NRRPT® NEWS

National Registry of Radiation Protection Technologists

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INSIDE THIS ISSUE

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Chairman's Message

Kelli Gallion

Greetings fellow RRPTs! I hope this newsletter finds you all in good health and good spirits.

We just concluded the 67TH **NRRPT** Board of Directors meeting in Knoxville, TN. Below are some highlights from the meeting:

- **Officer Elections:** Your 2008 Board of Director Officers are as follows: Barry Kimray (Secretary-Treasurer), Eddie Benfield (Vice Chairman), and Dave Biela (Chairman). Congrats to our 2008 Officers!!!!!

- **Update:** We are planning to have the registration maintenance process automated to allow the registry the ability to submit registration documents online by April 1st, 2007. To ensure adequate security of this process, members will use their **NRRPT** ID number and a protected password to access the registration forms online.

- **NEWSLETTER ARTICLES NEEDED!!!** We want to hear what is going on in your neck of the woods. Some areas of interest include, but are not limited to: special projects (current or future), unique training techniques, lessons learned (both good and needing improvement), ALARA saving techniques, pictures, one of-a-kind projects, etc. There is no article too small or too large. All are needed and welcomed!! Please send your articles to DeeDee McNeill, Newsletter Publisher at NRRPT@NRRPT.org.

- **Extreme Makeover!!** The NRRPT information booth will be undergoing a much needed makeover. The marketing committee is in the process of designing a new display using improved technology that will feature a listing of our Gold, Silver, and Corporate sponsors. The marketing committee anticipates having the new booth on display at the 68TH **NRRPT** Meeting in Portland, OR July 2007. Stop by and check us out!!!

"The Health Physics Society (HPS) posts Polonium-210 information sheet"
The HPS has prepared a polonium-210 information sheet for members, media, and the public, and made it available on the HPS web site (http://hps.org/documents/po210_information_sheet.pdf). The information sheet was developed in response to several media inquiries to the HPS following the suspected poisoning in early November of a Russian spy. (Source: HPS January 2007 Newsletter)

The next Board and Panel Mid-Year meeting will be held in conjunction with the HPS Annual Meeting July 8-12, 2007 in Portland, Or. For more information please visit http://hps.org/newsandevents/meetings/meeting7.html. **Remember, all members are invited to attend the NRRPT Board of Directors meeting held Saturday July 6th and Tuesday July 9th.**

At this special time of the year, we wish all the best to you and hope the year ahead brings happiness your way.

Respectfully,
Kelli Gallion
NRRPT, Chairman of the Board

Past Board Member Kevin Collin (left) and Board Elect Dave Tucker
enjoy the **NRRPT** Night-Out

Thank you to our NRRPT Night-Out Sponsors:

Duke Energy
FRHAM
General Engineering Laboratories
MJW Corporation

An Outline of Shielding Topics for the Radiation Protection Technologists

By Robert Wills, RRPT

Shielding Principles For: Alpha, Beta, Gamma, and Neutron Radiation

Shielding and ALARA

- The ALARA principles call for the reduction of exposure in a cost efficient manner utilizing Time / Distance / Shielding
- We can reduce the radiation hazard by placing suitable attenuating material between the source and worker
- The choice and/or thickness of attenuation materials will depend upon the type and energy of radiation you encounter, the dose rate desired and any weight or cost restrictions

NRC Regulatory Guide 8.38 Control of Access to High and Very High Radiation Areas in Nuclear Power Plants

Section 1.6 “Shielding” lists 4 requirements that shielding must meet:

- Shield that can be moved by hand must be secured in place by lock-wire, ties, bolts, etc
- Appropriate warning signs must be posted such as “Warning do not remove, High Radiation Levels may result”
- Local audible and visible alarming radiation monitors should be installed
- The facility’s routine radiological surveillance program should verify the effectiveness of the temporary shielding

Alpha Radiation

- Alpha particles are considered high LET (Linear Energy Transfer) radiations which require very light shielding.
- Alpha particles are released with energies generally between 3.5 and 10 MeV
- The range of alpha particles in air is only a few tens of mm
- The outer layer of skin (7 mg/cm^2) will absorb alpha particles up to 7.5 MeV (not an external hazard)
- The major focus in ALARA is to prevent the ingestion or inhalation of alpha contamination via engineering controls
- In applied HP the only external hazard from alpha particles exists when alpha particles impact light elements (Li, B, O, N, F) resulting in neutron emission

Not All Alphas Are The Same

- Short half-life alpha particles > 8 MeV
- Nuclear Material alpha particles 4 to 7 MeV
- Long half-life alpha particles < 4 MeV

Alpha Range as a function of energy

- $R = 0.56E$, for $E < 4MeV$
- $R = 1.24E – 2.62$, $4 < E < 8$

Beta Particles

- The energy range of Beta particles runs from 18 keV (H-3) to 2 MeV (Y-90)
- Beta particles can cause exposure to the skin, eye and the WB
- Secondary x-rays due to bremsstrahlung need to be evaluated when shielding high energy beta Beta particles.

Beta Radiation

- As Beta particles lose energy the effect of bremsstrahlung needs to be understood
- Bremsstrahlung increases as the atomic number increases
- A 1 MeV beta will lose about 3% of its energy to bremsstrahlung in lead but only about 0.4% in aluminum
- A 1 MeV beta will travel about 4 meters in air and penetrate 400 mg /cm^2
    - note the density of skin (7mg/cm^2) and the lens of the eye (300 mg/$cm^{2)}$
    - deep dose starts at 1000 mg / cm^2
- The dead layer of skin can be penetrated by a 70 keV beta
- Example isotopes and their maximum energy:
    - Co-60 - 290 keV
    - Kr-85 - 750 keV
    - Cs-137 - 470 keV
    - H-3 - 20 keV
    - C-14 - 150 keV
    - Sr-89 - 2 MeV
    - Y-90 - 2.3 MeV

Equation Used To Design Beta Shielding

Equation 1.0 is often used for design or beta shielding to take into account the fraction f of beta energy that is converted to bremsstrahlung:

- $f = k \times Z \times E_{max}$ (1.0)

  where

  $k = 3.5 \times 10^{-4}$ (low Z shield tissue) or

  $k = 5 \times 10^{-4}$ (high Z shield lead)

  Z = Atomic Number of Shield

  E_{max} = Maximum energy of isotopic beta emitter, in MeV

Gamma Radiation

- Gamma radiation is considered a low LET radiation
- As a result gamma radiation is much more penetrating than alpha or beta radiation

Gamma Shield Calculations

- If the value of shielding is known :

  Given: Co-60 Source, I_o = 500 mR/hr at 1 inch from the source, Pb shield material with a thickness of 0.5 inches thickness (the 1/10 value of Pb is 2 inches). What is the gamma dose rate without "buildup" at a 1/10 value thickness?

- Basic Shielding Equation, $I = I_o e^{-2.3\ (t)\ /\ T1/10}$ (1.1)

  $I\ (mR/hr) = 500\ mR/hr\ e^{-2.3\ (.5\ inches)\ /\ 2\ inches}$
  $I = 281\ mR/hr$

Remember if you only want a 50% reduction in exposure rate (HVL) the formula is modified for a ½ values as noted below.

- Basic shielding equation for HVL, $I = I_o e^{-.693(t)/T1/2}$ (1.2)

- Given that T = the value in inches of the shielding to provide a 1/10 or 1/2 reduction in exposure rate

Buildup in Gamma Shielding

What is buildup: As gamma radiation moves through a shield scattered radiation exits the shield and reaches the point of interest. This effect is also caused by the compton scattering and pair production that is not absorbed by the shield. The formula used to calculate the reduction of exposure by gamma rays is modified as noted.

- $I = I_o \mathbf{B} e^{-2.3\ (t)/T1/10}$ (1.3)

In the case of buildup the basic shielding formula is modified by a factor for buildup. (Eq. 1.3). Note the addition of the factor (**B**) has a multiplier effect on the final exposure rate exiting the shield. In this case we utilize tables that provide buildup factors for Point Isotropic Sources based on relaxation length for any given photon energy. For example photons with an energy of 1.0 MeV have a buildup factor in Pb (lead) of 1.37 for one relaxation length.
One relaxation length is the amount of any given shield that reduces the exposure rate by 1/e or 0.368.

Neutron Shielding

The most common neutron shields utilize a mixture of materials for shielding. The higher the hydrogen content the better the shield material

- For a 1 MeV neutron – a HVL = 6.8 cm concrete
- For a 5 MeV neutron – a HVL =11 cm concrete
- It takes ½ the amount of poly as concrete

Continued on page 11

A Brief Summary of Probability and Statistics

By Augustinus Ong, Dartmouth College

The purpose of this paper is to reacquaint ourselves with and to show how to apply simple equations from health physics' radio-analytical notes in order to calculate errors in counting measurements.

Summary

- Useful probability distributions are the Poisson distribution and Gaussian (Normal) distribution.
- The mean, median, and mode are single values that can be determined by any probability distribution.
- The precision of a series of measurements is described by the standard deviation.
- Student's t-test is a method for determining the statistical significance of a difference between sets of measurements.

I. Although the Poisson distribution accurately describes the random nature of radioactive decay of atoms, its equation is not relatively easy to solve. For this reason the Gaussian probability is used and is almost as accurate as the Poisson distribution.

Examples:

(1) What is the probability of obtaining a count of 15 when the average count is 18? Apply the Poisson probability distribution formula.

Poisson probability distribution formula:

P(n) = (r**n) x (e**-r) / n !

Where, P(n) is the probability of obtaining a count n and r is the true average count for the sample. The term n! is n factorial.

Solve:

P(15) = (18**15) x (e**-18) / 15 !
= (6.7 x 10**18) x (1.5 x 10**-8) / 1.3 x 10**12
= 0.0769

The probability is 0.0769 (or 7.69%) that a count of 15 will be obtained when the average count is 18.

(2) What is the probability of obtaining a count of 15 when the average count is 18? Apply the Gaussian probability distribution formula.

Gaussian probability distribution formula:

G(n) = [1 / SQRT (2 x pi x r)] x e**- [(n - r)**2] / 2 r

Where, G(n) is the probability of observing a count n when the true count is r.

Solve:

G(15) = [1 / SQRT (6.28 x 18] x e**- [(15 – 18)**2] / 2 x 18
= [0.094] x e**-[0.25]
= 0.073

The probability is 0.073 (or 7.3%) that a count of 15 will be obtained when the average count is 18, estimated by assuming the radioactive decay follows a Gaussian rather than a Poisson probability distribution.

II. Definitions of mean, median, and mode:

Mean: It is the result obtained by addition all measured values and dividing by the number of measurements.

Medium: When values are placed in order of magnitude the median is the center value.

Mode: It is the value that appears most often in a set of measurements.

III. The standard deviation for a series of measurements describes the reproducibility of the measurements.

Examples:

(1) Determine the standard deviation for a set of measurements given mean = 45,000 and the variance = 155,000.

Standard deviation = σ (s) = SQRT [Σ (x – r)**2 / N -1]

Where, N measurements of a variable are made. The individual measurements is the value x and the mean value of the sample is r. The quantity "Σ (x – r)**2 / N -1" is known as the variance of the measurements.

Solve:

σ (s) = SQRT (155,000) = 380

The mean may be expressed as 45,000 +/- 380, where 380 is understood to be 1 σ.

(2) What is the net count and standard deviation for a sample, if the count is 500 +/- 20 for the sample plus background and the background count is 70 +/- 15?

Net count =
(Sample count – background count) +/- SQRT [s(sample)**2 + σ (bkg)**2]

= (500 -70) +/- SQRT [20**2 + 15**2]
= 430 +/- 25 counts

(3) Repeated counts of a sample yielded a mean gross count of 232 +/- 16. The counting time for gross sample count was 2.0 +/- 0.1 minute. What are the mean gross sample count rate and the estimated standard deviation of the mean count rate?

Mean gross sample count rate = Mean gross sample count / Time

= (Gross count / Time) x [1 +/- SQRT [(σ (s)/Gross count)**2 + (σ (T)/Time)**2]

= (232/2.0) x [1 +/- SQRT [(16/232)**2 + (0.1/2.0)**2]
= 116 +/- 10 cpm

IV. Student's t-test is a method for testing for the significance of the difference between two measurements, or two sets of measurements.

Example:

(1) Activity in a sample was counted for 1 minute. The net count rate was 1500 +/- 50 cpm. A different sample yielded a count rate of 1600 +/- 40 cpm. Is the difference significant?

t-value = | n(1) – n(2) | / SQRT [σ(sample 1)**2 + σ (sample 2)**2]
= | 1500 –1600 | / SQRT [(50)**2 + (40)**2]
= 100 / 64
= 1.56

From a t-Test Table, the probability p is 0.122 (or 12.2%) that the difference is attributable to random variation of the count rate for similar samples. The probability is 1 – 0.122 = 0.878 that the difference between the samples is significant.

Analysis of error is important in radiological measurement. An appreciation of error allows a technician to judge the value of the data and to develop more informed decisions about measurement techniques.

2007 Sustaining Dues
** It's not too late **

If you haven't paid your 2007 annual dues, please submit to the Executive Secretary's office as soon as possible!

New Fee Prices

2007 USA NRRPT Exam Dates

August 11, 2007

Deadline for application: June 15, 2007

Application Fee: $250

Retake Fee: $125
*Late Fee: $50

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

www.NRRPT.org

Future Canadian NRRPT Exam Dates

February 26, 2007

Deadline for application: December 15, 2006

August 2007 Exam Date - TBD

Application Fee: $250

Retake Fee: $125
*Late Fee: $50

A special Canadian Exam will be held at Ontario Power Generation's Whitby site on 2007 February 26

To arrange for additional Canadian exam sites/dates, please contact the **NRRPT** office.

Call for Exam Panel Members from the Nuclear Power Arena!

The Exam Panel is looking for people with background in the nuclear power arena. To be considered for an Exam Panel position, please send an up to date resume along with a letter from your employer stating their support to attend two meetings per year to:

Karen Barcal
c/o **NRRPT**
P.O. Box 6974
Kennewick, WA 99336

For more details, email: kbporch928@sprintmail.com

Building Demolition – Lessons Learned (LL)

By Dave Biela

Recently, we open-air demolished our first radiological building at the West Valley Demonstration Project (WVDP). Although this has been done at a lot of other facilities, it was new for us. The building had been used to process our low level liquid waste and had been out of service for several years.

I wanted to take a few minutes to write up some of the things we learned from a Radiation Protection Operations (RPO) perspective.

The first thing that happened to the facility, after all the utilities were isolated from it, was the majority of equipment within the facility was removed. This took place several years ago. If the building demolition had taken place back then, the majority of the equipment could have stayed in place since it added no significant contribution to the radiological inventory of the facility. The removal of most of the equipment also would not have been a problem for the heavy equipment that eventually came in to take the building down.

(LL)-1 Facilities do not have to be completely gutted before demolition.

(LL)-2 It's amazing how powerful some of the equipment is out there.

One of the first things done by RPO was to perform a detailed survey of what was left in the facility. This included floors, walls, piping and any other source of radiological material. Using MicroShield and several other calculation methods, the remaining curie content in the facility was determined. This information was used in a couple ways: First, our environmental people calculated the potential dose to off site personnel. Secondly, and more importantly to the RPO department, we used calculations in the DOE-HDBK-3010-94 to determine the airborne activity in the immediate work area. Based on our curie content and the location of the equipment to demolish the building, we did not require any respiratory protection. If the results of either calculation were not acceptable, then plans could have been made to lower the radiological inventory in the facility.

(LL)-3 There are a lot of references on line to help with calculations supporting demolition work, the one mentioned above happens to be the one we used for what we were doing.

(LL)-4 RPO and RP Engineering need to work closely and early on in the planning to gather all the data needed to properly perform and document the calculations.

The RPO department than planned and set-up the radiological controls for the area. They first planned for potential water run off from rain and from the water mist that was used for dust suppression. The block building was knocked down and the debris was loaded into intermodels for shipment to an off-site disposal area. The contamination area was set up to encompass the building and the potential loading area. A buffer area was then set up for final check of equipment and personnel. Around the perimeter air samplers (3) were set up in the predominant up wind and down wind location (these were mobile if needed). Plastic was laid out on pallets in several locations for potential particulate sampling. The technician would routinely field check the air filters and the pads to verify all controls were adequate. A berm was built to direct water to a collection area.

(LL)-5 The water mist did not contribute much to run off, the mist was absorbed in the concrete debris.

(LL)-6 The perimeter needs to be big enough to support the release of intermodels while still filling others and staging ones to be filled.

(LL)-7 The concrete block building came down in one day, the clean up took weeks. Mainly due to the time it took to load, weigh and survey the intermodels. Some weather delays.

Post building demolition activities included surveying the remaining building pad, if not being removed, and containing/posting it properly. Release of the equipment that was used in the demolition and documenting all radiological surveys (ongoing during the project).

(LL)-8 Make sure all the equipment that is coming in for this work is completely sprayed down and cleaned off before arriving to perform the work. This makes release surveys much easier.

(LL)-9 Attempt to have separate equipment for inside the work area and outside work if possible. Using one piece of equipment for multiple jobs leads to many types of delays with surveys and end effector changes.

I would also like to thank Flour Hanford for the experience reports they published, we learned a lot from them.

(LL)-10 Try to avoid re-inventing the wheel, get out there and look/ask for information that may help you with what you are planning to do.

For more information contact me at:

Dave Biela
716-942-4423

NRRPT Members Receive ABHP Certification

The following **NRRPT** members have successfully completed the ABHP Certification Exam and are eligible for certification:

Jason A. Armstrong
Gretchen A. Farnung
Gregory J. Gibbons
Lori A. Glander
Lindsay A. Nelsen
Erin S. Niven
Dale E. Perkins

The following **NRRPT** members have successfully completed part one of the 2006 ABHP Certification Exam:

Gary L. Bosgraaf
John E. Dixon
Tracy D. Eaton
Andrew C. Edwards
Dwain A. Keith
Janet McCrary
Dustin G. Miller
Dennis J. Ryan
Mark Thomas Theis
Charles R. Williams

CONGRATUATIONS!

Continued from page 5

Neutron Shields

Most neutron shields for high energy neutrons are multi-layer in nature. The inner layer generally is iron for its inelastic scattering probability which causes the neutron to immediately lose energy (fast energy range). The next shield layer uses a high hydrogen based matrix such as polyethylene and causes elastic scattering of the fast neutrons (thermal energy range). Lastly, a boron or cadmium based material will likely absorb the resultant neutron.

Southern California Edison

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San Onofre Nuclear Generating Station is proud to have over 60 registered NRRPT members in our Health Physics, Training, Chemistry, Engineering, Operations, Oversight, and Maintenance organizations. We are especially proud that Kelli Gallion of our HP Planning group was a member of the Panel of Examiners, Board of Directors, and is currently the NRRPT Chairman.

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Detroit Edison Fermi 2

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The Center for Continuing Professional Education at HSPH offers courses that enhance your knowledge of up-to-date news and other practical, problem-solving approaches relevant to the radiation protection industry. You are invited to attend the following 2007 programs:

In-Place Filter Testing Workshop 8/20 – 8/24

Occupational and Environmental Radiation Protection: Principles and Practices of Radiation Safety
4/23 - 4/26

Radiation Safety Officer Training for Laboratory Professionals 6/11 – 6/15

Radiological Emergency Planning: Terrorism, Security, and Communication 8/7 – 8/10

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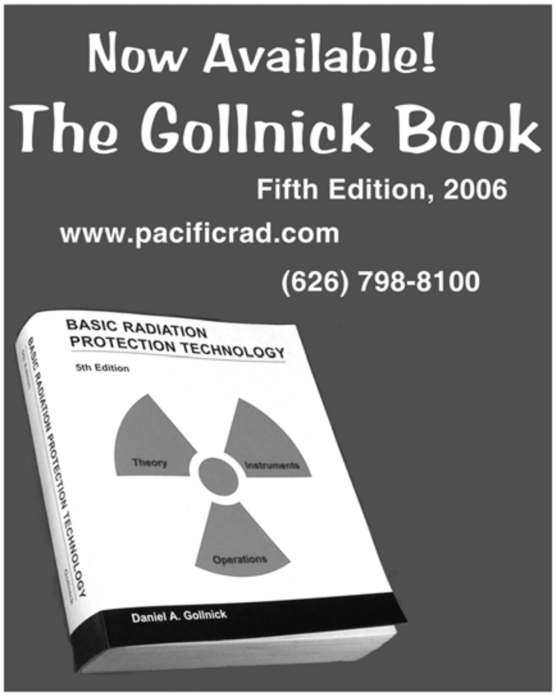

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PEP Courses

Unfortunately, **NRRPT** PEP Courses were not available at the HPS Mid-Year meeting held in January 2007.

We apologize for any inconvenience this may have caused.

Please watch the newsletters for future courses.

Save the Date!

NRRPT Board & Panel Meetings
July 7 - 10, 2007
Portland, OR
Doubletree Hotel & Convention Center

** All **NRRPT** members are welcome and encouraged to attend **

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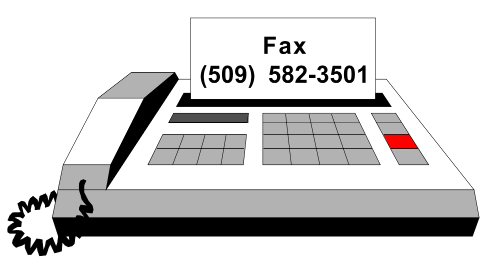

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