The Training Leader For Nuclear Industry Professionals
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Advanced Radiation Biology & Radiological Risk

December 3-7, 2018 ◆ Washington, DC ◆ Course Fee: $1295

This 5-day advanced course covers the current theories and risk-assessment models of the effects of ionizing radiation on the human body. Topics covered include:

- interaction of charged particles
- review of basic biology
- radiation cellular effects and cellular response to radiation damage
- system biological considerations
- high- and low-level radiation effects
- case studies of radiation accidents/incidents and resultant injuries
- radiation-induced heritable ill-health
- radiation effects on the embryo/fetus
- non-cancer effects such as the cardiovascular syndrome
- radiation risk
- human experience with radiation exposure

Emerging concepts such as non-targeted (bystander) effects, genomic instability, use of biomarkers in radiation therapy; apoptosis; delayed stress response protections; immediate operating protections; integrated defenses; adaptive response; development of radiation effectiveness factors (REFs) for radiation injury compensation programs; and endogenous vs. radiogenic cancers will be compared.

Theories of radiation carcinogenesis and dose models will be expanded on, including absolute risk, relative risk, and deterministic vs. probabilistic risk-assessment modeling.

The main points in reports BEIR and UNSCEAR will be covered, including a detailed discussion of BEIR VII and the BEIR IV and VI reports on radon. Other pertinent literature on radiation effects will be provided.

Human experience with dose reconstruction and radiation effects will be summarized, including discussion of at least 12 different cohorts which have been followed.

Increased use of radiation in diagnostic medical procedures will be discussed and comparisons made between charged particle and photon irradiation modalities for cancer patients.

Problem solving and case studies on dose/risk assessment and risk communication will be interspersed among the lectures. Students should bring a scientific calculator to class.

Course Instructor

DR. RODICAN P. REED has over 30 years of experience in health physics. From 1992 to 2007, he was a Senior Health Physicist at the U.S. Nuclear Regulatory Commission (NRC) Technical Training Center. At NRC, he provided health physics training to NRC inspectors, Agreement State inspectors, and other Federal agencies. He was responsible for the uranium fuel cycle technology training curriculum, including uranium mining and milling, health physics, nuclear criticality safety, fire protection, integrated safety analyses (ISA's), and uranium enrichment technologies. He trained fuel facility inspectors and license reviewers as part of the inspector qualification program. He briefed NRC Commissioners, the Office of the Inspector General (OIG), the Atomic Safety and Licensing Board Panel (ASLBP), and the news media, in radiation protection and uranium fuel cycle technology. He developed post-graduate training in radiation protection for the International Atomic Energy Agency (IAEA), which is now in use world-wide. He trained NRC and Agreement State health physics inspectors in the new 10 CFR Part 20. He developed and presented training on health physics for the proposed high-level waste geologic repository at Yucca Mountain.

He is certified by the American Board of Health Physics (ABHP) and is a member of the American Academy of Health Physics (AAHP). Most recently, he was a member of the History Committee of the Health Physics Society (HPS). He is also a past member of the HPS Continuing Education Committee and the Professional Development Committee of the AAHP. He has published papers in health physics, made numerous technical presentations, and prepared input to environmental impact statements (EIS's) for TVA's nuclear power plants and proposed coal gasification facility. He has a B.S. in Physics (1971), M.S. in Nuclear Engineering (1973), and Ph. D. in Health Physics (1977), all from Georgia Tech.

Interaction of Radiation with Matter
- Ionization and the W value
- Directly and Indirectly Ionizing Radiations
- Range of Charged Particles
- Density Thickness
- Specific Ionization
- Stopping Power
- High Atomic Number, High Energy (HZE) Charged Particles
- RBE vs. LET
- Photon Interactions
- Neutron Interactions

EXERCISE - Calculation of the RBE For Radiation Cataractogenesis in Mice Following Exposure to Fast Neutrons

Review of Basic Biology
- Cell Structure
- Chromosomes and Genes
- DNA (bases, sugar-phosphate matrix, H-bonding, telomeres)
- Cell cycle and mitosis
- Body Systems (Blood, GI, Respiratory, etc.)

Radiation Cellular Effects
- Direct vs. Indirect Effects
- Radiolysis of water
- Production of reactive oxygen species (ROS)
- Radiation Damage to DNA
- Chromosome Aberrations
- Oxygen Effect
- Cell Cycle Radiosensitivity
- Target Theory and G Values

EXERCISE - Calculation of Radiation-Induced DNA Single-Strand and Double-Strand Breaks Using G Values
- Law of Bergonie and Tribondeau
- Radiosensitivity of Various Cell Types

Cellular Response to Radiation Damage
- Non-targeted (e.g. bystander) effects
- Genomic Instability
- Repair mechanisms and scavenging of toxins
- Mitotic Delay
- Apoptosis
- Biomarkers

System Biological Considerations
- Propagation of Perturbations in the System
- Immediate Operating Protections
- Delayed Stress Response Protections
- Adaptive Response
- Integrated Defenses Against Cancer
- Endogenous vs. Radiogenic Cancer

High-Level Radiation Effects
- Acute vs. Chronic Exposure
- Definition of High Dose and High Dose-Rates
- Deterministic Effects
- Acute Radiation Syndrome
- Detailed discussion of acute exposure damage to hematopoietic, GI and CV systems as a function of dose
- LD50/60 for humans and animals
- Cataracts
- Impaired Fertility and Sterility
- Cutaneous Radiation Syndrome (CRS)
- Non-Specific Life Shortening
- Summary of Dose Thresholds for Various Types of Radiation Injury
- Case Studies of Radiation Accidents/Incidents (e.g. orphaned sources, spills, fires, criticalities) and Associated Injuries

EXERCISE - Dose Estimation/Reconstruction For the Tokaimura, Japan Criticality Accident

Low-Level Radiation Effects
- Stochastic Effects
- Theory of Radiation Carcinogenesis
- Latency Periods for Leukemia and Solid Cancers
- Non-cancer effects such as cardiovascular and circulatory
- Radiation-Induced Heritable Ill-Health
- Studies on Non-Humans (Drosophila and mice)
- Extrapolation to Humans

Radiation Effects on the Embryo/Fetus
- Embryonic Development
- Major Organogenesis
- Teratogenic Effects
- Mental Retardation and Developmental Anomalies
- Medical Implications

Radiation Risk
- Concepts of Absolute vs. Relative Risk
- Mortality vs. Morbidity (Total Detriment)
- Radiation Tissue Weighting Factors

EXERCISE - Calculation of the Relative Risk of Leukemia in Survivors of Hiroshima and Nagasaki
- Dose-Response Models (linear, quadratic, linear-quadratic, and linear-quadratic-exponential)
- Lifetime vs. Annual Risk
- Deterministic vs. Probabilistic Risk-Assessment Modeling
- Summary of Latest UNSCEAR Reports on Risk
- Evolution of BEIR Reports (BEIR III, V and VII)
- Detailed discussion of BEIR VII
- EPA Blue Book
- Risk From Radon (BEIR IV and VI Reports)

EXERCISE- Calculation of Lung Dose and Risk From Exposure to EPA's Indoor Radon Guideline

Human Experience
- Sources of Exposure (NCRP Report No. 160)

EXERCISE – Dose and Risk Communication to the Public From I-131 Fallout in Drinking Water
- Exposure and Risk from Medical Diagnostic Procedures
- National Cancer Institute (NCI) Dose Reconstruction for Medical X-Ray Technologists
- Radiation Treatment For Ankylosing Spondylitis
- Radium Dial Painters
- Uranium Miners
- Children Treated for Tinea Capitis and Enlarged Thymus
- Tuberculosis Patients and Breast Cancer
- Hiroshima and Nagasaki Survivors (Lifespan Study)
- Hanford Downwinders
- Chernobyl
- Russian Nuclear Workers (Mayak) and Extended Techa River Cohort
- Charged Particle vs. Photon Irradiation For Cancer Therapy
- Cancer Patients and Radiation-Induced Secondary Tumors
- Medical Misadministrations

EXERCISE - Dose Calculation and Risk Communication Due to A Medical Misadministration
- Interactive Radioepidemiological Program (IREP)
- Changes in Radiation Weighting Factor
- Radiation Effectiveness Factor (REF)
- USNRC-Sponsored Study of Cancer Risk in Populations Surrounding Nuclear Facilities
- Fukushima Daiichi Japanese Nuclear Power Plant Accident

EXERCISE– Dose and Risk to Fukushima Daiichi Nuclear Power Plant Workers Assisting in Recovery Effort

ACCOMMODATIONS

This course will be held at the Hilton Washington DC/Rockville hotel.

A block of rooms has been reserved at reduced rates for course participants. Please make your reservation directly with the hotel by calling 301-468-1100 and specify that you are attending Technical Management Services' short course to receive the group rate.

The reserved block of rooms will be released 3 weeks prior to the course (at which time rooms will be offered on an availability basis only).

HOW TO REGISTER ...

Register online:
www.tmscourses.com
or call 860-738-2440.

Registration questions can be emailed to info@tmscourses.com.

The American Academy of Health Physics (AAHP) awarded 40 continuing education credits for this course.

CANCELLATION POLICY:

Cancellations are accepted up to three weeks prior to the start of the course. After this time a $100 cancellation fee will be charged. Registrants who cancel within 1 week of the course will be liable for the full course fee. Occasionally, enrollment for a course is low and it becomes necessary for us to cancel the course. We apologize for any inconvenience a cancellation may cause and will make every effort to reschedule the course or make other arrangements for you.

In the event TMS may cancel a course due to low enrollment, notice will be given 2 weeks prior to the class.