NRRPT® NEWS

National Registry of Radiation Protection Technologists

Fall 2012 Edition

Incorporated April 12, 1976

INSIDE THIS ISSUE

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Chairman's Message

Kelly Neal

Greetings fellow RRPTs! As fall is now upon us I would like to review some of the educational benefits available to our members.

The American Council on Education's College Credit Recommendation Service provides the following credit recommendation for being a NRRPT member:

"In the lower division baccalaureate/associate or upper division baccalaureate degree category, 6 semester hours in Introduction to Radiological Science; 8 semester hours in Radiation Detection and Measurement; 8 semester hours in Radiation Protection and Control; and 8 semester hours in Applied Health Physics Internship."

This provides up to 30 semester hours of credit that can be used at various colleges and universities for completion of a bachelor's degree.

Personally, I have recently re-enrolled in college to finish my degree (talk about teaching an old dog a new trick…). I can speak from personal experience that the 30 semester hours of college credit that I received due to the NRRPT are a very welcome addition to my transcript!

Additionally, active practitioners and student members of the Registry can apply for scholarship money to help them work toward their college degrees. Thanks to a grant of $10,000/year for five years from Cabrera Services, the Registry currently has additional money that has not yet been committed to scholarships. If you are going to school in a nuclear related field and need help with the cost of books or tuition, please apply for one of our scholarships. The application form is available in the Forms section of our web page at www.NRRPT.org.

Sincerely,
Kelly Neal
NRRPT, Chairman of the Board

We Want You...

By Todd Davidson

…to be a member of the NRRPT Examination Panel! If you join, you get:

- The fun of volunteering your time for two full days of Exam Panel sessions during each of the NRRPT meetings (held once during the winter and once during the summer)!
- The excitement of reviewing exan questions to assess their accuracy, their applicability to the membership, and their difficulty!
- The chance to choose which questions from the bank will be placed on the next examination!
- To do your part to encourage and promote the education and training of radiation protection technologists!

We know, it sounds too good to be true. “So where do I sign up?” you’re asking.

Well, here is the answer. We need to add persons from the membership to our Examination Panel. We are looking for new blood to bring new ideas and perspective to our organization. If you are a radiation protection professional who has stable employment, and who can attend one or both meetings during a year, we would like to include you on the Panel. If you are chosen to serve on the panel, we would need a letter of support from your employer that basically states that the employer would allow you to take time away from work for travel to the meeting(s). If your employer will pay for your travel to the meeting(s), more power to you. Furthermore, if chosen, you would sign a non-disclosure agreement that states you will not reveal any of the questions in the examination bank to anyone outside of the Board of Directors and the Examination Panel, nor will you reveal the passing point on any of the examinations.

If you are interested in joining the Examination Panel, please contact us at nrrpt@nrrpt.org or the Exam Panel Chairman, Rick Rasmussen at rickras@lanl.gov. We look forward to hearing from you! This is an excellent way of getting involved with a great organization. It is also an excellent way of accumulating maintenance points for many registrations and certifications.

Editor's Message:

The topic of this message is the value of your registration with the NRRPT, or if a Registrant has graciously left this Newsletter in your break area, the value of registration to you professionally and personally.

I would be the first to agree that it is a royal pain to study, and then sit for an exam that is an even bigger pain. That being said, the advantages are twofold. The first advantage is that you have demonstrated to yourself and to a potential employer that you have the personal initiative to put forth the effort to study not only subjects and areas that are of value to you as a technologist, in your particular field, but to also demonstrate that you study those areas where you may or may not have ever

Continued on page 13

Components of an ALARA Program

By Dwaine Brown

Title 10, Part 20.1(c) , "*Standards for Protection Against Radiation*"
"…licensees should make every reasonable effort to maintain radiation exposures as far below the limits specified in that part as practicable"

As Low As Reasonably Achievable - ALARA

The objective of any ALARA Program is simply:
Reduction of occupational radiation exposures as far below the specified limits as is reasonably achievable by:

- Conducting good radiation protection pre-job planning.
- Employing good radiation protection practice before during and after any job associated with radiation or contamination.
- Having firm management commitment.

Management commitment is critical to the function of an ALARA Program. Management at all levels must:

- Provide clearly defined radiation protection responsibilities for workers and an environment that allows the radiation protection staff to maintain an effective radiation protection program.

Implementation of this philosophy is really very straight-forward and if properly implemented is not a costly effort. Implementation is achieved by:

- Making sure that all employees aware of management's commitment to keep occupational radiation exposures ALARA.
- Periodically performing, or causing to be performed, formal audits to identify means to lowering exposures.
- Providing radiation protection capability with well defined responsibilities.
- Providing employees with sufficient training to understand how radiation protection relates to his or her job.
- Providing for review and revision to operating and maintenance procedures and modification to equipment that will contribute to the reduction of radiation exposures.
- Giving the RSO sufficient authority and direct access to upper management to enforce safe operations.
- Giving the technicians sufficient authority and direct access to the RSO to enforce safe operations.

The Radiation Safety Officer (or the appropriate title du jour) must:

- Conduct or cause to be conducted surveillance programs and audits to verify that all radiation exposures are as far below the specified limits as achievable.
- Identify and trend the origins of all plant sources of radiation exposure.
- Continuously evaluate actions that would further reduce radiation exposure.
- Periodically review operational and maintenance procedures that may affect radiation exposure.
- Develop and maintain radiation protection program procedures.
- Maintain adequate equipment and supplies supporting radiological work.

Facility Operations must be closely supported by the radiation safety organization in a proactive manner. This support is enhanced by:

- Open and continuous communication between the RSO, technicians and operations management.
- Incorporation of necessary radiological controls into the operational procedures such that implementation will support, not hinder, operations.
- Start-of-shift briefings actively supported by radiation safety personnel to identify and clarify any anomalous radiological conditions.
- Detailed work area surveys to provide the operations staff with the necessary information to minimize their radiation exposure.

Continued on page 7

Professional Pool

By Todd Davidson

Welcome again to the Professional Pool feature – the feature is made for discussions about practical problems encountered in the field and their respective solutions. If any of the readers have a problem to discuss in this forum, please submit it to the author for publishing. If you have a solution to one of the problems presented, please submit it to us so that we can share it with our registry. This forum has been made for you, the practicioners. Please use it. You may contact me as follows:
t-davidson@sbcglobal.net, or todd.davidson@envirachem.com. Please note "Professional Pool" in the subject line of the email.

Problem

What approach is or has been taken when subcontractors that are monitored for radiation and/or radioactive materials are hired to perform particular tasks on a site that has a radiation protection program or a radioactive materials license?

A response to this problem will be posted by the author in the next issue of the Newsletter. However, any individual who would like to share their own experiences is welcome to respond.

CHPs Write

By Todd Davidson

One of the requirements for sitting for the second part of the ABHP examination (the CHP exam) is for the candidate to provide the board with an example of professional writing. Because the examination is a measure of mastery of the subject material, the example of the writing should consist of an overall professional approach to a radiological problem. The board will review the submitted document. They will use that review, at least in part, to determine if the candidate is qualified to sit for part two of the examination.

The NRRPT will include some of these examples, from various CHPs, as Newsletter articles. We are looking for CHPs and/or candidates who have been accepted to sit for part two of the exam, and are willing to share the example of your professional work. We would like to publish it in the Newsletter.

We will begin with the document written by Todd Davidson. This document will be split up and published over the next several volumes of the Newsletter. The entire document will be available on the NRRPT website while it is in the Newsletter. Please refer to the first part of the document titled: "*Determining the Need For External Radiation Monitoring at FUSRAP Projects Using Soil Characterization Data" on page 11 of this newsletter.*

** Exam applications may be downloaded
from our web page **

www.NRRPT.org

2013 USA NRRPT Exam Date

February 23, 2013

Deadline for application: Dec 31, 2012

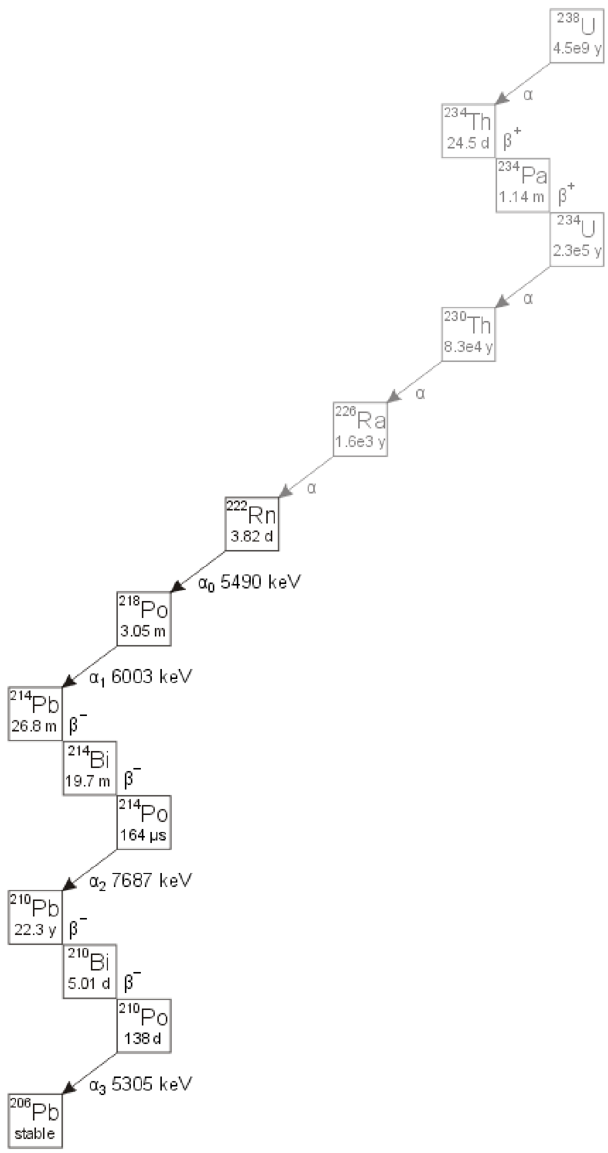
August 17, 2013

Deadline for application: Jun 21, 2013

What's the Deal with Radon and Its Progeny?

Error in Summer 2012 NRRPT News, Page 6

Below is the corrected flow chart



2013 NRRPT Sustaining Fee Due November 30, 2012!

A Microscopic View in ALARA Principles

By Leonard Manzanares

Almost always, sealed radioactive sources that are used in medicine or in industry have to be inspected and inventoried on a routine basis. Performing these inspections and inventories normally requires the RSO or source user to visually inspect the source for damage, verify the serial number against the inventory list and check the source for contamination and verify dose rates. These activities justify the risks incurred by the radiation exposure and yield a sufficient benefit to society by demonstrating that the sources are accounted for and are not presenting any greater hazard (contamination) than they were originally intended or designed for. In many cases these sources are quite radioactive and can deliver an unnecessary dose if not handled correctly (i.e. using a leaded glass shield, long handling tools) or other suitable methods. As a general rule radiation workers employ the ALARA principles of Time, Distance and Shielding when working with or around radioactive sources. Visually inspecting sources can be a challenge for many people for various reasons such as aging eyes, extremely small lettering and numbers, scratched or aged viewing shields and so on. The use of camera systems in the nuclear industry is nothing new to many and they come in a variety of configurations and price ranges. Technology has advanced so much over the years and with these advancements, size and portability tend to become the popular theme. USB digital microscopes come in a variety of small compact configurations that are very inexpensive ($150 - $200) and are capable of focusing on a human hair. Many of these digital microscopes also have built in LED lighting to further enhance the image in low light situations. The digital microscope software allows the image to be displayed in real time video and the displayed image can be captured and saved on a personal computer. Having worked with many radioactive sources of all shapes and sizes has presented its challenges over the past years and the need for two person verification of these sources just does not make sense when it comes to reducing personnel doses. The use of this inexpensive technology has drastically reduced personnel exposures in many instances and when you consider the low cost it just simply makes sense. I have found that the use of USB cable extensions are useful especially when you want to increase that distance for higher activity sources and the use of a turn table or some type of roller mechanism can decrease the need for manipulating the source with tongs any more than you need to. There are many different manufacturers of USB digital microscopes out there and it is always recommended that you do your research when looking for one that will satisfy your needs.

Remember.....

Job openings can be placed on the "Private Side" of the NRRPT website

Go to www.nrrpt.org, click on Members Section then Job Openings

** PLEASE SUPPORT OUR NRRPT® SPONSORS! **

Testing, testing...

By Todd Davidson

Welcome again to this recurring feature "Testing, testing..." It is designed to give problems and solutions that would be typical on a standardized examination for radiation protection. Please share the questions and solutions with other workers in the field who have may not have taken or passed the NRRPT test. The solution to this problem will be placed in the following issue of the Newsletter. If anyone else would like to solve the problem, please send your solution to me. If we publish your solution, you will get a free NRRPT t-shirt!
t-davidson@sbcglobal.net
todd.davidson@envirachem.com

Problem

An air sample of a long-lived radionuclide is collected after 5.75 hours of sampling. The sampler flow rate is 24 lpm. The efficiency of the low background instrument used to count the samples is 25.3% for alpha and 26.2% for beta/gamma. The sample is counted for 15 minutes and collects 5 counts in the alpha channel. The background is counted on this instrument for 60 minutes and collects 7 counts in the alpha channel. The sample collection efficiency is 95% for both the alpha and beta channel. For these air samples, there is a self-absorption factor of 0.70 for alpha and 0.95 for beta/gamma.

What is the alpha activity concentration and uncertainty for this air sample? Calculate the alpha minimum detectable concentration (MDC) for this sample. Is the activity concentration greater than the MDC?

Continued from page 3

- Clearly identify the on shift Radiation Safety Technician(s) and provide a means for immediate contact with the shift technician(s).
- Directly engage operations management and, as appropriate, operations employees in the development of radiation safety procedures and processes that may directly or indirectly impact maintenance activities.

Facility maintenance activities must be closely supported by the radiation safety organization in a proactive manner. This support may be achieved by:

- Active involvement of the radiation safety staff in the development of routine and non-routine maintenance activities associated with maintenance involving exposure to radiation or contamination.
- Directly engage maintenance management and, as appropriate, maintenance workers in the development of radiation safety procedures and processes that may directly or indirectly impact maintenance activities.

Summary

An effective ALARA (and by definition Radiation Safety) Program is <u>not</u> the sole responsibility of the Radiation Safety organization or any single entity within the company. For the ALARA program to be effective, readily accepted, and acknowledged as a worthwhile endeavor, each employee regardless of discipline must feel a sense of ownership. The following is integral to a successful ALARA program:

- Establish open communications between all facility disciplines and Radiation Safety.
- Provide each employee with a sense of ownership by seeking input from each discipline at all levels as contributors to the implementation of ALARA practices.
- Ensure that sound ALARA practices support and not hinder operational or maintenance commitments.
- Employ a proactive approach to the identification, review, and implementation of new or amended regulatory requirements to blend the implementation of these requirements seamlessly into operations and maintenance. AVOID "Oh by the ways" during the course of an operational process or maintenance action!

Remote Monitoring Technology

Seth J. Kanter, NRRPT, CHP

About the Author: Seth Kanter began his career at the Palo Verde Nuclear Generating Station as an RP Technician, and subsequently completed his degree, achieved NRRPT and ABHP certification and is now a member of the RP Manager's staff. He is a member of the EPRI Remote Monitoring Working Group that developed the current usage and training remote monitoring guidelines.

Radiation Protection organizations have been using remote monitoring technology for over two decades and while proper use of telemetric dosimetry, video cameras, and communication systems has reduced overall exposures for a variety of historically high dose jobs and to spread out job coverage resources, it is always important to remember that the intended purpose of remote monitoring is to supplement, not replace traditional RP oversight of the radiation workers.

In 2001, WANO (World Association of Nuclear Operators) issued SOER (Significant Operating Experience Report) 2001-01 to address a series of unplanned radiation exposure events that had occurred at WANO member nuclear power plants over the last several years, including stations in the U.S., then in April, 2003 another significant unplanned exposure event occurred, this time at the Perry Station (SEN 240 - Unplanned Radiation Exposure During Reactor Water Cleanup Heat Exchanger Work). Based on these events, a collaborative effort was undertaken by INPO, EPRI, and industry peers to address key aspects of these events. This group became known as the EPRI Remote Monitoring Technology (RMT) Working Group and the group's efforts culminated with the issuance of two remote monitoring related guidelines covering Remote Monitoring Field Implementation and Remote Monitoring Training.

During April 2003, at Perry Station one worker received an unplanned radiation exposure of 1,896 mrem, 896 mrem over the RWP limit. The most significant findings that resulted from the review of this event were the identification of several areas that could have prevented this unplanned exposure such as relying solely on the remote monitoring equipment to measure worker dose and dose rate. There were also multiple failed radiation exposure control barriers that contributed to the event. The workers could not self-monitor their radiation exposure because their dosimetry was inside the protective clothing due to high contamination levels in the area. Further, because the work area was noisy and the workers were wearing hearing protection, actions, such as the use of electronic dosimeters equipped with vibration or visual alarms, were not taken.

The radiation protection staff did not continuously monitor the workers exposure, and cumulative dose was not periodically communicated to each worker during the evolution. The names of personnel entering the heat exchanger room were not verified with those listed on the remote monitor software roster. And, stay times were not assigned to control worker radiation exposure as a back-up, defense in-depth mechanism. Finally, no one was assigned responsibility for individual exposure control. Compounding this issue, technical difficulties such as problems with the use of telemetry software and equipment were not communicated or addressed. A telemetric dosimeter had been losing contact with remote monitoring software on a prior shift; however, this problem was not communicated to other members of the radiological protection staff or investigated to determine why the dosimeter did not perform as expected. Later testing confirmed that the telemetry dosimetry worn by the worker had transmitted at an unacceptably low level, resulting in lost contact.

It was also learned that a default feature associated with the new software automatically removed individuals from the system after a loss of contact for over four minutes. This was unknown to the technicians operating the equipment and increased the likelihood that a failed transmitter would be missed. Because station procedures for software upgrades were not followed, training and field testing of new software associated with the telemetry dosimetry were inadequate. At the time, there was no program to functionally test equipment associated with dosimeters, such as alarms and telemetry transmitters.

There were many lessons learned and corrective actions taken as a result of this incident, but one of the most important conclusions reached in this evaluation was that RP staffs had an “over reliance” on technology. When providing radiological job coverage with the potential for a worker to receive radiation exposure in excess of federal limits, remote monitoring stations must be able to:

- Differentiate between radiation workers
- Have the capability to monitor dose and dose rate
- Maintain video surveillance of the radiation workers
- Maintain communications with the radiation workers and support RP technicians
- Have the capability to monitor other remote monitoring devices

In order to successfully perform remote job coverage, it essential that RP personnel be qualified, familiar, and proficient with remote monitoring equipment. To do this, stations need to have an RMT qualification program established for all personnel providing remote continuous surveillance. When workers cannot self monitor their Dosimetry, RP must formally relieve them of that responsibility through the use of remote video surveillance, effective audio communication and teledosimetry.

Effective use of RMT rests with the knowledge that the RP technicians and supervisors be familiar with the use of the equipment. Several unplanned radiation exposure events, like SEN 240, involved the use of remote monitoring equipment by experienced RP technicians who simply did not possess adequate skill in implementing this process. Investigations related to these events found that the personnel had not received sufficient training on the use of the equipment or on how to integrate it into the job coverage process. Adequate training (initial and reoccurring) must be provided to ensure that workers possess the required proficiency commensurate with their responsibility of overseeing worker exposure.

These events happened about 10 years ago and since that time there has been a concerted industry effort to improve performance and to try and prevent unplanned exposure events. Unfortunately, over the past few years there have been several unplanned exposure events (> 100 mrem above electronic dosimeter alarm set point) involving remote monitoring technology while monitoring and controlling dose.

To prevent unplanned exposure events, procedures must be followed; plans and contingencies must be understood before the job starts. High dose / high risk evolutions are too critical to undertake with hope as your primary prevent event tool. These recent industry events have shown that familiarity alone may not be adequate due to the complexity of the design and operations of remote monitoring equipment. Insufficient controls, incorrect assumptions, and lack of an effective verification method during the use of remote monitoring have all contributed to unplanned exposure events. Compounding the problem is the considerable variation in implementation programs across the industry. Once qualified, it is imperative that RP technicians maintain proficiency. The phrase “use it or lose it” certainly applies to technicians who were once trained, however due to the course of time and infrequency of use, they have lost information and skill. To fix this problem, once qualified, sharpen your skills as necessary to remain proficient. Prior to performing remote job coverage for high risk radiological activities, as well as other remote monitoring tasks, regain proficiency in using equipment applicable to your site, ensure that you fully understand the operation and limitations of the remote monitoring process, hardware and software restrictions.

In Memoriam: Michael S. Davidson, CHP, CHMM

On October 8, 2012 Michael Stephen Davidson, a member of the Health Physics Society (HPS) National and Baltimore-Washington Chapter, National Registry Radiation Protection Technologists (NRRPT), and the American Nuclear Society (ANS) died unexpectedly in his home in Severna Park, Maryland. I think I speak for all who knew Mike that he was a true and trusted friend, professional associate, and inspiration. Mike was both a Certified Health Physicist and a Certified Hazardous Material Manager.

Mike was born on December 14, 1958 in Middletown, New York the oldest son of Janet (McCool) and Richard (Dick) Davidson. He graduated from Severna Park High School in 1976. He studied Offshore Operations and Marine Biology at the Florida Institute of Technology, earned a B.S. degree in Vocational Education from Southern Illinois University and a Master of Science in Management from Johns Hopkins University. He was the Vice President of Radiological Services for Tidewater, Inc., an environmental and nuclear consulting company.

In 2010, Mike was awarded The Charles D. (Bama) McKnight Award which is presented to persons who have given outstanding efforts in the radiation protection training field leading to increased knowledge and professionalism among Radiation Protection Technologists. Mike was a member of the NRRPT since 1987 and has been a strong supporter of the NRRPT in his efforts to support training for the exam. Mike's contribution to training came in the form of an NRRPT preparation course. Over 1000 candidates have taken Mike's training course (with over 80% passing the exam). Mike had a degree in vocational education and therefore his teaching style and training was advantageous to the adult population taking the NRRPT exam. Mike also served as Chair, Professional Development Committee of the American Academy of Health Physics.

Mike was a truly happy person who always lived life to the fullest. He loved the outdoors, particularly sailing on the Chesapeake Bay, and held a U.S.C.G. Captains License. He enjoyed many athletic pursuits including biking, boating, scuba diving, hiking, and snow skiing. He was a talented musician who loved to play guitar, bass, piano, and often serenaded his friends and family. He was instrumental in organizing the famous "Open Mic Night" at the annual HPS meetings where he and several HPS musicians would entertain us for hours.

Mike was extremely loving and proud of his two daughters, Emily who is currently a senior at Villanova University and Caroline, a junior at Towson University. He is also survived by the love of his life, Diane Brown; his brother Rick, his wife Tina and their son, Justin; his brother Andy and his wife Margot and their children Sarah, Courtney and Fraser; his parents Janet and Dick Davidson of Annapolis, MD; and his many loving aunts, uncles, nieces, nephews and friends.

Donations may be made to the Chesapeake Bay Foundation, Attention: Memorial Gift, 6 Herndon Avenue, Annapolis, MD 21403 or on-line at http://www.cbf.org/gift .

by Claude Wiblin, CHP

Determining the Need For External Radiation Monitoring At FUSRAP Projects Using Soil Characterization Data

By Todd Davidson

Introduction

According to Regulatory Guide 8.34 *Monitoring Criteria and Methods to Calculate Occupational Radiation Doses*, monitoring an individual's external radiation exposure is required if the occupational dose is likely to exceed 10% of the appropriate dose limit. Monitoring is also required if the individual enters a high radiation area or a very high radiation area (1). These terms are defined in Table 1. According to 10 CFR 835.402 monitoring is required for workers who are likely to be exposed to greater than 100 mrem effective dose equivalent to the whole body (2). Although these limits are based on contributions from both internal and external exposure, only external radiation exposure will be considered here. Some limits have been compiled and are summarized in Table 1: *External Radiation Exposure Limits*. The values listed in the Limit column are the dose limits. The values listed in the Monitoring Limit column are the limits at which monitoring must begin.

Table 1: External Radiation Exposure Limits

Requirement	Limit	Monitoring Limit
Deep Dose Equivalent Limit (yearly)	5 rem (0.05 Sv)	500 mrem (5 mSv)
DOE Effective Dose Equivalent (yearly)	-	100 mrem (1 mSv)
Declared Pregnant Worker (gestation)	0.5 rem	50 mrem (0.5 mSv)
High Radiation Area	100 mrem/h at 0.3 m	100 mrem/h at 0.3 m
Very High Radiation Area	500 mrem/h at 1 m	500 mrem/h at 1 m
USACE Administrative Limit	500 mrem (1 mSv)	-
Detection Limit for a typical Thermoluminescent Dosimeter (TLD)	10 mrem (0.1 mSv)	-

The objective of this paper is to calculate the specific activity limits for various nuclides that mark the threshold where external radiation monitoring must begin. These values can then be compared to soil characterization data for a Formerly Utilized Sites Remedial Action Program (FUSRAP) project to demonstrate whether the threshold has been approached or exceeded at that particular site. If the monitoring threshold is approached or exceeded, engineering controls can be added, external monitoring can be used, or administrative controls can be reworked. The calculation uses the gamma constant and linear attenuation coefficient of each nuclide to determine its specific activity limit.

Method

It is assumed that the FUSRAP project has contamination or waste that is either made up of source material or byproduct material, but is not special nuclear material. That is, only the nuclides from the uranium series, the actinium series, or the thorium series are considered. The radioactive nuclide of potassium can also be considered because the data for this nuclide is typically available, as it is a common constituent of soil. It is assumed that the only operation that occurred at the project was the processing of uranium ore into uranium metal. In this case, there are only a handful of prime nuclides for which this process requires the soil characterization data. These prime nuclides are the nuclides that are at the top of the chain, or are long-lived daughters that have been chemically separated from the rest of the chain, and have not had enough time to reestablish equilibrium. The prime nuclides for three natural decay series are U-238, Th-230, and Ra-226 for the uranium series; U-235, Pa-231, and Ac-227 for the actinium series; and Th -232 for the thorium series. If curiosity demands, K-40 can also be considered as a prime nuclide. Specific activity limits were found for the prime nuclides only. It is also assumed that the soil characterization data is analyzed by gamma spectrometry. Because several of the prime nuclides are in secular equilibrium with their daughters, the dose contribution from each daughter are considered with that of the prime nuclide when calculating the specific activity limits. The reciprocal of the specific activity limit from each daughter or parent that emits gamma radiation are summed, then the reciprocal of this sum of reciprocals is used as the specific activity limit for the prime nuclide. For example, U-238 is a prime nuclide with the contributing daughters Th -234, $Pa\text{-}234^m$, Pa-234, and U-234. When looking for the specific activity which causes monitoring to begin for a typical worker, the reciprocal of the specific activity limits for U-238, Th-234, $Pa\text{-}234^m$, Pa-234, and U-234 nuclides are found and summed. The reciprocal of this sum is the specific activity limit used to compare with the specific activity of U-238 and its gamma emitting daughters. Because there is a specific activity limit for each of these prime nuclides, a sum of ratios (SOR) must be used to determine if there is an overall problem. This is shown in the following equation.

$$SOR = \sum_{1}^{j} \frac{A_i}{SA_i}$$

A_i is the specific activity of prime nuclide *i* in pCi/g, and SA_i is the specific activity limit of prime nuclide *i* in pCi/g, and *j* is the total number of prime nuclides. If the SOR is greater than or equal to one, then the threshold for monitoring has been exceeded.

Table 2: *Data For the Prime Nuclides* lists the prime nuclides and their contributing daughters if there are any, as well as the energies of the gamma rays that are actually detected to generate the soil characterization data. The energy in the table listed in *Italics* is that which was used when finding the value for the linear attenuation coefficient.

Table 2: Data For the Prime Nuclides

	Prime nuclide	Contributor	Gamma energy, MeV (yield, %)
Uranium series	U-238 *plus four daughters*	U-238	*0.0496 (0.07)*
		Th-234	*0.0663 (3.8)*, 0.0924 (2.7), 0.0928 (2.7), 0.1128 (0.24)
		$Pa\text{-}234^m$	0.766 (0.207), *1.001 (0.59)*
		Pa-234	*0.132 (19.7)*, 0.570 (10.7), 0.883 (11.8), 0.926 (10.9), 0.946 (12)
		U-234	*0.053 (0.12)*, 0.121 (0.04)
	Th-230	Th-230	*0.0677 (0.37)*, 0.142 (0.07), 0.144 (0.045)
	Ra-226 *plus six daughters*	Ra-226	*0.186 (3.28)*
		Rn-222	*0.510 (0.078)*
		Pb-214	0.2419 (7.5), 0.295 (19.2), *0.352(37.1)*
		Bi-214	*0.609 (46.1)*, 1.12 (15.0), 1.765 (15.9), 2.204 (5.0)
		Po-214	*0.7997 (0.010)*
		Pb-210	*0.0465 (4)*
		Po-210	*0.802 (0.0011)*
Actinium series	U-235 *plus one daughter*	U-235	0.1438 (10.5), 0.163 (4.7), *0.1857 (54)*, 0.205 (4.7)
		Th-231	*0.0256 (14.8)*, 0.0842 (6.5)
	Pa-231	Pa-231	*0.0274 (9.3)*, 0.2837 (1.6), 0.300 (2.3), 0.3027 (4.6), 0.33 (1.3)
	Ac-227 *plus nine daughters*	Ac-227	0.07 (0.017), *0.1 (0.032)*, 0.16 (0.019)
		Th-227	0.05 (8.5), *0.236 (11.2)*, 0.3 (2.0), 0.304 (1.1), 0.33 (2.7)
		Fr-223	*0.05 (34)*, 0.0798 (9.2), 0.2349 (3.4)
		Ra-223	0.144 (3.3), 0.154 (5.6), *0.269 (13.6)*, 0.324 (3.9), 0.338 (2.8)
		Rn-219	*0.271 (9.9)*, 0.4018 (6.6)
		Po-215	*0.4388 (0.04)*
		Pb-211	*0.405 (3.0)*, 0.427 (1.38), 0.832 (2.8)
		Bi-211	*0.351 (12.7)*
		Po-211	*0.57 (0.54)*, 0.898 (0.52)
		Tl-207	*0.897 (0.24)*
Thorium series	Th-232 *plus eight daughters*	Th-232	*0.059 (0.19)*, 0.126 (0.04)
		Ac-228	0.338 (11.4), *0.911 (27.7)*, 0.969 (16.6), 1.588 (3.5)
		Th-228	*0.084 (1.19)*, 0.132 (0.11), 0.166 (0.08), 0.216 (0.27)
		Ra-224	*0.241 (3.9)*
		Rn-220	*0.55 (0.07)*
		Po-216	*0.128 (0.002)*
		Pb-212	*0.239 (44.6)*, 0.300 (3.4)
		Bi-212	0.040 (1.0), *0.727 (11.8)*, 1.62 (2.75)
		Tl-208	0.277 (6.8), 0.5108 (21.6), 0.583 (85.8), 0.86 (12), *2.614 (100)*
	K-40	K-40	*1.46 (0.0118)*

-Book Review-

"Basic Radiation Protection Technology, 6th Edition, Gollnick"

This Book may be easily characterized as a text book, professional reference, study guide, training guide or any number of other terms to describe its functionality.

First of all the primary theme of the 6th Edition may be easily defined as current application and functionality. Incorporated into a dedicated section and expanded through all affected chapters is a discussion of current radiological events and the application of radiation protection methods for evaluation and mitigation of these occurrences.

Dr. Gollnick has demonstrated clearly to the technologist the application of theory, calculations and clear and concise discussion of radiation protection for all disciplines.

The reader/user must be cautioned that it is not practical or possible to address in great detail all aspects of the various professional and technical disciplines that may utilize this text. The user is encouraged to pursue the in depth study of the various disciplines through discipline specific texts, regulations, vendor documentation, or any number of publications through professional organizations.

The text is well written and clearly addresses the use and application with detailed examples, study problems and solutions methods.

NRRPT Newsletter Editor

Continued from page 3

been interested in, but were willing to put forth the effort in order to pass a comprehensive examination.

As a Manager who has at times interviewed a wide variety of personnel for technologist positions, I know that resumes are written by the owner of the resume, and without exhaustive research, the content of the resume may be fact or fiction. Registration with the NRRPT minimizes the fiction potential because I know that you, as an RRPT, didn't just wake up one morning with the knowledge requisite for registration, you worked for it on your own initiative, most likely without any paid time for study.

Secondly, as an interviewing Manager I know that you do not have any site or facility specific knowledge about my particular operation, but by virtue of your position as a Registered Radiation Protection Technologist, you have the ability to pursue and learn those specifics.

Because of your registration status, you have moved ahead of the competition.

Some companies actually pay "bonus" money to your hourly rate due to being a registered Radiation Protection Technologist. Even if you don't get any extra pay, believe me, you are again ahead of the competition when there is a Lead Technician or Supervisory position open.

Also, take a few minutes, or hours to investigate sites such as the HPS jobs site, Monster, Nukeworker, Simply-Hired and many other "headhunter" sites and take note of the number of positions that very clearly state under "qualifications", Certified Health Physicist with X number of years experience, or registered with the National Registry of Radiation Protection Technologist with X number of years of experience.

Think about it. Isn't that worth the study and exam effort to add that registration to you resume? Or if you have been a bit lazy, increase your efforts to maintain your existing registration.

Dwaine Brown, RRPT, NRRPT Newsletter Editor

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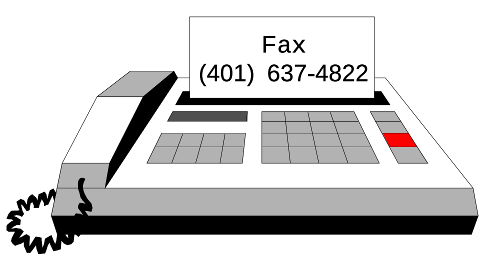

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