**PURPOSE**

Wagner-Meinert, LLC is constantly striving to improve the safety of our employees, customers, and community. To further that goal, we have developed and have implemented this program specific to Naturally Occurring Radioactive Materials Safety. Through this program we hope to assure that all company employees performing job tasks in which a potential Naturally Occurring Radioactive Materials exposure could occur, are protected.

Compliance with this program is mandatory and is applicable to all company employees who work in an environment where Naturally Occurring Radioactive Materials may be present in any amount. Failure to comply will result in disciplinary action and/or is grounds for termination.

**DEFINITIONS**

*Dose* - means the quantity of ionizing radiation absorbed, per unit of mass, by the body or by any portion of the body. When the provisions in this section specify a dose during a period of time, the dose is the total quantity of radiation absorbed, per unit of mass, by the body or by any portion of the body during such period of time. Several different units of dose are in current use. Definitions of units used in this section are set forth in paragraphs (a)(6) and (7) of this section.

*Rad* - means a measure of the dose of any ionizing radiation to body tissues in terms of the energy absorbed per unit of mass of the tissue. One rad is the dose corresponding to the absorption of 100 ergs per gram of tissue (1 millirad (mrad)=0.001 rad).

*Radiation* - includes alpha rays, beta rays, gamma rays, X-rays, neutrons, high-speed electrons, high-speed protons, and other atomic particles; but such term does not include sound or radio waves, or visible light, or infrared or ultraviolet light.

*Radioactive material* - means any material which emits, by spontaneous nuclear disintegration, corpuscular or electromagnetic emanations.

*Rem* - means a measure of the dose of any ionizing radiation to body tissue in terms of its estimated biological effect relative to a dose of 1 roentgen (r) of X-rays (1 millirem (mrem)=0.001 rem). The relation of the rem to other dose units depends upon the biological effect under consideration and upon the conditions for irradiation. Each of the following is considered to be equivalent to a dose of 1 rem

*Restricted area* - means any area access to which is controlled by the employer for purposes of protection of individuals from exposure to radiation or radioactive materials.

*Unrestricted area* - means any area access to which is not controlled by the employer for purposes of protection of individuals from exposure to radiation or radioactive materials.

**1.0 INTRODUCTION**

1.1 Exposure to Naturally Occurring Radioactive Materials occurs in many industries. Naturally Occurring Radioactive Materials pose a significant danger. If at all possible Wagner-Meinert, LLC employees are instructed to contact the Wagner-Meinert, LLC Safety Director if it is determined that employees will be exposed to Naturally Occurring Radio Active Materials.

**2.0 Exposures / Protection**

2.1 Exposures may not be immediately noticeable. During the initial review of site conditions by the Jobsite foreman. The facility administrator is required to inform Wagner-Meinert, LLC of potential hazards on the site. This includes Naturally Occurring Radioactive Materials and Technological Enhanced Naturally Occurring Radioactive Materials.

2.2 Precautions are to be taken when there is a possibility of exposure. Precautions / protections are divided into three areas.

2.2.1 Time. The length of exposure may be limited thereby eliminating the potential hazard. As an example, a five minute exposure to sunlight is in fact a safe exposure to radiation, whereas a sixteen hour unprotected exposure to sunlight is not.

2.2.2 Distance. Employee work may be relocated away from the potential exposure, thereby reducing or eliminating the hazard.

* + 1. Shielding. A shield may be erected to eliminate or reduce exposures.
    2. Personal hygiene is a factor in precautions of post exposure!
    3. Personal Protective Equipment may be needed in very rare cases.

2.3 Various types of nuclides may be encountered. The host employer will disclose this information during the initial site meeting with the jobsite foreman. Alternately the information may be disclosed to the Safety Director or Project Manager who will in turn convey the information to the jobsite foreman prior to the commencement of work. Over 60 radionuclides (radioactive elements) can be found in nature, and they can be placed in three general categories:

2.3.1. Primordial – from before the creation of the Earth:

Primordial radionuclides are left over from when the world and the universe were created. They are typically long lived, with half-lives often on the order of hundreds of millions of years. Radionuclides that exist for more than 30 half-lives are not measurable. The progeny or decay products of the long lived radionuclides are also in this heading. Here is some basic information on some common primordial radionuclides:

|  |  |  |  |
| --- | --- | --- | --- |
| **Primordial nuclides** | | | |
| **Nuclide** | **Symbol** | **Half-life** | **Natural Activity** |
| **Uranium 235** | 235U | 7.04 x 108 yr | 0.72% of all natural uranium |
| **Uranium 238** | 238U | 4.47 x 109 yr | 99.2745% of all natural uranium; 0.5 to 4.7 ppm total uranium in the common rock types |
| **Thorium 232** | 232Th | 1.41 x 1010 yr | 1.6 to 20 ppm in the common rock types with a crustal average of 10.7 ppm |
| **Radium 226** | 226Ra | 1.60 x 103 yr | 0.42 pCi/g (16 Bq/kg) in limestone and 1.3 pCi/g (48 Bq/kg) in igneous rock |
| **Radon 222** | 222Rn | 3.82 days | Noble Gas; annual average air concentrations range in the US from 0.016 pCi/L (0.6 Bq/m3) to 0.75 pCi/L (28 Bq/m3) |
| **Potassium 40** | 40K | 1.28 x 109 yr | soil – 1-30 pCi/g (0.037-1.1 Bq/g) |

2.3.2 Cosmogenic - formed as a result of cosmic ray interactions:

Cosmic radiation permeates all of space, the source being primarily outside of our solar system. The radiation is in many forms, from high speed heavy particles to high energy photons and muons. The upper atmosphere interacts with many of the cosmic radiations, and produces radioactive nuclides. They can have long half-lives, but the majority have shorter half-lives than the primordial nuclides. Here is a table with some common cosmogenic nuclides:

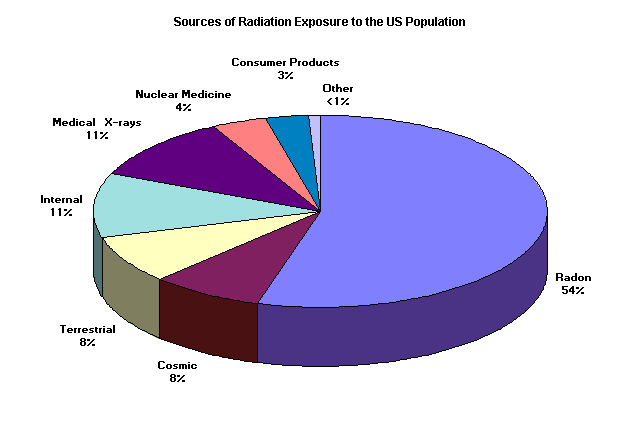
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| --- | --- | --- | --- | --- |
| **Cosmogenic Nuclides** | | | | |
| **Nuclide** | **Symbol** | **Half-life** | **Source** | **Natural Activity** |
| **Carbon 14** | 14C | 5730 yr | Cosmic-ray interactions, 14N(n,p)14C; | 6 pCi/g (0.22 Bq/g) in organic material |
| **Tritium 3** | 3H | 12.3 yr | Cosmic-ray interactions with N and O; spallation from cosmic-rays, 6Li(n,alpha)3H | 0.032 pCi/kg (1.2 x 10-3 Bq/kg) |
| **Beryllium 7** | 7Be | 53.28 days | Cosmic-ray interactions with N and O; | 0.27 pCi/kg (0.01 Bq/kg) |

* + 1. Human produced - enhanced or formed due to human actions (minor amounts compared to natural):

Humans have used radioactivity for one hundred years, and through its use, added to the natural inventories. The amounts are small compared to the natural amounts discussed above, and due to the shorter half-lives of many of the nuclides, have seen a marked decrease since the halting of above ground testing of nuclear weapons. Here are a few human produced or enhanced nuclides:

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| --- | --- | --- | --- |
| **Human Produced Nuclides** | | | |
| **Nuclide** | **Symbol** | **Half-life** | **Source** |
| **Tritium** | 3H | 12.3 yr | Produced from weapons testing and fission reactors; reprocessing facilities, nuclear weapons manufacturing |
| **Iodine 131** | 131I | 8.04 days | Fission product produced from weapons testing and fission reactors, used in medical treatment of thyroid problems |
| **Iodine 129** | 129I | 1.57 x 107 yr | Fission product produced from weapons testing and fission reactors |
| **Cesium 137** | 137Cs | 30.17 yr | Fission product produced from weapons testing and fission reactors |
| **Strontium 90** | 90Sr | 28.78 yr | Fission product produced from weapons testing and fission reactors |
| **Technetium 99** | 99Tc | 2.11 x 105 yr | Decay product of 99Mo, used in medical diagnosis |
| **Plutonium 239** | 239Pu | 2.41 x 104 yr | Produced by neutron bombardment of 238U  ( 238U + n--> 239U--> 239Np +ß--> 239Pu+ß) |

2.4 Where nuclides can be found:



**3.0 TESTING**

3.1 The jobsite foreman is responsible to assure that testing is completed.

3.2 Types of testing will be consistent with that of the host employer.

3.3 Testing may be done by qualified Wagner-Meinert, LLC personnel or by plant personnel.

3.4 Testing results will be compared to levels established by the facility.

**4.0 PREVENTING EXPOSURE**

Proper control of exposure to Naturally Occurring Radioactive Materials is the responsibility of both the host employer, Wagner-Meinert, LLC and the employee. When the exposures cannot be eliminated as outlined above, Wagner-Meinert, LLC employees will prevent exposure through the use of Personnel Protective Equipment. The Safety director shall be consulted on a case by case basis to determine the appropriate personnel protective equipment suitable to each potential exposure.

**5.0 EMPLOYEE INFORMATION & TRAINING**

5.1 Annual training will be conducted per the Wagner-Meinert, LLC Safety Program. Information and training for normal and emergency situations will be given to all employees who may be exposed to Naturally Occurring Radioactive Materials. The training program will inform employees of the following:

5.1.1 The characteristics, possible sources, and hazards of Naturally Occurring Radioactive Materials.

5.1.2 Proper use of the Naturally Occurring Radioactive Materials detection methods.

5.1.3 Proper use and maintenance of personal protective equipment. Demonstrated proficiency in using PPE should be required.

5.1.4 Use of safety equipment.

5.1.5 Use and operation of all Naturally Occurring Radioactive Materials monitoring systems.

**DOCUMENT MANAGEMENT:**

If after reading this program, you find that improvements can be made, please contact the Safety Director. We encourage all suggestions because we are committed to the success of our Naturally Occurring Radioactive Materials Safety Program. We strive for clear understanding, safe behavior, and involvement from every level of the company.

**CHANGE CONTROL:**

All management system changes are reviewed, approved or disapproved by the Safety Committee.

**PERSONNEL:**

The Owners of Wagner-Meinert, LLC have the ultimate responsibility for the Naturally Occurring Radioactive Materials Safety Program. They have designated the Safety Director to manage the Naturally Occurring Radioactive Materials Safety Program.

| **Revision / Review History** | | | |
| --- | --- | --- | --- |
| **Revision** | **Date** | **Authorized By** | **Changes** |
| 1 | 9/24/2004 | Safety Director | Annual review |
| 1 | 12/3/2006 | Safety Director | Annual review |
| 1 | 9/6/2007 | Safety Director | Annual review |
| 1 | 10/7/2011 | Safety Director | Annual review |
| 1 | 7/13/2016 | Safety Director | Annual review |
| 1 | 6/30/2017 | Safety Director | Annual review |
| 1 | 12/18/2018 | Safety Director | Annual review |
| 1 | 6/10/2019 | Safety Director | Annual review |
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