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15 May 1985

MILITARY STANDARD

GLOSSARY OF TERMS AND DEFINITIONS FOR NEUTRON RADIOGRAPHIC TESTING



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DEPARTMENT OF DEFENSE
WASHINGTON, DC 20301

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GLOSSARY OF TERMS AND DEFINITIONS FOR
NEUTRON RADIOGRAPHIC TESTING

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2. It is the intent to review this handbook periodically to insure its completeness and currency. Users of this document are encouraged to report any errors discovered and any recommendations for changes or inclusions to Army Materials and Mechanics Research Center, ATT: AMXMR-SMS, Arsenal Street, Watertown, MA 02172-2719.

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FOREWARD

This standard prescribes terminology for use with neutron radiographic methods and procedures.

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SCOPE

1.1 Purpose. The terminology in this standard for neutron radiographic methods and procedures is intended for use on drawings, and in specifications, standards, and technical documents.

1.2 Source of definitions. The source of each definition taken from a publication is so identified at the end of the definition. If the definition is a composite taken from several sources or a modification, it is so identified. Definitions without identified source are original.

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2. REFERENCED DOCUMENTS

2.1 Government documents.

2.1.1 Specifications, standards, and handbooks. Unless otherwise specified, the following specifications, standards, and handbooks of the issue listed in that issue of the Department of Defense Index of Specifications and Standards (DoDISS) specified in the solicitation form a part of this specification to the extent specified herein.

NONE

2.1.2 Other Government documents, drawings, and publications. The following other Government documents, drawings, and publications form a part of this standard to the extent specified herein.

NATIONAL BUREAU OF STANDARDS

NBS Handbook 72 - Measurement of Neutron Flux and Spectra for
Physical and Biological applications

Standard Definitions of Terms Relating to Nondestructive Testing
(Radiography) Note: Developed for the Department of Defense, 1984.

(Copies of specifications, standards, handbooks, drawings and publications required by contractors in connection with specific acquisition functions should be obtained from the contracting activity or as directed by the contracting officer.)

2.2 Other publications. The following document(s) form a part of this standard to the extent specified herein. The issues of the document(s) which are indicated as DoD adopted shall be the issue listed in the issue of the DoDISS specified in the solicitations. The issues of documents which have not been adopted shall be those in effect on the date of the cited DoDISS.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM E 545 - Standard Method for Determining Image Quality in Thermal
Neutron Radiographic Testing

ASTM E 748 - Standard Practices for Thermal Neutron Radiography of
Materials

ASTM E 803 - Standard Method for Determining the L/D Ratio of Neutron
Radiography Beams

(Application for copies should be addressed to the American Society for Testing and Materials, 1916 Race Street, Philadelphia, PA 19103).

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BRITISH STANDARDS INSTITUTION

BS 2597 - Glossary of Terms Used in Radiology

(Application for copies should be addressed to the British Standards Institution, British Standards House, 2 Park Street, London, United Kingdom).

NATIONAL COUNCIL ON RADIATION PROTECTION AND MEASUREMENTS

NCRP 57 - Instrumentation and Monitoring Methods for Radiation Protection

(Application for copies should be addressed to National Council on Radiation Protection and Measurements, 7910 Woodmont Avenue, Washington, DC 20014).

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3.0 Glossary of Terms and Definitions for
Neutron Radiographic Testing

A-B-C source - A shorthand notation for a radioactive source of the type americium-beryllium-curium.

Absorbed Dose - The amount of energy imparted by ionizing radiation per unit mass of irradiated matter. Symbol: D. Special Unit: rad. One rad is equal to 0.01 joules per kilogram. SI (international system) unit: gray. One gray is equal to one joule per kilogram.

Absorber - A material that reduces the intensity of a radiation beam passing through it because the radiation imparts a given fraction of its energy to that material.

Accelerator - A device used to impart kinetic energy to charged atomic particles.

Activation - The process by which substances are made radioactive by irradiation (bombardment by particles or gamma rays).

Activity - The rate at which spontaneous nuclear transitions occur in an amount of radioactive nuclide at a given time. Symbol: A. Special unit: curie. SI unit: becquerel.

Alpha-n source - A radioactive neutron source based on alpha bombardment of a suitable target such as beryllium.

Alpha particle - A positively charged particle emitted by certain radionuclides. It consists of two protons and two neutrons, and is identical to the nucleus of a helium atom.

Americium-beryllium source - A radioactive neutron source based on alpha particles from Am-241 bombarding a beryllium target.

Americium-curium-beryllium source - A radioactive neutron source based on alpha particles from Am-241 and Cm-242 bombarding a beryllium target.

Antimony-beryllium source - A radioactive neutron source based on gamma rays from Sb-124 bombarding a beryllium target.

Atom - The smallest particle of an element which can enter into a chemical combination.

Atomic number - The number of protons in a given nucleus. Symbol: Z.

Attenuation coefficient - The average fraction of photons or uncharged ionizing particles that interact per unit path length in an absorbing material.

Autoradiography - The process by which the image of an object is obtained on a photographic emulsion or other imaging devices or mechanisms by means of radiation emitted by the object itself.

BF-3 counter - A widely employed thermal neutron detector. The probe contains boron trifluoride gas. The boron isotope utilized is B-10.

BPI - A shorthand notation for beam purity indicator.

Barn - A unit used to express the probability of a specific atomic or nuclear interaction in terms of cross section (1 barn = 10^{-24} cm²).

Beam port - A channel usually free of neutron absorbers to direct the neutron beam from the moderator to the inspection area.

Beam purity indicator - An image quality indicator for neutron radiography. (ASTM E-545).

Becquerel - The SI unit of activity. One becquerel equals one nuclear transition per second. Symbol: Bq (1 Ci = 3.7×10^{10} Bq).

Beryllium - An element, atomic number 4, used in neutron radiography as a moderator. It is also a source of neutrons when it is bombarded with alpha particles, x-rays or gamma rays.

Beta particle - An elementary particle emitted from a nucleus during nuclear transition. It has a single electrical charge and a mass equal to 1/1836 that of a proton. A negatively charged beta particle is physically identical to the electron.

Betatron - A circular-orbit magnetic induction accelerator which makes use of a varying magnetic field to accelerate electrons. It can accelerate electrons to energies on the order of 10^6 to 10^8 electron volts, which can impinge on a heavy metal target to produce high-energy x-rays.

Bonner sphere - A spherical neutron counter or counters, usually consisting of polyethylene moderator spheres surrounding scintillation counters, whose spectral responses to a polyenergetic neutron spectrum approximately follow the dose that results from an exposure to multi-energy neutrons. For the purpose of using the detector as a spectrometer, one has to know the response factor of each diameter sphere used over the range of neutron energies encountered. Named after one of the developers, J. W. Bonner.

Boron nitride - A compound material used to attenuate neutrons; BN is used as one of the materials in the BPI.

Byproduct material - Any radioactive material (except source or fissionable material) obtained in the process of producing or using source or fissionable material. Includes fission products and many other radionuclides produced in nuclear reactors.

Cadmium cut-off - A filtering process for neutron beams in which neutrons of energy less than 0.5 eV are preferentially removed because of the sharp decrease in neutron attenuation by cadmium at energies above that level.

Cadmium ratio - The ratio of the response of two identical neutron detectors, usually activation types such as indium or gold, one exposed bare to the beam and the other cadmium covered: The cadmium covered detector records primarily neutrons having an energy above 0.5 eV (see cadmium cut-off) and the ratio is a measure of the thermalization in the neutron spectrum. NCRP No. 57 (mod.).

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Californium - A transuranium element, atomic number 98; isotope Cf-252 is used as a radioactive neutron source; it emits neutrons by spontaneous fission.

Cassette - A light-tight container for holding film or other light-sensitive detector and conversion screens in intimate contact during exposure.

Chain reaction - A reaction which is self-sustaining. In a nuclear reactor this is achieved by arranging the fuel and moderator so that for each fission that occurs at least one neutron is made available to produce a further fission. B.S. 2597 (mod.)

Cine-radiography - The production of a series of radiographs which can be viewed rapidly in sequence, thus creating an illusion of continuity.

Cockroft-Walton accelerator - An accelerator based on a circuit for generating high voltage devised by Cockroft and Walton. In neutron radiography this is used to accelerate deuterons into a tritium target; neutrons are produced from the d-T reaction.

Collimator - A device used to limit the size, shape, and direction of the primary radiation beam by shielding the unwanted radiation.

Collimator ratio - see L/D ratio.

Cold neutrons - Neutrons of energy less than 0.01 eV.

Contamination - The presence of unwanted radioactive matter, or the "soiling" of objects or materials with "radioactive dirt".

Contrast agent - Any suitable substance, solid, liquid, or gas, applied to a material being radiographed, to enhance the contrast of features of interest.

Conversion screen - A sheet of material which converts neutrons into some other form of energy such as alpha particles, beta particles or light. In neutron radiography this screen is placed in close contact with a detector such as film to produce an image.

Cross section - A measure of the probability for an atomic or nuclear interaction. It is usually expressed in barns. (1 barn = 10^{-24} cm²). It can be considered as the effective target area for a specified interaction; e.g., scattering, absorption, etc. or for the total process.

Curie - The special unit of activity. One curie = 3.7×10^{10} spontaneous nuclear transitions (disintegrations) per second exactly, or by popular usage, the quantity of any radioactive material having an activity of one curie. Symbon: Ci.

Curium-beryllium source - A radioactive neutron source based on alpha particles from Cm-242 bombarding a beryllium target.

Cyclotron - A particle accelerator in which the charged particles are accelerated in an orbit that is approximately a spiral between the ends of a huge magnet, gaining energy with each rotation. An RF voltage is applied to hollow, semicircular electrodes (dees). Particles are accelerated as they cross the gap between the dees. The cyclotron can be a source of charged particles, x-rays or neutrons.

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dT source - An accelerator-based neutron source in which neutrons are produced by the bombardment of a tritium target by deuterons. Usually a Cockroft-Walton circuit is used at the acceleration voltage of 300 kV or less; the neutrons are produced at energies of about 14 MeV.

Decay (radioactive) - The decrease in the activity of a radioactive source. The disintegration of an unstable nuclide by emission of charged particles and/or photons.

Deuterium - A heavy isotope of hydrogen of atomic weight 2, represented by the symbol D. The neutron attenuation of deuterium is less than that of hydrogen because the scattering cross section is less.

Deuteron - Nucleus of a deuterium atom. Deuterons may be used in accelerator reactions to produce neutrons; e.g., the d-T reaction.

Direct exposure imaging - An imaging method in which the conversion screen and image recorder are simultaneously exposed to the neutron beam.

Dosimeter - A device that measures radiation dose.

Dynamitron accelerator - Trade name for a particular accelerator that makes use of a modified Cockroft-Walton circuit to generate high voltage and accelerate particles. This accelerator utilizes a voltage multiplying circuit with the stages driven by high voltage capacitors in parallel. The capacitors are charged by a radio-frequency source. This accelerator can be used to produce neutrons by accelerating deuterons, protons or other charged particles.

Dysprosium - A rare earth element of atomic number 66. Metal foils of dysprosium are used as conversion screens particularly for transfer exposure methods.

Effective gamma content - The percentage of background film darkening caused by low-energy gamma radiation absorbed by 2mm of lead. (ASTM E-545)

Effective pair production content - The percentage of background exposure (film darkening) caused by pair production in 2 mm of lead. (ASTM E-545)

Effective scattered neutron content - The percentage of background film darkening caused by scattered neutrons. (ASTM E-545)

Effective thermal neutron content - The percentage of background film exposure (film darkening) due to unscattered thermal neutrons. (ASTM E-545)

Electron - An elementary particle with a negative electrical charge of 1.602×10^{-19} coulombs and a mass equal to 9.1×10^{-28} gram.

Electron volt - A unit of energy equal to the energy gained by an electron when it is accelerated through a potential difference of one volt in vacuum. (1 eV = 1.6×10^{-19} joules approximately).

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Element - A substance which cannot be decomposed by the ordinary types of chemical change or made by chemical union.

Encapsulation - The process of sealing a radioactive material in a capsule to prevent its dispersion during use as a radiation source. This term can also be used to describe the type, thickness and number of layers of material used to construct the capsule.

Energy - The capability of doing work. Neutron energy is normally given in terms of electron-volts (eV).

Epithermal neutrons - Neutrons of energy above that of thermal neutrons, energy greater than the cadmium cut-off energy, 0.5 eV; a general classification.

Exposure (radiographic) - The subjection of a recording medium to radiation for the purpose of producing an image; in neutron radiography exposure is often given in terms of neutrons/cm².

Facility scattered neutrons - Neutrons scattered in the facility that contribute to detector exposure. (ASTM E-545)

Fast neutrons - Neutrons in the energy range above that of resonance neutrons, about 100 keV to 20 MeV.

Filter - Material placed in a beam of radiation for the purpose of absorbing selectively that radiation which is within a certain range of wavelengths or energies.

Fission - The splitting of a heavy nucleus into two roughly equal parts (which are nuclei of lighter elements), accompanied by the release of a large amount of energy and usually one or more neutrons.

Fission neutrons - Neutrons liberated in the process of fission. The spontaneous fission of Cf-252 results in neutrons with energies up to about 10 MeV with a peak flux at about 1 MeV.

Fission products - The accumulated mass of radioactive materials resulting from fission.

Flash neutron radiography - A process by which neutron radiographs are taken in a short time frame, normally using a pulsed neutron source.

Fluence, particle - The number of particles incident on a sphere of unit cross-sectional area.

Fluence rate, particle - The fluence per unit time. Note: The term particle flux density is also used as the name for this quantity. As the word density has several connotations, the term particle fluence rate is preferable.

Flux (particle) - The number of particles passing through a unit area in a unit of time; for neutrons of a given energy, the product of neutron density with speed.

Flux density (particle) - Same as fluence rate (particle).

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Foil filter - A thin sheet of material placed in the neutron beam to remove some portion of the neutron spectrum.

GOS - A shorthand notation for the scintillator gadolinium oxysulfide.

Gadolinium - A rare earth element, atomic number 64. It is commonly used as a conversion screen.

Gadolinium oxysulfide - A scintillator material used to convert neutrons into light. It is used in image intensifier tubes and as a conversion screen.

Gamma-n source - A radioactive neutron source based on gamma ray bombardment of a suitable target such as beryllium.

Gamma radiation (gamma rays) - Electromagnetic radiation emitted by a radioactive nuclide as a result of a nuclear transition.

Half-life, radioactive - The time taken for the activity of an amount of radioactive nuclide to fall to half its initial value. Symbol: $T_{1/2}$.

Half-value layer - The thickness of a specified substance which, when introduced into the path of a given beam of radiation, reduces the value of a specified radiation quantity upon transmission through the substance by one-half. It is sometimes expressed in terms of mass per unit area.

Half value thickness - See half-value layer.

Helium-3 counter - A proportional gas detector for the detection of neutrons; the filling gas is enriched with the isotope He-3 to provide increased neutron detection.

Hot-Cell - A heavily shielded enclosure in which radioactive materials can be handled remotely through the use of manipulators and viewed through shielded windows so that there is no danger to personnel.

Image quality indicator (IQI) - A device used to determine from the appearance of its image in a radiograph the overall quality of that radiograph. For neutron IQI, see ASTM E-545.

Indirect exposure - A method in which only a gamma-insensitive conversion screen is exposed to the neutron beam. After exposure the conversion screen is placed in contact with the image recorder. See also Transfer exposure. (ASTM E-748)

Indium - An element, atomic number 49; foils of indium metal are used as conversion screens for transfer exposure methods.

Intensity, radiation - The amount of energy or number of particles passing per unit time through a unit area perpendicular to the line of propagation at the point in question.

Interference radiation - Radiation other than direct, image-forming neutrons in neutron radiography. This may include other radiation in a neutron beam, such as gamma rays.

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Internal conversion - The transfer of nuclear deexcitation energy directly to a bound electron in the same atom, which causes the electron to be ejected from the atom. Subsequent filling of the vacancy thus created results in the emission of characteristic x-rays or Auger electrons. In neutron radiography image detectors that employ gadolinium make use of internal conversion.

Ion - An atom or group of atoms that carries a positive or negative electric charge as a result of having lost or gained one or more electrons.

Ionization - The process of removing electrons from, or adding electrons to, atoms or groups of atoms, thereby creating ions.

Ion pair - A positive ion and a negative ion or electron having charges of the same magnitude, and formed simultaneously from a neutral atom or molecule with energy supplied by radiation or any other suitable source.

Isotopes - Atoms that have the same atomic number (same chemical characteristics) but have different mass numbers. An equivalent statement is that the nuclei have the same number of protons but different numbers of neutrons. Thus, $^{14}\text{C}_6$, $^{13}\text{C}_6$, $^{12}\text{C}_6$, are isotopes of the element carbon, the subscripts denoting their common atomic numbers, the superscripts denoting the different mass numbers.

L/D ratio - The ratio of the distance from the entrance aperture of a neutron source to the image plane (L) to the diameter of the source entrance aperture (D) as defined in ASTM E-748 and described in ASTM E-803. It is the measure of the resolving capability in the neutron radiographic system.

Licensed material - Source material, special nuclear material, or by-product material received, possessed, used, or transferred under a general or special license issued by the Nuclear Regulatory Commission or an Agreement State.

Linear accelerator (Linac) - An accelerator in which the charged particles are accelerated by continuous or successive applications of voltages at radio frequencies inside a waveguide. In neutron radiography the Linac can be used to produce photoneutrons.

Mass number - The total number of neutrons and protons in a nucleus. It is the whole number nearest to the exact atomic weight. Symbol: A.

Moderator - A material used to reduce the energy of, or to slow fast neutrons. Common moderators are light materials such as hydrogen, deuterium, beryllium or carbon. ASTM E-748 (mod.).

Monoenergetic - Having a single energy. For a neutron beam, the neutron energies are confined to a narrow range.

Neutron - An uncharged elementary particle having an atomic mass of 1. (ASTM E-748)

Neutron Camera - A source of neutrons arranged with a moderator and collimator assembly to provide a beam suitable for neutron radiography; term used commercially.

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Neutron image intensifier - An image intensifier tube that yields a bright image of an incoming neutron beam. The mechanism usually involves conversion of the incoming neutron image to light, then photoelectrons and back to light.

Neutron multiplier - An assembly of moderator and fissionable material surrounding a neutron source to add to the neutron population through fission reactions. See also subcritical assembly and subcritical flux booster.

Neutron radiography - The process whereby a photographic-like image of an object is produced by neutron radiation that has penetrated through the object.

Neutron spectrum (or neutron energy spectrum) - A description of a neutron radiation field in terms of the number of neutrons per energy unit interval versus energy; if neutron direction is important, this should also be specified. (NBS Handbook 72)

Neutron-to-gamma ratio - A ratio of the neutron intensity in a neutron imaging beam to the intensity of gamma rays in the beam. The gamma rays are usually regarded as interfering radiation. The ratio is often given in terms of n/cm^2 -mR.

Nuclear reaction - A reaction involving a change in the nucleus of an atom, such as during fission, fusion, neutron capture, or radioactive decay, as distinct from a chemical reaction, in which only the electron structure surrounding the nucleus is changed.

Nuclear transition - A change in the energy state or level of an atomic nucleus which may, or may not, result in the emission of radiation.

Nuclide - An atomic species characterized by the constitution of its nucleus, specifically by the number of protons and neutrons.

Object scattered neutrons - Neutrons scattered by the test object that contribute to the exposure but do not assist in image formation. (ASTM E-545)

Pair production - The transformation of a high-energy photon into an electron-positron pair in the field of an atomic nucleus or some other particle. It occurs only if the energy of the incident photon is above 1.02 MeV.

Paraffin - A waxy alkene (flammable), normally in solid form, obtained from the distillates of wood, coal, etc.; it is a complex mixture of hydrocarbons sometimes used as a neutron moderator.

Particle - A minute constituent of matter with a measurable mass, such as an electron or neutron.

Photoneutrons - Neutrons produced by the reaction of x-ray or gamma ray photons on a suitable target such as beryllium.

Plutonium - beryllium source - A radioactive neutron source based on alpha particles from Pu-239 bombarding a beryllium target.

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Positron - An elementary particle with a mass equal to that of the electron, and a positive charge equal to the negative charge of the electron.

Proton - An elementary particle with a single positive electrical charge and a mass approximately 1836 times that of the electron.

Quality factor - The linear-energy-transfer-dependent factor by which absorbed doses are to be multiplied to obtain, for radiation protection purposes, a quantity (i.e., dose equivalent) that expresses on a common scale for all ionizing radiations the irradiation incurred by exposed persons. The quality factor weights the absorbed dose for the biological effectiveness of the particular type of radiation producing the absorbed dose. Symbol: Q.

Radioactivity - The property possessed by some nuclides of emitting particulate or electromagnetic radiation as the result of spontaneous nuclear transition.

Radioisotope - Radioactive isotope of an element.

Reactor (nuclear) - An assembly of fissile material such that for each nucleus undergoing fission at least one neutron is available to permit further fission and thus to render the reaction self-sustaining.

Real-time neutron radiography - Imaging with a neutron system that usually involves electronic nonfilm detectors. Such a system often involves a neutron image intensifier and a closed circuit television system so the image can be viewed promptly at a location remote from the neutron beam.

Relative biological effectiveness (RBE) - A ratio of the absorbed dose of a reference radiation to the absorbed dose of a test radiation to produce the same level of biological effect, other conditions being equal. When two radiations produce an effect that is not of the same extent and/or nature, an RBE cannot be specified.

Relativistic neutrons - Neutrons of energy greater than 20 MeV.

Resolution - The smallest distance between adjacent distinguishable images on a radiograph or viewing screen; it may be expressed as the number of lines (or line pairs) per mm which can be seen as discrete images.

Resonance neutrons - Neutrons in the energy range in which materials exhibit resonance attenuation properties, about 1 eV to 1 keV.

Scattered neutrons - Neutrons that have undergone a scattering interaction but still contribute to the neutron radiographic exposure. (ASTM E-545 mod.)

Scintillator - A fluorescent material that emits a localized flash of light when excited by an incident particle or photon of ionizing radiation.

Screen - See conversion screen.

Sensitivity indicator - See image quality indicator.

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Sensitivity (neutron) - The value determined by the smallest discernible detail on the image of any given standard sensitivity indicator used on a neutron radiograph; indicators are defined in ASTM E-545.

Sensitivity (radiographic) The ratio of the smallest difference in thickness that is detectable on the radiograph to the thickness of the specimen. It may be expressed as a percentage, and is an indication of ability to detect a small discontinuity. In practice, it is determined by the use of an image quality indicator (penetrameter).

Single emulsion film - A radiographic film containing the sensitive emulsion only on one side. Such films are used to provide improved spatial resolution. For some neutron radiographic methods, such as the use of gadolinium conversion screens, single emulsion films are useful because the radiation from the screen produces only little exposure on a far-side emulsion.

Slow neutrons - A general term used for neutrons of energy less than 1 keV.

Specific activity - The activity per unit mass of a radioactive material (expressed in curies per gram or becquerels per gram).

Spontaneous fission - A process in which an unstable nucleus splits apart and releases neutrons without the need for incoming neutrons. The radioactive neutron source Cf-252 emits neutrons by this process.

Subcritical assembly - An assembly with an effective neutron multiplication constant less than one; a self-supporting chain reaction cannot be attained. See neutron multiplier.

Subcritical flux booster - See subcritical assembly and neutron multiplier.

Subthermal neutrons - See cold neutrons.

Thermal column - An area in a nuclear reactor, usually at the edge of the reflector, filled with a moderator material such as graphite. The neutrons emerging are well moderated, or thermal neutrons.

Thermal neutrons - Neutrons having energies between 0.01 eV and 0.5 eV; they are produced by slowing down of fast neutrons until the average energy of the neutrons is such that the neutrons are in the thermal equilibrium at the temperature of the surrounding medium. (ASTM E-748)

Thermalization - The process of slowing down neutrons by permitting the neutrons to come to thermal equilibrium with their surroundings.

Thermalization factor - A term used to compare neutron sources. It is the ratio of the source neutron yield in neutrons/second to the peak thermal neutron flux density (in neutrons/cm² second) for a given moderator (usually water).

Thermoluminescence - The property, possessed by certain crystals of emitting light when heated after having been exposed to ionizing radiation.

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Threshold - A point at which an effect begins to be produced. For neutron radiography, for example, there are threshold neutron energies below which certain nuclear reactions do not occur.

Threshold dose - The minimum absorbed dose or dose equivalent that will produce a specified effect.

Time-of-flight - A term that relates to the capability to separate neutrons of a particular energy from a neutron spectrum by taking the neutron velocity into account. In performing time-of-flight work, one determines the elapsed time from the instant a particle leaves the source to the instant it reaches a filter or detector.

Track-etch imaging - A process in which an image is produced by forming etch pits in radiation damaged material. For neutron radiography such images can be formed in certain plastics and other insulating sheets.

Transfer exposure - A neutron radiographic detection method in which the radiographic film is not exposed directly to the imaging neutron beam. Usually this term implies the use of a conversion screen of some material that becomes radioactive upon neutron exposure. The final image in this case is made by autoradiography on a radiographic film.

Tritium - A radioactive isotope of hydrogen of atomic weight 3. Tritium is used in neutron radiography in accelerator targets used to produce neutrons by the d-T reaction.

Uranium - An element of atomic number 92. Some isotopes of uranium undergo fission with relative ease and are often used in fuel material for reactors and subcritical assemblies.

Van de Graaff accelerator - An accelerator that is based on the principle of transfer of charge from a carrier (a moving belt) to the inside of a hollow conductor. The high potential thus generated is used to accelerate ions, or electrons, which can be impacted on a heavy-metal target to produce x-rays or neutrons.

WEP - An abbreviation for water-extended-polyester, a hydrogen-containing plastic material used as a moderator.

Window filter - A material or combination of materials used to filter a beam and remove or diminish radiation of energy below and above the energy of the desired transmission window.

X-n source - A neutron source based on x-ray bombardment of a suitable target such as beryllium or uranium; see photoneutrons.

Yield (neutron) - Of a neutron source is the total number of neutrons emitted from the source in all directions per unit time. Yield is normally given in neutrons/second and associated with a fast neutron source.

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Custodians:

Army -- MR
Navy -- AS
Air Force -- 20

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Army -- AR, AV, ME
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