil) on a yellow background that must be displayed where certain quantities of radioactive materials are present or where certain doses of radiation could be received.

Radiative capture: In radiative capture the incident neutron enters the target nucleus forming a compound nucleus. The compound nucleus then decays to its ground state by gamma emission.

Radioactive Contamination: Deposition of radioactive material in any place where it may harm persons or equipment.

Radioactive Dating: A technique for estimating the age of an object by measuring the amounts of various radioisotopes in it.

Radioactive Decay: Large unstable atoms can become more stable by emitting radiation. This process is called radioactive decay. This radiation can be emitted in the form of a positively charged alpha particle, a negatively charged beta particle, or gamma rays or x-rays.

Radioactive Series: A succession of nuclides, each of which transforms by radioactive disintegration into the next until a stable nuclide results. The first member is called the parent, the intermediate members are called daughters, and the final stable member is called the end product.

Radioactive Waste: Materials that are radioactive and for which there is no further use.

Radioactivity: The spontaneous emission of radiation, generally alpha or beta particles, often accompanied by gamma rays, from the nucleus of an unstable isotope. Also, the rate at which radioactive material emits radiation. Measured in units of becquerels or disintegrations per second.

Radiography: The making of a shadow image on photographic film by the action of ionizing radiation.

Radioisotope: An unstable isotope of an element that decays or disintegrates spontaneously, emitting radiation. Approximately 5,000 natural and artificial radioisotopes have been identified.

Radiological Sabotage: Any deliberate act directed against a plant or transport in which an activity licensed pursuant to 10 CFR Part 73 of NRC's regulations is conducted or against a component of such a plant or transport that could directly or indirectly endanger the public health and safety by exposure to radiation.

Radiological Survey: The evaluation of the radiation hazards accompanying the production, use, or existence of radioactive materials under a specific set of conditions. Such evaluation customarily includes a physical survey of the disposition of materials and equipment, measurements or estimates of the levels of radiation that may be involved, and a sufficient knowledge of processes affecting these materials to predict hazards resulting from expected or possible changes in materials or equipment.

Radiology: That branch of medicine dealing with the diagnostic and therapeutic applications of radiant energy, including x-rays and radioisotopes

Radionuclide: A radioactive nuclide. An unstable isotope of an element that decays or disintegrates spontaneously, emitting radiation.

Radiosensitivity: The relative susceptibility of cells, tissues, organs, organisms, or other substances to the injurious action of radiation.

Radium (Ra): A radioactive metallic element with atomic number 88. As found in nature, the most common isotope has a mass number of 226. It occurs in minute quantities associated with uranium in pitchblende, camotite, and other minerals.

Radon (Rn): A radioactive element that is one of the heaviest gases known. Its atomic number is 86. It is a daughter of radium.

Reaction: Any process involving a chemical or nuclear change.

Reactivity: A term expressing the departure of a reactor system from criticality. A positive reactivity addition indicates a move toward supercriticality (power increase). A negative reactivity addition indicates a move toward subcriticality (power decrease).

Reactor Coolant Pressure Boundary: means all those pressure-containing components of boiling and pressurized water-cooled nuclear power reactors, such as pressure vessels, piping, pumps, and valves, which are:

1. Part of the reactor coolant system, or
2. Connected to the reactor coolant system, up to and including any and all of the following:
   - **A.** The outermost containment isolation valve in system piping which penetrates primary reactor containment,
   - **B.** The second of two valves normally closed during normal reactor operation in system piping which does not penetrate primary reactor containment,
   - **C.** The reactor coolant system safety and relief valves.

For nuclear power reactors of the direct cycle boiling water type, the reactor coolant system extends to and includes the outermost containment isolation valve in the main steam and feedwater piping.

Reactor Coolant System: The system used to remove energy from the reactor core and transfer that energy either directly or indirectly to the steam turbine.

Reactor, Nuclear: A device in which nuclear fission may be sustained and controlled in a self-supporting nuclear reaction. The varieties are many, but all incorporate certain features, including fissionable material or fuel, a moderating material (unless the reactor is operated on fast neutrons), a reflector to conserve escaping neutrons, provisions of removal of heat, measuring and controlling instruments, and protective devices. The reactor is the heart of a nuclear power plant.

Reasonable: Rational, sensible, or resulting from sound judgment.

Reference Man: A person with the anatomical and physiological characteristics of an average individual that is used in calculations assessing internal dose.

Reflector: A layer of material immediately surrounding a reactor core that scatters back (or reflects) into the core many neutrons that would otherwise escape. The returned neutrons can then cause more fissions and improve the neutron economy of the reactor. Also called moderator.

Rem (Roentgen Equivalent Man): The acronym for roentgen equivalent man is a standard unit that measures the effects of ionizing radiation on humans. The dose equivalent in rems is equal to the absorbed dose in rads multiplied by the quality factor of the type of radiation (see 10 CFR 20.1004).

Research and Development: means (1) theoretical analysis, exploration, or experimentation; or (2) the extension of investigative findings and theories of a scientific or technical nature into practical application.

Responsible Officer: means, for the purposes of § 50.55(e) of this chapter, the president, vice-president, or other individual in the organization of a corporation, partnership, or other entity who is vested with executive authority over activities subject to this part.

Restricted Data: means all data concerning (1) design, manufacture, or utilization of atomic weapons; (2) the production of special nuclear material; or (3) the use of special nuclear material in the production of energy, but shall not include data declassified or removed from the Restricted Data category.

Restricted Area: Any area to which access is controlled for the protection of individuals from exposure to radiation and radioactive materials.

Risk: The combined answers to

1. What can go wrong?
2. How likely is it?
3. What are the consequences?

Risk-based Decision Making: An approach to regulatory decision making in which such decisions are made solely based on the results of a probabilistic risk analysis.

Risk-informed Decision Making: An approach to decision making in which insights from probabilistic risk analyses are considered with other engineering insights.

Risk-informed Regulation: Incorporating an assessment of safety significance or relative risk in NRC regulatory actions. Making sure that the regulatory burden imposed by individual regulations or processes is commensurate with the importance of that regulation or process to protecting public health and safety and the environment.

Risk-significant: When used to qualify an object, such as a system, structure, component, accident sequence, or cut set, this term identifies that object as exceeding a predetermined criterion related to its contribution to the risk from the facility being addressed.

Roentgen (R): A unit of exposure to ionizing radiation. It is the amount of gamma or x-rays required to produce ions resulting in a charge of 0.000258 coulombs/kilogram of air under standard conditions. Named after Wilhelm Roentgen, the German scientist who discovered x-rays in 1895.

Rubblization: A decommissioning technique involving demolition and burial of formerly operating nuclear facilities. All equipment from buildings is removed and the surfaces are decontaminated. Above-grade structures are demolished into rubble and buried in the structure's foundation below ground. The site surface is then covered, regraded and, landscaped for unrestricted use.

rem (röntgen equivalent, man): A measure of dose deposited in body tissue, averaged over the body. One rem is approximately the dose from any radiation corresponding to exposure to one röntgen of g radiation. The rem is no longer accepted for use with the International System. One rem is equivalent to 0.01 sievert.

Renewable Energy: Energy obtained from sources that are essentially inexhaustible (unlike, for example, the fossil fuels, of which there is a finite supply). Renewable sources of energy include conventional hydroelectric power, wood, waste, geothermal, wind, photovoltaic, and solar thermal energy.

Residual Strong Force: Force between composite objects (made of quarks) due to the remaining effect of the color force on colorless objects. These forces are much weaker than the strong color force.

Röntgen or **roentgen (R):** Unit of exposure measuring the ionizing ability of g radiation; one röntgen produces one electric charge (1.6×10^{-19} C) per 10^6 m^3 of dry air at 0° C and atmospheric pressure. This corresponds to an energy loss of 0.0877 joule per kilogram in air. The röntgen is no longer accepted for use with the International System.

Safe Shutdown Earthquake: Is the maximum earthquake potential for which certain structures, systems, and components, important to safety, are designed to sustain and remain functional.

Safeguards: As used in regulation of domestic nuclear facilities and materials, the use of material control and accounting programs verify that all special nuclear material is properly controlled and accounted for, and the physical protection (also referred to as physical security) equipment and security forces. As used by the International Atomic Energy Agency (IAEA), verifying that the "peaceful use" commitments made in binding non-proliferation agreements, both bilateral and multilateral, are honored.

Safety Injection: The rapid insertion of a chemically soluble neutron poison (such as boric acid) into the reactor coolant system to ensure reactor shutdown.

Safety Limit: A restriction or range placed upon important process variables that are necessary to reasonably protect the integrity of the physical barriers that guard against the uncontrolled release of radioactivity.

Safety Related: In the regulatory arena, this term applies to systems, structures, components, procedures, and controls of a facility or process that are relied upon to remain functional during and following design-basis events. Their functionality ensures that key regulatory criteria, such as levels of radioactivity released, are met. Examples of safety related functions include shutting down a nuclear reactor and maintaining it in a safe shutdown condition.

Safety-Related Structures: systems and components means those structures, systems and components that are relied upon to remain functional during and following design basis events to assure:

1. The integrity of the reactor coolant pressure boundary
2. The capability to shut down the reactor and maintain it in a safe shutdown condition
3. The capability to prevent or mitigate the consequences of accidents which could result in potential offsite exposures comparable to the applicable guideline exposures set forth in § 50.34(a)(1) or § 100.11 of this chapter, as applicable.

Safe Shutdown: (non-design basis accident (non-DBA)) for station blackout means bringing the plant to those shutdown conditions specified in plant technical specifications as Hot Standby or Hot Shutdown, as appropriate.

Safety-significant: When used to qualify an object, such as a system, structure, component, accident sequence, or cut set, this term identifies that object as having an impact on safety, whether determined through risk analysis or other means, that exceeds a predetermined significance criterion.

SAFSTOR: A method of decommissioning in which the nuclear facility is placed and maintained in such condition that the nuclear facility can be safely stored and subsequently decontaminated to levels that permit release for unrestricted use.

Scattered Radiation: Radiation that, during its passage through a substance, has been changed in direction. It may also have been modified by a decrease in energy. It is one form of secondary radiation.

Scintillation Detector: The combination of phosphor, photomultiplier tube, and associated electronic circuits for counting light emissions produced in the phosphor by ionizing radiation.

Scram: The sudden shutting down of a nuclear reactor, usually by rapid insertion of control rods, either automatically or manually by the reactor operator. May also be called a reactor trip. It is actually an acronym for "safety control rod axe man," the worker assigned to insert the emergency rod on the first reactor (the Chicago Pile) in the U.S.

Sealed Source: Any radioactive material or byproduct encased in a capsule designed to prevent leakage or escape of the material.

Secondary Radiation: Radiation originating as the result of absorption of other radiation in matter. It may be either electromagnetic or particulate in nature.

Secondary System: The steam generator tubes, steam turbine, condenser, and associated pipes, pumps, and heaters used to convert the heat energy of the reactor coolant system into mechanical energy for electrical generation. Most commonly used in reference to pressurized water reactors.

Seismic category I: Structures, systems, and components that are designed and built to withstand the maximum potential earthquake stresses for the particular region where a nuclear plant is sited.

Severe Accident: A type of accident that may challenge safety systems at a level much higher than expected.

Shallow-Dose Equivalent (SDE): The external exposure dose equivalent to the skin or an extremity at a tissue depth of 0.007 centimeters (7 mg/cm^2) averaged over an area of 1 square centimeter.

Shielding: Any material or obstruction that absorbs radiation and thus tends to protect personnel or materials from the effects of ionizing radiation.

Shutdown: A decrease in the rate of fission (and heat production) in a reactor (usually by the insertion of control rods into the core).

Shutdown Margin: The instantaneous amount of reactivity by which the reactor is sub-critical or would be sub-critical from its present condition assuming all full-length rod cluster assemblies (shutdown and control) are fully inserted except for the single rod cluster assembly of highest reactivity worth that is assumed to be fully withdrawn.

Source Material: means source material as defined in subsection 11z. of the Act and in the regulations contained in part 40 of this chapter.

Source Term: refers to the magnitude and mix of the radio-nuclides released from the fuel, expressed as fractions of the fission product inventory in the fuel, as well as their physical and chemical form, and the timing of their release.

Special Nuclear Material: means (1) plutonium, uranium-233, uranium enriched in the isotope-233 or in the isotope-235, and any other material which the Commission, pursuant to the provisions of section 51 of the act, determines to be special nuclear material, but does not include source material; or (2) any material artificially enriched by any of the foregoing, but does not include source material.

Standard Industrial Classification (SIC): A set of codes developed by the Office of Management and Budget which categorizes industries according to groups with similar economic activities.

Scaler: An electronic instrument for counting radiation induced pulses from radiation detectors such as a Geiger-Müller tube.

scintillation Counter: An instrument that detects and measures gamma radiation by counting the light flashes (scintillations) induced by the radiation.

Scintillator: Material that emits light when particles traverse it.

Secular Equilibrium: A state of parent-daughter equilibrium that is achieved when the half-life of the parent is much longer than the half-life of the daughter. In this case, if the two are not separated, the daughter will eventually decay at the same rate at which it is being produced. At this point, both parent and daughter will decay at the same rate until the parent is essentially exhausted.

Shielding: A protective barrier, usually a dense material, that reduces the passage of radiation from radioactive materials to the surroundings by absorbing it.

Sievert (Sv): A measure of dose (technically, dose equivalent) deposited in body tissue, averaged over the body. Such a dose would be caused by an exposure imparted by ionizing x-ray or gamma radiation undergoing an energy loss of 1 joule per kilogram of body tissue (l gray). One sievert is equivalent to 100 rem.

Somatic Effects of Radiation: Effects of radiation limited to the exposed individual, as distinguished from genetic effects, that may also affect subsequent unexposed generations.

Source Material: Uranium or thorium, or any combination thereof, in any physical or chemical form or ores that contain by weight 1/20 of one percent (0.05 percent) or more of:

1. uranium,
2. thorium,
3. any combination thereof.

Source material does not include special nuclear material.

Special Nuclear Material: Plutonium, uranium-233, or uranium enriched in the isotopes uranium-233 or uranium-235.

Spent (depleted) Fuel: Nuclear reactor fuel that has been used to the extent that it can no longer effectively sustain a chain reaction.

Spent Fuel Pool: An underwater storage and cooling facility for spent (used) fuel elements that have been removed from a reactor.

Spent Nuclear Fuel: Fuel that has been removed from a nuclear reactor because it can no longer sustain power production for economic or other reasons.

Stable Isotope: An isotope that does not undergo radioactive decay.

Standard Review Plan: A document that provides guidance to the staff for reviewing an application to obtain an NRC license to construct or operate a nuclear facility or to possess or use nuclear materials.

Standard Technical Specifications: NRC staff guidance on model technical specifications for an operating license. (See also Technical Specifications.)

Startup: An increase in the rate of fission (and heat production) in a reactor (usually by the removal of control rods from the core).

Station blackout: means the complete loss of alternating current (ac) electric power to the essential and nonessential switchgear buses in a nuclear power plant (i.e., loss of offsite electric power system concurrent with turbine trip and unavailability of the onsite emergency ac power system). Station blackout does not include the loss of available ac power to buses fed by station batteries through inverters or by alternate ac sources as defined in this section, nor does it assume a concurrent single failure or design basis accident. At single unit sites, any emergency ac power source(s) in excess of the number required to meet minimum redundancy requirements (i.e., single failure) for safe shutdown (non-DBA) is assumed to be available and may be designated as an alternate power source(s) provided the applicable requirements are met. At multi-unit sites, where the combination of emergency ac power sources exceeds the minimum redundancy requirements for safe shutdown (non-DBA) of all units, the remaining emergency ac power sources may be used as alternate ac power sources provided they meet the applicable requirements. If these criteria are not met, station blackout must be assumed on all the units.

Stay Time: The period during which personnel may remain in a restricted area in a reactor before accumulating some permissible occupational dose.

Steam Generator: The heat exchanger used in some reactor designs to transfer heat from the primary (reactor coolant) system to the secondary (steam) system. This design permits heat exchange with little or no contamination of the secondary system equipment.

Stochastic Effects: Effects that occur by chance, generally occurring without a threshold level of dose, whose probability is proportional to the dose and whose severity is independent of the dose. In the context of radiation protection, the main stochastic effects are cancer and genetic effects.

Source: A radioactive material that produces radiation for experimental or industrial use.

Stable: Non-radioactive.

Standard Model: Gauge theory encompassing the electroweak and strong interactions.

Strong Interaction: The interaction due to exchange of color. Also called strong force.

Sub-critical Mass: An amount of fissionable material insufficient in quantity or of improper geometrical configuration to sustain a fission chain reaction.

Sub-criticality: The condition of a nuclear reactor system when the rate of production of fission neutrons is lower than the rate of production in the previous generation owing to increased neutron leakage and poisons.

Substantial Safety Hazard: means, for the purposes of § 50.55(e) of this chapter, a loss of safety function to the extent that there is a major reduction in the degree of protection provided to public health and safety for any facility or activity authorized by the construction permit issued under this part.

Supercritical Reactor: A reactor in which the power level is increasing with time.

Supercriticality: The condition for increasing the level of operation of a reactor. The rate of fission neutron production exceeds all neutron losses, and the overall neutron population increases.

Superheating: The heating of a vapor, particularly steam, to a temperature much higher than the boiling point at the existing pressure. This is done in some power plants to improve efficiency and to reduce water damage to the turbine.

Survey Meter: Any portable radiation detection instrument especially adapted for inspecting an area or individual to establish the existence and amount of radioactive material present.

Symmetry: Invariance of equations of motion under changes in condition.

Tailings: Naturally radioactive residue from the processing of uranium ore into yellowcake in a mill. Although the milling process recovers about 93 percent of the uranium, the residues, or tailings, contain several naturally-occurring radioactive elements, including uranium, thorium, radium, polonium, and radon.

Testing Facility: A nuclear reactor of a type described in **10-CFR-50.21(c)** of this part and for which an application has been filed for a license authorizing operation at:

1. A thermal power level in excess of 10 megawatts

2. A thermal power level in excess of 1 megawatt, if the reactor is to contain:

A. A circulating loop through the core in which the applicant proposes to conduct fuel experiments

B. A liquid fuel loading

C. An experimental facility in the core in excess of 16 square inches in cross-section.

Thermal Energy: Random kinetic energy possessed by objects in a material at finite temperature.

Tracer: A small amount of radioactive isotope introduced into a system in order to follow the behavior of some component of that system.

Transmutation: The transformation of one element into another by a nuclear reaction.

Technical Specifications: Part of an NRC license authorizing the operation of a nuclear production or utilization facility. A Technical Specification establishes requirements for items such as safety limits, limiting safety system settings, limiting

control settings, limiting conditions for operation, surveillance requirements, design features, and administrative controls. (See also Standard Technical Specifications.)

Terrestrial Radiation: The portion of the natural background radiation that is emitted by naturally occurring radioactive materials, such as uranium, thorium, and radon in the earth.

Thermal Breeder Reactor: A breeder reactor in which the fission chain reaction is sustained by thermal neutrons.

Thermal power: The total core heat transfer rate to the reactor coolant.

Thermal Reactor: A reactor in which the fission chain reaction is sustained primarily by thermal neutrons. Most current reactors are thermal reactors.

Thermal shield: A layer, or layers, of high-density material located within a reactor pressure vessel or between the vessel and the biological shield to reduce radiation heating in the vessel and the biological shield.

Thermalization: The process undergone by high-energy (fast) neutrons as they lose energy by collision.

Thermoluminescent dosimeter: A small device used to measure radiation by measuring the amount of visible light emitted from a crystal in the detector when exposed to ionizing radiation.

Thermonuclear: An adjective referring to the process in which very high temperatures are used to bring about the fusion of light nuclei, such as those of the hydrogen isotopes deuterium and tritium, with the accompanying liberation of energy.

Total Effective Dose Equivalent (TEDE): The sum of the deep-dose equivalent (for external exposures) and the committed effective dose equivalent (for internal exposures).

Transient: A change in the reactor coolant system temperature and/or pressure due to a change in power output of the reactor. Transients can be caused by:

1. adding or removing neutron poisons,
2. increasing or decreasing electrical load on the turbine generator,
3. accidental conditions.

Transuranic Element: An artificially made, radioactive element that has an atomic number higher than uranium in the periodic table of elements such as neptunium, plutonium, americium, and others.

Transuranic waste: Material contaminated with transuranic elements that is produced primarily from reprocessing spent fuel and from use of plutonium.

Trip, Reactor: A term that is used by pressurized water reactors for a reactor scram (see Scram).

Tritium: A radioactive isotope of hydrogen (one proton, two neutrons). Because it is chemically identical to natural hydrogen, tritium can easily be taken into the body by any ingestion path. It decays by beta emission. It has a radioactive half-life of about 12.5 years.

Thorium: Thorium is an element with an atomic number of 90. This element occurs in nature almost entirely as a single nuclear isotope, with mass number of 232. Thorium is called a fertile material because when it absorbs a neutron it becomes **U^{233}** which is fissile.

Turbine: A machine for generating rotary mechanical power from the energy of a stream of fluid (such as water, steam, or hot gas). Turbines convert the kinetic energy of fluids to mechanical energy through the principles of impulse and reaction, or a mixture of the two.

A rotary engine made with a series of curved vanes on a rotating shaft, usually turned by water or steam. Turbines are considered the most economical means to turn large electrical generators.

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

Ultraviolet: Electromagnetic radiation of a wavelength between the shortest visible violet and low energy x-rays.

Ultraviolet Radiation: Electromagnetic radiation having wavelengths between the visible part of the spectrum and x-rays.

Uncertainty Range: Defines an interval within which a numerical result is expected to lie within a specified level of confidence. The interval often used is the 5-95 percentile of the distribution reporting the uncertainty.

Unique Purpose: means a project, program, or commercial activity which cannot reasonably be accomplished without the use of **Highly Enriched Uranium (HEU**) fuel, and may include:

1. A specific experiment, program, or commercial activity (typically long-term) that significantly serves the U.S. national interest and cannot be accomplished without the use of **HEU** fuel
2. Reactor physics or reactor development based explicitly on the use of **HEU** fuel
3. Research projects based on neutron flux levels or spectra attainable only with **HEU** fuel
4. A reactor core of special design that could not perform its intended function without using **HEU** fuel.

United States: when used in a geographical sense, includes Puerto Rico and all territories and possessions of the United States.

Unnecessary Regulatory Burden: Regulatory criteria that go beyond the levels that would be reasonably expected to be imposed on licensees given that regulations apply to conditions that incorporate normal operation and design-basis conditions.

Unrestricted area: The area outside the owner-controlled portion of a nuclear facility (usually the site boundary). An area in which a person could not be exposed to radiation levels in excess of 2 millirems in any one hour from external sources (see 10 CFR 20.1003).

Unstable isotope: A radioactive isotope (see also stable isotope).

Unwanted Radioactive Material (Orphan Sources): refers to sealed sources of radioactive material contained in a small volume (but not radioactively contaminated soils and bulk metals) in any one or more of the following conditions (taken from the NRC Orphan Source Initiative):

1. In an uncontrolled condition that requires removal to protect public health and safety from a radiological threat;
2. Controlled or uncontrolled, but for which a responsible party cannot be readily identified;
3. Controlled, but the material's continued security cannot be assured. If held by a licensee, the licensee has few or no options for, or is incapable of providing for, the safe disposition of the material;
4. In the possession of a person, not licensed to possess the material, who did not seek to possess the material; or
5. In the possession of a state radiological protection program for the sole purpose of mitigating a radiological threat because of one of the above conditions, and for which the state does not have a means to provide for the material's appropriate disposition.

Uranium: A radioactive element with the atomic number 92 and, as found in natural ores, an atomic weight of approximately 238. The two principal natural isotopes are uranium-235, **U^{235}.** (0.7 percent of natural uranium), which is fissile, and uranium-238, **U^{238}** (99.3 percent of natural uranium), which is fissionable by fast neutrons and is fertile. Natural uranium also includes a minute amount of uranium-234, **U^{234}**.

Uranium Fuel Fabrication Facility: A facility that:

1. Manufactures reactor fuel containing uranium for any of the following:
   - **A.** preparation of fuel materials;
   - **B.** formation of fuel materials into desired shapes;
   - **C.** application of protective cladding;
   - **D.** recovery of scrap material;
   - **E.** storage associated with such operations;
2. Conducts research and development activities.

Uranium Hexafluoride Production Facility: A facility that receives natural uranium in the form of ore concentrate, processes the concentrate, and converts it into uranium hexafluoride (**UF_6**).

Utilization Facility means any nuclear reactor other than one designed or used primarily for the formation of plutonium or **U^{233}**.

Van de Graaff Accelerator: Device using a high voltage terminal to accelerate charged particles.

Vapor: The gaseous form of substances that are normally in liquid or solid form.

Very High Radiation Area: An area accessible to individuals, in which radiation levels exceed 500 rad (5 gray) in one hour at 1 meter from the source or from any surface that the radiation penetrates (see 10 CFR 20.1003).

Viability Assessment: A Department of Energy decision making process to judge the prospects for geologic disposal of high-level radioactive wastes at Yucca Mountain based on;

1. Specific design work on the critical elements of the repository and waste package,
2. A total system performance assessment that will describe the probable behavior of the repository,
3. A plan and cost estimate for the work required to complete a license application,
4. An estimate of the costs to construct and operate the repository(see 10 CFR Part 60). The viability assessment was required by the **Energy and Water Development Appropriations Act,** 1997 (Public Law 104-206). After the viability assessment was completed, site-specific environmental standards at 40 CFR Part 197 and implementing regulations (see 10 CFR Part 63).

Void: In a nuclear power reactor, an area of lower density in a moderating system (such as steam bubbles in water) that allows more neutron leakage than does the more dense material around it.

Void Coefficient of Reactivity: A rate of change in the reactivity of a water reactor system resulting from a formation of steam bubbles as the power level and temperature increase.

Waste, Radioactive: Radioactive materials at the end of a useful life cycle or in a product that is no longer useful and should be properly disposed of.

Watt: An electrical unit of power. 1 watt = 1 Joule/second. It is equal to the power in a circuit in which a current of one ampere flows across a potential difference of one volt.

Watt-hour: An electrical energy unit of measure equal to 1 watt of power supplied to, or taken from, an electrical circuit steadily for 1 hour.

Weighting factor (WT): Multipliers of the equivalent dose to an organ or tissue used for radiation protection purposes to account for different sensitivities of different organs and tissues to the induction of stochastic effects of radiation

Well-logging: All operations involving the lowering and raising of measuring devices or tools that contain licensed material or are used to detect licensed materials in wells for the purpose of obtaining information about the well or adjacent formations that may be used in oil, gas, mineral, groundwater, or geological exploration (see 10 CFR 39.2).

Wheeling Service: The movement of electricity from one system to another over transmission facilities of intervening systems. Wheeling service contracts can be established between two or more systems.

Watt (Electric): The electrical unit of power. The rate of energy transfer equivalent to one ampere of electric current flowing under a pressure of one volt at unity power factor.

Watthour (Wh): The electrical energy unit of measure equal to 1 watt of power supplied to, or taken from, an electric circuit steadily for one hour.

Weak Interaction: The interaction responsible for weak decays of particles, mediated by the exchange of W± and Z0 gauge bosons.

Whole-body Counter: A device used to identify and measure the radioactive material in the body of human beings and animals. It uses heavy shielding to keep out naturally existing background radiation and ultrasensitive radiation detectors and electronic counting equipment.

Whole-body Exposure: Whole body exposure includes at least the external exposure, head, trunk, arms above the elbow, or legs above the knee. Where a radioisotope is uniformly distributed throughout the body tissues, rather than being concentrated in certain parts, the irradiation can be considered as whole-body exposure (see also 10 CFR 20.1003).

Wipe Sample: A sample made for the purpose of determining the presence of removable radioactive contamination on a surface. It is done by wiping, with slight pressure, a piece of soft filter paper over a representative type of surface area. It is also known as a "swipe" or "smear" sample.

Wind Energy: The kinetic energy of wind converted into mechanical energy by wind turbines (i.e., blades rotating from a hub) that drive generators to produce electricity.

X-radiation: Electromagnetic radiation usually produced in transitions of the inner electrons of atoms. The wavelength is between ultraviolet and gamma rays.

X-ray: Electromagnetic radiation with wavelengths between ultraviolet and gamma rays.

Radiation from cosmic sources; naturally occurring radioactive materials, including radon (except as a decay product of source or special nuclear material) and global

fallout as it exists in the environment from the testing of nuclear explosive devices. It does not include radiation from source, byproduct, or special nuclear materials regulated by the Nuclear Regulatory Commission. The typically quoted average individual exposure from background radiation is 360 millirems per year.

Penetrating electromagnetic radiation (photon) having a wavelength that is much shorter than that of visible light. These rays are usually produced by excitation of the electron field around certain nuclei. In nuclear reactions, it is customary to refer to photons originating in the nucleus as x-rays.

Yellowcake: Yellowcake is the product of the uranium extraction (milling) process; early production methods resulted in a bright yellow compound, hence the name *yellowcake*. The material is a mixture of uranium oxides that can vary in proportion and in color from yellow to orange to dark green (blackish) depending at which temperature the material was dried (level of hydration and impurities). Higher drying temperatures produce a darker, less soluble material. Yellowcake is commonly referred to as U3O8 and is assayed as pounds U3O8 equivalent. This fine powder is packaged in drums and sent to a conversion plant that produces uranium hexafluoride (UF6) as the next step in the manufacture of nuclear fuel.