This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.

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Standard Terminology Relating to Nuclear Materials[1]

This standard is issued under the fixed designation C859; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 This terminology standard contains terms, definitions, descriptions of terms, nomenclature, and explanations of acronyms and symbols specifically associated with standards under the jurisdiction of Committee C26 on Nuclear Fuel Cycle. The content of this terminology standard may also be applicable to documents not under the jurisdiction of Committee C26, in which case this terminology standard may be referenced in those documents.

1.2 While subcommittees within Committee C26 are free to only provide terms and definitions within individual standards, each subcommittee may request the addition of utilized terms and definitions to this terminology standard if it believes that such serves the broader interest of Committee C26 and the nuclear fuel cycle profession. Therefore, terms and definitions proposed for inclusion in Terminology C859 need not be used in more than one committee standard before being considered.

1.3 In general, technical terms that are defined in common dictionaries would not also be defined in this terminology standard unless there is a need to emphasize a specific definition in making appropriate use of a Committee C26 standard.

1.4 Subcommittee C26.10 (Nondestructive Assay) also has a terminology standard applicable to its standards: Terminology C1673.

1.5 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

2. Referenced Documents

2.1 *ASTM Standards:*[2]

C1108 Test Method for Plutonium by Controlled-Potential Coulometry

C1156 Guide for Establishing Calibration for a Measurement Method Used to Analyze Nuclear Fuel Cycle Materials

C1673 Terminology of C26.10 Nondestructive Assay Methods

3. Terminology

3.1 *Definitions:*

absorbed dose, D, [L^2 T^{-2}], *n*—absorbed dose is the mean energy imparted by ionizing radiation to a unit mass of specified material.

DISCUSSION—The SI unit for absorbed dose is the gray (Gy), defined as 1 J/kg.

abundance sensitivity, *n—in methods of chemical analysis*, the ratio of the ion beam intensity of the major isotope, *M*, to the background current at the adjacent mass positions.

$$\text{Abundance sensitivity} = \frac{\text{ion current at mass } M}{\text{ion current at } M \pm 1} \quad (1)$$

accelerated test, *n—for the prediction of long term behavior of materials*, a test that results in an increase either in the rate of an alteration mode or in the extent of reaction progress, when compared with expected service conditions.

DISCUSSION—Changes in the expected alteration mechanism (s) caused by the accelerated test conditions, if any, must be accounted for in the use of the accelerated test data.

accuracy, *n*—the closeness of agreement between a measurement result and an accepted reference. (E170)

activity, A, [T^{-1}], *n*—the measure of the rate of spontaneous nuclear transformations of a radioactive material. The SI unit

[1] This terminology is under the jurisdiction of ASTM Committee C26 on Nuclear Fuel Cycle and is the direct responsibility of Subcommittee C26.01 on Editorial and Terminology.

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[2] For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

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for activity is the becquerel (Bq), defined as one transformation per second. The original unit for activity was the curie (Ci), defined as 3.7×10^{10} transformations per second.

alpha radiation, *n*—is the spontaneous emission of an alpha particle, composed of two protons and two neutrons with a positive charge of plus two, during the nuclear transformation process.

DISCUSSION—An alpha particle is the same as a helium-4 atom with no electrons.

alteration, *n*—any change in the form, state, or properties of materials.

alteration layer, *n—in materials interaction with water*, a layer of alteration phases at the surface of the specimen.

DISCUSSION—Several distinct layers may form at the surface and within cracks in the material. Layers may be composed of discrete crystallites.

alteration mechanism, *n*—the series of fundamental chemical or physical processes by which alteration occurs.

alteration mode, *n—for the prediction of long-term behavior of materials*, a particular form of alteration, for example: general corrosion, localized corrosion.

alteration phase, *n—in materials interactions with their environment*, a solid phase formed as a result of material interactions, that replaces some amount of the original phase; may form by precipitation from solution of in-situ transformation of a chemically altered solid.

alteration product, *n*—see alteration phase.

aluminum-based spent nuclear fuel, *n*—irradiated nuclear fuel or target elements or assemblies, or both, that are clad in aluminum or aluminum-rich alloys.

DISCUSSION—The microstructures contain a continuous aluminum-rich matrix with fissile-rich particles dispersed in this matrix.

aluminum-based spent nuclear fuel form or waste form, *n*—any metallic form produced from aluminum-based spent nuclear fuel and having a microstructure containing a continuous aluminum-rich matrix with uranium-rich particles dispersed in this matrix.

DISCUSSION—This term may include the fuel itself or the product from the melt-dilute process.

analog, *n—for the prediction of long term behavior of materials*, a material, process, or system whose composition, and environmental history are sufficiently similar to those anticipated for the materials, processes, or systems of interest to permit use of insight gained regarding its condition or behavior to be applied to the material, process, or system of interest.

analysis (physical or chemical), *n*—the determination of physical or chemical properties or composition of a material.

analyte, *n—in method of chemical analysis*, a sample component whose presence and concentration is of interest.

analytical sample, *n*—a portion of a material (solid, liquid, or gas) used in chemical, physical, or radiological analysis.

annealing, *n—in glass leach tests*, a controlled cooling process for glass designed to reduce thermal residual stress to an acceptable level, and, in some cases, modify structure.

artificial aging, *n*—any short time treatment that is designed to duplicate or simulate the material/property changes that normally occur after prolonged exposure and radioactive decay.

attribute test, *n—for the prediction of long-term behavior of materials*, a test conducted to provide material property data that are required as input to behavior models, but are not themselves responses to the environment, such as density, thermal conductivity, mechanical properties, radionuclide content of waste forms, and so forth.

back-reaction, *n*—reaction between dissolved components and a material to re-form bonds that are broken during dissolution of this material.

becquerel (Bq), [T^{-1}], *n*—the SI unit of measure for activity, defined as one transformation per second.

beta radiation, *n*—an electron that was generated in the atomic nucleus during decay and has a negative charge of one.

bias of a measurement process, *n*—a consistent or systematic difference between a set of test results obtained from the process when measuring a property, and the accepted reference value of the property being measured.

bounding model, *n—for the prediction of long term behavior of materials*, a model that yields values for dependent variables or effects that are expected to be either always greater than or always less than those expected for the variables or effects to be bounded.

calcine, *v*—to fire or heat a granular or particulate solid at less than fusion temperature but sufficiently to remove most of its chemically combined volatile matter (for example, H_2O, CO_2) and otherwise to develop the desired properties for use.

calibration, *n*—the set of operations that establishes, under specified conditions, a relationship between a set of values measured or indicated by an instrument or system to a corresponding set of known values, typically derived from appropriate reference standards or established physical constants.

DISCUSSION—The calibration relationship can be expressed by a statement, function, diagram or table.

DISCUSSION—Test Method C1108 is an example of calibration using established physical constants.

DISCUSSION—Additional details on calibration requirements for measurement methods used for the nuclear fuel cycle can be found in Guide C1156.

DISCUSSION—Some applications or test methods will require the performance of metrologically traceable calibrations.

canyon, *n—in the nuclear industry*, a long, narrow, remotely operated, radiological facility.

DISCUSSION—A large, heavily-shielded facility where nuclear material is processed or stored.

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chemical durability, *n—in leach tests*, the resistance of a material to alteration, dissolution, and release of its constituents, under the specific conditions of the test.

chemisorbed water, *n—in the drying of spent nuclear fuel*, water that is bound to other species by forces whose energy levels approximate those of chemical bounds.

closed system, *n—in leach tests*, a system utilizing a test container that is impervious to material transport.

confinement, *n—in a dry cask storage system (DCSS) for spent nuclear fuel in the U.S.*, the ability of a DCSS to prevent the release of radioactive substances into the environment.[3]

confinement systems, *n—in a dry cask storage system (DCSS) for spent nuclear fuel in the U.S.*, the assembly of components of the packaging intended to retain the radioactive material during storage.

DISCUSSION—These may include the cladding, storage system shell, bottom and lid, penetration covers, the closure welds or seals, and bolts and other components.

confirmation test, *n—for the prediction of long term behavior of materials*, a test for which results are not used in the initial development of a model or the determination of parameter values for a model but are used for comparison with predictions of that model for model validation.

continuing calibration blank check solution (CCB)—*in methods of chemical analysis*, a standard solution that has no analyte and is used to verify blank response and freedom from carryover.

continuing calibration verification check solution (CCV)—*in methods of chemical analysis*, a standard solution (or set of solutions) used to verify freedom from excessive instrument drift; the concentration is to be near the midrange of a linear curve.

continuous flow, *n—for leach tests*, the continual replacement of solution in the reaction cell with fresh test solution.

control test, *n—for leach tests*, test conducted without a specimen to measure background concentrations in the leachant and contamination from interactions between test solution and apparatus.

corrosion product, *n—for aluminum-based spent fuel storage or disposal*, an ion or compound formed during the interaction of the aluminum-based spent nuclear fuel with its storage or disposal environment.

DISCUSSION—The corrosion product may be the result of aqueous corrosion, oxidation, reaction with moist air, or other types of chemical or electrochemical interactions.

CRUD, *acr—in nuclear waste management*, deposits on fuel surfaces of corrosion products that circulate in the reactor coolant.

DISCUSSION—Compositions reflect materials exposed to coolant and activation products formed during irradiation.

crushed glass, *n—in a glass leach test*, small particles of glass produced by mechanically fracturing larger pieces of glass.

cumulative fraction leached, *n—in leach tests*, the sum of the amounts of a species leached during all leaching intervals divided by the amount of that species originally present in the sample.

curie (Ci), $[T^{-1}]$—the original unit of measure for activity, defined as 3.7×10^{10} transformations per second.

debris waste, *n—in nuclear waste management in the U.S.*, solid material exceeding a 60 mm particle size that is intended for disposal.

DISCUSSION—Additionally, the solid material is a manufactured object, or plant, or animal matter, or natural geologic material.

destructive analysis (DA), *n*—measurement of one or more attributes of a test specimen in which the chemical or physical properties, or both, of the test specimen are altered either during sample preparation or as a result of the measurement, or both.

determination, *n*—the process of carrying out a series of operations specified in the test method whereby a single value is obtained.

devitrified glass, *n*—an initially homogenous or phase separated glass, or both, that has partially crystallized during cooling, heat treatment, or both.

diffusion coefficient, D, $[L^2T^1]$, *n—in diffusion modeling*, an intrinsic property of a species in a host matrix that relates (*1*) its concentration gradient to its flux (Fick's first law), (*2*) its spatial rate of change in the direction of the concentration gradient to the time rate of change in its concentration (Fick's second law), or (*3*) its mean square displacement to time (The Einstein's equation).

disposal, *n—in high-level radioactive waste management*, the emplacement in a geologic repository of high-level radioactive waste, spent nuclear fuel, or other highly radioactive material with no foreseeable intent of recovery, whether or not such emplacement permits the recovery of such waste.

dissolution, *n—for leach tests on solids*, the result of reactions in which chemical bonds are broken and species are released from a solid material and become solvated in the test solution.

dose equivalent, $[L^2\ T^{-2}]$, *n*—a measure of the biological effects of radiation dose from all types of radiation expressed on a common scale.

DISCUSSION—The SI unit for dose equivalent is the sievert (Sv), which is equal to 100 rem (specialized unit for human dose equivalent). Radiation dose equivalent is often expressed in terms of microsieverts (μSv) or millirem (mrem).

dose rate, $[L^2\ T^{-3}]$, *n*—a quantity of absorbed dose received in a given unit of time.

dry cask storage system (DCSS), *n—in nuclear waste management*, a set of components that performs the functions of confinement, radiological shielding, and physical

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[3] Raddatz, M. G., Waters, M. D., "Information Handbook on Independent Spent Fuel Storage Installations," U.S. Nuclear Regulatory Commission, Office of Nuclear Materials Safety and Safeguards, NUREG-1571, December 1996.

protection of spent nuclear fuel during normal, off-normal, and accident conditions.

DISCUSSION—Examples include canister-based systems with their metal or concrete overpack or vault, or an integrated cask.

drying, *n—in waste management*, removal by evaporation of uncombined water or other volatile substances from a raw material or product, usually expedited by low-temperature heating.

effective diffusion coefficient (effective diffusivity), D_e, $[L^2T^1]$, *n—in diffusion modelling*, the value of the diffusion coefficient of a species in a host matrix that includes the effects of other processes (for example, adsorption) or physical constraints (for example, tortuosity and constrictivity) and which may not be known independently.

DISCUSSION—The value of D_e is a function of temperature.

electro-mechanical manipulator (E/M), *n*—a remotely operated handling and lifting device, in which the various motions and functions are driven by electric motors or actuators.

DISCUSSION—An E/M is generally used in a hot cell or similar facility on objects that are too heavy to handle with master-slave manipulators. It can be mounted on a crane bridge, wall, pedestal, or ceiling.

finite cylinder (finite medium), *n—in diffusion modelling*, a bounded body for which Fick's diffusion equation can be solved.

forward glass dissolution rate, $[MT^1]$, *n—in glass dissolution*, the rate at which the glass dissolves into solution at specific values of temperature and pH in the absence of back reactions.

gamma radiation, *n*—photons emitted by nuclei during transitions from one nuclear excitation state to a lower-energy state (or to the ground state).

DISCUSSION—Gamma radiation often accompanies particle emissions associated with radioactive decay. Gamma radiation has no electrical charge.

geologic repository, *n—in high-level radioactive waste management*, a system which is used for, or may be used for, the disposal of radioactive waste in excavated geologic media.

DISCUSSION—A geologic repository includes the geologic repository operations area, and the portion of the geologic setting that provides isolation of the radioactive waste.

getter, *n—in nuclear waste management*, a material (typically a solid), used to chemicaly react with certain gases (for example, H_2, O_2, H_2O vapor) to form a solid compound of low vapor pressure.

glass-ceramic, *n*—a solid material composed of both crystalline and glassy phases.

gray (Gy), $[L^2\ T^{-2}]$, *n*—a gray is the SI unit of absorbed dose (1 J/kg).

hazardous waste glass, *n*—a glass composed of glass forming additives and hazardous waste.

high density concrete, *n*—a concrete having a density greater than 2400 kg per cubic meter (150 lb per cubic foot).

high-level liquid waste (HLLW), *n—in nuclear waste management in the U.S.*, the radioactive aqueous waste resulting from the operation of the first cycle extraction system, or equivalent concentrated wastes from subsequent extraction cycles, or equivalent wastes from a process not using solvent extraction, in a facility for processing irradiated reactor fuels.

high-level radioactive waste (HLW), *n*—(*1*) *in nuclear waste management in the U.S.*, a highly radioactive material resulting from the reprocessing of spent nuclear fuel, including liquid waste produced directly in reprocessing and any solid material derived from such liquid waste that contains fission products (U.S. Code Title 42 section 10101); (*2*) *in nuclear waste disposal in the U.S.*, high-level radioactive waste includes spent nuclear fuel and solid wastes obtained on conversion of wastes resulting from the processing of spent nuclear fuel and other waste as approved by the NRC for disposal in a deep geological repository.

homogeneous glass, *n*—a glass that is a single amorphous phase; a glass that is not separated into multiple amorphous phases.

hot cell, *n*—an isolated shielded containment that provides a controlled environment and is designed to safely handle radioactive and typically contaminated material and equipment.

DISCUSSION—The design radiation levels within a hot cell are typically 1 Gy/h (100 rads per hour) or higher.

important to safety, *adj—in high-level radioactive waste disposal in the U.S.*, refers to those engineered features of the geologic repository operations area whose function is: (*1*) to provide reasonable assurance that high-level waste can be received, handled, packaged, stored, emplaced, and retrieved without exceeding regulatory requirements for Category 1 design basis events; or (*2*) to prevent or mitigate Category 2 design basis events that could result in doses equal to or greater than the regulatory values to any individual located at or beyond any point on the boundary of the site.

important to waste isolation, *adj—in high-level radioactive waste disposal in the U.S.*, refers to those engineered and natural barriers whose function is to provide reasonable assurance that high-level waste can be disposed without exceeding the regulatory requirements.

incremental fraction leached, *n—in leach tests*, the amount of a species leached during a single leaching interval divided by the amount of that species in the test specimen before the test.

initial calibration verification check solution (ICV)—*in methods of chemical analysis*, a standard solution (or a set of standard solutions) used to verify calibration standard levels; the concentration of analyte is to be near mid-range of the linear curve that is made from a stock solution having a different manufacturer or manufacturer lot identification than the calibration standards.

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