

## Director

Robert Bruce Hayes, Ph.D, CHP, PE  
3040 Hamilton Street, North Las Vegas NV 89030,  
rob\_in\_nm@hotmail.com, (702) 307-7885

### Education

<u>University and location</u>	<u>Degree</u>	<u>Year</u>	<u>Field of Study</u>
University of Utah, Salt Lake City, UT	BS	1994	Physics
University of Utah, Salt Lake City, UT	BS	1994	Mathematics
University of Utah, Salt Lake City, UT	MS	1997	Physics
University of Utah, Salt Lake City, UT	PhD	1999	Nuclear Engineering

### Certifications and Licensure

Certified Health Physicist (CHP) by the American Board of Health Physics #05487.

Licensed Professional Engineer (PE) in Nuclear Engineering by the State of New Mexico #17913.

### Professional Experience

2005-present	Senior Scientist, National Security Technologies LLC (formerly Bechtel-Nevada/Lockheed Martin-Nevada), Remote Sensing Laboratory – Nellis, Las Vegas, NV. Duties include radiological emergency response including assessment, consequence management and R&D.
2000-2005	Senior Radiological Engineer, Washington TRU Solutions, LLC. Waste Isolation Pilot Plant, Radiological Technology, Carlsbad, NM. Duties include all radiological analysis for the WIPP remote handled TRU waste project including, dose rate prediction, shielding evaluation, air monitoring, access control and radiological surveys.
2003-2005	Senior Nuclear Criticality Safety Specialist, Washington TRU Solutions, LLC. Waste Isolation Pilot Plant, Radiological Technology, Carlsbad, NM. Duties include preparation and review of nuclear criticality safety evaluations.
2000-2004	Adjunct Professor of Mathematics and Physics, College of the Southwest-Carlsbad, Department of Arts and Sciences, Carlsbad, NM. Duties are to teach all undergraduate math and physics courses and physics labs.
1999-2000	Research Associate, Radiobiology Division, Radiology Dept., University of Utah. Center for Advanced Medical Technologies. Duties included a historical review of the radiation protection program at the Paducah Gas Diffusion plant.
1998-1999	Nuclear Reactor Lab Instructor, Nuclear Engineering Program, University of Utah, College of Engineering. Teaching a reactor lab course using a 100 kW TRIGA research reactor.
1997-1999	Head of Electron Paramagnetic Resonance (EPR) Laboratory, Radiobiology Division, University of Utah, Center for Applied Dosimetry. Duties included all research, analysis and measurements in the EPR lab relating to retrospective dosimetry for cumulative radiation exposures.
1994-1997	Research Specialist, Radiobiology Division, University of Utah, TL/EPR Laboratory. Duties included sample preparation and EPR measurement and analysis.

### Additional Qualifications and Achievements

Experienced user of MCNP5 and MCNPX for both radiation shielding and nuclear criticality calculations.

Current or past publication referee for the Health Physics Journal, Journal of Physics: Condensed Matter, Radiation Measurements, Physics in Medicine and Biology, Nuclear Technology and the journal of Applied Radiation and Isotopes.

Technical Program Chairman for the upcoming 2008 Winter Meeting of the American Nuclear Society (ANS) in Reno, NV

Member of the American Academy of Health Physics, the Health Physics Society, the American Nuclear Society, the American Association for the Advancement of Science, the American Physical Society, the Institute of Electrical and Electronics Engineers and The Gideons International.

Executive Committee Member for the ANS Radiation Protection and Shielding Division (RPSD) for the years 2006-2009, program chair for the ANS RPSD in years 2002-2005.

Technical Program Chair for the ANS 14<sup>th</sup> Biennial Topical Meeting of the RPSD, April 2-6, 2006. Carlsbad, NM.

## Peer Reviewed Journal Publications

- Hayes R. B. (2007) Use of a radon stripping algorithm for air filter activity assessment. *Health Phys.* (in press).
- Hayes R. B. (2007) Burn-up Characteristics of a light-water-cooled nuclear reactor of natural uranium and beryllium. ISSN 1936-6256, *J. Physical & Natural Sci.* **1** (2). 1-11.
- Hayes R. B. (2006) A light-water-cooled nuclear reactor of natural uranium and beryllium. *J. ASTM Int.* **3** (8), 1-11. Online Paper ID, September JAI100274.
- Hayes R.B., Pena A. M., Goff T. E. (2005) Use of alpha spectroscopy for conducting rapid surveys of transuranic activity on air sample filters and smears. *Health Phys.* **89**, 172-180.
- Hayes R.B. (2004) Collimated spectroscopy for specific activity determination behind a shield wall. *Radiat. Meas.* **39**, 43-46.
- Hayes R.B. (2004) A new technique for preliminary estimates of TRU activity on air sample filters and radiological smears. *Health Phys.* **87**, 429-436.
- Hayes R.B. (2004) Generalized photon skyshine calculations. *Radiat. Prot. Dosim.* **111**, 239-250.
- Hayes R. B. Chiou H. C. (2003) Curve fitting air sample filter decay curves to estimate transuranic content. *Health Phys.* **86**, 80-91.
- Hayes R. B. (2003) False CAM alarms from Radon fluctuations *Health Phys.* **85**, S81-S84.
- Hayes R. B. (2003) Diagnostic X-ray dose profiles in molar teeth using Monte Carlo simulation *Radiat. Prot. Dosim.* **104**, 153-158.
- Hayes R. B. and Chiou H. C. (2003) Preliminary evaluation of real time false CAM alarm prediction through continuous radon monitoring. *Health Phys.* **84** (Supplement 2), S89-S92.
- Hayes R. B (2002) Dose rate prediction methodology for remote handled transuranic waste workers at the Waste Isolation Pilot Plant. *Health Phys.* **83**, 449-455.
- Hayes R. (2002) Beta CAM alarm set-point determination using historical data at the WIPP. *Radiat. Prot. Mgt.* **19**, 16-24.
- Hayes R. B and Beekman M.L (2002) Alpha CAM alarm set points in a salt dust environment. *Health Phys.* **82**, 887-897.
- Hayes R. B, Haskell E. H and Kenner G H (2002) An EPR technique for separating internal Sr-90 doses from external gamma ray doses in teeth. *Health Phys.* **83**, 75-81.
- Hayes R. B, Gadbury C and Goff T (2002) Preliminary measurements of surface removable NORM activity in the WIPP underground. *Health Phys.* **82**(Supplement 2), S103-S107.
- Hayes R B and Haskell E H (2000) A method for identification of interfering signals in EPR dating of tooth enamel. *Radiat. Meas.* **32**, 781-785.
- Hayes R B, Haskell E H, Barrus J K, Kenner G H and Romanyukha A A (2000) Accurate EPR radiosensitivity calibration using small sample masses. *Nucl. Instr. Meth. A.* **441**, 535-550.
- Hayes R B, Haskell E H, Kenner G H and Barrus J K (2000) A virtually nondestructive EPR technique accounting for diagnostic X-rays. *Radiat. Meas.* **32**, 559-566.
- Hayes R B, Haskell E H, Wieser A, Romanyukha A A, Hardy B L and Barrus J K (2000) Assessment of an alanine EPR dosimetry technique with enhanced precision and accuracy. *Nucl. Instr. Meth. A.* **440**, 453-461.
- Hayes R B, Haskell E H and Kenner G H (1998) An assessment of the Levenberg-Marquardt fitting algorithm on saturating exponential data sets. *Ancient TL* **16**, 57-62.
- Hayes R B, Haskell E H, Romanyukha A A and Kenner G H (1998) Technique for increasing reproducibility in EPR dosimetry of tooth enamel. *Meas. Sci. Technol.* **9**, 1994-2006.
- Hayes R B, Kenner G H and Haskell E H (1998) EPR dosimetry of Pacific Walrus (*Odobenus Rosmarus Divergens*) teeth. *Radiat. Prot. Dosim.* **78**, 55-63.
- Hayes R B, Haskell E H and Kenner G H. (1997) A mathematical approach to optimal selection of dose values in the additive dose method of EPR dosimetry. *Radiat. Meas.* **27**, 315-323.
- Alexander G A, et al. (2007) BiodosEPR-2006 Meeting: Acute dosimetry consensus committee recommendations on biodosimetry applications in events involving uses of radiation by terrorists and radiation accidents. *Radiat. Meas.* doi:10.1016/j.radmeas.2007.05.035
- Chiou H C and Hayes R B (2004) Creating a baseline radiological standard for the Waste Isolation Pilot Plant underground. *Isot. Environ. Health Studies* **40**, 1-8.
- Chumak V, et al. (1996) The first international intercomparison of EPR-dosimetry of teeth: first results. *Appl. Radiat. Isot.* **47**, 1281-1286.
- Goff T and Hayes R. (2001) Internal contamination evaluation of a radioactive materials shipping container using a radiation assessment filter. *Radiat. Prot. Mgt.* **18**(6) 30-38.

- Haskell E H, Difley R, Kenner G, Hayes R, Snyder K, Gustafson D (1999) A comparison of optical stimulated luminescence dating methods applied to eolian sands from the Mohave Desert in Southern Nevada. *Quat. Geochron.* **18**, 235-242
- Haskell E H, Hayes R B and Kenner G H (1996) Preparation-induced effects in EPR dosimetry of tooth enamel: pre- and post-crushing sensitivity. *Appl. Radiat. Isot.* **47**, 1305-1310.
- Haskell E H, Hayes R B and Kenner G H (1997) Improved accuracy of EPR dosimetry using a constant rotation goniometer. *Radiat. Meas.* **27**, 325-329.
- Haskell E H, Hayes R B and Kenner G H (1998) A high sensitivity EPR technique for alanine dosimetry. *Radiat. Prot. Dosim.* **78**, 43-49.
- Haskell E H, Hayes R B and Kenner G H (1999) An EPR dosimetry method for rapid scanning of children following a radiation accident using deciduous teeth. *Health Phys.* **76**, 137-144.
- Haskell E H, Hayes R B, Kenner G H, Sholom S V, and Chumak V V (1997) EPR techniques and space biodosimetry. *Radiat. Res.* **148**, S51-S59.
- Haskell E H, Hayes R B, Kenner G H, Wieser A, Aragno D, Fattibene P, Onori S (1999) Achievable precision and accuracy in EPR dosimetry of tooth enamel. *Radiat. Prot. Dosim.* **84**, 527-535.
- Haskell E H, Hayes R B, Romanyukha A A and Kenner G H (2000) Preliminary report on the development of a virtually non-destructive additive dose technique for EPR dosimetry. *Appl. Radiat. Isot.* **52**, 1065-1070.
- Haskell E H, Hayes R B, Romanyukha A A, Barrus J K and Kenner G H (1999) Automated Spectral Manipulation and Data analysis for EPR Dosimetry of Teeth. *Radiat. Prot. Dosim.* **84**, 521-526.
- Haskell E H, Kenner G H and Hayes R B (1995) Electron paramagnetic resonance dosimetry of dentine following removal of organic material, *Health Phys.* **68**, 579-584.
- Haskell E H, Kenner G H, Hayes R B, Sholom S V, and Chumak V V (1997) An EPR intercomparison using teeth irradiated prior to crushing. *Radiat. Meas.* **27**, 419-424.
- Kenner G H, Haskell E H, Hayes R B, Baig A and Higuchi W I (1998) EPR properties of synthetic apatites, deorganified dentine and enamel. *Calcified Tissue Int.* **62**, 443-446.
- Kenner G H, Brik A B, Liu G, Haskell E H, Hayes R B, Knight J A, Vajda G, Miller S C, Jee W S S and Barrus J K. (2005) Variation of long-lived free radicals responsible for the EPR native signal in bone of aged or diseased human females and ovariectomized adult rats. *Radiat. Meas.* **39**, 255-262.
- Polyakov V I, Haskell E H, Kenner G H, Hutt G and Hayes R B (1995) Effect of mechanically induced background signal on EPR-dosimetry of tooth enamel. *Radiat. Meas.* **24**, 249-254.
- Romanyukha A A, Hayes R B, Haskell E H and Kenner G H (1999) Geographical variations in tooth enamel EPR spectra. *Radiat. Prot. Dosim.* **84**, 445-449.
- Sholom S V, Haskell E H, Hayes R B, Chumak V V and Kenner G H (1998) Influence of crushing and additive irradiation procedures on EPR dosimetry of tooth enamel. *Radiat. Meas.* **29**, 105-111.
- Sholom S V, Haskell E H, Hayes R B, Chumak V V and Kenner G H (1998) The properties of UV light induced EPR signals in enamel and their possible interference with gamma-induced signals, *Radiat. Meas.* **27**, 113-118.
- Sholom S V, Haskell E H, Hayes R B, Chumak V V and Kenner G H (2000) EPR-Dosimetry With Carious Teeth. *Radiat. Meas.* **32**, 799-803.
- Wieser A, et al. (2000) The second international intercomparison on EPR tooth dosimetry. *Radiat. Meas.* **32**, 549-557.
- Wieser A, Onori S, Fattibene P, Aragno D, Romanyukha A, Ignatiev E, Koshta A, Skvortzov V, Ivannikov A, Stepanenko V, Chumak V, Sholom S, Haskell E, Hayes R, and Kenner G (2000) Comparison of sample preparation and signal evaluation methods for EPR analysis of tooth enamel. *Appl. Radiat. Isot.* **52**, 1059-1064.

### Proceedings/Transactions

- 1) Hayes R. B., Marianno C. M. Use of MCNPX for alpha spectrometry simulations of a continuous air monitor. *Trans. Amer. Nucl. Soc.* **96**, 631-633, 2007..
- 2) Hayes R. B. MCNP comparison with point source measurements from a portable HPGe system. *Trans. Amer. Nucl. Soc.* **95**, 28-30, 2006.
- 3) Hayes R. B. An alternate error propagation approach. *Trans. Amer. Nucl. Soc.* **90**, 514-516, 2004.
- 4) Hayes R. B. and Straite A. E. Collimated spectroscopy for specific activity determination behind a shield wall. *Trans. Amer. Nucl. Soc.* **89**, 566-568, 2003.
- 5) Hayes R. B. Monte Carlo error propagation using spreadsheets. Proceedings of the 2003 Radiochemistry Conference, July 13-16, Carlsbad, NM 2003.
- 6) Hayes R and Golden G. Shielding verification process for the WIPP RH-TRU waste final emplacement configuration. Spectrum 2002, 9<sup>th</sup> Biennial International Conference on Nuclear and Hazardous Waste Management, August 4-8, Reno NV, American Nuclear Society, CD-ROM.

- 7) Hayes R B, Chester C A and Strait A E. Final results of the WIPP RH TRU facility shielding analysis. The 12<sup>th</sup> Biennial RPSD Topical Meeting, Radiation Serving Society. Sante Fe, NM April 14-18, 2002. The Radiation Protection and Shielding Division of the American Nuclear Society, CD-ROM.
- 8) Hayes R B. An efficient technique for constructing realistic curved penetrations in MCNP using VISED. The 12<sup>th</sup> Biennial RPSD Topical Meeting, Radiation Serving Society. Sante Fe, NM April 14-18, 2002. The Radiation Protection and Shielding Division of the American Nuclear Society, CD-ROM.
- 9) Hayes R B, Frye D A. Mixed Fe/Pb shielding approximations for design optimization. *Trans. Amer. Nucl. Soc.* **86**, 218-219, 2002.
- 10) Hayes R B. Difficulties with using spectral deconvolution in low-level EPR radiation dosimetry. Proceedings of the International Conference on Future Nuclear Systems, Global '99, Nuclear Technology-Bridging the Millennia, Aug 29-Sep 3, Jackson Hole WY, 1999. The American Nuclear Society, CD-ROM.
- 11) Brown F B, Sweezy J E, Hayes R B. Monte Carlo parameter studies and uncertainty analyses with MCNP5. PHYSOR 2004 -The Physics of Fuel Cycles and Advanced Nuclear Systems: Global Developments Chicago, Illinois, April 25-29, 2004, on CD-ROM, American Nuclear Society, Lagrange Park, IL. (2004)
- 12) Haskell E H, Kenner G H, Hayes R B, Sholom S V, and Chumak V V (1996) EPR dosimetry of teeth in past and future accidents: A prospective look at a retrospective method. In *Effects of Low-Level Radiation for Residents near Semipalatinsk Nuclear Test Site*. (Hoshi M, Takada J, Kim R and Nitta Y Eds). Pp. 261-274. Research Institute for Radiation Biology and Medicine, Hiroshima University.
- 13) Hendricks T, Hayes R. Enhancement of aerial gamma surveillance utilizing complementary characteristics of NaI and HPGe detection. 1<sup>st</sup> Joint Emer. Prep. & Response/Robotic & Remote Sys. Top. Mtg., Salt Lake City, UT, February 11-16, 2006.
- 14) Jierree C, Frank-Supka L, Waymire G and Hayes R, Effluent and environmental monitoring challenges for an underground transuranic mixed waste disposal site. Spectrum 2002, 9<sup>th</sup> Biennial International Conference on Nuclear and Hazardous Waste Management, August 4-8, Reno NV, American Nuclear Society, CD-ROM.
- 15) Rhoden W. G. and Hayes R. B. Alternate approach to the upper subcritical limit determination for MCNP. *Trans. Amer. Nucl. Soc.* **89**, 109-110, 2003.
- 16) Wieser A., Chumak V., Bailiff I., Baran N., Bougai A., Brik A., Dubrovsky S., Finin v., Haskell E., Hayes R., Ivannikov A., Kenner G., Kirillov V., Kolesnik S., Liidj G., Lippmaa E., Maksimenko V., Matyash M., Meijer A., Minenko V., Pasalskaya L., Past J., Pavlenko J., Puskar J., Radchuk V., Scherbina O., Sholom S., Skvortsov V., Stepanenko V., Vaher Ü. International intercomparison of dose measurements using EPR spectrometry of tooth enamel. In: *The Radiological Consequences of the Chernobyl Accident*. Report EUR 16544 EN, European Commission, Brussels, 1996, 957-964 (1996).
- 17) Wieser A, et al. *1996 Radiological Consequences of the Chernobyl Accident. Proceedings of the First International Conference (EUR 16544 EN)*, (Karaoglou A, Desmet G, Kelly G N and Menzel H G Eds.) Eur. Commission, Brussels, Belgium.

#### Peer reviewed Letters/Correspondence/Abstracts

- Hayes R. B., Marianno C. M. (2007) The next generation air particle detectors for the United States Navy. *Health Phys.* **93**, S98.
- Hayes R B, Kenner G H and Haskell E H (2003) Reply to Anspaugh et al. *Health Phys.* **85**, 624-625.
- Hayes R B (2000) Electron Paramagnetic Resonance Dosimetry: Methodology and material characterization. *Med.Phys.* **26**, 2516.
- Hayes R B (1999) Thesis Abstract: Electron Paramagnetic Resonance Dosimetry: Methodology and material characterization. *Ancient TL.* **17**, 65.
- Hayes R B (2000) Concerns Regarding Recent NIST Publications on Alanine Dosimetry. *Radiat. Phys. Chem.* **59**, 443-444.
- Haskell E H, Hayes R B and Kenner G H (1999) Native signal subtraction, g-factor normalization and constant rotation goniometry are valid methods in EPR dosimetry. *Health Phys.* **77**, 472-475.
- Haskell E H, Hayes R B and Kenner G H (1996) Plasterboard as an emergency EPR dosimeter. *Health Phys.* **71**, 95.

#### Chapters in Books

- 1) Emergency Response Air Monitoring, in *Air Monitoring*. CRC Press, Boca Raton, FL (accepted)