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Chairman's Message

Dave Biela

While we welcome Spring we are also welcoming the successful candidates that have passed the February exam. From the United States we have:

Derrick Albert, Alan Amundson, Heather Baer, Patrick Beall, Mark Bogenrieder, Kirsten Breeden, Christopher Brock, Darlene Brock, Henry Brogonia, John Burris, Jonathan Case, Rebecca Case, William Evers, Douglas Frenette, Anthony Hairston, Garry Harris, Curtis Hollar, David Hurd, Jonathan Klingler, Stuart McCullough, Mark Pflug, Bert Pugh, Cody Radford, Kevin Slavings, Edward Stanwood, Bruce Wainer, Ed Waters.

From Canada we welcome:

Joseph Cherkas, John de Mello, Christopher MacDonald, David Tatum

Congratulations on your success!

This past week I read the article below on RADSAFE and it made me feel good for several reasons. The first of which is that I worked for Westinghouse when I first got out of the military in 1981, the second is that it is good to see the industry poised to take off again in the United States and finally it helps support our belief that the nuclear industry will be needing a giant influx of quality personnel in coming years. Below is an article from the Tribune-Review.

Westinghouse Electric Co. on Tuesday landed the first contract for a new nuclear power plant in the United States in 30years.

The Monroeville Company agreed to supply Georgia Power with two AP1000 nuclear power plants for a site near Waynesboro, Ga. Also signing the engineering, procurement and construction contract was The Shaw Group, which owns 20 percent of Westinghouse.

"Today, the long-awaited nuclear renaissance in the United States has dawned," said Westinghouse chief executive Steve Tritch in a memo announcing the contract to employees.

Similar deals are likely to follow. American electric utilities have committed to acquiring at least 14 AP1000 reactor units from Westinghouse, according to plans filed with the U.S. Nuclear Power Commission.

"Agreements like this one announced today with Georgia Power will also ensure that the United States will have the power it will need to support long-term economic growth," Tritch said.

The two AP1000 units are expected to be placed in service in 2016 and 2017, pending final certification by the Georgia Public Service Commission, said The Shaw Group.

The AP1000 is a pressurized water reactor with a more streamlined and efficient design than previous power plants and more economical to operate, Westinghouse said. One unit can produce enough electricity for more than 800,000 homes.

The Shaw Group, of Baton Rouge, La., will construct the power plant at the Alvin W. Vogtle site in northeast Georgia, south of Augusta. Westinghouse will provide the plant design, components and nuclear fuel.

The companies declined to give the value of the Georgia Power contract.

Tritch was in Georgia for the contract signing, which occurred about 5 p.m., and not available for further comment.

The contract won't add more jobs at Westinghouse, but it will help perpetuate the company's pace of hiring, said spokesman Vaughn Gilbert. Westinghouse hired about 1,300 workers last year and will continue to add "several hundred more" a year for several more years, he said.

Westinghouse expects to create 1,000 to 2,000 jobs by 2016. The company employs more than 10,000 worldwide, including 4,000 in the region. To house the growth, Westinghouse plans to move its campus from Monroeville to a larger facility in Cranberry early next year.

Much of the corporation's newfound growth has been driven by China. Westinghouse signed a $5.3 billion contract in July to build four nuclear reactors for that nation to supply its burgeoning power needs.

"We're actually ahead of schedule there," Gilbert said. "We started clearing the ground a month ago, and engineering is under way. We'll officially begin construction in 2009."

Last week, South Carolina Electric & Gas agreed to have Westinghouse and The Shaw Group purchase materials for two Westinghouse reactors that the utility would use in a power plant that could be placed into service in 2016.

How many of us are planning on being retired by the time the first of these new reactors go on line. I ask that all of you help spread the word about what is happening within our industry and the future possibilities.

Mark your calendars, the NRRPT Summer meeting will be taking place July 12th – 15th, 2008 in Pittsburgh, PA. The meetings will be held at the Westin Hotel and everyone is welcome.

Sincerely,
Dave Biela
NRRPT, Chairman of the Board

Real Time Air Monitoring

By Steve Gernatt, Cabrera Services

One of the decisions made by RadCon is whether to require real time air monitoring for a specific work activity, facility, or area. The decision to perform real time air monitoring is based on consideration of both actual and potential radiological conditions. In the final analysis, the decision is usually made based on process history, historical sampling results, and radiological data from similar operations, in concert with prudent professional judgment. Once the decision has been made to perform real time air monitoring, the method used can vary depending on the availability of equipment, the levels of airborne anticipated, the radionuclides present, and the duration of the work to be performed. Continuous air monitors (CAMs) or alternative methods of periodically checking a running sample or grab sampling with rapid analysis each have advantages and disadvantages.

Beta/gamma emitters or uranium isotopes, due to their relative high DAC values, do not present the unique difficulties of monitoring for low levels of transuranic alpha in the presence of radon progeny. To understand the difficulties of detecting transuranics in a radon environment, a basic knowledge of radon and alpha spectroscopy is beneficial. The common term “radon” usually refers to the decay products of Rn-222 (radon) and Rn-220 (thoron) gas. The historic terms of radon (Rn) and thoron (Tn) were used; their sequential decay products were named RaA, RaB, ThA, ThB, etc. Radon decay progeny contain both alpha and beta/gamma emitting isotopes. The major alpha isotopes are Po-218 (RaA) with a 6.0 MeV energy alpha; Bi-212 (ThC) with 5.6-6.0 MeV energy alpha; Po-214 (RaC) with a 7.7 MeV energy alpha; and Po-212 (ThC) with an 8.8 MeV energy alpha. Uranium and most transuranics have alpha energies less than that of radon progeny; the range of energy is approximately from 4.2 MeV to 5.5 MeV (Curium has energies up to 6.1 MeV). Alpha particles are emitted from the nucleus of an atom with a specific [kinetic] energy. When an alpha particle interacts with matter, it looses some or all of its energy. The energy remaining when the alpha particles reach the detector forms a spectrum of energies. Higher energy particles from radon progeny can be detected in the lower energy region associated with transuranics. The result of this interference is an overestimation of the transuranics activity.

The CAM has the ability to monitor for transuranic activity by discriminating radon. Various models of CAMs perform this function by using energy regions or sophisticated curve fitting algorithms to subtract radon interference. Automated alarm function provides the warning to personnel to limit exposures. The main disadvantages of CAMs are their cost and the frequency of false alarms. Because CAMs require periodic testing, their use in high contamination areas may not be economically or operationally feasible.

Periodic checking of a running air sample with a field instrument is an inexpensive alternative to a CAM. A predetermined count rate for defined time period and flow rate is used to indicate that a control level has been exceeded. The interference from radon can be reduced by preloading the filter with short lived radon progeny and subtracting this value as background. The use of this method is usually limited to areas of very low radon or very high transuranics. If control levels are exceeded, the technician is responsible to warn personnel to take actions to limit exposure.

Grab sampling with rapid analysis has little advantage over periodic checking the running sample for real time monitoring. A simple count rate per volume calculation can be predetermined. This method does not provide radon subtraction and requires the technician to provide the warning that a control level has been exceeded.

A method currently being tested in the Acid Recovery Cell (ARC) at the West Valley Demonstration Project is a combination of a CAM and the direct checking of a running sample method of real time monitoring. The ARC is

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Welcome New Members

Congratulations to the following individuals who successfully passed the NRRPT February 23, 2008 examination:

Derrick E. Albert	John N. Burris	Jonathan E. Klingler
Alan D. Amundson	Jonathan G. Case	Stuart K. Mccullough
Heather S. Baer	Rebecca L. Case	Mark D. Pflug
Patrick S. Beall	William C. Evers	Bert L. Pugh
Mark E. Bogenrieder	Douglas E. Frenette	Cody B. Radford
Kirsten L. Breeden	Anthony E. Hairston	Kevin D. Slavings
Christopher T. Brock	Garry W. Harris	Edward K. Stanwood
Darlene D. Brock	Curtis R. Hollar	Bruce R. Wainer, Jr.
Henry C. Brogonia, Ii	David I. Hurd	Ed G. Waters

Congratulations to the following individuals who successfully passed the NRRPT Canadian exam administered in Ontario Canada on February 29, 2008:

Joseph A. Cherkas
John L. de Mello
Christopher J. MacDonald
David K. Tatum

New Members: If you do not have access to the "Members Only" portion of the website, please contact the Executive Secretary (nrrpt@nrrpt.org). Your email address must be on file in order for you to gain access.

2008 USA NRRPT Exam Date

August 2, 2008

Deadline for application: June 13, 2008

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

www.NRRPT.org

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

The Medical Reserve Corps: An Opportunity for Health and Medical Physicists to Volunteer in Their Communities

By John J. Lanza, MD, PhD, MPH, FAAP with information from MRC website

The mission of the Medical Reserve Corps (MRC) is to improve the health and safety of communities across the country by organizing and utilizing public health, medical and other volunteers.

The MRC was founded after President Bush's 2002 State of the Union Address, in which he asked all Americans to volunteer in support of their country. It is a partner program with Citizen Corps, a national network of volunteers dedicated to ensuring hometown security. Citizen Corps, along with AmeriCorps, Senior Corps, and the Peace Corps are part of the President's USA Freedom Corps, which promotes volunteerism and service nationwide.

MRC units are community-based and function as a way to locally organize and utilize volunteers who want to donate their time and expertise to prepare for and respond to emergencies and promote healthy living throughout the year. MRC volunteers supplement existing emergency and public health resources. They are NOT first responders.

MRC volunteers include medical and public health professionals such as physicians, nurses, pharmacists, dentists, veterinarians, epidemiologists, and could include medical and health physicists. Many community members—interpreters, chaplains, office workers, legal advisors, and others—can also fill key support positions.

MRC units may have specific areas that are targeted to strengthen the public health infrastructure of their communities by increasing disease prevention activities, eliminating health disparities, and improving public health preparedness. Public health preparedness encompasses preparation and response activities involved with natural and man-made disasters. Currently, there are over 731 MRC units and more than 153,000 volunteers nationwide.

Due to the need to have radiation health and safety professionals available to support local, state, and federal responders after a radiological incident or event, in 2007, the Homeland Security Committee of the Health Physics Society adopted the project of recruiting health physicists into their local MRC units. Medical physicists would also clearly be beneficial members of their local MRC.

Examples of how health and medical physicists could be used after a radiological incident/event would include: 1. Acting as consultants to public health officials regarding human health effects from radiation exposures; 2. Providing contamination screening services at Community Receptions Centers; 3. Assisting in collecting bioassays at Alternative Medical Treatments Sites; and, 4. Being the liaison between hospital emergency personnel and public health authorities in identifying and triaging radiation exposure victims.

Each MRC will provide benefits to volunteers including: 1. The opportunity to serve your community during times of need; 2. Education and training availability including learning about the Incident Command System; 3. Participation in table-top and field exercises; and, 4. First access to vaccinations and other medications during a biological event or disease outbreak (as well as your immediate family members).

This is a great opportunity for health and medical physicists to learn about disaster preparedness activities in their community and to be part of a response effort to mitigate the effects of natural or man-made disasters.

You can find out more information on the Medical Reserve Corps and can find your local unit by visiting the MRC website at: http://www.medicalreservecorps.gov

Additional information on medical radiological emergency response can also be found on the Health Physics Society Homeland Security Committee Medical Response Subcommittee web page:
https://hps.org/hsc/responsemed.html

'WHY DID THEY CALL IT THAT? The Origin of Selected Radiological and Nuclear Terms

By Paul W. Frame
Oak Ridge Associated Universities

- Alpha, Beta, and Gamma Radiation
- Barn
- Becquerel
- Curie
- Cutie Pie
- Fission
- Gray
- Health Physics
- K-25
- Manhattan Project
- Rad
- RADIAC
- Radiation Safety Officer
- Rem
- Scram
- Sievert
- X-10
- X-rays

Alpha, Beta, and Gamma Radiation

The first reference in the scientific literature to alpha and beta radiation is found in the following statement by Ernest Rutherford (1899): "These experiments show that the uranium radiation is complex and that there are present at least two distinct types of radiation - one that is very readily absorbed, which will be termed for convenience the alpha-radiation, and the other of more penetrative character which will be termed the beta-radiation."

The physicist and historian Alfred Romer (1960) commented that the name "alpha radiation" had been chosen for "no particular reason." While it is true that Rutherford didn't explain why he chose the first letters of the Greek alphabet, Rontgen had already set a precedent for an alphabetical designation with the name "X-rays," and Rutherford, like many of his generation, had studied the Greek language.

In1902, Rutherford moved on to the third letter of the Greek alphabet when he applied the name gamma rays to the very penetrating radiation described by Villard. Soon thereafter, J.J. Thompson employed the term delta rays, and today we have a veritable alphabet soup of subatomic particles.

Reference

E. Rutherford, Uranium Radiation and the Electrical Conduction Produced by it, Philosophical Magazine 47:116, 1899

A. Romer, The Restless Atom Doubleday and Company Inc, 1960.

Barn

A unit of cross section equal to 10^{-24} cm^2, more or less equivalent to the physical cross-sectional area of a typical nucleus.

The following explanation for the origin of the term comes from a report by Holloway and Baker (1944).

"Some time in December of 1942, the authors, being hungry and deprived temporarily of domestic cooking, were eating dinner in the cafeteria of the Union Building of Purdue University. . . In the course of the conversation it was lamented that there was no name for the unit of cross sections of 10^{-24} cm^2 . . . The tradition of naming a unit after some great man closely associated with the field ran into difficulties . . . The "Oppenheimer" was discarded because of its length . . . The "Bethe" was thought to lend itself to confusion because of the widespread use of the Greek letter. Since John Manley was directing the work at Purdue, his name was tried, but Manley was thought to be too long. The "John" was considered, but was discarded because of the use of the term for purposes other than as the name of a person. The rural background of one of the authors then led to the bridging of the gap between the "John" and the "barn." This immediately seemed good, and further it was pointed out that a cross section of 10^{-24} cm^2 for nuclear processes was really as big as a barn. Such was the birth of the barn."

A less well-known unit of cross section was used in the late 1940s and 1950s: the shed. Much smaller than a barn, the shed had an area of 10^{-48} cm^2

Reference

M.G. Holloway and C.P. Baker, Note on the Origin of the Term "Barn" LAMS 523, Sept. 1944.

Becquerel (Bq)

The SI special name for a unit of activity equal to 1 dps. The becquerel replaced the curie.

In a letter sent to numerous journals in August of 1975, the International Commission on Radiological Units and Measurements (ICRU) stated that the General Conference of Weights and Measures had adopted the ICRU's recommendation that the SI unit of activity take the name the becquerel. The ICRU explained: "Antoine Henri Becquerel (1852-1908) discovered radioactivity in 1896 ("rayons de Becquerel") and was given the Nobel Prize in Physics in 1903 together with Marie and Pierre Curie." Since the Curies and Becquerel shared the first Noble Prize awarded for work with radioactive substances, it might be considered appropriate that it was the becquerel that superseded the curie.

In the May-June issue of the Health Physics Society Newsletter (1974), one year prior to the ICRU announcement, Keith Schiager proposed that the name "becquerel," abbreviated Bq, be adopted as the SI unit equivalent to one transformation per second. Schiager's intent was to honor the discoverer of radioactivity, Henri Becquerel. If the ICRU was aware of Schiager's recommendation, which seems likely, they don't appear to have acknowledged it.

Reference

L. Taylor Organization for Radiation Protection, The Operations of the ICRP and NCRP DOE/TIC 10124, 1979.

Curie (Ci)

A unit of activity equal to 3.7 x 10^{10} disintegrations per second . The curie has been replaced by the becquerel.

The original intent of the Standards Committee that defined the curie was for it to be based on a smaller activity, similar to those routinely employed in the laboratory. But Marie Curie had other ideas. If it was to bear the name Curie, it had to be large (Badash 1969)!

In the October 1910 issue of Nature, Ernest Rutherford, who chaired the Standards Committee, said "In the course of the Congress it was suggested that the name Curie, in honor of the late Prof. [Pierre] Curie, should if be possible, be employed for a quantity of radium or the emanation [radon]. This matter was left for the consideration of the standards committee. The latter suggested that the name Curie be used as a new unit to express the quantity or mass of radium emanation in equilibrium with one gram of radium (element)."

Note that Rutherford did not say that the committee agreed with, or adopted, the suggestion that the unit be named after Pierre Curie. Three years latter, Rutherford (1913) wrote: "At the Radiology Congress in Brussels in 1910, it was decided to call this equilibrium quantity a "curie" in honor of M. and Mme. Curie.

For a more complete and detailed explanation, refer to the story "<u>How the Curie Came to Be</u>"

References

L. Badash Rutherford and Boltwood – Letters on Radioactivity, Yale Univ. Press, New Haven, 1969.
E. Rutherford, Radium Standards and Nomenclature, Nature 84 (2136) 430-431, 1910.
E. Rutherford, (Radioactive Substances and Their Radiations, Cambridge University Press, 1913.

Cutie Pie

Versions of the Cutie Pie, the first survey meter to employ a pistol grip, appear to have been in use in 1944 at both Oak Ridge National Laboratory (then known as the Clinton Laboratory) and Hanford. According to K. Z.

Morgan, he first saw a Cutie Pie two months or so after his arrival at Oak Ridge National Laboratory - this would place its use there in 1944 (Stabin 1998). According to Howell et al (1988), the first Hanford Cutie Pie instruments were designed and constructed in early 1944. The basis for this claim is not known. In both places, its primary use would have been to measure the intense radiation fields associated with reactors.

A widely circulated story claims that the name Cutie Pie derives from the formula, Q t p where Q refers to the collected charge within the chamber, and t p refers to "two pi" - the solid angle viewed by the detector. Alternatively, the t is sometimes said to refer to time. In my opinion, this explanation is a bit fanciful and overly convoluted.

Another story is that the name was derived from the alpha-numeric designation given to many Manhattan District documents: CP-XXX. The CP, which referred to "Chicago Pile," presumably became "Cutie Pie."

Nevertheless, the best evidence regarding anything is usually the contemporary literature. In this case, it is the declassified Manhattan District report MDDC-997 "Cutie Pie, A Portable Radiation Instrument", written in September of 1945, by C.O. Ballou. Ballou, an employee at the Clinton Laboratories, describes in detail the reasons behind the development of the Cutie Pie. Among other things, an instrument was needed that was capable of holding its calibration and of being zeroed regardless of humidity conditions. As Ballou noted, "humidity conditions at Clinton run at saturation during the night."

Amazingly, and this is more than one could hope for, Ballou also gives the explanation for the name: "The instrument has been named "Cutie Pie" due to its diminutive size." Most of the other survey instruments that were available during the war were big and heavy, primarily due to the batteries. Since the Cutie Pie only weighed four pounds, picking it up for the first time might well have drawn the reaction: "Hey, that's a real cutie pie!" - a common phrase at the time to describe something really neat.

The Manhattan District Report MDDC-1059 (1947) includes a photograph of a Cutie Pie and states "this instrument has just been declassified and was developed at Clinton Laboratories."

References

C.O. Ballou. "Cutie Pie," A Portable Radiation Instrument. MDDC-997. Sept. 22, 1945
H.U. Fisher. Instrument Work in an Atomic Energy Laboratory. MDDC-1059. June 17, 1947.
W. Howell et al, Historical Review of Portable Health Physics Instruments and Their Use in Radiation Protection Programs at Hanford 1944 through 1988.
M. G. Stabin, A Window into Health Physics History, Health Physics Society's Newsletter, July 1998.

Fission

In late 1938, Lise Meitner and Otto Frisch determined that it was energetically possible for uranium atoms to split in two when struck by neutrons. To observe this phenomenon, Frisch, working in the basement of Niels Bohr's Institute for Theoretical Physics in Copenhagen, placed a piece of uranium next to the chamber of a proportional counter and exposed the uranium to neutrons. Using an oscilloscope, Frisch looked for the extremely large pulses coming from the detector chamber that would indicate the energetic fragments of the splitting atoms. Among the inhabitants of the Institute who went down to the basement to see what Frisch was up to was the biologist William Arnold (Arnold 1996; Ermanc 1989. At first, all Arnold saw on the oscilloscope screen was a series of small pulses produced by uranium's alpha particles. But then, at Frisch's suggestion, he picked up a neutron source by the handle and put it next to the uranium. The world changed! Huge pulses began appearing - pulses far larger than anything produced by the alpha particles - pulses produced by the fragments of the splitting uranium nuclei! Later that day, Frisch tracked Arnold down and said something to the effect "You're supposed to be some kind of biologist. What is the term you use to describe dividing bacteria?" Arnold replied, "Binary fission." Frisch then asked if the word "fission" would suffice and Arnold agreed that it would.

References

Arnold, W. Personal communication; 1996.
Ermenc, J. Atomic Bomb Scientists. Meckler; Westport; 1989.
Frisch, O. What Little I Remember. University Press; Cambridge; 1979.

Gray (Gy)

The SI special name for the unit of absorbed dose, equal to 1 J/kg. The gray replaced the rad.

In a letter sent to numerous journals in August of 1975, the ICRU stated that the General Conference of Weights and Measures had adopted the ICRU's recommendation that the SI unit of absorbed dose take the name the gray. In an explanatory note, the ICRU commented: "Louis Harold Gray (1905-1965) made one of the most fundamental contributions to radiation dosimetry, the principle now known as the Bragg-Gray Principle." It probably didn't hurt that Gray had once served as Vice-Chairman of the ICRU.

Reference

L. Taylor Organization for Radiation Protection, The Operations of the ICRP and NCRP DOE/TIC 10124, 1979

Health Physics

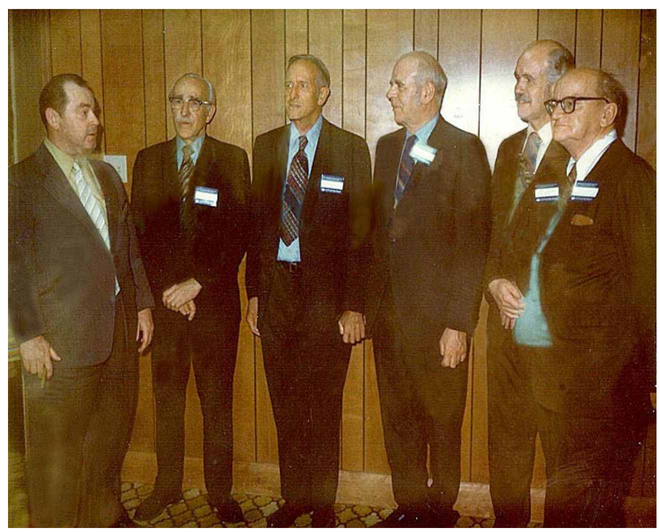
Health Physics refers to the field of radiation protection. How appropriate the name is has been a matter of some debate (Taylor 1982).

The term Health Physics originated in the Metallurgical Laboratory at the University of Chicago in 1942, but it is not known exactly why, or by whom, the term was chosen. Most likely, the term was coined by Robert Stone or Arthur Compton. Stone was the head of the Health Division, of which Health Physics was one of four sections. Arthur Compton was the head of the Metallurgical Laboratory.

Because the first task of the Health Physics Section was to design shielding for the reactor (CP-1) Fermi was constructing, the original HPs were mostly physicists who were trying to solve health-related problems. This is the crux of the following explanation given by Robert Stone (1946): "The term Health Physics has been used on the Plutonium Project to define that field in which physical methods are used to determine the existence of hazards to the health of personnel."

A slight variation on this explanation was given by Raymond Finkle, an early Health Division employee (Hacker 1987): "the coinage at first merely denoted the physics section of the Health Division . . . The name also served security: "radiation protection" might arouse unwelcome interest; "health physics" conveyed nothing."

The first group of health physicists at the Metallurgical Laboratory consisted of Ernest Wollan, Carl Gamertsfelder, Herb Parker, Karl Morgan, James Hart, Bob Coveyou, and Louis Pardue. John Rose is sometimes added to the mix.



The above photo, taken by Jim Berger, includes most of the original group who used the title "Health Physicist." From left to right: Jim Hart, Ernest Wollan, K.Z. Morgan, Herb Parker, Carl Gamertsfelder and Bob Coveyou.

References

B. Hacker, The Dragon=s Tail, Univ. Of California Press, 1987.
R. Stone, Health Protection Activities of the Plutonium Project, Proc. Am. Phil. Soc. 90(1); 1946.
L. Taylor, Who is the Father of Health Physics? Health Physics 42: 91-92; 1982.

K-25

K-25 was the name given to the gaseous diffusion facility that was built in Oak Ridge during WWII to enrich uranium. At the time, it was the largest building under a single roof - some 47 acres. The K in the name probably derives from the fact that the facility was constructed by the Kellex Corporation, a subsidiary of the Kellogs construction Company. The 25 was a WW II code name for U-235, the desired product of the enrichment process. The code was the combination of the last digit of the nuclide's atomic number (92) and the last digit of its atomic mass number (235). Similarly, U-238 was sometimes referred to as 28, and Pu-239 (atomic number 94) was referred to as 49 (Serber 1992). Of course, the name K-25 might have signified absolutely nothing and simply served as a code name for security purposes. The latter is the opinion of the authors of City Behind a Fence (Johnson and Jackson 1981).

A very common explanation is that K-25 was the facility's location on a map. The same explanation is given for the names of the other two major WW II Oak Ridge facilities: X-10 and Y-12. A problem with this explanation is that X-10 is physically closer to K-25 than Y-12. Furthermore, given the security requirements during WW II, it is unlikely that a potential target for enemy attack would be identified by map coordinates.

Reference

Johnson, C.W., and Jackson, C.O., City Behind a Fence, Univ. of Tennessee Press, 1981.
Serber, R. The Los Alamos Primer, The First lectures on How to Build an Atomic Bomb, University of California Press, 1992.

Manhattan Project

Although the official and legal term for the atomic bomb project was the "Manhattan District," more often than not it was referred to as the Manhattan Engineer District (MED). The Manhattan Project was a popular variation on the official terminology.

Since the Army Corps of Engineers had the overall responsibility for the atomic bomb project, and since the Corps was divided into Districts, it was natural that the organization being established within the Corps to manage the project would be designated as a new District. These districts were normally named after the city in which they were located. The man initially responsible for establishing the organizational structure of the project, Colonel James Marshall, was head of the Syracuse District.

The term Manhattan District was chosen during a meeting between Marshall and Colonel Leslie Groves, who would later take over administrative control of the project. As Groves described it (1962): "After some discussion, during which we considered the possibility of using "Knoxville," we decided upon "Manhattan," since Marshall's main office would at first be in New York City."

The office Groves referred to was at 270 Broadway, very close to New York's City Hall, and across the street from a park in which there is a memorial to Marie Curie. Within months, the Manhattan District headquarters moved to a building (in Oak Ridge, Tennessee) known as the Castle - the latter name derived from the fact that the Corps of Engineers uses a Castle as its symbol.

At first, Marshall argued that the project should be known as Development of Substitute Materials (DSM), but Groves vetoed this name because he felt that it would draw too much suspicion. Despite Groves' objections, the atomic bomb project was known, at least for a period of time, as both DSM and the Manhattan District.

Reference
L. Groves, Now it Can be Told, Harper and Row, 1962.

Rad

A unit of absorbed dose. The rad replaced the rep but it has now been replaced by the gray

The name rad was adopted by the ICRU in 1953 at the Seventh International Congress of Radiology. There appears to have been no documented discussion regarding the use of the name prior to this meeting, even though it was determined at the previous ICRU meeting in 1951 that there was a need for such a unit. Aside from the use of rad some three decades earlier as a unit relating to mouse tumors, the rad seems to have made its first appearance in the ICRU report of the 1953 meeting. The reason for selecting the name was not given, nor is it explained in subsequent ICRU, ICRP, or for that matter, NCRP reports.

There is a widespread belief that rad is an acronym for "radiation absorbed dose." This seems reasonable since many other contemporary units (the reb, rep and rem) were acronyms. However, if rad were an acronym, one would expect the ICRU to have identified it as such - something they did not do. If, on the other hand, the rad was just a convenient and concise name, there would be no reason for the ICRU to have explained it. The lack of any explanation in the official literature for the name is totally inconsistent with the idea that rad is an acronym.

This issue has been addressed explicitly by Dr. Lauriston Taylor, Chairman Emeritus of the ICRU (1990). In a 1982 article in the ICRU News Dr.Taylor states: "The term rad was simply suggested as a word by itself. Since then it has frequently been improperly referred to as an abbreviation for "radiation absorbed dose." This is simply incorrect."

Reference

L. Taylor, 80 Years of Quantities and Units - Personal Reminiscences. ICRU News June 1990

RADIAC

A military term from the late 1940s. An "official" explanation (Campbell, 1950) is as follows: "The field of radiological instrumentation, as it applies to the defense establishment, has been assigned the name "RADIAC". This new word for the military vocabulary has been taken from the initial letters of - RAdiation Detection, Indication, And Computation."

Like many so-called acronyms, this one is a bit too convoluted to be believable, especially since the first five letters of RADIAC are the same as those in the word radiation. Undoubtedly, the word came first and the explanation followed.

Reference

D.C. Campbell, Radiological Defense, Volume IV, Armed Forces Special Weapons Project, 1950.

Radiation (or Radiological) Safety Officer (RSO)

"Radiological Safety Officer" was the title given to the military officer who was responsible for radiological safety during the U.S. atomic weapons tests in the Pacific during the late 1940s.

The earliest use of this term that I know of was in Joint Task Force 7, the group established in 1947 to oversee Operation Sandstone at Enewetak. The regulations for Operation Sandstone read in part:

> "Permissible radiological exposure is established at 0.1 roentgens per twenty-four (24) hours. Under unusual circumstances, the Scientific Director and the Radiological Safety Officer may authorize a total exposure up to three (3) roentgens."

As Barton Hacker observed (1994), the regulation's careful wording was chosen to accommodate the sometimes conflicting needs of the military and scientific participants in the atomic tests. The military, represented by the Radiological Safety Officer, insisted on the ultimate authority for radiological safety, but the civilian scientists, represented by the Scientific Director, frequently needed to enter contaminated areas to perform their experiments and make radiation measurements.

The physicist Karol Froman served as Joint Task Force 7's Scientific Director, and Col. James Cooney of the Army Medical Corps served as the Radiological Safety Officer. Cooney's position was essentially the same as that of Col. Stafford Warren in Joint Task Force 1 during Operation Crossroads at Bikini in1946. Warren had been known as the Radiological Safety Advisor.

A distinction was sometimes attempted between the military's radiological measurements performed for the purpose of safety, and the civilian radiation measurements performed for scientific purposes. Long after the atomic tests were completed in the Pacific, the military tended to favor the word "radiological" over "radiation."

Reference

B. Hacker, Elements of Controversy Univ. of California Press, 1994

Rem

A unit of the quantity dose equivalent . The rem replaced the reb but the rem has now been superseded by the sievert.

Although the term rem was used as early as 1945, it first appeared in the literature in 1950 (Parker). In this paper, Herbert Parker explained what the rem and another unit of his, the rep (predecessor of the rad), stood for: "The rep is an abbreviation of roentgen equivalent physical. The rem is an abbreviation of roentgen equivalent man or mammal. The more obvious choice of reb (roentgen equivalent biological) is avoided because of the confusion in speech between rep and reb."

Ron Kathren (1986) explains Parker's comment regarding a "confusion in speech" as follows "The unit [the rem] was originally called the reb (roentgen equivalent biological), but during one of his early presentations of the new unit, Parker was suffering from a cold, which led to difficulty in differentiating it from the rep. Accordingly, the name of the unit was changed to rem."

Reference

R. Kathren, Herbert M. Parker, Publications and Other Contributions to Radiological and Health Physics Battelle Press, 1986
H. Parker Tentative Dose Units for Mixed Radiations, Radiology 54, 1950

Scram

"Scram" refers to the sudden shutdown of a reactor, usually by the insertion of control rods into the core. Also referred to as a "trip."

The term appears to have been coined by Volney Wilson at the University of Chicago during World War two. Wilson was in charge of the instrumentation at Chicago Pile one (CP-1) when Enrico Fermi and his coworkers achieved the first controlled self-sustaining nuclear chain reaction. In particular, Wilson oversaw the construction of the pile's control rods.

Leona Marshall Libby, the only woman present at CP-1's initial criticality, had the following to say about the initial use of the term scram: "the safety rods were coated with cadmium foil, and this metal absorbed so many neutrons that the chain reaction was stopped. Volney Wilson called these "scram" rods. He said that the pile had "scrammed," the rods had "scrammed" into the pile." (1979)

Scram is often said to be an acronym for "safety control rod axe man." A common variant, "safety control reactor axe man," is far less plausible because the word "reactor" was not in use at the time (i.e., the mid 1940s). The "axe man" being referred to is Norman Hilberry who stood by with an axe ready to cut a rope tied to the railing of the balcony overlooking the pile. At the other end of the rope was an emergency control rod. If the chain reaction got out of control, Hilberry was supposed to shut it down by cutting the rope and allowing the control rod to fall by gravity into the pile.

A problem with this explanation is that we have Libby's account that the word scram was applied to the process of shutting down the reactor or to the control rods. But there is no record that the term scram was used, at the time the pile was being constructed or at the time of the first criticality, to refer to an individual. Almost certainly, the "safety control rod axe man" story was developed after the fact as a humorous way to explain the origin of a newly invented word that lacked any other convenient explanation.

In a letter written to Dr. Raymond Murray (January 21, 1981), Norman Hilberry wrote: "When I showed up on the balcony on that December 2, 1942 afternoon, I was ushered to the balcony rail, handed a well sharpened fireman's ax and told that was it, "if the safety rods fail to operate, cut that rope." The safety rods, needless to say, worked, the rope was not cut . . . I don't believe I have ever felt quite as foolish as I did then." More to the point, he also stated "I did not get the SCRAM [Safety Control Rod Ax Man] story until many years after the fact. Then one day one of my fellows who had been on Zinn's construction crew called me Mr. Scram. I asked him, "How come?" And then the story." Regarding Leona Marshall Libby's account of the first criticality, from which her previous quotes were taken, Hilberry states " I have not yet had a chance to read Leona Wood Marshal Libby's book, but if she describes that day as I'm sure she must do, her's should be the most authentic re-counting on record."

Carl Gamertsfelder, a health physicist who was present at the initial criticality, said that they joked that scram was what you did if there was a problem with the pile (personal communication with Ron Kathren).

Reference

L. Marshall Libby The Uranium People, Crane, Russak & Co., 1979.

Sievert (Sv)

The SI special name for the unit of dose equivalent equal to 1 J/kg . The sievert replaced the rem.

In the same letter in which the ICRU described its adoption of the name gray (after former ICRU Vice-chairman Harold Gray) as a unit of absorbed dose, they also stated : "The formulation (for selection) of a suitable unit for dose equivalent is therefore a special problem which will be thoroughly discussed by ICRU."

Before the ICRU completed such a discussion, the ICRP (ICRP 1977) selected the name sievert for the unit of dose equivalent. They did so in honor of former ICRP Chairman, Rolf Sievert, whose research focused on the biological effects of the low doses of radiation received by workers and the public. During the latter part of his life, Sievert devoted most of his attention to radiation protection issues.

Reference

International Commission on Radiological Protection, ICRP Publication 26 Recommendations of the International Commission on Radiological Protection, Pergamon Press 1977.
L. Taylor, Organization for Radiation Protection, The Operations of the ICRP and NCRP DOE/TIC 10124, 1979

X-10

X-10 was the name given to what is now Oak Ridge National Laboratory. The X probably derives from the fact that Oak Ridge was site X during WWII. Los Alamos was site Y and Hanford was site W. The 10 in X-10 might simply refer to the meaning of the Roman numeral X.

Of course, the name might have signified absolutely nothing, and simply served as a code name for security purposes. The latter is the opinion of the authors of City Behind a Fence (Johnson and Jackson 1981).

A very common explanation for the name is that X-10 was the facility's location on a map. The same explanation is given for the names of the other two major WW II Oak Ridge facilities: K-25 and Y-12. A problem with this explanation is that X-10 is physically closer to K-25 than Y-12. Furthermore, given the security requirements during WW II, it is unlikely that a potential target for enemy attack would be identified by map coordinates. Finally, is it simply coincidence that the first facility built at "Site X," a code name for Oak Ridge, was X-10?

Reference

Johnson, C.W., and Jackson, C.O., City Behind a Fence, Univ. of Tennessee Press, 1981.

X-Rays

In the following sentence from his paper Ueber eine neue Art von Strahlung [On a New Kind of Ray] (December 28, 1895), Rontgen used the term "x-rays" for the first time in print:

"A piece of sheet aluminum, 15 mm thick, still allowed the X-rays (as I will now call the rays, for the sake of brevity) to pass . . . I find the justification for using the name "rays" for the agent emanating from the wall of the discharge apparatus in the very regular formation of shadows that are produced if one brings more or less transparent materials between the apparatus and the fluorescent screen (or the photographic plate)."

Brevity is the operative word in Rontgen's explanation for his choice of the term. Unlike some of his contemporaries (e.g., William Crookes), Rontgen was not one for flowery language. Designating the rays with a single letter was more his style.

Certainly Rontgen needed to select a name to distinguish these new rays from the other rays associated with gas discharge tubes (e.g., cathode rays and Lenard rays), but why did he chose the letter X? Why not call them Y-rays or Z-rays? The most common explanation is that Rontgen chose the term X-rays to indicate that these rays were of an unknown nature. Although I know of nothing he wrote to suggest this, it makes sense - the letter x is used in mathematics to identify the principle unknown quantity.

Continued from page 3

highly contaminated with transuranics and has high levels of radon interference. Field checking the running air sample often exceeded the desired control level, requiring additional protective equipment. In this test, an older model CAM is used as an air sampler with a fixed detector. The radon subtraction algorithms are used, but the alarm function is not set. Local procedures require testing of an automatic alarm weekly which, in the ARC, is not deemed practical. A count rate from a previous air filter was used to set a count rate per run time control level. The CAM is only operated for the duration of the entry. The CAM will be calibrated just prior to placing in the ARC to allow use for the entire calibration period. Additionally, a camera will be used to monitor the reading on the CAM as an ALARA consideration. When the control level is exceeded, the technician is required to provide the warning that a control level has been exceeded. The CAM, in this case is considered expendable, since this model has been replaced by a newer model. Government facilities may be able to obtain equipment for this purpose through the excess equipment process.

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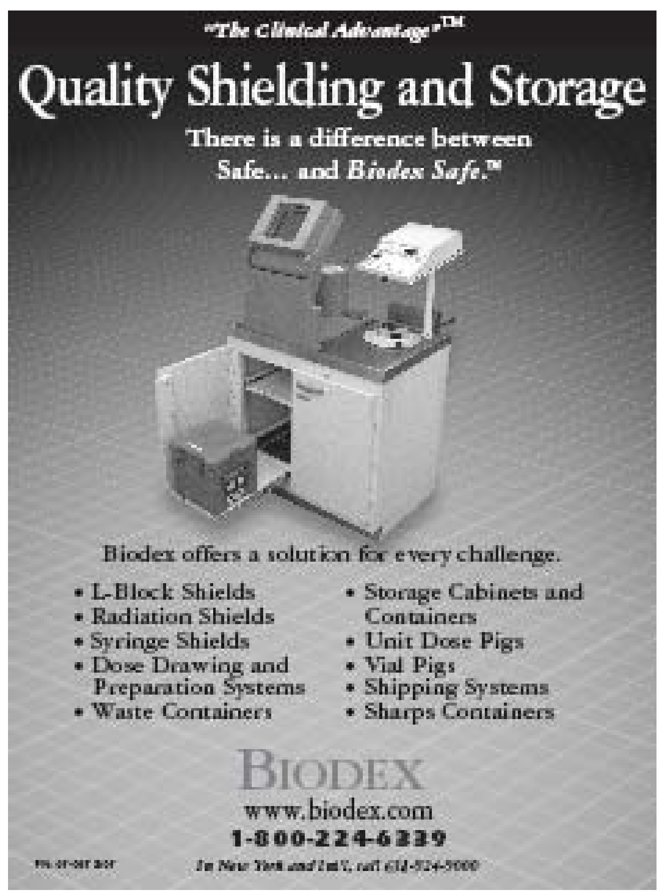

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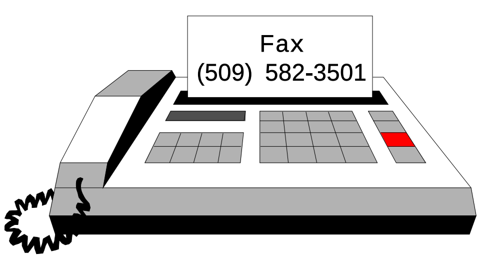

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