Since this is the spring issue of our newsletter, I thought I’d share some springtime facts (and myths). In astronomy the **vernal equinox** *(spring equinox, March equinox, or northward equinox)* is the moment when the sun appears to cross the celestial equator, heading northward. It is the precise moment that spring begins in the Northern Hemisphere and autumn in the Southern Hemisphere. At this moment, night and day are equal all over the world, the sun sets at the South Pole and rises at the North Pole and anyone standing on the equator at noon will not cast a shadow. The term can also be used to refer to the point on the sky defined as the first point of Aries.

The equinox occurs from March 19 to March 21, the precise time being about 5 hours 49 minutes later in a common year, and about 18 hours 11 minutes earlier in a leap year, than in the previous year. It is the balance of common years and leap years that keeps the calendar date of the vernal equinox from drifting more than a day from March 20 each year. *(Reference: http://en.wikipedia.org/wiki/Vernal_equinox)*

Egg balancing myth or fact??? A common old wives’ tale regarding the vernal equinox is that this is the one day of the year that eggs can be balanced on their end. While this myth is untrue (eggs can be balanced on any date with enough patience) and unsound (would it be different in the southern hemisphere? why not only the instant of vernal equinox? why not autumnal equinox?) it is often perpetuated in the news.
Okay, now for some NRRPT news. The development of the Canadian exam is now complete and is scheduled to be administered in August at multiple locations in Canada. In addition, we are planning to attend our first Canadian Radiation Protection Association (CRPA) Conference in Winnipeg, Manitoba June 19-23, 2005. The purpose of the visit is to promote and provide information relating to the NRRPT exam. Look for our trip report in the summer newsletter.

Congratulations to the 16 successful February 2005 and March 2005 exam takers! Great job and welcome aboard!

The 63rd NRRPT Board and Panel meeting was held January 8-12, 2005 in Ft. Lauderdale, Florida. Dave Biela (Panel Chairman) announced the selection of our newest Panel members. I would like to welcome Jim Miller (Ca. Food and Drug Administration) and Barry Kimray (Catawba). Their terms are effective immediately and end January 1, 2009.

On behalf of the Board and Panel members, we would like to encourage you to send us those articles. We are always looking for a variety of articles for our quarterly newsletter such as new technology and techniques, experience with first time evolutions, improved ALARA techniques, process improvements, recognition of a co-worker or colleague, homeland security, brain teasers, human performance issues, and lessons learned, to name just a few. A sincere “thank you” goes out to those members who have, and those that continue to contribute to the newsletters. Please send your articles to Bob Farnam at refarnam@cal.ameren.com or DeeDee McNeill at NRRPT@NRRPT.org.

Just as a reminder, our annual meeting is being held in conjunction with the HPS Annual Meeting in Spokane, Washington July 10-14, 2005. All members are welcome, and remember, you receive 2 points towards your Registration Maintenance for attending the conference. The meeting registration form is located on page 23.

Best wishes and thank you for your continued support!!

Sincerely,
Kelli Gallion

---

Welcome New Members

Congratulations to the following individuals who successfully passed the NRRPT February 5, 2005 examination:

John Daniel Brasfield  
Jack D. Chadwick  
Daniel R. Conley  
Jeffrey M. Dillion  
David W. Duffey  
Kenneth D. Kuhns  
Charlie S. Lagarde  
Larry D. Larson  
Larry S. Loftus  
Brett T. Meyer  
Robert A. Rodgers  
Steven P. Schlerf  
Gregory P. Yuhas

Congratulations to the following individuals who successfully passed the NRRPT March 26, 2005 Special examination:

Phil H. Lashley  
Russell A. Pucci  
Jeffrey A. Wilbur

New Members: If you do not have access to the private side of the web page please contact the Executive Secretary (nrrpt@nrrpt.org). She must have your email address on file in order for you to gain access.
A General Review of the Characteristics of Gas-Flow Proportional Counter

By Augustinus Ong

Dartmouth College

The purpose of this paper is to reacquaint ourselves with and to remind ourselves how to apply a simple method from health physics’ radio-analytical notes to determine the characteristics of a 2 p gas-flow proportional counter, where 2 p is the geometry of radiation detection.

Briefly, a 2 p proportional counter is a gas-filled radiation detector (see illustration below). It is a two electrode device, arranged so that the cathode is the inner surface of the chamber and the anode at the center. The windowless proportional counter uses a continuous flow of low pressure counting gas to the sample chamber.

Because of operation at relatively low voltages, the gas multiplication of the 2 p gas-flow proportional counter is reduced and the resultant electrical pulse is the result of a single avalanche rather than a succession of avalanches. There are two obvious advantages as a result. The pulse formation and its decay time is shortened to around 0.5 microseconds. This enables the proportional counter to handle high pulse rates before counting losses are significant. The second advantage is that the number of ions in the avalanche is directly proportional to the energy deposited in the counter, which is why a proportional counter is so named. This proportional counter can thus be used for alpha/beta energy spectrometry.

For beta efficiencies, it is generally reported that thin-window counters and gas-flow proportional counters are independent of beta energy above approximately 0.6 MeV. For beta particles with maximum energy, the particle range greatly exceeds the chamber dimensions. The number of ion pairs formed in the gas is then proportional to only that small fraction of the particle energy lost in the gas before reaching the cathode wall. The thickness and the source covering can also affect the counter efficiency for beta radiation of various energies. These factors can affect the efficiency of detection; particle emissions from the source are removed from the beam before they can strike the detector gas, thus lowering the observed count rate.

For alpha particles of various energies, the chamber dimensions are adequate in capturing those energies. In the proportional counter, an alpha plateau occurs at a lower voltage than the beta plateau. At low voltages, only the most energetic alpha particles will produce pulses large enough to be counted. Increasing the voltage causes the count rate to reach a plateau when essentially all of the alpha particles are being counted. With a further increased gas multiplication, pulses from beta particles surpass the proportional counter’s discriminator level and can be counted. At still higher voltages, a steeper combined alpha-beta plateau is reached (see graph).
Alpha particles can only penetrate thin material. Alpha emitters must therefore be thin sources if a large fraction of alpha particles is to escape from the source itself. A source that is physically thicker is subject to self-absorption, which is likely to affect both the number and the energy spectrum of the radiation that emerges from the surface of that source. In the case of a typical standard alpha-emitting source, the radioactive material is evaporated onto a metal disk. A beta-emitting source, on the other hand, emits generally more penetrating particles than those from an alpha-emitting source. Beta emitters can have a thickness of few tenths of a millimeter thick without any significant self-absorption problem. In short, depending on the thickness of the source, the self-absorption errors can be a factor in the counting efficiency.

At the higher photon energies, more typical of gamma rays, proportional counters are no longer attractive as the detector of choice. Counting efficiency becomes very small because the direct interaction probability of the photon in the gas drops rapidly with energy. The gamma detection then arises from those photon capable of interactions within the counter wall for which the resulting secondary electron deposits its energy in the counter gas. This process results in an intrinsic efficiency of only 1 percent or so.

**General experimental procedures:**

1. The alpha and alpha / beta plateaus of a proportional counter can be determined with alpha / beta sources, such as U-238, by varying the high voltage (400 to 2500 volts) to the counter and recording the count-rate as a function of high voltage. The voltage can be varied in 50 volt steps. Plot the results with Total Counts per minute on the Y-axis and Volts on the X-Axis.

2. The effects of pulse amplification upon the alpha plateau and the alpha / beta plateau of the proportional counter can be studied by varying the discriminator setting of the detector.

3. Tl-204 (Energy Max = 763 keV) and Sr-90 (Energy Max = 546 keV) sources of known activities can be used to demonstrate the effect of beta energy on the overall count-rate efficiency, where

\[
\text{Detector Efficiency} = \frac{\text{Observed CPM}}{\text{Current Source Activity in DPM}}
\]

4. A Co-60 source of known activity can be used to demonstrate the effect of gamma energy on the count-rate efficiency. Since Co-60 is a beta-gamma emitter, the beta particles can be attenuated by wrapping the source with thick aluminum foil.
A Unique Decontamination Project
The XF-90A, SIN 46-688
By James Seals

The XF-90 was designed to be a long range penetration fighter that escorted long range bombers (B-36 and B-50) to their targets.

On June 20, 1946, the U.S. Army Air Force (AAF) issued a contract to Lockheed for two prototypes. The first prototype was delivered for flight testing in the spring of 1949. The XF-90 reached a maximum speed of 668 mph in level flight at 100 feet and a maximum speed of mach 1.2 in a dive. The XF-90A’s had 35-degree sweptback wings, a sharply pointed nose, and a pressurized cockpit. The plane could be fitted with supplemental wingtip-mounted fuel tanks and twin side-by-side Westinghouse XJ34-WE-15 turbojets with afterburners producing 4,200 pounds static thrust. Soon after initial flight testing in June 3, 1949, the two aircraft were retrofitted with afterburning J34 engines.

The XF-90 project was terminated in September 1950. One of the planes had been tested to destruction in the NACA (National Advisory Committee for Aeronautics, now NASA, National Aeronautics and Space Administration) laboratory in Cleveland, Ohio. The other plane was used in above ground nuclear testing at Frenchman’s Flat on the Nevada Test Site (NTS).

In November 2001, the United States Air Force Museum at Wright-Patterson Air Force Base contacted Fluid Tech, Inc. in Las Vegas, Nevada, to decontaminate the only remaining XF-90A, which was located in Area 11, Plutonium (Pu) Valley, on the NTS. Robert E. Friedrichs, U.S. Department of Energy, Nevada, provided invaluable support acting as liaison between the Air Force Museum, Bechtel Nevada (the Prime contractor at the NTS), the Nevada Department of Energy, and Fluid Tech, Inc.

Area 11, Pu valley, is considered to be one of the most highly contaminated areas on the NTS. In 1957, four safety experiments for Pu dispersal were conducted with several kilograms of Pu at ground level. The immediate ground zero (GZ) areas are high contamination areas,
approximately 300 feet in diameter with transuranic soil concentrations ranging from 2,700 to 8,100 microcuries per square meter.

The plane had been broken into two pieces right behind the engines with the wing, fuselage, engines at the center of one GZ and the tail section at the center of another GZ. The plane sections had been placed at these locations to provide realistic training for Broken Arrow (plane accident with nuclear material on board) exercises. Contaminated soil had been placed on surfaces and in openings of the plane. The plane had been exposed to more than 40 years of whirlwinds, winds, and weathering which resulted in slight amounts of airborne contamination (femtocuries) in the air and depositing on the plane’s surfaces.

The main source of the plane’s contamination was a colony of transuranic loving white tailed antelope squirrels, like small chipmunks, who considered the plane to be a high-rise condominium. The squirrels had dug burrows in the contaminated soil and collected twigs and brush from the highest concentration of contamination at the base of local vegetation and moved into the plane. Once in the plane, the squirrels, with their contaminated fur and contaminated twigs, set up housekeeping. The squirrels seemingly could penetrate a keyhole; every crack and cranny in the plane had contamination and brush.

Fluid Tech first stabilized the desert soils immediately surrounding the plane and the dirt roadways leading to the plane using TranSeal I. TransSeal I is Fluid Tech’s own dust suppressant and complies with U.S. EPA and Nevada regulations.

Due to the squirrels that had occupied the aircraft for forty years and the possibility of the Hanta Virus, the plane was disinfected with sodium hypo-chlorite (bleach) using a water truck and a high-pressure spray washer. Every piece that left the contamination zone was pressure washed with water and soap, surveyed, and if necessary, pressure washed with water and sand using a pressure washer wand that had a venturi producing suction from the water flow pulling sand into the high pressure water. The sand was purchased from America Cement and Aggregate, located at the south-east boundary of the NTS. Every piece of the plane was identified in a schematic showing location before removal and the final contamination survey results for gamma, beta, and alpha contamination.

Disassembly of the aircraft involved using Fluid Tech’s all terrain 38K lb. capacity crane to remove the engines and to separate the fuselage from the wings. The two engines were removed and wrapped for shipment to Fluid Tech’s
EMAD (Engine Maintenance and Disassembly) facility. Interestingly, after fifty years, the engine compressor blades still rotated freely when spun by hand. The good bearings were from different manufacturers.

Every rivet on the fuselage, wings, tail section, and outer skin was drilled out to the correct size for replacement with original size rivets. Drilling the rivets required an enormous quantity of drill bits and the careful selection of drill bit types (angle of tip point) and drill bit material (carbide, high speed, titanium nitride, titanium carbonitride or aluminum nitride coated).

With the outer skin removed, every piece of equipment on the wings, tail section, and fuselage was removed. This included fuel tank, hydraulic lines, electrical junction boxes, electrical wiring, motor insulation, and miscellaneous parts too numerous to mention. Interestingly, the fuel tanks seemed to be a type of rubberized canvas and there was a lead counterbalance on the vertical stabilizer.

Fluid Tech positioned a self-contained laboratory skid outside the fenced contamination zone opposite the hot line. The lab skid had a diesel electrical generator, potable water, electric air conditioning/heating, regulated power for instruments, hood and laboratory counting gear, and shelving for anti-c’s. All swipes and air samples were counted daily when decontamination was taking place in the field. During the summer months, due to the severe heat, flood lights and generators were used and disassembly and decontamination activities took place during the graveyard shift.

Instrumentation used during preliminary surveys and the final survey included: Ludlum Model 2360 with 100 cm² 43-93 alpha/beta probes; Ludlum Model 19 scintillation gamma detector; 2 Tennelec Automatic Planchet Counting Systems Series II swipe and air sample counters; numerous Ludlum Model 2200 scalers with Alpha 43-1 probes; and an Eberline Personnel Contamination Monitor PCM-1B alpha/beta monitor.

Calibration and instrument verification was done using Eberline Model 594-4 Pu 239 and Eberline DNS-19 Tc 99 alpha/beta standards.
Additional Pictures
Curt's Continuing Ed Corner
By Curt Repass

I have been involved in many continuing education courses in the past, and math is something that many people struggle with. Everyday we are challenged with performing an analysis of the data gathered during the course of our duties. When counting smears, we use multiplication skills to convert cpm to dpm. In order to properly analyze air sample results, we have to be familiar with scientific notation and understand the magnitude of the number. This will be a basic review of typical problems an RRPT may encounter on the job. I will cover the following:

1. How to express a given number in exponential form and scientific notation.
2. Comparing the magnitude of numbers expressed in exponential form and scientific notation.
3. How to add, subtract, multiply and divide numbers in exponential form and in scientific notation.
4. Solving for the unknown value in equations.
5. Using equation solving techniques to solve word problems.

### Exponential form
Exponential form is often used to express numbers that are very large or very small. The number 0.000001 can be expressed as $10^{-6}$. The number 100,000,000,000,000 can be expressed as $10^{14}$. An exponent is the superscript that tells us what power a base number is to be raised to. A base is the number that will be raised to some power. A coefficient is the multiplier for the base (if there is one). (For example: in the expression $4y^3$, $y$ is the base, 3 is the exponent, and 4 is the coefficient). A rule of exponents states “When the exponent is zero, the value of the term will always be 1” ($5^0=1$). Negative exponents can be expressed as the reciprocal of the expression. When using the reciprocal, the exponent’s sign will change to positive. ($8^{-5} = 1/8^5$)

### Scientific Notation
Scientific Notation (as with exponential form), is often used to express numbers that are very large or very small. Expressed as a number multiplied by a power of ten. The number 0.00000234 can be expressed as $2.34 \times 10^{-6}$. 98,400,000,000,000,000 can also be expressed in the abbreviated form: $9.84E16$, in which the ‘E’ replaces ‘x 10’.

When comparing the magnitude of numbers in exponential form, a few rules are to be followed. Expressions with positive exponents are always greater than 0, assuming no negative coefficient exists. ($3^4 = 3 \times 3 \times 3 \times 3 = 81$). Expressions with exponents of zero are always equal to 1, assuming no coefficient exists. ($45^0 = 1$). Expressions with negative exponents are always less than 1, assuming the base is greater or equal to 1. ($216^{-4} = 1/216^4 = 1/2176782336$).

Comparing magnitude of numbers in scientific notation is simply identifying what is the largest of a group of numbers. To identify the larger number, a few simple steps are required. First, observe the sign of the base. If the base is negative, then the number is less than zero regardless whether or not the exponent is negative or positive. If the base is positive, then the number is greater than zero regardless whether or not the exponent is negative or positive. For example, 1.01E2 is larger than -2.45E6.

Second, observe the sign of the exponent if the bases have the same sign. If the exponent is positive, the number will move farther from zero as the exponent becomes larger. If the exponent is negative, the number will move closer to zero as the exponent becomes larger. For example, 2.22E1 is larger than 3.89E-6.
Adding or subtracting numbers in exponential form is performed as follows: Convert numbers from exponential form to standard form. Add or subtract as normal. For example, \(5^2 + 6^3 = (5 \times 5) + (6 \times 6 \times 6) = 25 + 216 = 241\)

Two general rules apply when multiplying and dividing numbers in exponential form. When multiplying an exponential by another with the same base, the base stays the same and the exponents are added together. For example, \(3^4 \times 3^7 = 3^{4+7} = 3^{11}\). When dividing an exponential by another with the same base, the base stays the same and the exponent of the divided is subtracted from the exponent of the divisor. For example, \(5^8 \div 5^3 = 5^{8-3} = 5^5\).

When multiplying or dividing numbers with unlike bases, convert the numbers to standard form and solve the equation. For example, \(4^3 \times 2^6 = (4 \times 4 \times 4) \times (2 \times 2 \times 2 \times 2 \times 2) = 64 \times 64 = 4096\).

Adding or subtracting numbers in scientific notation is performed as follows: Convert numbers from scientific notations to standard notation, then add or subtract as normal. For example, add \(4.32E5\) and \(2.001E3\). Convert to standard notation: \(4.32E5 = 432,000\), \(2.001E3 = 2001\). Add them together: \(432,000 + 2001 = 434,001\).

Multiplying numbers in scientific notation requires the following steps: Multiply the bases together, and then add the exponents together. For example, multiply \(4.32E5 \times 2.001E3\). Multiply the bases: \(4.32 \times 2.001 = 8.64432\). Add the exponents: \(5 + 3 = 8\). The answer is: \(8.64432E8\).

Dividing numbers in scientific notation requires the following steps: Divide the bases, and then subtract the exponent of the divisor from the exponent of the divided. For example, divide \(9.6E-2\) by \(5.7E4\). Divide the coefficients: \(9.6 \div 5.7 = 1.6842\). Divide the exponents: \(-2 - 4 = -6\). The answer is \(1.6842E-6\).

Equations are used routinely in math and science. An equation is a mathematical statement that two expressions are equal. \((6 \times 5 = 30\). \(6 \times 5\) is an expression that is equal to 30).

Equations often have an unknown value that may need to be found. These unknown values are often represented by a literal number. \((5x + 4 = 24\). “x” is an unknown).

Applications to radiation protection may include finding the half-life of a certain radioactive isotope, determining decay time or shielding needs, and calculating curie content of a radioactive shipment.

Solving equations involves performing the same mathematical operation for both sides of the equation. By performing the same operation, both sides of the equation will always be equal. We may add, subtract, multiply or divide both sides of an equation by the same number, as long as it is not zero. We may even invert, square, or take the square root of both sides of an equation and still have both sides remain equal.
Solving word problems is nothing more than changing verbal statements into mathematical equations. The basic keys to performing this task are as follows: Recognize what arithmetic operation to use by identifying the key word in a problem. Identify what data is necessary to arrive at the answer. Transfer the data into equation form. Key words identifying the correct arithmetic operation:

- For addition: And, expand, gain, grow, increase, rise, total, plus, sum. Greater than, more than, larger than, etc.
- For subtraction: Minus, difference, from, lose, lower. Less, less than, smaller than, etc.
- For multiplication: Times, product, and multiple. Twice, double, triple, etc.
- For division: Divided by, ratio, and quotient. Into, half, third, per, etc.

EXAMPLE 1: A radiation worker has 492 mrem TEDE, 28 mrem LDE, and 654 mrem SDE, and enters an area of 100 mrem/hr for 1 hour accumulating another 100 mrem TEDE, what will his total TEDE exposure be? The key word is ‘total’. The problem is identified to be an addition problem.

EXAMPLE 2: A radiation worker has 492 mrem TEDE, 28 mrem LDE, and 654 mrem SDE, and enters an area of 100 mrem/hr for 1 hour. What is his total TEDE exposure? The key word for the example is ‘TEDE’. The problem is only concerned with TEDE exposure. The LDE or SDE exposure are inserted as distracters and do not come into play when solving the question.

To solve a word problem, transfer the data into equation form. List the numbers necessary to solve the equation with their respective units. Identify which side of the equation they should be on.

EXAMPLE: A radiation worker has 492 mrem TEDE, 28 mrem LDE, and 654 mrem SDE, and enters an area of 100 mrem/hr for 1 hour. What is his total TEDE exposure? The numbers are 492 and 100. The units are TEDE. The equation is: 492 mrem TEDE + (100 mrem x 1) TEDE = “x” mrem TEDE. 492 mrem TEDE + 100 mrem TEDE = “x” mrem TEDE. The solution is 592 mrem TEDE.

The basic math concepts covered in this article are some of the fundamental knowledge requirements necessary for the RRPT to have. Everyday, the radiation protection technician is challenged with performing analysis of data gathered during the course of his/her duties. In order to adequately perform this analysis, a firm understanding of basic math skills is required.

I hope that you find this type of information useful. If you have ideas on articles you would like to see, or comments please do not hesitate to contact me. I can be reached by email, phone or mail.

Curt Repass  (815) 626-6804
1504 Locust St crepass@insightbb.com
Sterling, IL  61081
NRRPT Membership Status Levels

Registered Practitioner: A registered practitioner is a member that has satisfied all their registration maintenance requirements or that has not yet come to the conclusion of their first cycle. In addition, a registered practitioner is current on their annual dues.

Registered Supporter: A registered supporter is an annual dues paying member that has not maintained their registration requirements.

Retired: A retired member is a non-dues paying member and no longer practices in the radiation protection field. The Registry maintains a list of retired practitioners as a convenience for other Registry members that may need to contact those persons.

Deceased Members: The NRRPT, in memory of deceased members, maintains an up to date listing of past and present practitioners in the radiation protection field. The Registry maintains a list of deceased members in their handbook and encourages all practitioners to report the passing of any members to the Executive Secretary for inclusion in the list.

Awards Bestowed by the NRRPT

Arthur F. Humm, Jr. Award: This award is presented to persons who have given outstanding support to the NRRPT. The Awards Committee is chartered to deliberate on potential nominees for this recognition at least annually. However, the award is not made at any established frequency; the frequency of this award is at the sole discretion of the Board of Directors.

Don Marshall Scholarship Award: This award may be presented to one or two registered members each year, who are planning on attending an accredited educational institution in a course of study in Health Physic or a closely related technical discipline. Applications for the Don Marshall Scholarship Award can be printed from the NRRPT Web site.

Charles D. (Bama) McKnight Memorial Award: This award is presented to trainers/instructors in the radiation protection field who have demonstrated outstanding efforts to increase knowledge and professionalism among Radiation Protection Technologist. The recipient of this award must be a current member of the Registry and in good standing. The Awards Committee accepts nominations for this award from the members of the Registry and presents recommended recipients to the Board of Directors for approval.

Fellow Members: Members who have given outstanding service to the NRRPT in the form of educational, administrative or scientific contributions. The Fellow candidate must have served at least one term on the Board of Directors or the Panel of Examiners. They must also have served as Chairman or similar position on one or more NRRPT committees. The Fellow must be a strong supporter and actively promote the goals, programs and benefits of the Registry. Fellows will be afforded all the privileges of Registered Practitioners but do not have to pay annual dues. Current or present Board or Panel members may submit a candidate, for Fellow, to the Awards Committee. If the Awards Committee approves, the committee will present the candidate to the Board of Directors.

Member Emeritus: A member emeritus is one who has made sustained and substantial contribution(s) to the Registry. A member emeritus must be a registered member who has reached the age of 60 years or more and is no longer active in the radiation protection field because of a disability or retirement. A member emeritus also must have been an active member of the Registry for at least 10 years prior to application. Member Emeritus status conveys all the privileges afforded a registered practitioner without having to pay annual dues.

These are brief overviews of the membership status levels obtained through involvement in the NRRPT. The awards described above are obtainable by either registered members or non-registered supporters of the Registry.
A Review of the Quantities and Models Used in Internal Dose Calculations and ALARA Calculations

By Robert Wills
General Engineering Laboratories, LLC

Absorbed Dose

The basic dosimetric quantity in radiation protection is the absorbed dose, defined as the energy absorbed per unit mass of material, and usually represented by the letter D. For assessing doses to organs or tissues, the dose is normally the average dose over the entire organ or tissue. The currently recommended unit for absorbed dose is joules per kilogram, with the special unit of gray (Gy), equal to 1 J/Kg. The older and still widely used unit of dose is ergs/gm, with the special unit of rad, equal to 100 ergs/gm, or 0.01 J/Kg, giving the relationship of 100 rad per Gy. The rate of energy deposition or loss by radiation is called the stopping power, S, or the linear energy transfer, LET. Low-LET radiations produce sparsely distributed ionizations along their tracks, whereas high-LET radiations produce densely packed ionizations. The density of ionizations has a significant impact on the biological effect of the radiation, with the result that a dose of 1 rad will have a different biological impact depending on the type and energy of the radiation that produced that dose, that is, on the LET of the radiation. For assessing health effects, therefore, the dose in rads by itself is not a satisfactory quantity. Note also that doses in rads produced by different types of radiation with very different LETs are generally not additive when assessing health effects or risk. That is, a dose in rads produced by photons cannot be directly added to a dose in rads produced at the same location by, say, neutrons, without first making allowances for the differences in effectiveness of the two types of radiation in producing the health effect under consideration.

Dose Equivalent/Equivalent Dose

To produce a more uniform scale of biological impact by different types of radiation, and also to permit the addition of doses deposited by different types and energies of radiation in order to obtain the total dose that is indicative of risk, the absorbed dose caused by each type of radiation is multiplied by a normalizing factor that takes into account the relative effectiveness of the radiation in producing the biological effect in question. In radiation protection, the effect of concern is normally radiogenic cancer and hereditary effects, known as stochastic effects. The product of the absorbed dose and this modifying factor is called the dose equivalent. The modifying factor used to obtain the dose equivalent is called the quality factor, Q, and the factor used to calculate the equivalent dose is called the radiation weighting factor, WR.

Effective Dose Equivalent /Effective Dose

Prior to 1977, radiation protection was based on the concept of the critical organ, which was defined as the organ whose radiation exposure posed the greatest risk to the exposed person. This was normally the organ that received the highest dose, and the dose to the critical organ was used to control radiation exposure. Starting in 1977, use of the critical organ concept was discontinued, and a new quantity was introduced, called the effective dose equivalent. This was defined as the sum of the doses to a defined set of organs thought to be most susceptible to radiation-induced cancer, with each organ dose weighted by a factor that is proportional to the relative contribution of that organ or tissue to the overall stochastic detriment (which includes cancer mortality, cancer morbidity, years of loss of life, and hereditary effects) when the body is subjected to uniform whole body radiation exposure. HE = \( \sum HT \times WT \) (Eq. 1) where, \( HT = \) average dose equivalent in tissue or organ \( T \), \( WT = \) tissue weighting factor for tissue or organ \( T \).

Committed Effective Dose Equivalent

Internally deposited radionuclides deliver dose to organs over a period of time that may last up to the lifetime of the exposed individual, and the doses delivered from one year to the next are usually not equal. One approach
to assessing the impact of these radionuclides is to calculate the dose for each year following intake, and add that to any external dose for that year to arrive at the total dose for the year. This approach, however, was tried and has been found to be logistically very difficult to implement. The year-by-year approach is especially challenging when estimating doses to members of the public. Therefore, the nearly universal practice now is to calculate the total dose that would be delivered to the organ from the time of intake up to 50 years following the intake for workers, and up to age 70 for members of the public, and to assign that dose to the year in which the intake occurred. A more important reason for adopting this method of control of exposure is that it achieves the primary protection purpose of limiting the lifetime risk committed in a year of practice, and not the risk incurred in one year as a result of an intake. The integrated dose is called the committed dose equivalent or the committed equivalent dose, depending on whether Q or WR is used in the calculations, respectively. As with external dose, the weighted tissue and organ doses are added to calculate the committed effective dose equivalent or the committed effective dose. Finally, adding the external and internal dose components yields the total effective dose equivalent or the total effective dose.

Collective Dose

Another quantity that has found wide application is the collective dose, which is the sum of all doses received by all members of a specified exposed population, such as all members of the public exposed to radiation and radioactive materials from a decommissioning project. The concept of collective dose has been used extensively in optimization, or ALARA (As Low As is Reasonably Achievable) assessments, and is one of the useful means available to compare the total radiation risk resulting from different ways of completing a project, or to compare different options for achieving a specified goal. Although the use of the collective dose to predict the number of latent cancer fatalities from a proposed action is controversial, this quantity continues to be very useful and is used widely.

PLEASE SUPPORT THE NRRPT® CORPORATE SPONSORS

Gold Corporate Sponsors

Bartlett Nuclear, Inc.
Pacific Gas and Electric Co.

Silver Corporate Sponsors

Biodex Medical Systems
Canberra Industries
Detroit Edison Fermi 2
Duke Power Company
FRHAM Safety Products, Inc.
Lakeshore Technical College
Master-Lee Decon Services
Nevada Technical Associates, Inc.
RADCeCO, LLC
Reef Industries, Inc.
Southern California Edison
STP Nuclear Operating Company
Thermo Electron Corp.

Corporate Sponsors

AmerenUE – Callaway Plant
American Electric Power
Calvert Cliffs Nuclear Power Plant
Chase Environmental Group, Inc.
F&J Specialty Products, Inc.
General Engineering Laboratories, LLC
Global Dosimetry Solutions, Inc.
HI-Q Environmental Products Company
MGP Instruments
MJW Corporation, Inc.
Pacific Radiation Corp.
RAD-Ware, Inc.
RETN, Inc.
Safety and Ecology Corporation
Server Solutions
Technical Management Services
UniTech Services Group, Inc.
Bartlett Nuclear, Inc.

Paul Lovendale
60 Industrial Park Road
Plymouth, MA 02360
(508) 746-6464 Ext 305
(508) 830-3616 (fax)
paull@bartlettinc.com
www.bartlettinc.com

Bartlett Nuclear, Inc. has over 20 years experience providing health physics, decontamination, mechanical maintenance, janitorial and other staff augmentation services to the commercial nuclear industry and Department of Energy facilities. Bartlett provides decommissioning and decontamination services and equipment, including remote monitoring systems, strippable coatings, liquid decontamination processes, and scaffolding.

Pacific Gas and Electric Co.
Diablo Canyon

Robert E. Hite
Box 56
Avila Beach, CA 93424
(805) 545-4591
(805) 545-3459 (fax)
REHY@PGE.com
www.pge.com

Diablo Canyon is located on California's central coast on some of the most picturesque and pristine coastline in the world. Diablo Canyon generates enough electricity to meet the needs of over 2 million homes.
## Biodex Medical Systems

Lila Corwin  
20 Ramsay Road  
Shirley, NY 11967  
(800) 224-6339  
(631) 924-8355 (fax)  
sales@biodex.com  
www.biodex.com

Biodex Medical Systems is a manufacturer and distributor of radiation shielding, protection and detection products for nuclear medicine, diagnostic imaging and radiation safety. Products range from syringe shields, lead-lined cabinets and PET shipping systems to survey meters, wipe counters and Radiacwash, a decontamination solution. Call to request a catalog or visit their website.

## Canberra Industries

Tammie Pattison  
800 Research Pkwy  
Meriden, CT 06450  
(800) 243-3955  
(203) 235-1347 (fax)  
tpattison@canberra.com  
www.canberra.com

Radiation measurement, detection and monitoring equipment. Alpha and gamma spectroscopy systems, portal monitors, personal contamination monitors, trucks, vehicle monitors, survey meters, personal dosimeters, specialty research HPGE detectors.

## Detroit Edison Fermi 2

Hal Higgins  
6400 N. Dixie Hwy  
Newport, MI 48182  
(734) 586-1825  
(734) 586-1883 (fax)  
higgins@duke-energy.com  
www.dteenergy.com

Detroit Edison operates the Fermi 2 Nuclear Power Plant located in Monroe, MI along the shores of Lake Erie. Fermi is a 1200 MW power plant supplying electricity to the metropolitan Detroit area. Fermi’s USA Supplier of the Year TLD lab provides dosimetry services to USA facilities and other non-power plant entities.

## Duke Power Company

Larry Haynes  
526 S. Church Street, Box 1006, MS-EC07F  
Charlotte, NC 28201  
(704) 382-4481  
(704) 382-3797 (fax)  
lehaynes@duke-energy.com  
www.dukepower.com

Duke Power provides safe, reliable and economical power to the Carolinas. We deliver electricity to more than 2 million customers – balancing the region’s growing electricity needs with care for the environment and the communities we serve. We currently operate seven reactors and are proud to support the NRRPT.
Master-Lee is a leading supplier of refueling, maintenance, inspection, operations and outage management services for PWR Nuclear Power Plants in the U.S. Market and has supported the major NSSS companies in the performance of similar tasks at BWR sites. Master-Lee also designs, fabricates and supplies specialty products, tools and parts in support of our various product lines. These capabilities are provided by our broad range of Product Lines: Refueling and Related Services; Pump and Motor Services; NDE – Eddy Current Testing Services; Specialized Reactor Services; Decontamination Services; Decommissioning Services; Engineered Products; and Technical Services.

Nevada Technical Associates, Inc.

Robert Holloway
P.O. Box 90748
Henderson, NV 89009
(702) 564-2798
(702) 558-7672 (fax)
nta@ntanet.net
www.ntanet.net

Nevada Technical Associates, Inc. provides training courses in radiation safety including an NRRPT Exam Review Course. See www.ntanet.net or call (702) 564-2798.

FRHAM Safety Products, Inc.

Fred H. Nance, Jr.
318 Hill Avenue
Nashville, TN 37210
(615) 254-0841
fnance@frhamsafety.com
www.frhamsafety.com

Frham Safety Products, Inc. introduces the ultimate in comfort and safety, Frham Tex II. This waterproof, breathable, reusable and stretchable Frham Tex II coverall provides the ultimate in cool, comfort and dry protection. It offers supreme comfort and coolness, while simultaneously maintaining a total barrier -- keeps you dry from the outside and dry on the inside.

Frham Tex II is constructed of multi-layer absorption, diffusion, and desorption patented technology that consists of a unique fabric matrix. This matrix contains a synthetic polyester crepe tricot, a hydrophilic monolithic co-polyether-ester elastomer, and a bi-directional synthetic polyester interlock substrate that is treated with a one hundred spray rated D.W.R. This Frham Tex II system creates a protective garment, utilizing a heat stress reduction fabric that protects the user from harmful environments while keeping the highest individual comfort.

Earn Your Degree ONLINE

Lakeshore Technical College offers its associate degree Health Physics Technician completely online.

Go To LTC
Details available at gotoltc.edu/hp

1.888.GO TO LTC
(1.888.468.6582) • TTY: 920.693.8956
1290 North Avenue
Cleveland, WI 53015

LTC is an equal opportunity/access employer and educator.
**RADeCO**

Fred Lucci  
509 Norwich Avenue  
Taftville, CT 06380  
(860) 823-1220  
(860) 823-1521 (fax)  
flucci@radecooinc.com  
www.radecooinc.com

For over 25 years, RADeCO has set the standard for air sampling in the nuclear industry. We supply the highest quality air sampling equipment, filter media, and sampling cartridges. We also provide a full range of calibration, repair service, and spare parts for all your air sampling and air flow measurement equipment. In addition to being an NRRPT Corporate Sponsor, RADeCO offers special discounts to the NRRPT membership.

**Reef Industries, Inc.**

Tom Scarborough  
P.O. Box 750250  
Houston, TX  77275-0250  
(800) 231-6074 Ext 207  
(713) 507-4387 (fax)  
tscarborough@reefindustries.com  
www.reefindustries.com

Plastic laminates for floor covers, containment enclosures, bags, tubing and outdoor storage. Properties include fire retardancy, incinerability and reusability. Stock sizes as well as custom design and fabrication are available.

**Southern California Edison**

Bob Corbett, RPM  
P.O. Box 128  
San Clemente, CA 92672  
(949) 368-9645  
corbetrt@songs.sce.com

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.

San Onofre is a three unit site with two operating 1170 MWe Combustion Engineering reactors and one early Westinghouse unit in decommissioning. The station is located in Southern California on the Pacific Ocean and midway between San Diego and Los Angeles.

**STP Nuclear Operating Company**

Bill Bullard, RPM  
P.O. Box 289  
Wadsworth, TX 77843  
(361) 972-7130  
wtbullard@stpegs.com  
www.stpegs.com

More than fifty registered Radiation Protection Technologists are proud to work at the South Texas Project's two nuclear power plants. These plants, some of the world's newest, produce more than 2500 megawatts of electricity. The plants, and the team that operates them, set industry standards in safety, reliability and efficiency.
AmerenUE-Callaway Plant

Among the nation’s top utility companies in size and sales, Ameren is the parent of AmerenUE, based in St. Louis, MO, and AmerenCIPS, based in Springfield, IL. Ameren is also parent to several nonregulated trading, marketing, investment and energy-related subsidiaries. Ameren employees, totaling approximately 7,400, provide energy services to 1.5 million electric and 300,000 natural gas customers over 44,500 square miles in Illinois and Missouri.

Contact: Bob Farnam (573) 676-8784

Thermo Electron Corp
Radiation Measurement & Protection

Barry J. Wilson
P.O. Box 2108
Santa Fe, NM 87504-2108
(800) 274-4212
(505) 473-9221 (fax)
barry.wilson@thermo.com
www.thermo.com/rmp

An extensive range of radiation protection instruments and products for contamination, environmental and portable survey monitoring including personnel contamination monitors, air monitors, area monitors, waste monitors, TLD readers/materials, radiation shielding and smart portable survey meters.

F&J Specialty Products, Inc.

F&J SPECIALITY PRODUCTS, INC. (F&J) has a registered ISO9001 quality management system implemented for its production of air samplers, airflow calibrators, radiiodine collection cartridges, tritium and C-14 collectors, radon detection products and more. Many instruments are certified to UL and CSA electrical safety standards. F&J provides a complete line of accessories and consumables such as filter paper, smears, filter holders and radiiodine collection cartridges. Providing our customers with reliable and durable products is our corporate goal. Contact: Frank Gavila (352) 680-1177

American Electric Power

American Electric Power is a multinational energy company with a balanced portfolio of energy assets. AEP, the United States’ largest electricity generator, owns and operates more than 42,000 MW of generating capacity in the U.S. and select international markets. AEP is a leading wholesale energy marketer, ranking among North America’s top providers of wholesale power and natural gas with a growing wholesale presence in European markets. In addition to electricity generation, AEP owns and operates natural gas pipeline systems, natural gas storage, coal mines, and the fourth-largest inland barge company in the U.S. AEP is also one of the largest electric utilities in the U.S., with almost 5 million customers linked to AEP’s wires. Contact: David Wood (616) 465-2559

Chase Environmental Group, Inc.

Chase maintains a staff of professionals with years of experience in providing radioactive and mixed waste disposal solutions. Chase also offers comprehensive remediation and decommissioning services.

Contact: John O'Neil (877) 382-2124

Calvert Cliffs Nuclear Power Plant

Constellation Nuclear, LLC, a member of the Constellation Energy Group, owns and operates the Calvert Cliffs Nuclear Power Plant and Nine Mile Point Units 1 and 2 and Ginna Unit 1. Constellation Nuclear was created to ensure CEG has a reliable, efficient and diversified fuel base for its merchant energy business.

Contact: Steve Sanders (410) 495-3574

Catawba Nuclear Station

Catawba Nuclear Station, operated by the Duke Power Nuclear Generation group, is a dual unit 1129 Mw Westinghouse PWR facility on the shores of Lake Wylie. We are proud to have over 35 members of our Radiation Protection staff, registered by NRRPT, working at our nuclear station.

Contact: Mark Helton (803) 831-3777

F&J Specialty Products, Inc.

F&J SPECIALITY PRODUCTS, INC. (F&J) has a registered ISO9001 quality management system implemented for its production of air samplers, airflow calibrators, radiiodine collection cartridges, tritium and C-14 collectors, radon detection products and more. Many instruments are certified to UL and CSA electrical safety standards. F&J provides a complete line of accessories and consumables such as filter paper, smears, filter holders and radiiodine collection cartridges. Providing our customers with reliable and durable products is our corporate goal. Contact: Frank Gavila (352) 680-1177
General Engineering Laboratories, LLC

GEL provides the nuclear industry with radiochemistry, bioassay and analytical chemistry support. GEL is a provider of 10CFR61, REMP and hazardous waste characterization to commercial nuclear reactor sites, DOE sites and DOD facilities throughout the US. For information regarding analytical services please contact Robert Wills (843) 766-8171.

MJW Corporation, Inc.

The MJW Corporation is a professional consulting firm specializing in radiological and health physics for private industry, governmental agencies and educational institutions. The company expertise is divided into the general areas of Health Physics (Radiation Protection), Radiological Engineering, Decontamination and Decommissioning Services, Regulatory Support and Health Physics Consulting Services. Contact: David A. Dooley (716) 631-8291

RAD-Ware, Inc.

RAD-Ware, Inc., a woman-owned small business, is a professional consultancy, providing safe, quality, Radiation Protection - training (ABHP & AIBH approved), software, and services - for individuals, medical facilities, universities, commercial and government agencies. On-site training & project quotes available upon request. Our services are available, both nationally and internationally. Our CHP has more than 15 years in field operations, with more than 50 years combined experience, and we are proud of what we do! Contact: Dixie J. Wells-O'Dou (702) 645-9313

Global Dosimetry Solutions, Inc.

Global Dosimetry Solutions, Inc. is one of the world's largest providers of radiation dosimetry services. Global Dosimetry offers a full range of services for measuring ionizing radiation, through thermoluminescent (TLD) and track etch technologies. GDS also provides the Redi-Dose Electronic Dosimeters for immediate dose and dose rate readings. GDS is accredited by NVLAP in the USA and we are an approved dosimetry service for TLD, CR39 and MeasuRings in Canada. Contact: L. Biacchi (888) 437-1714

MGP Instruments

MGP Instruments designs, develops, markets and supports operational survey equipment and measurement systems. We are #1 in North America in electronic dosimetry, offering a broad spectrum of detection/protection devices and products for virtually any need. We are also recognized for our outstanding customer support.

Contact: Audrey Summers (770) 432-2744

HI-Q Environmental Product Company

HI-Q Environmental Products Co. is ready to help with your stack sampling requirements: State and Federal nuclear regulatory agencies require a stack discharge sampling program as part of the licensing process. Radionuclides discharged to the air in the form of particulate and volatile compounds must be assayed. Therefore, nuclear facilities are required to follow standard protocol for sampling their effluent. Possible emission of radionuclides to the general public has to be monitored in a systematic and acceptable manner. In the U.S., the U.S. Environmental Protection Agency has the authority over such matters, and the current requirements and guidelines for sampling in nuclear stacks and ducts are laid down in ANSI N13.1 1999. Contact: Marc Held (858) 549-2820

EARN REGISTRATION MAINTENANCE POINTS THROUGH HOME STUDY!

BASIC RADIATION PROTECTION TECHNOLOGY

Pacific Radiation Corporation
2945 Stonehill Drive
Altadena, CA 91001
(626) 798-8100
www.pacificrad.com

2, 4 or 6 points awarded
SAFETY...

Our Name
Our Business
YOUR Success!

Safety and Ecology Corp. leads the industry as one of the top 100 environmental firms offering Radiological Remediation, Industrial Hygiene, & MARSSIM Experts. Contact Marty Gray @ 800-905-0501. Check out our website: www.sec-tn.com

Server Solutions

Server Solutions, Inc. has been developing and hosting web-based applications since 1996. SSI specializes in applications using database back ends, allowing input and retrieval of data using a web browser. Technologies used include Windows 2000/2003 Servers, ColdFusion MX, MySQL and Microsoft Access databases. SSI’s content management system provides a means for users to update web content without having to learn HTML or other web languages. Standard web page hosting and email services are also offered. Contact: Vince Bishop (850) 899-4242

UniTech Services Group, Inc.

UniTech Services Group is the largest protective garment service organization in the world. With 11 licensed plant locations in the U.S. and Europe, UniTech provides waterwash decontamination, protective clothing sales and leasing, respirator cleaning and leasing in addition to both onsite and offsite tool and metal decontamination services.

Contact: Gregg Johnstone (413) 543-6911

Future NRRPT Exam Dates

August 13, 2005
Deadline for application: June 17, 2005
Application Fee: $200
Retake Fee: $100
Late Fee: $30
** Exam applications may be downloaded from our web page **

www.NRRPT.org

Continued from page 12

organization. The Awards Committee always welcomes solicitation from the Registry for persons they believe may be fitting of one of the aforementioned awards. To nominate a person for one of these awards, please e-mail Eddie Benfield, Awards Committee Chairman, at embenfie@duke-energy.com and note on the subject line as NRRPT Awards Nomination. Also, remember that some of the above awards and membership statuses have forms that are available from the NRRPT web site that should be completed and forwarded to the Executive Secretary for routing to the Awards Committee. The additional Awards Committee personnel that can be contacted about awards nominations are:

Steve Lancaster (lancastersteve@msn.com) and Tim Kirkham (tim.kirkham@constellation.com).
# NRRPT Merchandise Order Form

## Logo Apparel

### Available Styles & Prices

<table>
<thead>
<tr>
<th>Description</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>Outer Banks Polo</td>
<td>$23</td>
</tr>
<tr>
<td>Jerzee Polo</td>
<td>$18</td>
</tr>
<tr>
<td>Denim Long Sleeve</td>
<td>$21</td>
</tr>
<tr>
<td>Denim Short Sleeve</td>
<td>$20</td>
</tr>
<tr>
<td>Blue Fleece Vest</td>
<td>$37</td>
</tr>
<tr>
<td>Khaki Nylon Vest</td>
<td>$40</td>
</tr>
<tr>
<td>Blue Nylon/Fleece Jacket</td>
<td>$49</td>
</tr>
<tr>
<td>Black Nylon/Microfiber Jacket</td>
<td>$59</td>
</tr>
<tr>
<td>Khaki/Navy Hat</td>
<td>$15</td>
</tr>
<tr>
<td>Khaki/Black Hat</td>
<td>$15</td>
</tr>
</tbody>
</table>

**Available Styles & Prices**

<table>
<thead>
<tr>
<th>Quantity</th>
<th>Size</th>
<th>Description</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Outer Banks Polo</td>
<td>$23</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Jerzee Polo</td>
<td>$18</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Denim Long Sleeve</td>
<td>$21</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Denim Short Sleeve</td>
<td>$20</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Blue Fleece Vest</td>
<td>$37</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Khaki Nylon Vest</td>
<td>$40</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Blue Nylon/Fleece Jacket</td>
<td>$49</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Black Nylon/Microfiber Jacket</td>
<td>$59</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Khaki/Navy Hat</td>
<td>$15</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Khaki/Black Hat</td>
<td>$15</td>
</tr>
</tbody>
</table>

Orders with less than 5 items — add $5.00 for shipping

**Total:**

### Book

"Problem Solving in Preparation for the NRRPT Exam"

by David Waite, Ph.D. and James Mayberry Ph.D.

$27 Each

<table>
<thead>
<tr>
<th>Quantity</th>
<th>Price</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$27.00 ea</td>
<td></td>
</tr>
</tbody>
</table>

**Total Amount Enclosed:**

$ _____________

Send order form with payment to:

NRRPT
P.O. Box 6974
Kennewick, WA 99336

**Check, Money Order, Visa & MasterCard Accepted**

**Visa or Mastercard**

**Card#:**

**Exp Date:**

**Billing Address:**
Health Physics Society’s 50th Annual Meeting  
July 10-14, 2005 Spokane, WA

REGISTRATION FEES: (Mark Appropriate Boxes)

Preregistration Fees  |  On-Site Fees
---|---
HS Member (Sun. Reception, Mon. Lunch, Tues. Awards Dinner) | $340  |  $415
Non-Member (Sun. Reception, Mon. Lunch, Tues. Awards Dinner) | $410  |  $485*
Student (Sun./Student Receptions, Mon. Lunch, Tues. Awards Dinner)  |  $60  |  $60
One-Day Registration  |  $225
HS Emeritus Member (Sun. Reception, Mon. lunch, Tues. Awards Dinner)  |  No Fee  |  No Fee
Companion (Sun. Reception, Mon.-Wed. Continental Breakfast & pm snacks) | $55  |  $55
Exhibition ONLY (Exhibit Hall Badge) | $25  |  $25
Exhibitor (Two Per Booth) | No Fee  |  No Fee
Additional Tues. Awards Dinner Ticket(s)  |  $60  |  $60
AAHP Awards Lunch Ticket(s) (Tues.)  |  Free  |  Free
AAHP Awards Lunch Ticket(s) (Tues.) CHP other than above | $10  |  $10
AAHP Awards Lunch Ticket(s) (Tues.) Guest | $15  |  $15
*Includes Associate Membership for year 2005 - FIRST TIME MEMBERS ONLY

Would you like your name included on the Attendee List? | Yes  | No

SPECIAL PROGRAM:

Preregistration Fees  |  On-Site Fees
---|---
Historic Spokane’s “Age of Elegance” (Sunday, 7/10) | # of Tickets  |  $16  |  # of Tickets  |  $21
River Rafting on Spokane River (Sunday, 7/10) | # of Tickets  |  $60  |  # of Tickets  |  $65
“Age of Elegance” & Steam Plant Lunch (Monday, 7/11) | # of Tickets  |  $33  |  # of Tickets  |  $38
Pub Crawl (Monday 7/11) Shirt Size: S  M  L  XL  XXL | # of Tickets  |  $20  |  # of Tickets  |  $25
HPS Golf Tour (Tuesday 7/12) Shirt Size: S  M  L  XL  XXL | # of Tickets  |  $55  |  # of Tickets  |  $65
5K Fun Run/Walk (Tuesday 7/12) Shirt Size: S  M  L  XL  XXL | # of Tickets  |  $12  |  # of Tickets  |  $16
Spokane Winery Tour (Tuesday 7/12) | # of Tickets  |  $27  |  # of Tickets  |  $32
Cruise on Lake Coeur D’Alene (Wednesday 7/13) | # of Tickets  |  $42  |  # of Tickets  |  $47
Adult-Night Out - Rockin’ B Ranch (Wednesday 7/13) | # of Tickets  |  $33  |  # of Tickets  |  $40
Child (10 & Under) Night Out - Rockin’ B Ranch (Wednesday 7/13) | # of Tickets  |  $16.50  |  # of Tickets  |  $20
Silver Valley & Historic Wallace (Thursday 7/14) | # of Tickets  |  $53  |  # of Tickets  |  $58

TECHNICAL TOURS:

Preregistration Fees  |  On-Site Fees
---|---
Medical Facilities (Monday, 7/11), 9am-12pm  |  # of Tickets  |  $10  |  # of Tickets  |  $15
Dawn Mining Company Mill Site Tour (Tuesday 7/12)  |  # of Tickets  |  $25  |  # of Tickets  |  $30
Hanford Tour (Thursday 7/14)  |  # of Tickets  |  $70  |  # of Tickets  |  $75

PAYMENT INFORMATION - Government Requisitions are accepted for registration, however Purchase Orders are NOT accepted for PEP AAHP, Social/Technical Tour Registration.

Check Payment:  |  Health Physics Society, 1313 Dolley Madison Blvd., Suite 402, McLean, VA 22101
---|---
VISA  |  MasterCard  |  American Express  |  Discover
Card Number: | Exp. Date: |
Credit Card Billing Address: | |
Cardholder Name: | Signature: |

Please see AAHP/PEP Registration form and Disabiliies information on following page

Registration Section Total $  
Social Program/Technical Tours Total $  
AAHP/PEP Total (From Back of Form) $  
TOTAL FEES ENCLOSED $ 

Are you interested in being a Mentor at the meeting? | Yes  | No
Are you interested in working with a Mentor at the meeting? | Yes  | No

Preregistration Deadline is June 13
CHANGE OF ADDRESS FORM:

NAME: _____________________________________________________________

OLD ADDRESS: ______________________________________________________

____________________________________________________________________

____________________________________________________________________

NEW ADDRESS: ______________________________________________________

____________________________________________________________________

____________________________________________________________________

EFFECTIVE DATE: _____________________    NEW PHONE NUMBER: _____________________

EMAIL ADDRESS: _____________________________________________________

If you have moved, please complete this form so you don't miss out on any issues of the News.