CHP Corner

AMERICAN **A**CADEMY OF **H**EALTH **P**HYSICS email: AAHP@burkinc.com

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Summary of the AAHP Special Session

Robert Miltenberger, CHP, Past President of the AAHP

Editor's Note: For those of us who could not attend the annual meeting, Robert has provided us an excellent summary of the content of the session, which was titled "Nuclear Weapons—Past and Present." Interesting stuff!

Nuclear Weapon Basics – Scottie Walker

This presentation focused on the generic physics and energy-release mechanisms associated with a nuclear weapon. A review of the basic difference between power reactor and weapons physics was also covered. The heat characteristics of various nuclear weapons (fission vs. fusion) was discussed. The energy difference required to produce a prompt critical state with fissile and fissionable material was reviewed in generic form for various weapon types.

Prompt Effects From Nuclear Detonations – Gus Potter

The speaker reviewed the various impacts associated with a nuclear weapon detonation: blast, thermal damage, prompt radiation, and electromagnetic pulse (EMP).

The blast phase acts like a chemical bomb, only much larger. Approximately 50% of the total damage comes from the blast phase. This phase causes building destruction, rubble, debris, broken glass, and related injuries.

Thermal damage is caused by the heat transmitted by the weapon over the entire energy spectrum. The thermal phase causes first- through third-degree burns to people exposed to the energy pulse. Clothing material and the color of clothing are important protectors of the skin. Light-color clothing protects better than dark-color clothing.

Prompt radiation is due to gamma and neutron radiation. Blast and thermal effects can exceed the extent of prompt radiation impacts, but the combination of these results in synergistic negative impacts.

The EMP impacts from a surface detonation are short-range (a few tenths of a kilometer) but energetic. Airburst detonations have a lower, less-energetic EMP, but because they affect the general magnetic field, the impacts are far reaching.

Fallout From a Nuclear Detonation, Delayed Effects, and Shelter Opportunities – Brooke Buddemeier

A ground-level (or near-ground-level) nuclear explosion can produce fallout, which is generated when dust and debris created by the explosion are combined with radioactive fission products and drawn upward by the fireball produced by the detonation. Due to the heat of the explosion, the fireball rapidly climbs through the atmosphere, potentially reaching heights of 8 km for a 10 kt explosion and forming a mushroom cloud under ideal conditions. Highly radioactive particles drop back down to earth as the cloud cools.

Although only a small physical quantity of radioactive material is produced in a nuclear detonation by the nuclear fission process (about 0.6 kg for a 10 kt device) this material is highly radioactive. One minute after the explosion, there are more than 10 billion TBq present. Because of the large amount of short-lived fission products, the activity (and the radiation) levels decrease rapidly with time. Fallout gives off more than 50% of its energy in the first hour and continues to decay rapidly even after that initial hour. The Cold War “7:10 Rule” was that after the first hour, the radiation levels from fallout will decrease by a factor of 10 for every factor of 7 in elapsed time.

As the fireball cools, the highly radioactive fission products coalesce on the millions of kilograms of dirt and debris pulled up by the heat of the fireball. Large particles tend to fall close to the detonation site, whereas small particles, such as those that might pose an inhalation hazard, tend to stay in the upper atmosphere much longer, perhaps for days or weeks. The most dangerous concentrations of fallout particles (i.e., those resulting in potentially fatal external exposures to people outdoors) occur within 15 to 30 km downwind of the explosion and are clearly visible as they fall, often being the size of fine sand or table salt.

Once fallout particles reach the ground, the primary hazard arises from external exposure to penetrating gamma rays. The exposure to radioactive fallout, and its resulting health impacts, can be significantly reduced by moving inside a protective structure (sheltering). The protection from radioactive fallout that a building provides is described by its protection factor (PF). Adequate protection, which protects occupants against acute radiation sickness, is defined as a PF of 10 or greater.

Health Impacts From Nuclear Weapon Effects in Modern Urban Environments – Paul Blake

Current health-effect models are based on range-to-effect relationships, which depend on weapon yield and distance, as discussed in the publicly available, joint Department of Defense-Department of Energy (DOD-DOE) publication *The Effects of Nuclear Weapons* by Glasstone and Dolan. These models were developed primarily from open-field tests, focused on the military of that day (young males), and do not properly account for combined (e.g., blast, thermal, and/or radiation) injuries.

DOD is developing new health-effects models and associated software codes that better account for nonideal settings (e.g., the urban environment), age and sex differences, and combined injury. These newer models will support national concerns of an urban detonation where combined blast and thermal injuries with survivable radiation doses may occur across a varied demographic population. Gaps still exist in our understanding of cutaneous, inhomogeneous, and neutron exposures in a diverse population.

For acute radiation syndrome, DOD sets the dose necessary to kill 50% of the exposed population in 60 days, without medical treatment, at 4.1 Gy based on the Nagasaki cohort.

One data source for blast wave survivability models is based on Nevada Test Site sheep-tumbling-injury data. Humans aren’t shaped like sheep, so blast injury models have also incorporated injury data from motorcycle accident victims. Thermal injuries have been modified by current information on direct and flash burns from nonnuclear weapon environments.

The general consensus is that combined injuries together result in more casualties than a single insult.

Fallout: You Can Take It to the Bank – Antone Brooks

This presenter lived in St. George, Utah, during the years when fallout was an issue from atmospheric and surface detonations at the Nevada Test Site. Fallout in St. George was easily visible, and there was significant concern from the local population during the tests. The testing was designed so that plumes would travel over relatively uninhabited regions, thus depositing fallout in those directions were few people lived. Unfortunately some plumes traveled over the corner of Utah where St. George is located. The fallout dose to some St. George residents was estimated to be 37 mSv.

There are five key myths associated with this fallout:

- The fallout was like snow.
- Multiple deaths occurred four years after significant testing events in 1951.
- The reunion of Enterprise High School graduates was attended by only one person, with the rest of the class dead due to radiation exposure.
- There was an abnormal cancer rate in St. George.
- Actor John Wayne died of cancer, due to exposure to fallout while making a film in the area.

According to the author, the facts tell a different story:

- There is no pictorial evidence that the fallout was "like snow."
- There was only one death four years later, and that was due to an accident.
- There was no reunion, and only one person from the graduating classes had died at that point (again, in an accident).
- The cancer rate was 30% less than the national average.
- The John Wayne movie was filmed one year after the fallout when the dose rates had decayed to "background."

Editor's Note: John Wayne contracted lung cancer in 1964 and died of stomach cancer in 1979. He attributed his cancer to his cigarette smoking, at a rate of six packs per day!

Internal dose studies at the Lovelace Respiratory Research Institute (LRRI) indicate internal doses were not significant. The LRRI data suggests that, following inhalation of beta/gamma-emitting radionuclides, there was no decrease in lifespan nor increase in disease (including lung cancer) when the dose was less than 20 mGy. Internally deposited radioactive materials were never more serious than protracted whole-body exposure to similar types of radiation.

Research from the DOE's Low Dose Radiation Research Program resulted in several paradigm changes in the field of radiation biology.

- The hit theory has to give way to bystander effects or intercellular communication. Hit cells communicate with nonhit cells; the organ responds as a whole and not as single cells.

- The mutation theory of cancer must be replaced by an appreciation for the effects of tissue changes such as chronic inflammatory disease and genomic instability.

- It is important to reevaluate the linear no-threshold model for extrapolation of high-dose responses to predict responses in the low-dose and low-dose-rate region.

To expound the last point, at the cellular and molecular level, very different biological changes are induced by low doses as compared to those observed following high doses, suggesting different mechanisms of actions as a function of dose. Many low-dose responses seem to be protective.

Much more research is needed in the low-dose exposure region, since it impacts all areas of our lives. Medical exposures, dirty bombs, nuclear energy production, and nuclear waste cleanup are billion-dollar activities and are all concerned with effects in the low-dose region. We need to have a sound scientific basis for these activities. Perhaps funding for research could come from a "tax" on these efforts, which could provide funding for research into this important area.

Internal and External Dosimetry of the Early Nuclear Weapons Worker – Elizabeth Brackett and Tosh Ushino

The presenters discussed some of the types of personnel monitoring that were in use during the early phases (1943 to 1963) of the nuclear weapon program. A brief overview of the early exposure limits was presented, and it was noted that monitoring methods were being developed during this time.

Early in vitro bioassay samples were typically analyzed by chemical separation followed by gross counting methods (alpha/beta/gamma), while routine in vivo bioassay wasn't introduced until around 1960. Pocket ionization chambers were the first dosimeters used (1943), followed by primitive film dosimeters with two windows (1944).

Selected highlights of monitoring efforts at Oak Ridge, Mound, Hanford, and Los Alamos were discussed, along with summaries of the numbers of samples collected and dosimeters processed on an annual basis.

Nuclear Weapons Worker Compensation Energy Employees Occupational Illness Compensation Program (EEOICP) Act – Jeff Kotsch

The EEOICP Act was codified in October 2000. Part B of the act compensates current or former employees (or their survivors) of the DOE, its predecessor agencies, and certain of its vendors, contractors, and subcontractors, who as a result of exposure while employed at covered facilities were diagnosed with:

- A radiogenic cancer.
- Chronic beryllium disease (or beryllium sensitivity).
- Chronic silicosis.

The act also provides compensation to individuals awarded benefits by the Department of Justice (DOJ) under Section 5 of the Radiation Exposure Compensation Act (RECA).

Implementation of the act involves the coordinated efforts of four federal agencies:

- Department of Labor (DOL)
- DOE
- DOJ
- Department of Health and Human Services (specifically National Institute for Occupational Safety and Health [NIOSH])

The DOL has primary responsibility for administering the act, including adjudication of claims for compensation and payment of benefits for conditions covered by Part B. Over the years, there have been potentially 650,000 workers in the nuclear weapon complex, 100,000 atomic workers (contractors), and 50,000 miners.

Workers or survivors go to resource centers to file claims. The Final Adjudication Board makes decisions on the merits of the claims. The following are some information summaries:

- NIOSH dose reconstructions:
  - 44,000 dose reconstructions have been completed, encompassing 200 facilities.
  - 87% of claimants are men.
  - 28% of claimants are survivors of workers.
  - 84% of claimants are DOE nuclear workers.
- Probability of causation (PoC) is used to make awards, but the requirements of the act provide for very claimant-favorable dose reconstructions. This approach is intended to minimize the possibility of denying compensation to claimants with cancer that may have been caused by ionizing radiation.
- Number of cases filed with DOL:
  - 187,607 total.
  - 46,205 required dose reconstructions.
  - 44,187 cases returned to DOL from NIOSH.
  - 9,850 dose-reconstructed cases (with PoCs >50%) have received $1.5 billion.
- "Special exposure cohort" (SEC) cases have received $3.6 billion. The SEC is a group of employees who work or have worked at the same facility as compensated workers and for whom dose cannot be reconstructed. For this group, a worker has to have been employed at the site for 250 days and have 1 of 22 specified cancers.
- The Part B Program has paid a total of $6 billion in compensation.

Continuing Education Committee Update

Jim Willison, CHP, Chair

Greetings, certified health physicists (CHPs)! We had three 8-hour courses at the 2016 Health Physics Society (HPS) Annual Meeting in Spokane. Altogether, 76 CHPs attended the three courses.

- Course 1 was "The Role of a Radiological Operations Support Specialist (ROSS)," taught by a team that was led by William Irwin.
- Course 2 was "Lessons in Communication From HPS's Ask the Experts," taught by Linnea Wahl.
- Course 3 was "How Randomness Affects Understanding of Radiation Risk Assessments and Decisions for Radiation Safety," taught by Ray Johnson.

The two courses for the 2017 HPS Midyear Meeting in Bethesda, Maryland, are being finalized. Titles and abstracts will be listed in the preliminary program when it is released.

The Continuing Education Committee is currently soliciting ideas for the three American Academy of Health Physics (AAHP) 8-hour courses to be held on the Saturday before the 2017 HPS Annual Meeting in Raleigh, North Carolina. Instructors receive a $1,000 honorarium and 20 continuing education credits for their troubles (as well as the opportunity to share their knowledge with their colleagues).

If you would like to be considered to present one of these courses, please contact us at aahpcec@burkinc.com.

AAHP Treasurer's Report

Steven Brown, CHP, AAHP Treasurer

The American Academy of Health Physics (AAHP) Finance Committee met on 9 June 2016 at the Burk and Associates office in McLean, Virginia. The proposed operating budget for fiscal year 2016–2017 was presented by the executive director, and budget requests from each of the AAHP committees were reviewed and approved with only a few minor adjustments. The most significant was an addition of a "special project" line item of $6,000 to support the transition of the executive director position from Nancy Johnson to a new person this coming fiscal year, as Nancy will be retiring in early 2017.

The AAHP investment manager, Neal Abravanel of Wells Fargo Advisors, met with the committee to provide an overview of the status of our intermediate and long-term investment accounts [*Editor's Note: see Bob Cherry's "From the President" message on this topic*]. Neal indicated we are currently invested in about 60% equity and 40% bond markets. The AAHP investment accounts did not perform as well in the last 12 to 18 months as in previous years. This mirrors the investment market in general over the same time period. Nonetheless, the AAHP has in excess of $760,000 as of 31 May 2016 in its investment accounts.

As treasurer and chair of the Finance Committee, I provided an update on the status of the AAHP fiscal year 2016–2017 operating budget and intermediate and long-term investment accounts at the Executive Committee meeting at the 2016 Health Physics Society Annual Meeting in Spokane on 17 July. I summarized this information for the general academy membership at the AAHP business meeting on 19 July.

Over the last decade, annual operating expenses of the AAHP have been several tens of thousands of dollars more than revenue. Shortfalls have been covered by successes in our intermediate-term investment account. As operating expenses have continued to rise, AAHP receivables have remained fairly constant—i.e., the number of certified health physicists (CHPs) remains steady at about 1,300–1,350. These shortfalls depleted the cash reserve in our operating account (think checkbook) to the point that the Executive Committee, in accordance with the AAHP investment policy, had to approve moving money from the intermediate-investment account to cover current operating budget needs.

This condition is not sustainable. Accordingly, the AAHP Finance Committee recommended and the AAHP Executive Committee approved a $25 increase in AAHP annual fees to $100 per year beginning with the 2017 maintenance fee. The last time AAHP maintenance fees were increased was in fiscal year 2003–2004 (by $20 at that time), for similar reasons. In other words, it will be 13 years between fee increases, and the percent increase this time is less than in 2004. Assuming 1,350 AAHP members and all other expenses and receipts being equal, the additional income should arrest the current condition and eliminate the shortfall for the near term. At the AAHP business meeting, several members raised concerns about the need to raise maintenance fees and suggested fees associated with the CHP examination process could be raised as well. It was agreed that the matter of source(s) of needed additional revenue would be a topic of future discussions of the Finance and Executive Committees.

Code of Ethics for the Members of the Health Physics Society

These principles are intended to aid members of the Health Physics Society, individually and collectively, in maintaining a professional level of ethical conduct. They are intended as guidelines by which members may determine the propriety of their conduct in relationships with employers, coworkers, clients, governmental agencies, members of other professions, and the public.

- Members of the Society shall give support to the objectives of the Health Physics Society.
- Members shall strive to improve their professional knowledge and skill.
- Each member shall be a judge of his/her competence and will not undertake any assignment beyond his/her abilities.
- All relations with employers, coworkers, clients, governmental agencies, and the general public shall be based upon and shall reflect the highest standard of integrity and fairness.
- Members shall never compromise public welfare and safety in favor of an employer's interest.
- No employment or consultation shall be undertaken which is contrary to law or the public welfare.
- Members will gladly accept every opportunity to increase public understanding of radiation protection and the objectives of the Society.
- Professional statements made by members shall have sound scientific basis. Sensational and unwarranted statements of others concerning radiation and radiation protection shall be corrected, when practical.
- Members shall protect the sources of confidential communications, provided that such protection is not itself unethical or illegal.

The Lighter Side of Health Physics