Attachment 2.9-1 Data Quality Assurance Documentation

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Education

Ph.D., Radiation Biology, Colorado State University, Fort Collins, Colorado, 1977
M.S., Health Physics, Colorado State University, Fort Collins, Colorado, 1973
Former Line Officer, U.S. Naval Reserve
U.S. Navy Officer Candidate School, Newport, Rhode Island, 1969
B.A., Physics, St. Olaf College, Northfield, Minnesota, 1967

Specialties

Human health risk assessment
Radiation protection and measurement
Public involvement

Professional Experience

MFG Inc.

Senior Scientist and Project Manager, Fort Collins, Colorado (5/2000-present)

Managing the radiation protection and measurements group, including a large set of gamma, alpha and beta monitoring systems. MARSSIM experience in the context of pre- and post-remedial action surveys. Co-developer of MFG Inc.'s global positioning system-based field gamma scanning hardware/software systems. Currently Radiation Safety Officer (RSO) for the Highlands former uranium mill site (Wyoming) and the Felder Ray Point former uranium mill site (Texas). Co-editor and author of 900-page graduate textbook, "Radiological Assessment, A Textbook on Environmental Risk Analysis". MFG project leader on National Institutes of Occupational Safety and Health Atomic Energy Worker Compensation Project. Performing radiation measurements, human health risk and regulatory assessments of various facilities, including scanning, sampling and analysis. License-related assistance for uranium and related mine/mill facilities in western U.S. ASTM environmental site assessment professional. Environmental Impact Statement and related support. Accreditation Board on Engineering Technology, Health Physics Society university program evaluator. National Council on Radiation Protection and Measurements committee on radioactive metals recycling. Guest lecturer at Colorado State University.

Keystone Scientific, Inc.

President, Fort Collins, Colorado (1992–5/2000)

Performed radiation and chemical dose evaluation/reconstruction analyses at weapons complex facilities as a private consultant to the Centers for Disease Control and Prevention. Included research at Idaho National Engineering and Environment Laboratory, and the Savannah River Site near Aiken, South Carolina. Performed similar research for the Colorado Department of Public Health and Environment at the Rocky Flats Environmental Technology Site (Rocky Flats

Plant) near Denver, Colorado. Primary project-related public speaker at numerous risk-related meetings in South Carolina, Georgia and Colorado. Uranium mill tailings facility radiation protection licensing, environmental transport modeling and procedures development. NCRP committee member. Member, National Academy of Sciences Board on Radioactive Waste Management. Invited graduate school lecturer at Colorado State University.

Chem-Nuclear Systems, Inc.

Vice President, Harrisburg, Pennsylvania (1990–1992)

Responsible for initiation and management of a contract with the Commonwealth of Pennsylvania to site, design, construct, and operate a low-level radioactive waste facility. On-site reviews of all power reactor operations in the Compact region. Located and staffed a new office in Harrisburg, negotiated prime contract with State health department, and subcontracts with individual companies, developed and negotiated technical work plans including emergency preparedness plan, led the public involvement effort as primary project speaker for numerous presentations throughout the Appalachian Compact region; directed the project's first two years. Member, U.S. Environmental Protection Agency's Science Advisory Board. Guest lecturer, Harvard School of Public Health.

Chem-Nuclear Systems, Inc.

Executive Director, Albuquerque, New Mexico (1983–1990)

Developed and managed all aspects of environmental monitoring, dosimetry, radiation protection, verification, radiological emergency response and quality assurance programs for the U.S. Department of Energy's Uranium Mill Tailings Project (UMTRA Project, under subcontract to MK-Ferguson, Inc.). Responsible for uranium, radium, thorium-related radioactivity/radiation measurements at up to eight field sites simultaneously, managed 138 health physics field staff. Negotiated regulatory requirements and compliance specifics with USDOE, USNRC, USEPA, State health departments. Primary UMTRA project speaker at numerous public meetings in eight states. Consultant, International Atomic Energy Agency, Vienna, Austria. Guest lecturer, Harvard School of Public Health.

Oak Ridge National Laboratory

Research Staff Member, Oak Ridge, Tennessee (1976–1983)

Performed radionuclide and chemical environmental risk assessments of: proposed uranium and thorium ore mining, milling, and refining; fuel reprocessing and refabrication facilities; power reactor operations; breeder reactor fuel cycle; and high temperature gas-cooled reactor fuel recycling. Research also included assessments of non-nuclear energy sources, including toxics released during wood combustion, coal liquefaction, and coal gasification. Responsible for regular professional presentations related to research and publications.

Colorado State University

Graduate Research Assistant, Fort Collins, Colorado (1972–1976)

Prepared and presented laboratory and classroom lectures. Conducted Ph.D. research on plutonium uptake characteristics of bacteria immobilized on a polymer matrix.

U.S. Navy

Line Officer, Little Creek, Virginia (1969–1972)

Three years active duty. Shipboard experience: qualification as Command Duty Officer, Officer of the Deck, Engineering Watch Officer, Electrical Division Officer. Training in radiation contamination emergency response at Naval Damage Control Training Center, Camden NJ.

Patent

RTRAK autolocating mobile gamma scanning system, U.S. Patent #5,025,150, J. Oldham, R. Meyer, C. Begley, and C. Spencer, 1991.

Professional Activities

Accreditation Board for Engineering and Technology (ABETS) University Program Evaluation Team Leader, 2001 – present

National Council on Radiation Protection and Measurements, Subcommittee on Radioactive Metals Recycling, 1999 – 2002.

RESRAD model, training course at Argonne National Laboratory, 2001.

Certified Environmental Site Assessment Professional, ASTM training course, 2000.

Lecturer (occasional), Colorado State University, 1993-present.

National Academy of Sciences, Member, Board on Radioactive Waste Management (1992-1998)

National Academy of Sciences, Subcommittees: Review of the New York State Low Level Waste Siting Project, 1996; DOE Site Decommissioning, 1997; the National Low Level Waste Problem, 1998.

U.S. Environmental Protection Agency Science Advisory Board, Radiation Advisory Committee Member, 1990–1992.

High intensity training: "Dealing with the Media", interactive 6-student, 3-day course directed by Dr. Leonard Roller, 1989.

Invited lecturer, Harvard School of Public Health, 1988-1994.

Consultant to the International Atomic Energy Agency, Vienna. Co-authored IAEA Technical Report STI/DOC/10/327, "Planning for Cleanup of Large Areas Contaminated as a Result of a Nuclear Accident," 1988.

Consultant to the US EPA Science Advisory Board, technical review of National Emissions Standards for Hazardous Air Pollutants, 1988.

Consultant to the Centers for Disease Control, Fernald Dose Assessment Project, 1987.

Invited participant, "European Seminar on the Risks from Tritium Exposure," Mol, Belgium, November 1982.

Invited participant, "Light Water Reactor Accident Mitigation Workshop," West Germany, April 1981.

Faculty Affiliate, Colorado State University Ph.D. committee member, 1980–1982.

Governor's Planning Committee for the Management of Radioactive and Hazardous Wastes for the State of Tennessee, 1979–1980.

Health Physics Society, Environmental Section, Education and Training Committee.

Expert Testimony

"Review of the Radiological Hazard Associated with the Durango Uranium Mill Tailings Pile." Court testimony for the *State of Colorado vs. HECLA.* Durango, Colorado, April 20–22, 1987.

Honors and Awards

Society for Technical Communications 1985 Award for “Radiological Assessment–A Textbook on Environmental Dose Analysis," edited by John E. Till and H. Robert Meyer, NUREG/CR-3332.

Society for Technical Communications 1980 Award for “Radiological Impact of Thorium Mining and Milling,” H.R. Meyer et al., *Nuclear Safety* 20 (3).

American Nuclear Society's P.W. Jacoe Award–outstanding nuclear science student, 1976.

Phi Kappa Phi Graduate Honor Society, 1976.

Distinguished Naval Graduate, Officer Candidate School, 1969.

NASA Summer Fellowship, 1966.

Selected Publications

Emery, R.M., M.L. Warner, **H.R. Meyer**, C.A. Little and J.E. Till. 1977. Environmental Assessment Strategies in Support of the Nonproliferation Alternative Systems Assessment Program (NASAP). PNL-2415. Battelle Pacific Northwest Laboratories. October.

Meyer, H.R., and J.E. Till. 1978. “Global/Generic Studies.” In HTGR Fuel Recycle Development Program Annual Report. ORNL-5423. Oak Ridge National Laboratory.

Meyer, H.R., J.E. Till, E.A. Bondietti, D.E. Dunning, C.S. Fore, C.T. Garten, Jr., and S.V. Kaye. 1978. Nonproliferative Alternative Systems Assessment Program - Preliminary Environmental Assessment of Thorium/Uranium Fuel Cycle Systems. ORNL/TM-6069. Oak Ridge National Laboratory. June.

Meyer, H.R., and J.E. Till. 1978. “Radiological Hazards of Denatured U-233 Fuel.” In Interim Assessment of the Denatured Fuel Cycle. Edited by L.S. Abbott, D.E. Bartine and T.J. Burns. ORNL-5388. Oak Ridge National Laboratory. December.

Tennery, V.J., E.S. Bomar, W.D. Bond, L.E. Morse, **H.R. Meyer** and J.E. Till. 1978. Environmental Assessment of Alternate FBR Fuels: Radiological Assessment of Reprocessing and Refabrication of Thorium/Uranium Carbide Fuels. ORNL/TM-6493. Oak Ridge National Laboratory. August.

Tennery, V.J., E.S. Bomar, W.D. Bond, L.E. Morse, **H.R. Meyer**, J.E. Till and M.G. Yalcintas. 1978. Environmental Assessment of Advanced FBR Fuels: Radiological Assessment of Airborne Releases from Thorium Mining and Milling. ORNL/TM-6474. Oak Ridge National Laboratory. October.

Braid, R.B., C.A. Little, **H.R. Meyer**, J.P. Witherspoon, A. Brandstetter, and R.M. Ecker. 1979. “Interim Report—Environmental Assessment of Alternative Reactor/Fuel Cycle Systems—NASAP.” In Nuclear Proliferation and Civilian Nuclear Power. NE-001. Volume 6. U.S. Department of Energy. December.

Carnes, S.A., E.D. Copenhaver, L. Martin-Bronfman, **H.R. Meyer**, T.W. Oakes, D.C. Parzyck, L.W. Rickert, E.G. St. Clair, C.W. Tevepaugh, L.F. Willis, and D.W. Weeter. 1979. Report of the UCC-ND Task Force on Waste Management in Tennessee. September.

Dunning, D.E. and **H.R. Meyer**. 1979. “An Evaluation of Thorium-232 Dose Conversion Factors.” In The Validation of Selected Predictive Models and Parameters for the Environmental

Transport and Dosimetry of Radionuclides. ORNL/TN-6663. Edited by C.W. Miller. Oak Ridge National Laboratory. July.

Faust, R.A., C.S. Fore, M.V. Cone, **H.R. Meyer** and J.E. Till. 1979. Biomedical and Environmental Aspects of the Thorium Fuel Cycle. ORNL/EIS-111. Oak Ridge National Laboratory. July.

Meyer, H.R. and D.E. Dunning. 1979. "Reevaluation of Dose Equivalent per Unit Intake for Th232." Health Physics 37 (4): 595–598. October.

Meyer, H.R. and J.E. Till. 1979. "Anticipated Radiological Impacts of the Mining and Milling of Thorium for the Nonproliferative Fuels." Proceedings of the Symposium–Radioactivity and Environment. Edited by W. Feldt. German-Swiss Society for Radiation Protection, Norderney, Federal Republic of Germany, October 2–6, 1978, IRPA.

Meyer, H.R, J.E. Johnson, R.P. Tengerdy, and P.M. Goldman. 1979. "Use of a Bacteria-Polymer Composite to Concentrate Plutonium from Aqueous Media." Health Physics 37 (3): 359–363. September.

Meyer, H.R, C.A. Little, J.P. Witherspoon and J.E. Till. 1979. "A Comparison of Potential Radiological Impacts of U233 and Pu239 Fuel Cycles." Transactions of the American Nuclear Society, Winter Meeting, November 12–16, 1979.

Meyer, H.R, J.E. Till, E.S. Bomar, W.D. Bond, L.E. Morse, V.J. Tennery, and M.G. Yalcintas. 1979. "Radiological Impacts of Thorium Mining and Milling." Nuclear Safety 20 (3). June.

Meyer, H.R, J.E. Till and E.L. Etnier. 1980. "Reprocessing Thorium-Based Fuels." and "Tritium Doses and Dosimetry." HASRD Technical Progress Report. ORNL-5595. Oak Ridge National Laboratory. January.

Meyer, H.R, D.E. Dunning, D.C. Kocher and K.K. Kanak. 1980. "Dose Conversion Factors." In Recommendations Concerning Models and Parameters Best Suited to Breeder Reactor Environmental Radiological Assessments. Edited by C.W. Miller. ORNL-5529. Oak Ridge National Laboratory. May.

Miller, C.W., D.E. Dunning, E.L. Etnier, D.C. Kocher, L.M. McDowell-Boyer, **H.R. Meyer** and P.S. Rohwer. 1980. Recommendations Concerning Research and Model Evaluation Needs to Support Breeder Reactor Environmental Radiological Assessments. ORNL/TM-7491. Oak Ridge National Laboratory. December.

Tennery, V.J., E.S. Bomar, W.D. Bond, **H.R. Meyer**, L.E. Morse, J.E. Till and M.G. Yalcintas. 1980. Summary of the Radiological Assessment of the Fuel Cycle for a Thorium-Uranium Carbide-Fueled Fast Breeder Reactor. ORNL/TM-6953. Oak Ridge National Laboratory. January.

Till, J.E., **H.R. Meyer** and E.L. Etnier. 1980. "Updating the Tritium Quality Factor—The Argument for Conservatism." Proceedings of Tritium Technology in Fission, Fusion, and Isotopic Applications. American Nuclear Society National Topical Meeting, Dayton, Ohio. U.S. Department of Energy CONF-800427.

Till, J.E., **H.R. Meyer**, V.J. Tennery, E.S. Bomar, M.G. Yalcintas, L.E. Morse, and W.D. Bond. 1980. "Reprocessing Nuclear Fuels of the Future: A Radiological Assessment of Advanced (Th, U) Carbide Fuel." Nuclear Technology 48 (1). April.

Till, J.E., **H.R. Meyer**, E.L. Etnier, E.S. Bomar, R.D. Gentry, G.G. Killough, P.S. Rohwer, V.J. Tennery, and C.C. Travis. 1980/ "Tritium—An Analysis of Key Environmental and Dosimetric Questions. ORNL/TM-6990. Oak Ridge National Laboratory. May.

Travis, C.C., **H.R. Meyer**, and C.S. Dudney. 1980. "Health and Environmental Effects of Residential Wood Heat." Proceedings of the National Conference on Renewable Energy Technologies. Honolulu, Hawaii, December 7–11, 1980.

Yalcintas, M.G., T. D. Jones, **H.R. Meyer**, H. Ozer, and S Unsal. 1980. "Estimation of Dose Due to Accidental Exposure to a Cobalt 60 Therapy Source." Health Physics 38 (2): 187–191. February.

Meyer, H.R. 1981. "Radiological Assessment of an Alternate Breeder Reactor Fuel Cycle." In Symposium on Intermediate Range Atmospheric Transport Processes and Technology Assessment. Edited by C.W. Miller, S.J. Cotter and S.R. Hanna. U.S. Department of Energy CONF-801064. October.

Meyer, H.R. 1981. "The Contribution of Residential Wood Combustion to Local Airshed Pollutant Concentrations." Proceedings of the International Conference on Residential Solid Fuels. Portland, Oregon, December.

Miller, C.W. and **H.R. Meyer**. 1981. Breeder Reactor Program Summary. HASRD Technical Progress Report. ORNL-5750. Oak Ridge National Laboratory. October.

Till, J.E., E.L. Etnier, and **H.R. Meyer**. 1981. "Methodologies for Calculating the Radiation Dose from Environmental Releases of Tritium." Nuclear Safety 22(2): 205–213. March–April.

Meyer, H.R. 1982. "Health and Environmental Effects." In Life Sciences Synthetic Fuels Semi-Annual Progress Report. Edited by K.E. Cowser. ORNL/TM-8229. Oak Ridge National Laboratory. May.

Meyer, H.R. 1982. "Coal Liquefaction: Health and Environmental Risk Analysis Program." Proceedings of the Third Annual Contractor's Meeting. Alexandria, Virginia, U.S. Department of Energy Document No. CONF-820250. July.

Meyer, H.R and F. O'Donnell. 1982. "University of Minnesota—Duluth Coal Gasification Project." In Life Sciences Synthetic Fuels Semi-Annual Progress Report. Edited by K.E. Cowser. ORNL/TM-8441. Oak Ridge National Laboratory. November.

Meyer, H.R., J.P. Witherspoon, J.P. McBride, and E.J. Frederick. 1982. Comparison of the Radiological Impacts of Thorium and Uranium Nuclear Fuel Cycles. NUREG/CR-2184. U.S. Nuclear Regulatory Commission. April.

Smith, W.J., F.W. Whicker, and **H.R. Meyer**. 1982. "A Review and Categorization of Saltation, Suspension, and Resuspension Models." Nuclear Safety 23 (6). November–December.

DesRosiers, A.E., **H.R. Meyer**, R.E. Swaja, and K. Brusserman. 1983. "Emergency Planning for Accident Mitigation." In Report of the Workshop on the Evaluation and Mitigation of the Consequences of Accidental Releases of Radioactivity: Identification of Uncertainties. Bad Munstereifel, Federal Republic of Germany.

Killough, G.G., **H.R. Meyer**, and D.E. Dunning. “Radionuclide Dosimetry.” In Models and Parameters for Environmental Radiological Assessments. Edited by C.W. Miller. U.S. Department of Energy Critical Review Series.

Meyer, H.R, and G. Holton, “Modeling the Potential Public Health Impacts of Airborne Releases.” In Proceedings of the Health and Environmental Risk Analysis Workshop. Brookhaven National Laboratory, Upton, New York.

Meyer, H.R., C.W. Miller, A.E. DesRosiers, G. Stoetzel, D. Strenge, and R.E. Swaja. 1983. “Assessment of Accidental Releases of Radionuclides.” In Radiological Assessment: A Textbook on Environmental Dose Analysis. Chapter 14. Edited by J.E. Till and **H.R. Meyer**. NUREG/CR-3332, ORNL-5968. U.S. Nuclear Regulatory Commission.

Till, J.E. and **H.R. Meyer**, eds. 1983. Radiological Assessment: A Textbook on Environmental Dose Analysis. NUREG/CR-3332, ORNL-5968. U.S. Nuclear Regulatory Commission.

Coffman, J., **H.R. Meyer**, and D. Skinner. 1984. “Radiological Measurements to Support Remedial Action on Uranium Mill Tailings.” Proceedings of the American Nuclear Society Annual Meeting.

Meyer, H.R., D. Skinner, J. Coffman, and J. Arthur. 1984. “Environmental Protection in the UMTRA Project.” Proceedings of the Fifth U.S. Department of Energy Environmental Protection Information Meeting. CONF-841187, Volume 2. November.

Meyer, H.R. et al. 1984. Health and Environmental Effects Document for the Liquid Metal Fast Breeder Reactor Fuel Cycle-1982. ORNL/TM-8802. Oak Ridge National Laboratory. March.

Meyer, H.R and J. Purvis. 1985. “Development of an Interference-Corrected Soil Radium Measurement System.” Proceedings of the American Nuclear Society Annual Meeting. San Francisco, California. November. 184–186.

Meyer, H.R, D. Skinner, and J. Coffman. 1985. “Environmental Monitoring in the UMTRA Project.” Proceedings of the Health Physics Society Midyear Symposium on Environmental Radioactivity. Colorado Springs, Colorado. January.

Skinner, D. and **H.R. Meyer**. 1985. “Demonstration of 10CFR20 Air Particulate Compliance Requirements on the UMTRA Project.” Proceedings of the Health Physics Society Midyear Symposium on Environmental Radioactivity. Colorado Springs, Colorado. January.

Travis, C.C., E.L. Etnier, and **H.R. Meyer**. 1985. “Health Risks of Residential Wood Heat.” Environmental Management 9 (3).

Meyer, H.R and D. Skinner. 1986. “Public Information Experience in the UMTRA Project.” Proceedings of the Health Physics Society Midyear Symposium. Knoxville, Tennessee. February.

Miller, C.W. and **H.R. Meyer**. 1986. “Estimated Doses and Risks Resulting from Routine Radionuclide Releases from Fast Breeder Reactor Fuel Cycle Facilities: A Summary.” Nuclear Safety 27 (1): 28–35. January–March.

Skinner, D., **H.R. Meyer**, and L.G. Hoffman. 1986. “Environmental Monitoring Requirements During Remedial Action and Stabilization of the Uranium Mill Tailings Project.” Proceedings of the Health Physics Society Midyear Symposium. Knoxville, Tennessee. February.

Holton, G.A., K.R. Meyer, and **H.R. Meyer**. 1987. “Siting a Radioactive Waste Facility: A Pathways Analysis Case Study.” Proceedings of the Air Pollution Control Association Annual Meeting. New York, New York, June 21–26, 1987.

Meyer, H.R. 1987. “Hazardous and Radioactive Wastes: Public Health Issues and Concerns.” Proceedings of the American Institute of Chemical Engineers Meeting. Houston, Texas. March.

Meyer, H.R. and C. Daily. 1987. “QA Verification Procedures in Uranium Mill Tailings Processing Site Remedial Action.” Proceedings of the American Society for Quality Control, Second Topical Conference on Nuclear Waste Management Quality Assurance. Las Vegas, Nevada, February 9-11, 1987.

Meyer, H.R., C. Begley, and C. Daily. 1987. “Field Instruments Developed for Use on the UMTRA Project.” Proceedings of the Waste Management 1987 Annual Meeting. University of Arizona, Tucson. March.

Reith, C.H., R. Richey, M. Matthews, **H.R. Meyer**, C. Daily, F. Petelka, W. Glover, D. Lechel, and J.E. Till. 1988. “Characterization and Remedial Planning for Non-Radiological Toxicants at UMTRA Project Sites.” In Waste Management 88. Edited by R.G. Post and M.E. Wacks. Tucson, Arizona: University of Arizona Press.

Reith, C.H., J.E. Till, and **H.R. Meyer**. 1989. “DECHEM: A Program for Characterization and Mitigation.” In Proceedings of the American Institute of Chemical Engineers. 1989 Summer Meeting, Philadelphia, Pennsylvania, August 20–23, 1989.

Reith, C.H., **H.R. Meyer**, J.E. Till, and M.L. Matthews. 1989. “DECHEM: A Program for Characterizing and Mitigating Chemical Contaminants at UMTRA Project Sites.” In Waste Management 89, Proceedings. DOE Waste Management Meeting, Denver, Colorado, April.

Faraday, M.A., B. Legrand, and **H.R. Meyer**. 1991. Planning for Cleanup of Large Areas Contaminated as a Result of a Nuclear Accident. IAEA STI/DOC/10/327. Vienna.

Grogan, H., K. Meyer, P. Voillequé, S. Rope, M. Case, H. Meyer, R. Moore, T. Winsor, and J. Till. 1993. The Rocky Flats Nuclear Weapons Plant Dose Reconstruction Project - Task 2: Verify Phase I Source Term and Uncertainty Estimates. RAC Report No. CDH-1. Radiological Assessments Corporation, Neeses, South Carolina. December.

Meyer, H.R. et al. 1993. Program Plan—Siting a Low Level Radioactive Waste Facility in Pennsylvania. March.

Grogan, H.A, M.O. Langan, **H.R. Meyer**, E.A. Stetar, and J.E. Till. 1995. Savannah River Site Dose Reconstruction Project Phase I: Tasks 1 and 2, Identification and Cataloging of Information Sources. RAC Report No. 3-CDC-SRS-95-Final. Radiological Assessments Corporation, Neeses, South Carolina. June.

Stetar, E.A., M.J. Case, L.W. Bell, H.A. Grogan, K.R. **Meyer, H.R** Meyer, S.K. Rope, D.W. Schmidt, T.F. Winsor, and J.E. Till. 1995. Savannah River Site Dose Reconstruction Project Phase I: Task 4, Identifying Sources of Environmental Monitoring and Research Data. RAC Report No. 2 CDC-SRS-95-Final. Radiological Assessments Corporation, Neeses, South Carolina. June.

Meyer, H.R., S.K. Rope, T.F. Winsor, P.G. Voillequé, K.R. Meyer, L.A. Stetar, J.E. Till, and J.M. Weber. 1996. The Rocky Flats Plant 903 Area Characterization. RAC Report

No. 2-CDPHE-RFP-1996-Final. Radiological Assessments Corporation, Neeses, South Carolina. December.

Wiltshire, S., R. Ahrens, G. Anderson, C. Baskerville, R. Bassett, L. Brothers, H. Brown, G. Cederberg, J. Croes, W. Dornsife, J. Ebel, W. Freudenburg, R. Hatcher, C. Hornibrook, J. Johnson, L. Lehman, **H.R. Meyer**, D. Roy, M. Salamon, L. Slosky, and A. Socolow. 1996. Review of New York State Low-Level Radioactive Waste Siting Process. National Research Council, National Academy of Sciences. Washington, D.C.: National Academy Press.

Meyer, H.R. 1997. Savannah River Site Reactor Power and Canyon/Tritium Production Levels. Technical report. Radiological Assessments Corporation, Neeses, South Carolina. July 21.

Meyer, H.R. 1997. Book review of Radiation Risk, Risk Perception and Social Constructions. Health Physics 73 (3). September.

Weber J.M., A.S. Rood, J. Binder, and **H.R. Meyer**. 1998. Task 3: Development of the Rocky Flats Plant 903 Area Source Term. RAC Report No. 3-CDPHE-RFP-1999. Phase II, Rocky Flats Historical Public Exposure Studies. Radiological Assessments Corporation, Neeses, South Carolina. October.

Till, J. E., **H.R. Meyer**, Mohler, J., et al. 1999. Savannah River Site Dose Reconstruction Project Phase II Report. RAC Report No. 1-CDC-SRS-1999-Draft Final, Radiological Assessments Corporation, Neeses, SC. April 30. Published on paper and CD-ROM.

Meyer, H. R. 1998 – 2001. Book reviews published in Health Physics Journal.

Meyer, H.R. 2000-2001. Project research reports released as SMI documents, various topics and dates.

Till, JE, AS Rood, PG. Voillequé, PD McGavran, K.R. Meyer, H.A. Grogan, W.K. Sinclair, J.W. Aanenson, **H.R. Meyer**, S.K. Rope, and M.J. Case. 2002. Risks to the public from historical releases of radionuclides and chemicals at the Rocky Flats Nuclear Weapons Plant. *J of Exp. Analysis and Epidemiology* 12(5): 355-372.

Chen, Shih-Yew, D.J. Strom, J.G. Yusko, A. LaMastra, **H.R. Meyer**, D.W. Moeller. 2002. Managing potentially radioactive scrap metal. National Council on Radiation Protection and Measurements Report No. 141. November.

Meyer, H.R., J. Johnson, C. Little, R. Whicker. 2005. Use of a GPS-based gamma scanning system during field characterization activities. Proceedings, American Nuclear Society topical session, Denver, CO. July.

Meyer, H.R., M. Shields, S. Green. 2005. Scanning for radioactive contamination at remedial action facilities in the U.S. and Eurasia. 2005. Uranium mining remedial action conference, Friesing, Germany. September.

Selected Presentations

Meyer, H.R. et al. 1978. "Thorium Mining and Milling—An Analysis of Radiological Impacts." Health Physics Society Annual Meeting, Minneapolis, Minnesota, June.

Meyer, H.R. 1979. "An Overview of the Radiological Risks Associated with Thorium Mining in the Lemhi Pass Region." Department of Radiology and Radiation Biology Seminar Series, Colorado State University, Fort Collins, May.

Meyer, H.R., C.A. Little, J.P. Witherspoon, and J.E. Till. 1979. “A Comparison of Potential Radiological Impacts of 233U and 239Pu Fuel Cycles.” American Nuclear Society Winter Meeting, San Francisco, California, November.

Meyer, H.R. et al. 1979. “Recycle of Thorium-Uranium Fuels—A Radiological Assessment.” Health Physics Society Annual Meeting, July.

Meyer, H.R. 1980. “Radiological Assessment of an Alternate Breeder Reactor Fuel Cycle.” Presented at the Symposium on Intermediate Range Atmospheric Transport Processes and Technology Assessment, Gatlinburg, Tennessee, October 1–3.

Meyer, H.R., J.E. Till, and E.L. Etnier. 1980. “Tritium—Potential Impacts of Nuclear Fuel Cycle Releases.” Health Physics Society Annual Meeting, Seattle, Washington, July.

Meyer, H.R. 1981. “The Contribution of Residential Wood Combustion Emissions to Local Airshed Concentrations.” Presented at the Conference on Residential Solid Fuels, Portland, Oregon, June 1–5.

Meyer, H.R. 1981. “The Human Health Risk Associated with Coal Liquefaction, Residential Wood Combustion and Nuclear Fuel Reprocessing.” Department of Radiology and Radiation Biology Seminar Series, Colorado State University, Fort Collins, Colorado, July 30.

Meyer, H.R. 1981. “Coal Liquefaction.” Presented at U.S. Department of Energy Health and Environmental Risk Analysis Program (HERAP) Annual Technical Review Session, Germantown, Maryland, December 7.

Meyer, H.R. 1982. “Coal Conversion Risk Assessment Research Requirements.” Presented at the U.S. Department of Energy Retreat/Workshop, Warrenton, Virginia, January 26–28.

Meyer, H.R. 1982. “Breeder Reactor Risk Assessment.” Presented at U.S. Department of Energy Annual Contractors Meeting for the Health and Environmental Risk Assessment Program, Alexandria, Virginia, February 16–18.

Meyer, H.R. 1982. “Reactor Emergency Planning—Analysis of Key Uncertainties.” Presented at the Annual Health Physics Society Meeting, Las Vegas, Nevada, June 30.

Meyer, H.R. 1982. “Long Range Transport and Effects Modeling.” Invited presentations at the U.S. Department of Energy Workshop on Risk Assessment Modeling, Airlie House, Virginia, August 2–4.

Meyer, H.R. 1982. “Assessment of Dose from Tritium Releases—Application of Environmental Transport Models” and “Tritium Source Terms.” Invited presentations at the European Seminar on the Risks from Tritium Exposure. Sponsored jointly by CEC, CEN/SCK, Mol, Belgium, November 22.

Meyer, H.R. 1983. “The LMFBR Health and Environmental Effects Document Risk Assessment.” Project Review for U.S. Department of Energy Health and Environmental Risk Assessment Program (HERAP), Washington, D.C., February 7.

Meyer, H.R. 1983. “Assessing the Environmental Impact of the LMFBR Fuel Cycle—A Multiple-Site Approach.” Department of Radiology and Radiation Biology Seminar Series, Colorado State University, Fort Collins, Colorado, February 17.

Meyer, H.R. 1984. “Environmental Assessment in the UMTRA Project.” Health Physics Society Annual Meeting, New Orleans, Louisiana, June.

Meyer, H.R. 1984. “Relative Risks Associated with the Uranium Mill Tailings Remedial Action (UMTRA) Program.” Series of public meetings held in Canonsburg, Pennsylvania, before cleanup of the uranium mill tailings site. Separate presentations were made to the school board, teachers and administrators, nurses, realtors, and several mid school and high school classes, August 21–24.

Meyer, H.R. 1984. “Environmental Protection in the UMTRA Project.” Fifth U.S. Department of Energy Environmental Protection Information Meeting, Albuquerque, New Mexico, November.

Meyer, H.R. 1984. “How to Communicate Health Effects Facts to Laymen.” 1985 U.S. Department of Energy Remedial Action Annual Meeting, Albuquerque, New Mexico, November.

Meyer, H.R. 1985. “Analysis of Radon and Air Particulate Data in the UMTRA Project.” Health Physics Society Midyear Symposium on Environmental Radioactivity, Colorado Springs, Colorado, January.

Meyer, H.R. 1985. “The UMTRA Project Health Physics Program.” Presented to the U.S. Department of Energy Policy, Safety and Environment Appraisal Team, Carl Welty, Chairman, Albuquerque, New Mexico, April.

Meyer, H.R. 1985. “Relative Risks Associated with the Uranium Mill Tailings Remedial Action (UMTRA) Program.” Presented in a series of public meetings held in Tuba City, Window Rock, and Moenkopi, Arizona, before the cleanup of mill tailings sites, October 8–9.

Meyer, H.R. and J. Purvis. 1985. “Development of an Interference-Corrected Soil Radium Measurement System.” American Nuclear Society Annual Meeting (invited paper), San Francisco, November.

Meyer, H.R. 1986. “Review of Uranium Mill Tailings Remedial Action Project.” Presented at the U.S. Department of Energy Remedial Action Contractors Annual Meeting, Oak Ridge, Tennessee, May 5–6.

Meyer, H.R. 1986. “Relative Risks Associated with the Uranium Mill Tailings Remedial Action (UMTRA) Program.” Presented at a public meeting to explain the UMTRAP radiation protection program before cleanup work began. Lakeview, Oregon, May 20.

Meyer, H.R. 1986. “Health Risk Experience on the UMTRA Project.” Presented at a U.S. Department of Energy Seminar on Concerns of Insurance Companies Regarding Remedial Action Risk, Denver, Colorado, November.

Meyer, H.R. 1987. “Instrumentation and Quality Control Techniques for Mill Tailings Remedial Action.” Invited presentation at a U.S. Nuclear Regulatory Commission Workshop for mill owners, Denver, Colorado, June 3.

Meyer, H.R. 1987. “Relative Risks Associated with the Uranium Mill Tailings Remedial Action (UMTRA) Program.” A series of public meetings held to discuss the UMTRAP radiation protection program before cleanup began. Held in Durango, Colorado, January 20; Rifle, Colorado, May 21; Gunnison, Colorado, July 7; and Mexican Hat, Utah, July 14.

Meyer, H.R. 1989. “Risk Assessment—Disposal in Arid Lands.” American Association for the Advancement of Science, Southwest Chapter, topical meeting, Las Cruces, New Mexico, April 6.

Meyer, H.R. 1989. “Proposed LLRW Facility Contract Status and Schedule, Site Screening and Characterization, Design and Operation.” Invited presentation, Penn State University, State College, Pennsylvania, November 4.

Meyer, H.R. 1989. “Site Screening and Characterization, Facility Design, Contract Status.” Invited presentation, Sierra Club, Pennsylvania PA Chapter, and Environmental Coalition on Nuclear Power joint meeting, State College, Pennsylvania, November 18.

Meyer, H.R., V.J. Barnhart, and M.T. Ryan. 1989. “Developing a Low Level Radioactive Waste Site for the Commonwealth.” A series of seven public meeting presentations throughout Pennsylvania, January–February.

Meyer, H.R. 1990. “Political, Administrative and Public Information Aspects.” Invited lecture, Management and Disposal of Radioactive Wastes, Harvard School of Public Health, Boston, Massachusetts, July 18.

Meyer, H.R. 1990. “Status of Pennsylvania's Contract with Chem-Nuclear Systems.” Invited presentation, Appalachian States Low-Level Radioactive Waste Compact Commission meeting, Harrisburg, Pennsylvania, September 24.

Meyer, H.R. 1990. “Status Report, Low-Level RadWaste Siting Project.” Invited presentation to Pennsylvania’s Citizens Low-Level Waste Advisory Committee, Harrisburg, Pennsylvania, October 5.

Meyer, H.R. 1990. “Progress Report, LLRW Siting.” Presentation to CNSI’s Citizens Task Force on Siting, Harrisburg, Pennsylvania, November 7.

Meyer, H.R. 1990. “Status of the Siting Plan.” Presentation to CNSI’s Citizens Low-Level Waste Advisory Committee, Harrisburg, Pennsylvania, December 13.

Meyer, H.R. 1991. “The LLRW Siting Plan Review Process” and “Site Design.” Presentations to CNSI’s Citizens Low-Level RadWaste Advisory Committee, Harrisburg, Pennsylvania, February 15.

Meyer, H.R. 1991. “Siting a Low-Level Radioactive Waste Facility for the Commonwealth.” Invited presentation, Three Mile Island Alert Annual Meeting, Harrisburg, Pennsylvania, March 28.

Meyer, H.R. and T. Noel. 1991. “Progress in Siting Pennsylvania's LLRW Facility.” Invited presentation, Appalachian Compact Users of Radioactive Isotopes Board of Directors Meeting, Allentown, Pennsylvania, April 10.

Meyer, H.R. 1991. “Siting a Low-Level Radioactive Waste Facility for the Commonwealth.” Invited presentation, Headwaters Resource Conservation and Development Council, Clearfield, Pennsylvania, April 25.

Meyer, H.R. 1991. “Siting a Low-Level Radioactive Waste Facility for the Commonwealth.” Invited presentation, East York Rotary Club, York, Pennsylvania, April 30.

Meyer, H.R. 1991. “The Pennsylvania Low-Level Radioactive Waste Facility Siting Process; Host Community Benefits.” Invited presentation, NorthWest Planning Commission, Franklin, Pennsylvania, May 3.

Meyer, H.R. 1991. “The Low Level Radioactive Waste Site.” Invited presentation, Limerick Community Advisory Council, Linfield, Pennsylvania, May 8.

Meyer, H.R. 1991. “Low Level Radioactive Waste.” Invited presentation, Pennsylvania League of Women Voters Annual Meeting, Ligonier, Pennsylvania, May 11.

Meyer, H.R. 1991. “Siting a Low-Level Radioactive Waste Facility in Pennsylvania.” Invited presentation, Peach Bottom Community Advisory Council, Peach Bottom, Pennsylvania, May 16.

Meyer, H.R. 1991. “A Program Overview for Siting the Appalachian States’ LLRW Disposal Facility.” Invited presentation, PELLRAD Annual Meeting, Penn State University, State College, Pennsylvania, May 23.

Meyer, H.R. 1991. “Status Report from Chem-Nuclear Systems, Inc.” Invited presentation at Appalachian States Low-Level Radioactive Waste Compact Commission Meeting, Harrisburg, Pennsylvania, June 12.

Meyer, H.R., T. Loughead, K. Kingsley, and J. Barron. 1991. “The Revised Siting Plan.” Invited presentation, Pennsylvania's Citizens Low-Level Waste Advisory Committee Meeting, Harrisburg, Pennsylvania, June 21.

Meyer, H.R. 1991. “Political, Administrative and Public Information Aspects.” invited lecture in “Management and Disposal of Radioactive Wastes.” Harvard School of Public Health, Boston, Massachusetts, July 17.

Meyer, H.R. 1991. “The Low Level Radioactive Waste Siting Process.” Invited presentation at Penn State University Nuclear Concepts Program, State College, Pennsylvania, July 18.

Meyer, H.R. 1991. “Siting a Low Level Radioactive Waste Facility in Pennsylvania—Risk Communication in the Correct Direction.” Opening invited paper, Plenary Session, Risk Communication for the 90’s, Annual Health Physics Society National Meeting, Washington, D.C., July 22.

Meyer, H.R. 1991. “Risk Communication in the Right Direction.” Invited presentation, joint meeting, American Nuclear Society Northern Ohio Section and Health Physics Society Northern Ohio Section, Independence, Ohio, September 11.

Meyer, H.R. 1991. “Low Level Radwaste Siting in Pennsylvania.” Invited presentation at Appalachian Compact Users of Radioactive Isotopes breakfast for State Legislators, Harrisburg, Pennsylvania, September 24.

Meyer, H.R. 1991. “Low Level RadWaste.” Invited presentation, American Nuclear Society Chapter Meeting, Allentown, Pennsylvania, September 25.

Meyer, H.R. 1991. “Status of the Low Level Radioactive Waste Project.” Invited presentation at Appalachian Compact Users of Radioactive Isotopes breakfast for State Legislators, Harrisburg, Pennsylvania, October 23.

Meyer, H.R. and J. Barron. 1991. “Release of Stage One Disqualification Information.” Press Conference, Pennsylvania State Capital Media Center, Harrisburg, Pennsylvania, November 13.

Meyer, H.R. and J. Barron. 1991. “Results of Stage One Disqualification.” Invited presentation, meeting of Pennsylvania's Low Level Radioactive Waste Citizens’ Advisory Committee, Harrisburg, Pennsylvania, November 13.

Meyer, H.R. and W. Dornsife. 1991. “Disposal of Low-Level Radioactive Waste in Pennsylvania.” Invited presentation, PP&L media day, Berwick, Pennsylvania, September 26.

Meyer, H.R., K. Kingsley, and T. Loughead. 1991. “LLRW Project Overview.” Presentation at bimonthly meeting of CNSI’s Low Level Waste Citizens Advisory Committee, Harrisburg, Pennsylvania, June 5.

Meyer, H.R. 1992. “Siting Process Update.” Invited presentation, Appalachian Compact Users of Radioactive Isotopes Board of Directors Meeting, King of Prussia, January 8.

Meyer, H.R. 1992. Series of public information presentations—status of the low level radioactive waste site selection process in Pennsylvania.

Meyer, H.R. and G. Longwell. 1992. “The Radioactive Waste Site Selection Process.” Invited presentation at Leadership Lackawanna, City and County Government session, Scranton, Pennsylvania, January 9.

Meyer, H.R. 1993. Series of public information presentations—status of dose reconstruction research at the Savannah River Site.

Meyer, H.R. 1994. Series of public information workshops and presentations—status of dose reconstruction research at the Savannah River Site

Meyer, H.R. 1994. “Windblown Suspension of Plutonium from the Rocky Flats Plant.” Public workshop, Boulder, Colorado, June.

Meyer, H.R. 1995. Instructor, personal computer laboratory and problem sessions, Radiological Assessments Corporation course in Chemical Risk Assessment, Kiawah Island, South Carolina, February 27–March 3.

Meyer, H.R. 1995. Series of public information workshops and presentations—status of dose reconstruction research at the Savannah River Site

Meyer, H.R. 1996. Series of presentations to the Savannah River Site Centers for Disease Control Citizens’ Health Effects Subcommittee on the status of the dose reconstruction project.

Meyer, H.R. 1996. Series of public information workshops and presentations on the status of dose reconstruction research at the Savannah River Site.

Meyer, H.R. 1996. Series of presentations to the Rocky Flats Dose Reconstruction Project Citizens Health Advisory Panel on 903 area risk assessment research.

Meyer, H.R. 1997. Series of presentations to the Centers for Disease Control SRS Citizens’ Health Effects Subcommittee.

Meyer, H.R. 1997. Series of public information workshops and presentations on the status of dose reconstruction research at the Savannah River Site.

Meyer, H.R. 1997. Series of presentations to the Rocky Flats Dose Reconstruction Project Citizens Health Advisory Panel on the 903 Area Risk Assessment.

Meyer, H.R. 1998. “The Savannah River Site Dose Reconstruction, a Summary.” Presentations at public meetings held in Columbia and Aiken, South Carolina, and Savannah, Georgia, February 18–20.

Meyer, H.R. 1998. Instructor, Risk Assessment Modeling, RAC-sponsored public course in Radiological Risk Assessment, Seattle, Washington.

Meyer, H.R. 1999. "The Savannah River Site Dose Reconstruction Project." Presentations at public meetings held in Columbia SC, Aiken SC and Savannah GA, February 1999.

Meyer, H.R. 1999. Series of presentations to the Rocky Flats Dose Reconstruction Project Citizens Health Advisory Panel, and to members of the public, January - August, 1999.

JANET A. JOHNSON, Ph.D., CHP, CIH
SENIOR RADIATION SCIENTIST
Tetra Tech Inc. (formerly MFG, Inc.)

SUMMARY

Dr. Johnson has extensive experience in radiation health physics, specifically in the following areas:

Radiological Site Surveys, including MARSSIM	NRC License Applications for Consumer Products
RSO 40-Hour Course Instructor	Radiation Risk Assessment
Radon Measurements and Risk Assessment	Radiation Worker Training

Dr. Johnson has evaluated radiation exposure rate, dose and risk from facilities with residual radioactive materials from both licensed activities and from naturally occurring radioactive materials. Dr. Johnson was a member of the U.S. Environmental Protection Agency Science Advisory Board Radiation Advisory Committee (RAC) from 1995 to 2003. She chaired the EPA RAC from 1999 through 2003. During her tenure on the committee the RAC reviewed the Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM) and the Multi-Agency Radiation Laboratory Analytical Protocols Manual (MARLAP). Dr. Johnson is a member of Scientific Committee 64-22 of the National Council on Radiation Protection and Measurements (NCRP). She has experience in planning and conducting MARSSIM-based site surveys. She has also developed and implemented radiation safety training programs for workers and radiation safety officers. Dr. Johnson taught in the Department of Radiological Health Sciences at Colorado State University for fourteen years. She is currently working on radiological aspects of the reclamation plans for several uranium mills and has performed risk assessments for a variety of uranium recovery facilities. In addition, Dr. Johnson assessed the adequacy of the monitoring methods used at a former nuclear weapons production facility, the Rocky Flats plant, as a member of the Scientific Panel on Monitoring at Rocky Flats, an independent panel commissioned and appointed by the Governor of Colorado. Dr. Johnson is a member of the Colorado Radiation Advisory Committee and served on the Colorado Hazardous Waste Commission from 1993 to 1997. Dr. Johnson, with her colleagues at MFG, Inc. developed training manuals and visuals for radiation safety officers involved in NORM and uranium facilities. The MFG, Inc. team taught 40-hour 40-hour RSO refresher training classes in May 2003 and in May 2005.

Dr. Johnson managed the environmental health and safety program at Colorado State University from 1993 to 1995. The program included industrial hygiene, radiation protection, hazardous waste management, and biosafety.

Dr. Johnson assisted legal counsel for Rockwell International in regard to a class action suit against the corporation. Dr. Johnson served on the Westinghouse Government Operations Nuclear Safety and Environmental Oversight Committee. In that capacity she visited six of the major facilities for which Westinghouse was a contractor during the late 1980s and early 1990s.

Dr. Johnson is a Fellow of the Health Physics Society.

EDUCATION

Ph.D. Microbiology/Environmental Health, Colorado State University (1986)

M.S. Health Physics, AEC Health Physics Fellow, University of Rochester (1959)

B.S. Chemistry, University of Massachusetts (1958)

CERTIFICATIONS

- Certified in the Comprehensive Practice of Health Physics, American Board of Health Physics, 1976; Recertified 1985, 1989, 1993, 1997, 2002
- Certified Industrial Hygienist (Radiological Aspects), 1986; Recertified 1992, 1998

PROFESSIONAL SERVICE

- Colorado Radiation Advisory Committee, 1988-present
- Colorado Hazardous Waste Commission, 1993-1997
- National Academy of Sciences Committee on Low-Level Radioactive Waste Siting, New York State, 1993-1996
- EPA Science Advisory Board, Radiation Advisory Committee, 1994-2004, Chair 1999-2003
- EPA Science Advisory Board, Executive Committee, 1999 - 2003
- Governor's Rocky Flats Scientific Panel on Monitoring, 1989-1992. Chair, Radiation Committee
- NCRP Scientific Committee 64-22 (Environmental Measurements)

PROFESSIONAL SOCIETIES AND HONORS

- Health Physics Society
  - Chair, Public Education Committee, 1992-1995
  - Radon Section President 2000 – 2001; President-elect, 1998; Secretary Treasurer, 1996-1998
  - Board of Directors – 2000 – 2002
  - Fellow - 2002
- American Industrial Hygiene Association
- American Academy of Health Physics
- American Academy of Industrial Hygiene

PROFESSIONAL HISTORY

1995 - Present	MFG Inc. (formerly Shepherd Miller, Inc.) Fort Collins, Colorado	
	1998-present	Senior Technical Advisor
	1997-1998	Vice-president for Radiation and Risk Assessment Services
	1995-1997	Senior Radiation Scientist
1964 - 1995	Colorado State University, Fort Collins, Colorado	
	1995	Research Associate, Environmental Health Services
	1993-1995	Interim Director, Environmental Health Services
	1992-1993	Associate Director, Environmental Health Services
	1988-1992	Hazardous Waste Coordinator, Environmental Health Services
	1984	Instructor, Environmental Health and Microbiology (part time)
	1964-1979	Research Associate, Radiological Health Sciences (1/2 time)
1970-1995	Western Radiation Consultants, Inc., Fort Collins, Colorado President and Consultant	
1959	Student Intern, Brookhaven National Laboratory (3 months)	

PROJECT EXPERIENCE

- Radiological Site Assessment. Background radiation measurement and assessment of impacts of uranium mill operation in regard to the reclamation plan.
- Preparation and oversight of site characterization based on MARSSIM
- Preparation of NRC license applications for consumer products. Dose assessment, development of radiological safety and regulatory compliance programs.
- Risk assessment for uranium mill reclamation plans. Preparation of dose/risk assessment under routine operating conditions and potential accident scenarios for a reclamation plan which includes accepting off-site waste byproduct material.
- Risk assessment for uranium in water. Preparation of comments in regard to EPA and Colorado Water Quality Control Commission proposed regulations for uranium in drinking water and ground water.
- Uranium Mill Tailings Remedial Action Program Health and Safety Audit. Industrial hygiene and radiation protection.
- Radon measurements. Gamma and Ambient Radon Dosimeter (GARD).
- Westinghouse Government Operations Nuclear Safety and Environmental Oversight Committee. Review of safety and environmental programs at DOE sites managed and operated by Westinghouse, including evaluation of Total Quality Management programs as they pertained to environmental protection and safety.
- Radiological Health Consultant to legal counsel for Rockwell (Rocky Flats Plant).
- Health Risk Assessment Panel Subcommittee. Preparation of toxicity profiles and radiation risk assessment (Cotter Corporation Canon City Uranium Mill)

- Development and presentation of Radiation Safety Training and Hazardous Waste Operations Training, including training and regulatory compliance for radioactive materials licensees.
- Risk assessment for Naturally Occurring Radioactive Materials (NORM).
- Managed the environmental health and safety program for Colorado State University including routine operations, strategic planning, budgeting and personnel.
- Managed environmental restoration program.
- Managed hazardous waste program for Colorado State University including routine disposal, environmental restoration and emergency response.
- Taught basic industrial hygiene course.
- Taught radiation physics and radiochemistry laboratories and radiation chemistry course.
- Occupational health and safety review for a gold mine in Peru
- Baseline radiological survey for an *in situ* uranium recovery operation in Kazakhstan.
- Taught and developed the training manual for a 40-hour radiation safety officer (RSO) training class for NORM and Uranium facilities (May 2003 and December 2003)

REPRESENTATIVE JOURNAL PUBLICATIONS AND PROCEEDINGS

Johnson, J.A. Riding the RCRA Roller Coaster - Adventures in closing a micro-mixed waste site. Managing Radioactive and Mixed Waste, *Proceedings of the Twenty-seventh Midyear Topical Meeting of the Health Physics Society*. February 1994.

Johnson, J.A., R.M. Buchan and J.S. Reif. Effect of waste anesthetic gas and vapor exposure on reproductive outcome in veterinary personnel. *American Industrial Hygiene Association Journal* 48(1): 62-66, 1987.

Johnson, J.E. and J.A. Johnson: Radioactivity and detection limit problems of environmental surveillance at a gas-cooled reactor. *ACS symposium Series 361, detection in Analytical Chemistry, Importance, Theory, and Practice.* American Chemical Society, Washington, DC, 1988.

Borak, T.B., J.A. Johnson and K.J. Schiager. A comparison of radioactivity and silica standards for limiting dust exposures in uranium mines. In *Radiation Hazards in Mining: Control, Measurement and Medical Aspects*, M. Gomez, ed. Society of Mining Engineers. New York, NY, 1981.

Borak, T.B., E. Franko, K.J. Schiager, J.A. Johnson and R.F. Holub. Evaluation of recent developments in radon progeny measurements. In *Radiation Hazards in Mining: Control, Measurement and Medial Aspects*, M. Gomez, ed. Society of Mining Engineers, New York, NY, 1981.

Johnson, J.A., K.J. Schiager, T.B. Borak. Contribution of human errors to uncertainties in radiation measurements and implications for training. In Radiation *Hazards in Mining:*

Control, Measurement and Medical Aspects, M. Gomez, ed. Society of Mining Engineers, New York, NY, 1981.

Schiager, J.J., J.A. Johnson and T.B. Borak. Radiation monitoring priorities for uranium miners. In *Radiation Hazards in Mining: Control, Measurement and Medical Aspects*, M. Gomez, ed. Society of Mining Engineers, New York, NY, 1981.

Johnson, J.A. "Basic Radiation Protection for Use of Radionuclides in Laboratories," 1991. Teaching manual for forty-hour course.

Johnson, J.A. "Radiation Protection for Uranium Mills," 1997 (Revised 2000). Teaching manual for forty-hour course.

REPORTS

Hersloff, J., J.A. Johnson and S. Ibrahim. *Radiological Risk Assessment of Abandoned Mine Lands, Radium Land Clean-up Standard*. Wyoming Department of Environmental Quality, 1988.

Borak, T.B. and J.A. Johnson. *Estimating the Risk of Lung cancer from Inhalation of Radon Daughters Indoors: Review and Evaluation.* Colorado State University for USEPA, 1988.

Schiager, K.J., T.B. Borak and J.A. Johnson. *Radiation Monitoring for Uranium Miners: Evaluation and Optimization.* U.S. Department of the Interior, Bureau of Mines. Final Report on contract.

TECHNICAL PRESENTATIONS:

Dr. Johnson has presented numerous technical papers at Health Physics Society Annual Meetings, Mid-year Symposia, Mill Tailings Conferences, American Industrial Hygiene Association Conferences, European Conferences and a meeting of the American Veterinary Medicine Association. She presented a paper and a poster summary at a conference on uranium in groundwater in Freiburg Germany (1998) and presented an invited paper at a SCOPE Radsite meeting in Munich in September 2000. Dr. Johnson presented an invited paper on the effects of radon and smoking at the American Radiation Safety Conference and Exposition in San Diego in June 2003.

CRAIG A. LITTLE

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Grand Junction, Colorado 81506
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craig.little@mfgenv.com

PROFESSIONAL EXPERIENCE

2002 – pres	Sr. Scientist, Tetra Tech Inc. (formerly MFG, Inc.). Conduct radiation risk assessments, dose calculations and field assessments of radioactivity for a variety of clients nationwide. Projects include field surveys of contaminated sites to design cleanup plans and to assure remedial action effectiveness, calculation of potential radiation dose and risk to members of the public and workers at radiation sites, and development of presentations to summarize results to public meetings. Write project proposals, develop work plans and cost estimates, produce site investigation reports, and write monthly reports. Manage projects.
2000 – 2001	Manager, Western Operations, Advanced Infrastructure Management Technologies, a division of the Department of Energy's Y-12 National Security Complex, Oak Ridge, Tennessee. Responsible for twenty-five project managers in offices in Grand Junction, Colorado; Sacramento, California; and Lancaster, California. Projects included a variety of site assessment, risk analysis, and infrastructure improvements at numerous federal facilities nationwide. Projects were funded by Dept. of Energy, Dept. of Defense, Environmental Protection Agency, and others.
1983 – 2000	Leader, Environmental Technology Section (ETS), Life Sciences Division, Oak Ridge National Laboratory located in Grand Junction. Originally established the group to support USDOE Uranium Mill Tailings Remedial Action Project (UMTRAP). Staff developed and applied technologies and methodologies to remedy chemical and radiological pollution at numerous locations nationwide. Section staff conducted over 12,000 field surveys of contaminated properties nationwide. Projects were funded by Dept. of Defense, Dept. of Energy, and other agencies.
1987 – 1998	Adjunct Professor, Department of Radiological Health Sciences, Colorado State University. Served on graduate research committees.
Fall 1979	Guest scientist, Federal Health Office, Munich, Federal Republic of Germany. Assisted in planning and implementing monitoring system for actinides released from nuclear power plants in the Federal Republic.
1976 – 1982	Research Staff, Health and Safety Research Division, ORNL. Developed and applied computer codes to predict transport of nuclear and non-nuclear pollutants through the environment and subsequent impacts on ecosystems and human systems. Conducted research to assess the accuracy of environmental transport models.
Fall 1976	Environmental Research Assistant, Department of Radiology and Radiation Biology, Colorado State University. Collected environmental samples of plutonium for analysis; analyzed, reduced and summarized subsequent data for publication.

EDUCATION AND TRAINING

1976	Ph.D., Radioecology. Department of Radiology and Radiation Biology, Colorado State University, Ft. Collins, CO. Dissertation title: *Plutonium in a Grassland Ecosystem.*
1971	M.S., Radiation Biology/Health Physics. Department of Radiology and Radiation

	Biology, Colorado State University, Ft. Collins, CO.
1970	B. A., Biology. McPherson College, McPherson, KS.
1996	Leading Out Loud. TPG/Learning Systems. Knoxville, Tennessee.
1993	The Effective Executive. American Management Association, New York, NY
1990	Strategic Planning. American Management Association, New York, NY.
1989	Senior Project Management. American Management Association, New Your, NY.
1987	Cost and Schedule Control Systems Criteria (C/SCSC). Humphreys and Associates, Santa Clara, CA. Included project planning, work breakdown structures, and control systems.
1986	The Management Course. American Management Association, New York, NY. Four week course covering all aspects of management including financial analysis of businesses, human resource management, and business simulation.
1980	Modeling of Groundwater Flow. Holcomb Research Institute, Butler University, Indianapolis, IN. Two week course on computer models of groundwater flow.

PUBLICATIONS AND PRESENTATIONS

Author or co-author of more than seventy reports, journal articles, and book chapters on topics such as risk analysis, environmental transport processes, pollutants in the environment, radiological assessments, and computer programming. Presented numerous papers at professional meetings, as both contributing and invited speaker. Served on Oak Ridge Associated Universities speakers bureau for several different terms.

OTHER ACTIVITIES

2003 - pres	Member, Board of Directors, Marillac Clinic. Provides low-cost medical, dental and vision care to uninsured, low-income patients. Previously served as board president in earlier term.
1999 - pres	Member, Board of Trustees, McPherson College, McPherson, Kansas
2000 - 2003	Member, Board of Directors, Health Physics Society
1998 - 2001	Member, Board of Directors, Joint Utilization Commission and Riverview Technology Corp.; groups founded to negotiate and receive the DOE/Grand Junction property into private, non-for-profit ownership.
1991 - pres	Associate Editor, *Health Physics* journal.
2005 - pres	Editor-in-Chief, *Operational Radiation Safety* journal.
1996 - 2001	Member, Victim-Witness/Law Enforcement Board, Mesa County District Court. Provide court-raised funds to victim advocacy/services organizations.
1997 - 1999	Member, Environmental Pathways Modeling Working Group of Health Physics Standards Committee
1996 - 1999	Member, Program Committee, Health Physics Society.
1995 - 1999	Member, Program Advisory Board of Foster Grandparents, Inc. Served as Chair.
1994 - 1996	Member, Board of Directors, Environmental Radiation Section, Health Physics Society.
1991 - 1996	Member, Board of Directors, Public Radio of Colorado, Inc., operator of Colorado Public Radio network.
1990 - 1996	Member, Nominating Committee, Health Physics Society. Chair, 1994-1996.

1989 - 1995	Member, Board of Directors, Mesa County United Way. President, 1993-1994.
1987 - 1990	Chair, Public Information Committee, Environmental Radiation Section, Health Physics Society.
1988 - 1991	Member, Board of Directors, Chemrad Tennessee, Inc., manufacturer of ultrasonic-based system for transmitting environmental data to computers in the field.
1987 - 1991	Chairman, Board of Directors, Western Colorado Public Radio, Inc., operator of public radio station KPRN. Development and Planning chairman.
1986 - 1987	Member, Mesa County (CO) Task Force to Evaluate the Aid to Families with Dependent Children (AFDC) Program. Edited final report of task force.

Designer and Manufacturer of Scientific and Industrial Instruments

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Check mark ☑ applies to applicable instr. and/or detector IAW mfg. spec. T. 72 °F RH 48 % Alt 697.8 mm Hg

☐ New Instrument Instrument Received ☐ Within Toler. +-10% ☐ 10-20% ☐ Out of Tol. ☐ Requiring Repair ☑ Other-See comments

☑ Mechanical check ☑ Input Sens. Linearity
☑ F/S Resp. check ☑ Reset check ☑ Window Operation
☑ Audio check ☑ Alarm Setting check ☑ Battery check (Min. Volt) 4.4 VDC
☑ Ratemeter Linearity check ☑ Integrated Dose check ☑ Recycle Mode check
☑ Data Log check ☑ Overload check ☑ Scaler Readout check Threshold Dial Ratio 100 = 10 mV
☑ Calibrated in accordance with LMI SOP 14.8 rev 12/05/89. ☑ Calibrated in accordance with LMI SOP 14.9 rev 02/07/97.

☑ HV Readout (2 points) Ref./Inst. 500 / 497 V Ref./Inst. 2000 / 1996 V

COMMENTS: Firmware: 37122N26 Resolution for Cs-137 ≈ 10% No as-founds (Loss of memory)
ID Firmware: 37123N05 Calibrated w/39" cable.

Gamma Calibration: GM detectors positioned perpendicular to source except for M 44-9 in which the front of probe faces source.

	Probe Model	Serial #	High Voltage	Threshold	Units/ Time Base	Dead Time Correction Factor	Calibration Constant	Linearity ±10%*
Detector # 1	LMI44-10	PR-102508	1000	100	7 / 1	1.629357E-05	1.000000E+00	
Detector # 2	LMI44-10	PR-102508	1000	100	4 / 2	1.629357E-05	5.568443E+10	✓
Detector # 3	PEAK	CS-137	694	642	7 / 1	0.000000E+00	1.000000E+00	
Detector #								
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Units: 0 -- rad, 1 -- Gray, 2 -- rem, 3 -- Sv, 4 -- R, 5 -- C/Kg, 6 -- Disintegrations, 7 -- Counts, 8 -- Ci/cm sq., 9 -- Bq/cm sq.
Time Base: 0 -- Seconds, 1 -- Minutes, 2 -- Hours

* See attached detector documentation, if applicable.

Digital Readout	REFERENCE CAL. POINT	INSTRUMENT RECEIVED	INSTRUMENT METER READING*	REFERENCE CAL. POINT	INSTRUMENT RECEIVED	INSTRUMENT METER READING*
	400kcpm	40012 (0)	40012 (0)	400cpm	40 (0)	40 (0)
	40kcpm	4011 5	4011 5	40cpm	4 5	4 5
	4kcpm	401 5	401 5			

Ludlum Measurements, Inc. certifies that the above instrument has been calibrated by standards traceable to the National Institute of Standards and Technology, or to the calibration facilities of other International Standards Organization members, or have been derived from accepted values of natural physical constants or have been derived by the ratio type of calibration techniques. The calibration system conforms to the requirements of ANSI/NCSL Z540-1-1994 and ANSI N323-1978. State of Texas Calibration License No. LO-1963

Reference Instruments and/or Sources: Cs-137 Gamma S/N
☐ 1162 ☐ G112 ☑ M565 ☐ 5105 ☐ T1008 ☐ T879 ☐ E552 ☐ E551 ☐ 720 ☐ 734 ☐ 1616 ☐ Neutron Am-241 Be S/N T-304
☑ Alpha S/N ☐ Beta S/N ☑ Other Am 241 ≈ 0.76 μCi
☑ m 500 S/N 50800 ☑ Multimeter S/N 83990502

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MFG-3

LUDLUM MEASUREMENTS, INC.
POST OFFICE BOX 810 PH. 325-235-5494
501 OAK STREET FAX NO. 325-235-4672
SWEETWATER, TEXAS 79556, U.S.A.

CUSTOMER MFG INC ORDER NO. 263479/306131

Mfg. Ludlum Measurements, Inc. Model 2350-1 Serial No. 98631

Cal. Date 25-Sep-06 Cal Due Date 25-Sep-07 Cal. Interval 1 Year Meterface N/A

Check mark ☑ applies to applicable instr. and/or detector IAW mfg. spec. T. 74 °F RH 33 % Alt 708.8 mm Hg

☐ New Instrument Instrument Received ☑ Within Toler. +-10% ☐ 10-20% ☐ Out of Tol. ☐ Requiring Repair ☐ Other-See comments

☑ Mechanical check ☑ Input Sens. Linearity

☑ F/S Resp. check ☑ Reset check ☑ Window Operation

☑ Audio check ☑ Alarm Setting check ☑ Battery check (Min. Volt) 4.4 VDC

☑ Ratemeter Linearity check ☑ Integrated Dose check ☑ Recycle Mode check

☑ Data Log check ☑ Overload check ☑ Scaler Readout check Threshold Dial Ratio 100 = 10 mV

☑ Calibrated in accordance with LMI SOP 14.8 rev 12/05/89. ☐ Calibrated in accordance with LMI SOP 14.9 rev 02/07/97.

☑ HV Readout (2 points) Ref./Inst. 500 / 500 V Ref./Inst. 2000 / 1997 V

COMMENTS: *Firmware: 37122N26*

I/O firmware:37123n05 Instrument calibrated with 39 "C cable

resolution for Cs-137 9%

Gamma Calibration: GM detectors positioned perpendicular to source except for M 44-9 in which the front of probe faces source.

	Probe Model	Serial #	High Voltage	Threshold	Units/ Time Base	Dead Time Correction Factor	Calibration Constant	Linearity ±10%*
Detector # 1	LMi44-10	RN011772	850	100	4 / 2	1.498379E-05	5.549865E+10	
Detector # 2	LMI44-10	RN011772	850	100	7 / 1	1.498379E-05	1.000000E+00	
Detector # 3	CS-137	662KEV	599	642	7 / 1	0.000000E+00	1.000000E+00	
Detector #								
Detector #								
Detector #								
Detector #								
Detector #								
Detector #								
Detector #								
Detector #								
Detector #								
Detector #								
Detector #								
Detector #								
Detector #								

Units: 0 -- rad, 1 -- Gray, 2 -- rem, 3 -- Sv, 4 -- R, 5 -- C/Kg, 6 -- Disintegrations, 7 -- Counts, 8 -- Ci/cm sq., 9 -- Bq/cm sq.

Time Base: 0 -- Seconds, 1 -- Minutes, 2 -- Hours

* See attached detector documentation, if applicable.

Digital Readout	REFERENCE CAL. POINT	INSTRUMENT RECEIVED	INSTRUMENT METER READING*	REFERENCE CAL. POINT	INSTRUMENT RECEIVED	INSTRUMENT METER READING*
	400kcpm	399243	399243	400cpm	399	399
	40kcpm	39926	39926	40cpm	40	40
	4kcpm	3993	3993			

Ludlum Measurements, Inc. certifies that the above instrument has been calibrated by standards traceable to the National Institute of Standards and Technology, or to the calibration facilities of other International Standards Organization members, or have been derived from accepted values of natural physical constants or have been derived by the ratio type of calibration techniques. The calibration system conforms to the requirements of ANSI/NCSL Z540-1-1994 and ANSI N323-1978. State of Texas Calibration License No. LO-1963

Reference Instruments and/or Sources: Cs-137 Gamma S/N ☐ S-394 ☐ 1122 ☐ 781

☐ 1162 ☐ G112 ☑ M565 ☐ 5105 ☐ T1008 ☐ T879 ☐ E552 ☐ E551 ☐ 720 ☐ 734 ☐ 1616 ☐ Neutron Am-241 Be S/N T-304

☐ Alpha S/N ☐ Beta S/N ☑ Other Am-241 ~0.77uCi

☑ m 500 S/N 121025 ☑ Multimeter S/N 78846185

Calibrated By: Date 25-Sep-06

Reviewed By: Date 25 Sep 06

FORM C44A 06/02/2006

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Designer and Manufacturer of Scientific and Industrial Instruments

CERTIFICATE OF CALIBRATION

LUDLUM MEASUREMENTS, INC.
POST OFFICE BOX 810 PH. 325-235-5494
501 OAK STREET FAX NO. 325-235-4672
SWEETWATER, TEXAS 79556, U.S.A.

CUSTOMER MFG INC ORDER NO. 257271 / 303277

Mfg. Ludlum Measurements, Inc. Model 2350-1 Serial No. 120625

Cal. Date 19-Jun-06 Cal Due Date 19-Jun-07 Cal. Interval 1 Year Meterface N/A

Check mark ☑ applies to applicable instr. and/or detector IAW mfg. spec. T. 73 °F RH 47 % Alt. 700.8 mm Hg

☐ New Instrument Instrument Received ☐ Within Toler. +-10% ☐ 10-20% ☐ Out of Tol. ☐ Requiring Repair ☑ Other-See comments

☑ Mechanical check ☑ Input Sens. Linearity

☑ F/S Resp. check ☑ Reset check ☑ Window Operation

☑ Audio check ☑ Alarm Setting check ☑ Battery check (Min. Volt) 4.4 VDC

☑ Ratemeter Linearity check ☑ Integrated Dose check ☑ Recycle Mode check

☑ Data Log check ☑ Overload check ☑ Scaler Readout check Threshold Dial Ratio 100 = 10 mV

☑ Calibrated in accordance with LMI SOP 14.8 rev 12/05/89. ☑ Calibrated in accordance with LMI SOP 14.9 rev 02/07/97.

☑ HV Readout (2 points) Ref./Inst. 500 / 498 V Ref./Inst. 2000 / 1998 V

COMMENTS: *Firmware: 37122N28*

I/O Firmware: 37123N05

No "As Found" readings because of M2350-1 memory loss.

Calibrated using 39" C-cable.

Resolution for Cs137 ≈ 9.37%

Gamma Calibration: GM detectors positioned perpendicular to source except for M 44-9 in which the front of probe faces source.

	Probe Model	Serial #	High Voltage	Threshold	Units/ Time Base	Dead Time Correction Factor	Calibration Constant	Linearity ±10%*
Detector # 1	LMI44-10	PR122614	900	100	4 / 2	1.290054E-05	5.418134E+10	✓
Detector # 2	LMI44-10	PR122614	900	100	7 / 1	1.290053E-05	1.000000E+00	
Detector # 3	CS137PK	662KEV	605	642	7 / 1	0.000000E+00	1.000000E+00	
Detector #								
Detector #								
Detector #								
Detector #								
Detector #								
Detector #								
Detector #								

Units: 0 -- rad, 1 -- Gray, 2 -- rem, 3 -- Sv, 4 -- R, 5 -- C/Kg, 6 -- Disintegrations, 7 -- Counts, 8 -- Ci/cm sq., 9 -- Bq/cm sq.

Time Base: 0 -- Seconds, 1 -- Minutes, 2 -- Hours

* See attached detector documentation, if applicable.

Digital Readout	REFERENCE CAL. POINT	INSTRUMENT RECEIVED	INSTRUMENT METER READING*	REFERENCE CAL. POINT	INSTRUMENT RECEIVED	INSTRUMENT METER READING*
	400kcpm		39922 (0)	400cpm		40 (0)
	40kcpm	N/A	3994	40cpm	N/A	4
	4kcpm		400			

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Reference Instruments and/or Sources: Cs-137 Gamma S/N

☐ 1162 ☐ G112 ☑ M565 ☐ 5105 ☐ T1008 ☐ T879 ☐ E552 ☐ E551 ☐ 720 ☐ 734 ☐ 1616 ☐ Neutron Am-241 Be S/N T-304

☐ Alpha S/N ☐ Beta S/N ☑ Other Am241 ≈ 0.83 μCi

☑ m 500 S/N 81084 ☑ Multimeter S/N 78401030

Calibrated By: Sebastián Ceballos Date 19-Jun-06

Reviewed By: [illegible] Date 19 Jun 06

FORM C44C 11/26/2003

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#5

CERTIFICATE OF CALIBRATION

LUDLUM MEASUREMENTS, INC.
POST OFFICE BOX 810 PH. 325-235-5494
501 OAK STREET FAX NO. 325-235-4672
SWEETWATER, TEXAS 79556, U.S.A.

CUSTOMER MFG INC ORDER NO. 257273 / 303278

Mfg. Ludlum Measurements, Inc. Model 2350-1 Serial No. 129426

Cal. Date 16-Jun-06 Cal Due Date 16-Jun-07 Cal. Interval 1 Year Meterface N/A

Check mark ☑ applies to applicable instr. and/or detector IAW mfg. spec. T. 70 °F RH 36 % Alt 699.8 mm Hg

☐ New Instrument Instrument Received ☑ Within Toler. +-10% ☐ 10-20% ☐ Out of Tol. ☐ Requiring Repair ☐ Other-See comments

☑ Mechanical check ☑ Input Sens. Linearity
☑ F/S Resp. check ☑ Reset check ☑ Window Operation
☑ Audio check ☑ Alarm Setting check ☑ Battery check (Min. Volt) 4.4 VDC
☑ Ratemeter Linearity check ☑ Integrated Dose check ☑ Recycle Mode check
☑ Data Log check ☑ Overload check ☑ Scaler Readout check Threshold Dial Ratio 100 = 10 mV
☑ Calibrated in accordance with LMI SOP 14.8 rev 12/05/89. ☑ Calibrated in accordance with LMI SOP 14.9 rev 02/07/97.

☑ HV Readout (2 points) Ref./Inst. 500 / 499 V Ref./Inst. 2000 / 1996 V

COMMENTS: *Firmware: 37122N21*

I/O Firmware: 37123N05

Resolution for Cs137 ≈ 9.67%.

Gamma Calibration: GM detectors positioned perpendicular to source except for M 44-9 in which the front of probe faces source.

	Probe Model	Serial #	High Voltage	Threshold	Units/ Time Base	Dead Time Correction Factor	Calibration Constant	Linearity ±10%*
Detector # 1	LMI44-10	PR135855	1050	100	4 / 2	1.461701E-05	5.414237E+10	✓
Detector # 2	LMI44-10	PR135855	1050	100	7 / 1	1.461701E-05	1.000000E+00	
Detector # 3	CS137PK	662KEV	708	642	7 / 1	0.000000E+00	1.000000E+00	
Detector #								
Detector #								
Detector #								
Detector #								
Detector #								
Detector #								
Detector #								

Units: 0 -- rad, 1 -- Gray, 2 -- rem, 3 -- Sv, 4 -- R, 5 -- C/Kg, 6 -- Disintegrations, 7 -- Counts, 8 -- Ci/cm sq., 9 -- Bq/cm sq.
Time Base: 0 -- Seconds, 1 -- Minutes, 2 -- Hours

* See attached detector documentation, if applicable.

Digital Readout	REFERENCE CAL. POINT	INSTRUMENT RECEIVED	INSTRUMENT METER READING*	REFERENCE CAL. POINT	INSTRUMENT RECEIVED	INSTRUMENT METER READING*
	400kcpm	39978(0)	39978(0)	400cpm	40(0)	40(0)
	40kcpm	3996	3996	40cpm	4	4
	4kcpm	400	400			

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Reference Instruments and/or Sources: Cs-137 Gamma S/N

☐ 1162 ☐ G112 ☑ M565 ☐ 5105 ☐ T1008 ☐ T879 ☐ E552 ☐ E551 ☐ 720 ☐ 734 ☐ 1616 ☐ Neutron Am-241 Be S/N T-304

☐ Alpha S/N ☐ Beta S/N ☑ Other Am241≈ 0.83 μCi

☑ m 500 S/N 81084 ☑ Multimeter S/N 78401030

Calibrated By: Sebastn Ceballos Date 16-Jun-06

Reviewed By: [illegible] Date 19 Jun 06

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CERTIFICATE OF CALIBRATION

MFG-2

LUDLUM MEASUREMENTS, INC.
POST OFFICE BOX 810 PH. 325-235-5494
501 OAK STREET FAX NO. 325-235-4672
SWEETWATER, TEXAS 79556, U.S.A.

CUSTOMER MFG INC ORDER NO. 263479/306131

Mfg. Ludlum Measurements, Inc. Model 2350-1 Serial No. 152361

Cal. Date 22-Sep-06 Cal Due Date 22-Sep-07 Cal. Interval 1 Year Meterface N/A

Check mark ☑ applies to applicable instr. and/or detector IAW mfg. spec. T. 73 °F RH 24 % Alt 693.8 mm Hg

☐ New Instrument Instrument Received ☑ Within Toler. +-10% ☐ 10-20% ☐ Out of Tol. ☐ Requiring Repair ☐ Other-See comments

☑ Mechanical check ☑ Input Sens. Linearity

☑ F/S Resp. check ☑ Reset check ☑ Window Operation

☑ Audio check ☑ Alarm Setting check ☑ Battery check (Min. Volt) 4.4 VDC

☑ Ratemeter Linearity check ☑ Integrated Dose check ☑ Recycle Mode check

☑ Data Log check ☑ Overload check ☑ Scaler Readout check Threshold Dial Ratio 100 = 10 mV

☑ Calibrated in accordance with LMI SOP 14.8 rev 12/05/89. ☐ Calibrated in accordance with LMI SOP 14.9 rev 02/07/97.

☑ HV Readout (2 points) Ref./Inst. 500 / 500 V Ref./Inst. 2000 / 1995 V

COMMENTS: *Firmware: 37122N24*

I/O firmware:37123n05 Instrument calibrated with 39"C cable

resolution for Cs-137 11%

Gamma Calibration: GM detectors positioned perpendicular to source except for M 44-9 in which the front of probe faces source.

	Probe Model	Serial #	High Voltage	Threshold	Units/ Time Base	Dead Time Correction Factor	Calibration Constant	Linearity ±10%*
Detector # 1	LMI44-10	PR121036	1100	100	4 / 2	1.594473E-05	5.359899E+10	
Detector # 2	LMI44-10	PR121036	1100	100	7 / 1	1.594473E-05	1.000000E+00	
Detector # 3	CS-137PK	662KEV	799	642	7 / 1	0.000000E+00	1.000000E+00	
Detector #								
Detector #								
Detector #								
Detector #								
Detector #								
Detector #								
Detector #								
Detector #								
Detector #								
Detector #								
Detector #								
Detector #								
Detector #								

Units: 0 -- rad, 1 -- Gray, 2 -- rem, 3 -- Sv, 4 -- R, 5 -- C/Kg, 6 -- Disintegrations, 7 -- Counts, 8 -- Ci/cm sq., 9 -- Bq/cm sq.

Time Base: 0 -- Seconds, 1 -- Minutes, 2 -- Hours

* See attached detector documentation, if applicable.

Digital Readout	REFERENCE CAL. POINT	INSTRUMENT RECEIVED	INSTRUMENT METER READING*	REFERENCE CAL. POINT	INSTRUMENT RECEIVED	INSTRUMENT METER READING*
	400kcpm	400354	400354	400cpm	400	400
	40kcpm	39994	39994	40cpm	40	40
	4kcpm	3999	3999			

Ludlum Measurements, Inc. certifies that the above instrument has been calibrated by standards traceable to the National Institute of Standards and Technology, or to the calibration facilities of other International Standards Organization members, or have been derived from accepted values of natural physical constants or have been derived by the ratio type of calibration techniques. The calibration system conforms to the requirements of ANSI/NCSL Z540-1-1994 and ANSI N323-1978. State of Texas Calibration License No. LO-1963

Reference Instruments and/or Sources: Cs-137 Gamma S/N ☐ S-394 ☐ 1122 ☐ 781

☐ 1162 ☐ G112 ☑ M565 ☐ 5105 ☐ T1008 ☐ T879 ☐ E552 ☐ E551 ☐ 720 ☐ 734 ☐ 1616 ☐ Neutron Am-241 Be S/N T-304

☐ Alpha S/N ☐ Beta S/N ☑ Other Am-241 ~0.77μCi

☑ m 500 S/N 121025 ☑ Multimeter S/N 78846185

Calibrated By: [signature] Date 22-Sep-06

Reviewed By: [signature] Date 25 Sep 06

FORM C44A 06/02/2006

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MFG #8

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501 OAK STREET FAX NO. 325-235-4672
SWEETWATER, TEXAS 79556, U.S.A.

CUSTOMER MFG INC ORDER NO. 261133 / 304908

Mfg. Ludlum Measurements, Inc. Model 2350-1 Serial No. 134759

Cal. Date 24-Aug-06 Cal Due Date 24-Aug-07 Cal. Interval 1 Year Meterface N/A

Check mark ☑ applies to applicable instr. and/or detector IAW mfg. spec. T. 72 °F RH 40 % Alt 700.8 mm Hg

☐ New Instrument Instrument Received ☐ Within Toler. +-10% ☐ 10-20% ☐ Out of Tol. ☐ Requiring Repair ☑ Other-See comments

☑ Mechanical check ☑ Input Sens. Linearity
☑ F/S Resp. check ☑ Reset check ☑ Window Operation
☑ Audio check ☑ Alarm Setting check ☑ Battery check (Min. Volt) 4.4 VDC
☑ Ratemeter Linearity check ☑ Integrated Dose check ☑ Recycle Mode check
☑ Data Log check ☑ Overload check ☑ Scaler Readout check Threshold Dial Ratio 100 = 10 mV
☑ Calibrated in accordance with LMI SOP 14.8 rev 12/05/89. ☑ Calibrated in accordance with LMI SOP 14.9 rev 02/07/97.

☑ HV Readout (2 points) Ref./Inst. 500 / 498 V Ref./Inst. 2000 / 1997 V

COMMENTS: *Firmware: 37122N28*

I/O Firmware: 37123N05

Calibrated using 39" C-cable.

Resolution for Cs137 ≈ 10.12%

No "As Found" readings because of M2350-1 memory loss.

Gamma Calibration: GM detectors positioned perpendicular to source except for M 44-9 in which the front of probe faces source.

	Probe Model	Serial #	High Voltage	Threshold	Units/ Time Base	Dead Time Correction Factor	Calibration Constant	Linearity ±10%*
Detector # 1	LMI44-10	PR139483	950	100	4 / 2	1.218875E-05	5.244675E+10	✓
Detector # 2	LMI44-10	PR139483	950	100	7 / 1	1.218874E-05	1.000000E+00	
Detector # 3	CS137PK	662KEV	672	642	7 / 1	0.000000E+00	1.000000E+00	
Detector #								
Detector #								
Detector #								
Detector #								
Detector #								
Detector #								
Detector #								

Units: 0 -- rad, 1 -- Gray, 2 -- rem, 3 -- Sv, 4 -- R, 5 -- C/Kg, 6 -- Disintegrations, 7 -- Counts, 8 -- Ci/cm sq., 9 -- Bq/cm sq.
Time Base: 0 -- Seconds, 1 -- Minutes, 2 -- Hours

* See attached detector documentation, if applicable.

Digital Readout	REFERENCE CAL. POINT	INSTRUMENT RECEIVED	INSTRUMENT METER READING*	REFERENCE CAL. POINT	INSTRUMENT RECEIVED	INSTRUMENT METER READING*
	400kcpm	N/A	39966(0)	400cpm	N/A	40(0)
	40kcpm		3997	40cpm		4
	4kcpm		400			

Ludlum Measurements, Inc. certifies that the above instrument has been calibrated by standards traceable to the National Institute of Standards and Technology, or to the calibration facilities of other International Standards Organization members, or have been derived from accepted values of natural physical constants or have been derived by the ratio type of calibration techniques. The calibration system conforms to the requirements of ANSI/NCSL Z540-1-1994 and ANSI N323-1978. State of Texas Calibration License No. LO-1963

Reference Instruments and/or Sources: Cs-137 Gamma S/N

☐ 1162 ☐ G112 ☑ M565 ☐ 5105 ☐ T1008 ☐ T879 ☐ E552 ☐ E551 ☐ 720 ☐ 734 ☐ 1616 ☐ Neutron Am-241 Be S/N T-304

☐ Alpha S/N ☐ Beta S/N ☑ Other Am241 ≈ 0.83 μCi

☑ m 500 S/N 81084 ☑ Multimeter S/N 78401030

Calibrated By: Sebastian Ceballos Date 24-Aug-06
Reviewed By: [signature] Date 25 Aug 06

FORM C44C 11/26/2003

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CERTIFICATE OF CALIBRATION

MFG-9

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POST OFFICE BOX 810 PH. 325-235-5494
501 OAK STREET FAX NO. 325-235-4672
SWEETWATER, TEXAS 79556, U.S.A.

CUSTOMER MFG INC ORDER NO. 263479/306131

Mfg. Ludlum Measurements, Inc. Model 2350-1 Serial No. 129403

Cal. Date 22-Sep-06 Cal Due Date 22-Sep-07 Cal. Interval 1 Year Meterface N/A

Check mark ☑ applies to applicable instr. and/or detector IAW mfg. spec. T. 73 °F RH 24 % Alt 693.8 mm Hg

☐ New Instrument Instrument Received ☑ Within Toler. +-10% ☐ 10-20% ☐ Out of Tol. ☐ Requiring Repair ☐ Other-See comments

☑ Mechanical check ☑ Input Sens. Linearity
☑ F/S Resp. check ☑ Reset check ☑ Window Operation
☑ Audio check ☑ Alarm Setting check ☑ Battery check (Min. Volt) 4.4 VDC
☑ Ratemeter Linearity check ☑ Integrated Dose check ☑ Recycle Mode check
☑ Data Log check ☑ Overload check ☑ Scaler Readout check Threshold Dial Ratio 100 = 10 mV

☑ Calibrated in accordance with LMI SOP 14.8 rev 12/05/89. ☐ Calibrated in accordance with LMI SOP 14.9 rev 02/07/97.

☑ HV Readout (2 points) Ref./Inst. 500 / 500 V Ref./Inst. 2000 / 1997 V

COMMENTS: *Firmware: 37122N21*
I/O Firmware:371230n5 Instrument calibrated with 39"C cable
Resolution for Cs-137 11%
Gamma Calibration: GM detectors positioned perpendicular to source except for M 44-9 in which the front of probe faces source.

	Probe Model	Serial #	High Voltage	Threshold	Units/ Time Base	Dead Time Correction Factor	Calibration Constant	Linearity ±10%*
Detector # 1	LMI44-10	PR135858	1150	100	4 / 2	1.307108E-05	5.294387E+10	
Detector # 2	LMI44-10	PR135858	1150	100	7 / 1	1.307108E-05	1.000000E+00	
Detector # 3	CS-137PK	662KEV	821	662	7 / 1	0.000000E+00	1.000000E+00	
Detector #								
Detector #								
Detector #								
Detector #								
Detector #								
Detector #								
Detector #								
Detector #								
Detector #								
Detector #								
Detector #								
Detector #								
Detector #								

Units: 0 -- rad, 1 -- Gray, 2 -- rem, 3 -- Sv, 4 -- R, 5 -- C/Kg, 6 -- Disintegrations, 7 -- Counts, 8 -- Ci/cm sq., 9 -- Bq/cm sq.
Time Base: 0 -- Seconds, 1 -- Minutes, 2 -- Hours

* See attached detector documentation, if applicable.

Digital Readout	REFERENCE CAL. POINT	INSTRUMENT RECEIVED	INSTRUMENT METER READING*	REFERENCE CAL. POINT	INSTRUMENT RECEIVED	INSTRUMENT METER READING*
	400kcpm	400222	400222	400cpm	400	400
	40kcpm	39979	39979	40cpm	40	40
	4kcpm	3998	3998			

Ludlum Measurements, Inc. certifies that the above instrument has been calibrated by standards traceable to the National Institute of Standards and Technology, or to the calibration facilities of other International Standards Organization members, or have been derived from accepted values of natural physical constants or have been derived by the ratio type of calibration techniques. The calibration system conforms to the requirements of ANSI/NCSL Z540-1-1994 and ANSI N323-1978. State of Texas Calibration License No. LO-1963

Reference Instruments and/or Sources: Cs-137 Gamma S/N ☐ S-394 ☐ 1122 ☐ 781
☐ 1162 ☐ G112 ☑ M565 ☐ 5105 ☐ T1008 ☐ T879 ☐ E552 ☐ E551 ☐ 720 ☐ 734 ☐ 1616 ☐ Neutron Am-241 Be S/N T-304

☐ Alpha S/N ☐ Beta S/N ☑ Other Am-241 ~0.77uCi

☑ m 500 S/N 121025 ☑ Multimeter S/N 78846185

Calibrated By: Date 22-Sep-06
Reviewed By: Date 25 Sep 06

FORM C44A 06/02/2006

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Designer and Manufacturer of Scientific and Industrial Instruments

MFG-12

CERTIFICATE OF CALIBRATION

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501 OAK STREET FAX NO. 325-235-4672
SWEETWATER, TEXAS 79556, U.S.A.

CUSTOMER MFG INC ORDER NO. 257557 / 303433

Mfg. Ludlum Measurements, Inc. Model 2350-1 Serial No. 134764

Cal. Date 13-Jul-06 Cal Due Date 13-Jul-07 Cal. Interval 1 Year Meterface N/A

Check mark ☑ applies to applicable instr. and/or detector IAW mfg. spec. T. 71 °F RH 49 % Alt 701.8 mm Hg

☐ New Instrument Instrument Received ☐ Within Toler. +-10% ☐ 10-20% ☐ Out of Tol. ☐ Requiring Repair ☑ Other-See comments

☑ Mechanical check
☑ F/S Resp. check
☑ Audio check
☑ Ratemeter Linearity check
☑ Data Log check
☑ Calibrated in accordance with LMI SOP 14.8 rev 12/05/89.

☑ Reset check
☑ Alarm Setting check
☑ Integrated Dose check
☑ Overload check

☑ Window Operation
☑ Battery check (Min. Volt) 4.4 VDC
☑ Recycle Mode check
☑ Scaler Readout check
☑ Calibrated in accordance with LMI SOP 14.9 rev 02/07/97.

☑ Input Sens. Linearity
Threshold Dial Ratio 100 = 10 mV

☑ HV Readout (2 points) Ref./Inst. 500 / 499 V Ref./Inst. 2000 / 1997 V

COMMENTS: *Firmware: 37122N21*

I/O Firmware: 37123N05

Calibrated using 39" C-cable.

Resolution for Cs137 ≈ 9.52%

No "As Found" readings because of M2350-1 memory loss.

Gamma Calibration: GM detectors positioned perpendicular to source except for M 44-9 in which the front of probe faces source.

	Probe Model	Serial #	High Voltage	Threshold	Units/ Time Base	Dead Time Correction Factor	Calibration Constant	Linearity ±10%*
Detector # 1	LMI44-10	PR139484	900	100	4 / 2	1.259847E-05	5.465646E+10	✓
Detector # 2	LMI44-10	PR139484	900	100	7 / 1	1.259846E-05	1.000000E+00	
Detector # 3	CS137PK	662KEV	596	642	7 / 1	0.000000E+00	1.000000E+00	
Detector #								
Detector #								
Detector #								
Detector #								
Detector #								
Detector #								
Detector #								

Units: 0 -- rad, 1 -- Gray, 2 -- rem, 3 -- Sv, 4 -- R, 5 -- C/Kg, 6 -- Disintegrations, 7 -- Counts, 8 -- Ci/cm sq., 9 -- Bq/cm sq.
Time Base: 0 -- Seconds, 1 -- Minutes, 2 -- Hours

* See attached detector documentation, if applicable.

Digital Readout	REFERENCE CAL. POINT	INSTRUMENT RECEIVED	INSTRUMENT METER READING*	REFERENCE CAL. POINT	INSTRUMENT RECEIVED	INSTRUMENT METER READING*
	400kcpm	N/A	39989(0)	400cpm	N/A	40(0)
	40kcpm		3995	40cpm		4
	4kcpm		400			

Ludlum Measurements, Inc. certifies that the above instrument has been calibrated by standards traceable to the National Institute of Standards and Technology, or to the calibration facilities of other International Standards Organization members, or have been derived from accepted values of natural physical constants or have been derived by the ratio type of calibration techniques. The calibration system conforms to the requirements of ANSI/NCSL Z540-1-1994 and ANSI N323-1978. State of Texas Calibration License No. LO-1963

Reference Instruments and/or Sources: Cs-137 Gamma S/N

☐ 1162 ☐ G112 ☑ M565 ☐ 5105 ☐ T1008 ☐ T879 ☐ E552 ☐ E551 ☐ 720 ☐ 734 ☐ 1616 ☐ Neutron Am-241 Be S/N T-304

☐ Alpha S/N ☐ Beta S/N ☑ Other Am241≈0.83 μCi

☑ m 500 S/N 81084 ☑ Multimeter S/N 78401030

Calibrated By: Sebastian Caballero Date 13-Jul-06

Reviewed By: [illegible] Date 13 Jul 06

FORM C44C 11/26/2003

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Designer and Manufacturer of Scientific and Industrial Instruments

MFG #13

CERTIFICATE OF CALIBRATION

LUDLUM MEASUREMENTS, INC.
POST OFFICE BOX 810 PH. 325-235-5494
501 OAK STREET FAX NO. 325-235-4672
SWEETWATER, TEXAS 79556, U.S.A.

CUSTOMER MFG INC ORDER NO. 261133/304908 261654 / 305206

Mfg. Ludlum Measurements, Inc. Model 2350-1 Serial No. 129434

Cal. Date 24-Aug-06 Cal Due Date 24-Aug-07 Cal. Interval 1 Year Meterface N/A

Check mark ☑ applies to applicable instr. and/or detector IAW mfg. spec. T. 72 °F RH 40 % Alt 700.8 mm Hg

☐ New Instrument Instrument Received ☑ Within Toler. +-10% ☐ 10-20% ☐ Out of Tol. ☐ Requiring Repair ☐ Other-See comments

☑ Mechanical check ☑ Input Sens. Linearity

☑ F/S Resp. check ☑ Reset check ☑ Window Operation

☑ Audio check ☑ Alarm Setting check ☑ Battery check (Min. Volt) 4.4 VDC

☑ Ratemeter Linearity check ☑ Integrated Dose check ☑ Recycle Mode check

☑ Data Log check ☑ Overload check ☑ Scaler Readout check Threshold Dial Ratio 100 = 10 mV

☑ Calibrated in accordance with LMI SOP 14.8 rev 12/05/89. ☑ Calibrated in accordance with LMI SOP 14.9 rev 02/07/97.

☑ HV Readout (2 points) Ref./Inst. 500 / 498 V Ref./Inst. 2000 / 1999 V

COMMENTS: *Firmware: 37122N21*

I/O Firmware: 37123N05

Calibrated using 39" C-cable.

Resolution for Cs137 ≈ 9.97%

Gamma Calibration: GM detectors positioned perpendicular to source except for M 44-9 in which the front of probe faces source.

	Probe Model	Serial #	High Voltage	Threshold	Units/ Time Base	Dead Time Correction Factor	Calibration Constant	Linearity ±10%*
Detector # 1	LMI44-10	PR135854	1050	100	4 / 2	1.450212E-05	5.233001E+10	✓
Detector # 2	LMI44-10	PR135854	1050	100	7 / 1	1.450211E-05	1.000000E+00	
Detector # 3	CS137PK	662KEV	721	642	7 / 1	0.000000E+00	1.000000E+00	
Detector #								
Detector #								
Detector #								
Detector #								
Detector #								
Detector #								
Detector #								

Units: 0 -- rad, 1 -- Gray, 2 -- rem, 3 -- Sv, 4 -- R, 5 -- C/Kg, 6 -- Disintegrations, 7 -- Counts, 8 -- Ci/cm sq., 9 -- Bq/cm sq.

Time Base: 0 -- Seconds, 1 -- Minutes, 2 -- Hours

* See attached detector documentation, if applicable.

Digital Readout	REFERENCE CAL. POINT	INSTRUMENT RECEIVED	INSTRUMENT METER READING*	REFERENCE CAL. POINT	INSTRUMENT RECEIVED	INSTRUMENT METER READING*
	400kcpm	39979(0)	39979(0)	400cpm	40(0)	40(0)
	40kcpm	3993	3993	40cpm	4	4
	4kcpm	400	400			

Ludlum Measurements, Inc. certifies that the above instrument has been calibrated by standards traceable to the National Institute of Standards and Technology, or to the calibration facilities of other International Standards Organization members, or have been derived from accepted values of natural physical constants or have been derived by the ratio type of calibration techniques. The calibration system conforms to the requirements of ANSI/NCSL Z540-1-1994 and ANSI N323-1978. State of Texas Calibration License No. LO-1963

Reference Instruments and/or Sources: Cs-137 Gamma S/N

☐ 1162 ☐ G112 ☑ M565 ☐ 5105 ☐ T1008 ☐ T879 ☐ E552 ☐ E551 ☐ 720 ☐ 734 ☐ 1616 ☐ Neutron Am-241 Be S/N T-304

☐ Alpha S/N ☐ Beta S/N ☑ Other Am241 ≈ 0.83 μCi

☑ m 500 S/N 81084 ☑ Multimeter S/N 78401030

Calibrated By: Sebastián Ceballos Date 24-Aug-06

Reviewed By: [illegible] Date 25 Aug 06

FORM C44C 11/26/2003

This certificate shall not be reproduced except in full, without the written approval of Ludlum Measurements, Inc.

Designer and Manufacturer of Scientific and Industrial Instruments

MFG-15

CERTIFICATE OF CALIBRATION

LUDLUM MEASUREMENTS, INC.
POST OFFICE BOX 810 PH. 325-235-5494
501 OAK STREET FAX NO. 325-235-4672
SWEETWATER, TEXAS 79556, U.S.A.

CUSTOMER MFG INC ORDER NO. 257557 / 303433

Mfg. Ludlum Measurements, Inc. Model 2350-1 Serial No. 134768

Cal. Date 13-Jul-06 Cal Due Date 13-Jul-07 Cal. Interval 1 Year Meterface N/A

Check mark ☑ applies to applicable instr. and/or detector IAW mfg. spec. T. 71 °F RH 49 % Alt 701.8 mm Hg

☐ New Instrument Instrument Received ☑ Within Toler. +-10% ☐ 10-20% ☐ Out of Tol. ☐ Requiring Repair ☐ Other-See comments

☑ Mechanical check ☑ Input Sens. Linearity

☑ F/S Resp. check ☑ Reset check ☑ Window Operation

☑ Audio check ☑ Alarm Setting check ☑ Battery check (Min. Volt) 4.4 VDC

☑ Ratemeter Linearity check ☑ Integrated Dose check ☑ Recycle Mode check

☑ Data Log check ☑ Overload check ☑ Scaler Readout check Threshold Dial Ratio 100 = 10 mV

☑ Calibrated in accordance with LMI SOP 14.8 rev 12/05/89. ☑ Calibrated in accordance with LMI SOP 14.9 rev 02/07/97.

☑ HV Readout (2 points) Ref./Inst. 500 / 499 V Ref./Inst. 2000 / 1997 V

COMMENTS: *Firmware: 37122N21*

I/O Firmware: 37123N05

Calibrated using 39" C-cable.

Resolution for Cs137 ≈ 10.42%

Gamma Calibration: GM detectors positioned perpendicular to source except for M 44-9 in which the front of probe faces source.

	Probe Model	Serial #	High Voltage	Threshold	Units/ Time Base	Dead Time Correction Factor	Calibration Constant	Linearity ±10%*
Detector # 1	LMI44-10	PR139491	1100	100	4 / 2	1.379348E-05	5.412704E+10	✓
Detector # 2	LMI44-10	PR139491	1100	100	7 / 1	1.379348E-05	1.000000E+00	
Detector # 3	CS137PK	662KEV	751	642	7 / 1	0.000000E+00	1.000000E+00	
Detector #								
Detector #								
Detector #								
Detector #								
Detector #								
Detector #								
Detector #								

Units: 0 -- rad, 1 -- Gray, 2 -- rem, 3 -- Sv, 4 -- R, 5 -- C/Kg, 6 -- Disintegrations, 7 -- Counts, 8 -- Ci/cm sq., 9 -- Bq/cm sq.

Time Base: 0 -- Seconds, 1 -- Minutes, 2 -- Hours

* See attached detector documentation, if applicable.

Digital Readout	REFERENCE CAL. POINT	INSTRUMENT RECEIVED	INSTRUMENT METER READING*	REFERENCE CAL. POINT	INSTRUMENT RECEIVED	INSTRUMENT METER READING*
	400kcpm	39990(0)	39990(0)	400cpm	40(0)	40(0)
	40kcpm	3997 ↓	3997 ↓	40cpm	4 ↓	↓
	4kcpm	400 ↓	400 ↓			

Ludlum Measurements, Inc. certifies that the above instrument has been calibrated by standards traceable to the National Institute of Standards and Technology, or to the calibration facilities of other International Standards Organization members, or have been derived from accepted values of natural physical constants or have been derived by the ratio type of calibration techniques. The calibration system conforms to the requirements of ANSI/NCSL Z540-1-1994 and ANSI N323-1978. State of Texas Calibration License No. LO-1963

Reference Instruments and/or Sources: Cs-137 Gamma S/N

☐ 1162 ☐ G112 ☑ M565 ☐ 5105 ☐ T1008 ☐ T879 ☐ E552 ☐ E551 ☐ 720 ☐ 734 ☐ 1616 ☐ Neutron Am-241 Be S/N T-304

☐ Alpha S/N ☐ Beta S/N ☑ Other Am241 ≈ 0.83 μCi

☑ m 500 S/N 81084 ☑ Multimeter S/N 78401030

Calibrated By: Sebastian Ceballos Date 13-Jul-06

Reviewed By: [illegible] Date 13 July 06

FORM C44C 11/26/2003

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Designer and Manufacturer of Scientific and Industrial Instruments

#16

CERTIFICATE OF CALIBRATION

LUDLUM MEASUREMENTS, INC.
POST OFFICE BOX 810 PH. 325-235-5494
501 OAK STREET FAX NO. 325-235-4672
SWEETWATER, TEXAS 79556, U.S.A.

CUSTOMER MFG INC ORDER NO. 257271 / 303277

Mfg. Ludlum Measurements, Inc. Model 2350-1 Serial No. 129405

Cal. Date 19-Jun-06 Cal Due Date 19-Jun-07 Cal. Interval 1 Year Meterface N/A

Check mark ☑ applies to applicable instr. and/or detector IAW mfg. spec. T. 73 °F RH 47 % Alt 700.8 mm Hg

☐ New Instrument Instrument Received ☐ Within Toler. +-10% ☐ 10-20% ☐ Out of Tol. ☐ Requiring Repair ☑ Other-See comments

☑ Mechanical check ☑ Input Sens. Linearity

☑ F/S Resp. check ☑ Reset check ☑ Window Operation

☑ Audio check ☑ Alarm Setting check ☑ Battery check (Min. Volt) 4.4 VDC

☑ Ratemeter Linearity check ☑ Integrated Dose check ☑ Recycle Mode check

☑ Data Log check ☑ Overload check ☑ Scaler Readout check Threshold Dial Ratio 100 = 10 mV

☑ Calibrated in accordance with LMI SOP 14.8 rev 12/05/89. ☑ Calibrated in accordance with LMI SOP 14.9 rev 02/07/97.

☑ HV Readout (2 points) Ref./Inst. 500 / 499 V Ref./Inst. 2000 / 1996 V

COMMENTS: *Firmware: 37122N21*

I/O Firmware: 37123N05

No "As Found" readings because of M2350-1 memory loss.

Calibrated using 39" C-cable.

Resolution for Cs137 ≈ 9.82%

Gamma Calibration: GM detectors positioned perpendicular to source except for M 44-9 in which the front of probe faces source.

	Probe Model	Serial #	High Voltage	Threshold	Units/ Time Base	Dead Time Correction Factor	Calibration Constant	Linearity ±10%*
Detector # 1	LMI44-10	PR137085	900	100	4 / 2	1.444180E-05	5.491888E+10	✓
Detector # 2	LMI44-10	PR137085	900	100	7 / 1	1.444180E-05	1.000000E+00	
Detector # 3	CS137PK	662KEV	583	642	7 / 1	0.000000E+00	1.000000E+00	
Detector #								
Detector #								
Detector #								
Detector #								
Detector #								
Detector #								
Detector #								

Units: 0 -- rad, 1 -- Gray, 2 -- rem, 3 -- Sv, 4 -- R, 5 -- C/Kg, 6 -- Disintegrations, 7 -- Counts, 8 -- Ci/cm sq., 9 -- Bq/cm sq.

Time Base: 0 -- Seconds, 1 -- Minutes, 2 -- Hours

* See attached detector documentation, if applicable.

Digital Readout	REFERENCE CAL. POINT	INSTRUMENT RECEIVED	INSTRUMENT METER READING*	REFERENCE CAL. POINT	INSTRUMENT RECEIVED	INSTRUMENT METER READING*
	400kcpm		39977 (0)	400cpm		40 (0)
	40kcpm	N/A	3993	40cpm	N/A	4
	4kcpm		400			

Ludlum Measurements, Inc. certifies that the above instrument has been calibrated by standards traceable to the National Institute of Standards and Technology, or to the calibration facilities of other International Standards Organization members, or have been derived from accepted values of natural physical constants or have been derived by the ratio type of calibration techniques. The calibration system conforms to the requirements of ANSI/NCSL Z540-1-1994 and ANSI N323-1978. State of Texas Calibration License No. LO-1963

Reference Instruments and/or Sources: Cs-137 Gamma S/N

☐ 1162 ☐ G112 ☑ M565 ☐ 5105 ☐ T1008 ☐ T879 ☐ E552 ☐ E551 ☐ 720 ☐ 734 ☐ 1616 ☐ Neutron Am-241 Be S/N T-304

☐ Alpha S/N ☐ Beta S/N ☑ Other Am241 ≈ 0.83 μCi

☑ m 500 S/N 81084 ☑ Multimeter S/N 78401030

Calibrated By: Sebastian Ceballos Date 19-Jun-06

Reviewed By: [illegible] Date 19 Jun 06

FORM C44C 11/26/2003

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Designer and Manufacturer of Scientific and Industrial Instruments

#17

CERTIFICATE OF CALIBRATION

LUDLUM MEASUREMENTS, INC.
POST OFFICE BOX 810 PH. 325-235-5494
501 OAK STREET FAX NO. 325-235-4672
SWEETWATER, TEXAS 79556, U.S.A.

CUSTOMER MFG INC ORDER NO. 257271 / 303277

Mfg. Ludlum Measurements, Inc. Model 2350-1 Serial No. 120630

Cal. Date 19-Jun-06 Cal Due Date 19-Jun-07 Cal. Interval 1 Year Meterface N/A

Check mark ☑ applies to applicable instr. and/or detector IAW mfg. spec. T. 73 °F RH 47 % Alt 700.8 mm Hg

☐ New Instrument Instrument Received ☑ Within Toler. +-10% ☐ 10-20% ☐ Out of Tol. ☐ Requiring Repair ☐ Other-See comments

☑ Mechanical check ☑ Input Sens. Linearity

☑ F/S Resp. check ☑ Reset check ☑ Window Operation

☑ Audio check ☑ Alarm Setting check ☑ Battery check (Min. Volt) 4.4 VDC

☑ Ratemeter Linearity check ☑ Integrated Dose check ☑ Recycle Mode check

☑ Data Log check ☑ Overload check ☑ Scaler Readout check Threshold Dial Ratio 100 = 10 mV

☑ Calibrated in accordance with LMI SOP 14.8 rev 12/05/89. ☑ Calibrated in accordance with LMI SOP 14.9 rev 02/07/97.

☑ HV Readout (2 points) Ref./Inst. 500 / 498 V Ref./Inst. 2000 / 2001 V

COMMENTS: *Firmware: 37122N21*

I/O Firmware: 37123N04

Calibrated using 39" C-cable.

Resolution for Cs137 ≈ 9.21%

Gamma Calibration: GM detectors positioned perpendicular to source except for M 44-9 in which the front of probe faces source.

	Probe Model	Serial #	High Voltage	Threshold	Units/ Time Base	Dead Time Correction Factor	Calibration Constant	Linearity ±10%*
Detector # 1	LMI44-10	PR135847	900	100	4 / 2	1.313019E-05	5.377700E+10	✓
Detector # 2	LMI44-10	PR135847	900	100	7 / 1	1.313018E-05	1.000000E+00	
Detector # 3	CS137PK	662KEV	566	642	7 / 1	0.000000E+00	1.000000E+00	
Detector #								
Detector #								
Detector #								
Detector #								
Detector #								
Detector #								
Detector #								

Units: 0 -- rad, 1 -- Gray, 2 -- rem, 3 -- Sv, 4 -- R, 5 -- C/Kg, 6 -- Disintegrations, 7 -- Counts, 8 -- Ci/cm sq., 9 -- Bq/cm sq.

Time Base: 0 -- Seconds, 1 -- Minutes, 2 -- Hours

* See attached detector documentation, if applicable.

Digital Readout	REFERENCE CAL. POINT	INSTRUMENT RECEIVED	INSTRUMENT METER READING*	REFERENCE CAL. POINT	INSTRUMENT RECEIVED	INSTRUMENT METER READING*
	400kcpm	39958(0)	39958(0)	400cpm	40(0)	40(0)
	40kcpm	3996	3996	40cpm	4	4
	4kcpm	400	400			

Ludlum Measurements, Inc. certifies that the above instrument has been calibrated by standards traceable to the National Institute of Standards and Technology, or to the calibration facilities of other International Standards Organization members, or have been derived from accepted values of natural physical constants or have been derived by the ratio type of calibration techniques. The calibration system conforms to the requirements of ANSI/NCSL Z540-1-1994 and ANSI N323-1978. State of Texas Calibration License No. LO-1963

Reference Instruments and/or Sources: Cs-137 Gamma S/N

☐ 1162 ☐ G112 ☑ M565 ☐ 5105 ☐ T1008 ☐ T879 ☐ E552 ☐ E551 ☐ 720 ☐ 734 ☐ 1616 ☐ Neutron Am-241 Be S/N T-304

☐ Alpha S/N ☐ Beta S/N ☑ Other Am241≈ 0.83 μCi

☑ m 500 S/N 81084 ☑ Multimeter S/N 78401030

Calibrated By: Sebastn Ceballos Date 19-Jun-06

Reviewed By: [illegible] Date 19 Jun 06

FORM C44C 11/26/2003

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Reuter-Stokes

Calibration Certificate

Reuter-Stokes certifies that the Environmental Radiation Monitor, identified below, has been calibrated for output using the shadow shield technique*, and calibrated with radiation sources traceable to the National Institute of Standards and Technology.

Sensor Type: 100 mR/Hr

Serial Number: 98100046

Calibration Date: 9/8/06

Sensitivity: 12.24 mV/μR/h

Ken Lambach
Authorized Signature

*Calibration Procedure: RS-SOP 238.1

Reuter-Stokes

Calibration Data

Sensor Type:	100 mR/Hr	Source (CS-137):	BB-400
Serial Number:	98100046	Date of Certification:	12/1/94
Calibration Date:	9/8/06	Exposure Rate at 1 meter:	4.226 mR/h
Customer Name: MFG			
Sensitivity (Ra-226):	12.24 mV/μR/h		

Distance		Exposure Rate	P+S+A	S+A	P	k(CS-137)
Feet	cm	μR/h	V	V	V	mV/μR/h
11.8	359	244.936	3.840	0.807	3.033	12.38
13.8	420	178.300	2.913	0.708	2.205	12.37
15.8	481	135.430	2.307	0.631	1.676	12.38
17.8	542	106.250	1.887	0.571	1.316	12.39

k(CS-137) = 12.38 mv/μR/h

k(Ra-226) = .9892 k(CS-137)

k(Ra-226) = 12.24 mv/μR/h

$\bar{k}$ = 12.38 mv/μR/h

σ = .009 mv/μR/h

$V = \frac{\sigma}{k} =$ 0.075%

By: Wm Radwanski Date: 9/15/06

Reuter-Stokes

RSS-131 FIRMWARE PARAMETERS

S/N 98I00046

RAC	2.497E-08
ZLN	0.000E-00
ZMN	5.513E-02
ZHN	2.431E-04
ZLD	0.000E-00
ZMD	3.720E-05
ZHD	-5.600E-06
RLN	4.901E+11
RMN	2.016E+09
RHN	1.998E+07
RLV	-1.150E+08
RMV	2.520E+05
RHV	3.030E+03

Only change in constants is the RAC.
As found RAC 2.536E-08.

By: Ken Radwanski
Level 2 Nuclear / Electrical Inspector

Date: 9/15/06

Reviewed By: Ken Lambach
Senior Engineer

CHAIN OF CUSTODY RECORD
REQUEST FOR ANALYSIS

MFG, Inc.
3801 Automation Way #100
Fort Collins, CO 80525
(970) 223-9600 Fax (970) 223-7171

consulting scientists and engineers

Client/Project Name: Red Desert

MFG, Inc. Contact / Phone Number: Randy Whicker / 970-556-1174

Project Number: 181445

P.O. Number: 181445-10-5-06

Delivery Method / Shipping Document Number:

Send Results / Report To:
Randy Whicker
MFG INC.
3801 Automation Way, Suite 100
Ft. Collins, CO 80525

Sampler (Print Name / Affiliation): Randy Whicker

Signature: [signature]

Analysis Requested: Ra-226 by HPGe Gamma-Spec; U-nat by wet Radiochemistry Methods

Preservative

Container Type and Size

Field Sample No./ Identification	Date	Time	Sample Matrix	Total No. of Cont.	~~Filt. Y N~~	~~Filt. Y N~~	Filt. Y N	Filt. Y N	Filt. Y N	Filt. Y N	Remarks
LC-1	9-29-06		soil		X	X					These are composite samples -
LC-2	↓		↓		X	X					please dry, crush and grind
LC-3					X	X					all rocks, and thoroughly
LC-4					X	X					homogenize each sample.
LC-5					X	X					
LC-6					X	X					For Ra-226, allow 21 days
LC-7					X	X					after sealing containers
LC-8					X	X					to insure Rn-222 equilibrium
LC-9					X	X					
LC-10	↓		↓		X	X					

Relinquished by: (Print Name/Affiliation)	Date:	Received by: (Print Name/Affiliation)	Date:	Analytical Laboratory (Destination):
Randy Whicker / MFG Signature: [signature]	10-5-06 Time:	Signature:	Time:	Energy Laboratories Incorporated 2393 Salt Creek Highway Casper, WY 82602
Relinquished by: (Print Name/Affiliation) Signature:	Date: Time:	Received by: (Print Name/Affiliation) Signature:	Date: Time:	
Relinquished by: (Print Name/Affiliation) Signature:	Date: Time:	Received by: (Print Name/Affiliation) Signature:	Date: Time:	Condition/Temperature of Samples when Received:

Serial No.: № 005662

White: Return to MFG, Inc. Yellow: Laboratory Pink: Field Team

Matrix Codes: SW=Surface Water GW=Ground Water S=Soil Sediment ___ = _____

CHAIN OF CUSTODY RECORD
REQUEST FOR ANALYSIS

MFG, Inc.
3801 Automation Way #100
Fort Collins, CO 80526
(970) 223-9600 Fax (970) 223-7171

consulting scientists and engineers

Client/Project Name: Red Desert

MFG, Inc. Contact / Phone Number: Randy Whicker / 970-556-1174

Project Number: K1495

P.O. Number: 181445-10-5-06

Delivery Method / Shipping Document Number:

Send Results / Report To:
Randy Whicker
MFG Inc.
3801 Automation Way, suite 100
Ft. Collins, CO 80525

Sampler (Print Name / Affiliation): Randy Whicker

Signature: [signature]

Analysis Requested: Ra-226 by Hyper Gamma-Spec; U-Nat by wet Radiochemistry methods

Preservative

Container Type and Size

Field Sample No./ Identification	Date	Time	Sample Matrix	Total No. of Cont.	Filt. Y+	Filt. N-	Filt. Y+	Filt. N-	Filt. Y	Filt. N	Filt. Y	Filt. N	Filt. Y	Filt. N	Filt. Y	Filt. N	Remarks
LS-1	9-27-06		Soil		X		X										- Please follow special
LS-2	↓		↓		X		X										instructions on
LS-3					X		X										page 1 of 2
LS-4					X		X										
LS-5	9-28-06				X		X										
LS-6	↓				X		X										
LS-7					X		X										
LS-8					X		X										
LS-9					X		X										
LS-10	↓		↓		X		X										

Relinquished by: (Print Name/Affiliation)	Date:	Received by: (Print Name/Affiliation)	Date:	Analytical Laboratory (Destination):
Randy Whicker / MFG Signature: [signature]	10-5-06 Time:	Signature:	Time:	Energy Laboratories, Inc 2393 Salt Creek Highway Casper, WY 82602
Relinquished by: (Print Name/Affiliation) Signature:	Date: Time:	Received by: (Print Name/Affiliation) Signature:	Date: Time:	
Relinquished by: (Print Name/Affiliation) Signature:	Date: Time:	Received by: (Print Name/Affiliation) Signature:	Date: Time:	Condition/Temperature of Samples when Received: Serial No.: № 005663

White: Return to MFG, Inc. Yellow: Laboratory Pink: Field Team

Matrix Codes: SW=Surface Water GW=Ground Water S=Soil Sediment ___ = _____

8-28-06

Rhino - 1 (main with which)

	L	C	R
meter	MFG-12	MFG-15	MFG-3

Rhino - 2 (2nd ATV)

L	C	R
MFG-9	MFG-5	MFG-6

8-29-06 sunny, mild ≈ 75°F

- Mobilized to Red Desert - arrived @ Lost Creek Site ≈ 10:30 am.
- set up Rhinos & system checks
- ironing out problems most of day
- 3 ft & 6 ft grid meas.
-

8-30-06 RW

- switched detector MFG-9 on Rhino-2 (MFG-9 reading low)
- QC

		mean	σ	Battery
(L)	MFG-12	24.61	1.12	
(R)	MFG-3	23.8	0.93	5.6
(C)	MFG-15	23.64	0.91	5.9

} Rhino-1 after scans

QC		(BKG) mean	σ	Battery
(L)	MFG-17	23.4	5.5	3.7
(C)	MFG-5	21.7	7.3	5.4
(R)	MFG-6	19.9	4.6	5.7

} Rhino-2 after scans

Rhino switch problems repaired

8-31-06 RW Sunny, mild, windy

QC		BKG x̄	BKG σ	Source x̄	Source σ	Battery
(L)	MFG-12	29.5	1.04	126.0	2.0	5.9
(R)	MFG-3	22.5	5.3	112.4	26	6.0
(C)	MFG-15	24.5	0.8	111.1	37	5.7
(L)	MFG-17	21.5	9.1	118	2.3	5.8
(C)	MFG-5	25.2	1.1	109	25	6.2
(R)	MFG-6	20.4	4.7	92	21	5.8

9-1-06 RW sunny, mild, windy

QC		BKG x̄	BKG σ	Source x̄	Source σ	Battery
Rhino-1	MFG-12	24.8	1.1	122	2.5	5.7
	MFG-3	21.5	9.1	110	25.3	3.8
	MFG-16	22.0	7.4	115	2.7	5.9
	MFG-17	26.0	0.9	113	26	6.2
	MFG-5	22.0	7.4	110	25	6.0
	MFG-6	21.6	5.1	123	2.4	6.2

switched detector 15 for detector 16
↳ bad switch
switched detector 6 for detector 15 - detector 6 is broken

9-6-06 RW Cloudy mild

- returned ATV's to site after repairs & revision of design & systems

left - QC for Rhino - 2

MFG-17	BKG x̄	Source x̄	ore rock x̄	ore rock σ
1	24	83	1882.5	143
2	24.7	82.4		
3	24.9	81.9		
4	24.3	82.6		
5	23.0	80.5		
6	24.8	81.7		
7	24.6	82.6		
8	24.8	80.7		
9	24.5	80.9		
10	24.1	81.9		

Right

MFG-4	BKG x̄	Source x̄	ore Rock x̄	ore Rock σ
1	23.4	70.3	2312	28
2	24.1	69.2		
3	24.1	69.8		
4	24.0	69.0		
5	24.3	69.9		
6	23.7	69.9		
7	23.8	69.2		
8	23.8	69.5		
9	23.8	69.5		
10	23.9	69.6		

center

MFG-5	BKG (x̄)	Source (x̄)	ore Rock x̄	ore Rock σ
1	24.6	73.7	2500	13
2	24.0	74.0		
3	23.4	75.6		
4	23.7	73.4		
5	24.1	73.8		
6	24.2	72.9		
7	23.9	74.6		
8	24.5	73.4		
9	23.7	71.7		
10	24.2	74.0		

9-7-06 RW P. Sunny, mild, breezy

QC Rhino-2

		x̄ (BKG)	x̄ (Source)	Battery
Left	MFG-17	25.9	82.4	6.2
Right	MFG-4	25.0	71.2	6.0
Center	MFG-5	23.8	73.5	6.0

97-06 Cont....

Rhino-1 Control limit measurements:

Left

MFG-12	BKG	Source	$\bar{x}$	σ	Battery
				6	5.8
1	24.9	89.6	2255	204	
2	25.0	89.9			
3	25.1	88.7			
4	25.1	90.4			
5	24.8	88.3			
6	24.4	88.0			
7	24.6	88.8			
8	24.4	87.7			
9	23.9	88.8			
10	24.1	88.2			

Right

MFG-15					
					6.0
1	24.8	84.3	2335	32	
2	24.8	84.8			
3	24.5	84.1			
4	25.0	84.6			
5	24.9	84.7			
6	24.2	82.6			
7	24.4	83.1			
8	25.1	84.9			
9	24.4	83.8			
10	25.1	87.7			

Software says Right, but active meter is Center.

Center

MFG-3	BKG	Source	$\bar{x}$	σ	Battery
			2114	8.6	5.9
1	25.5	76.0			
2	24.9	75.3			
3	25.4	76.5			
4	25.1	75.9			
5	25.1	76.7			
6	25.4	76.1			
7	25.0	77.0			
8	25.2	76.5			
9	24.9	76.5			
10	24.9	76.0			

9-8-06 RW Cloudy/Hazy mild ≈ 70°F

QC Rhino-2		$\bar{x}$ (bkg)	$\bar{x}$ (source)	Battery
Left	MFG-1	23.4	60.1	6.0
Right	MFG-4	24.7	74.23	
Center	MFG-5	software not reading MFG-5		

Rhino-1

Left	MFG-12	23.8	89.4
Right	MFG-15	24.4	85.6
Center	MFG-3	25.3	78.5

Replaced meter 17 w/ meter 1

9-9-06 RW cloudy cool, rain

QC Rhino-1		BKG	Source
Left	MFG-12	24.0	115.1
Right	MFG-15	23.9	119.1
Center	MFG-16	24.7	116.0

(Replaced MFG-3 w/ MFG-16 same for Cs-137 source!)

* made all detector operative

QC Rhino-2			
Left	MFG-1	22.8	100.6
Right	MFG-4	24.3	108.6
Center	MFG-5	24.7	115.0

wiring switched Right is center & vice versa in software.

9-10-06 RW Sunny, mild

QC Rhino-1		BKG	Source	Battery
Left	MFG-12	24.8	116	>6
Center	MFG-15	25.1	120	>6
Right	MFG-16	25.5	118	>6

QC Rhino-2		BKG	Source
Left	MFG-1	23.9	105
Center*	MFG-4	N/A	N/A
Right (center)	MFG-5	25.6	114

*note: "center" is the right side detector which is not working

"Right is the center detector which is working

9-11-06 RW sunny, mild

QC Rhino-1		BKG	Source
Left	MFG12	27.2	117
Center	15	27.1	124
Right	16	26.8	119

QC Rhino-2		BKG	Source
L	MFG-1	24.9	106
C	MFG-4	N/A	N/A
R	MFG-5	27.8	114

(center detector is actual detector)

Lost Soldier – new staging location

9-19-06 RW Sunny, mild ≈ 70°F

QC Rhino-1		BK	Source
Left	MFG-12	18.1	113
Center	MFG-16	19.4	112
Right	MFG-15	19.3	116

QC Rhino-2		BKG	Source
Left	MFG-1	19.4	101
Center	MFG-5	20.0	110
Right	MFG-4	21.3	106

9-20-06 RW P. Cloudy mild

same detectors as day before

Rhino-1 Left		BKG	Source	Rhino-2	BKG	Source
9-20	1	21.4	118	9-20	18.0	99
9-25	2	19.5	115	9-25	18.8	100
9-26	3	19.7	118	9-26	17.7	99
	4	19.6	116		17.7	99
	5	19.5	118		18.3	99
	6	18.3	116		18.8	101
	7	18.3	114		19.6	98
	8	18.1	117		19.7	99
	9	19.6	116		19.6	99
	10	19.7	116		19.3	100

Center		BKG	Source		BKG	Source
9-20	1	20.0	109	9-20	18.3	111
9-25	2	18.0	113	9-25	20.2	111
9-26	3	17.7	106	9-26	20.4	108
	4	18.7	113		20.3	110
	5	18.3	112		21.4	111
	6	19.6	113		21.4	108
	7	19.4	112		21.9	111
	8	19.5	109		21.8	108
	9	18.1	110		20.6	112
	10	19.0	110		20.4	111

Rhino-1

Right		BKG	Source	Rhino-2 BKG	Source
9-20	1	19.4	118		
9-25	2	19.7	118	9-25	not working
9-26	3	19.5	117	9-26	
	4	19.7	119		
	5	19.7	116		
	6	20.9	116		
	7	20.0	115		
	8	20.2	118		
	9	20.0	116		
	10	19.8	115		

9-27-06 RW P. Sunny windy ≈ 60F

PIC X-calibrations

Location 1 N42.23550 W107.64167

PIC	mR/hr
1	.0605
2	.0601
3	.0599
4	.0601
5	.0593
6	.0575
7	.0593
8	.0599
9	.0605
10	.0617

x-cal NaI mean (MFG-13) uR/hr = 103.9

Rhino Tie-in:

Rhino-1	MFG	uR/hr	MFG-13
Left	12	78.4	81.9
Center	16	57.0	59.4
Right	15	80.2	86.0

Location 2 N42.23539 W107.64165

1	.0281
2	.0279
3	.0273
4	.0267
5	.0283
6	.0297
7	.0301
8	.0287
9	.0297
10	.0305

MFG-13 uR/hr = 46.7 uR/hr

Rhino-1 tie in:

	uR/hr	MFG-13
Left 12	49.4	50.5
Center 16	47.9	49.7
Right 15	46.5	47.9

Location 3 / use these counts! N42. W107.

1.	.0328	.0354
2.	.0318	.0336
3.	.0326	.0340
4.	.0340	.0363
5.	.0342	.0377
6.	.0373	.0375
7.	.0342	.0363
8.	.0348	.0350
9.	.0350	.0346
10.	.0324	.0344

MFG-13 uR/hr = 56.3

Rhino-1 tie in

	uR/hr	MFG-13
Left	46.6	48.5
Center	49.2	51.2
Right	54.4	56.2

Location 4 N42.23531 W107.64160

1.	.0259
2.	.0252
3.	.0230
4.	.0224
5.	.0234
6.	.0228
7.	.0244
8.	.0246
9.	.0240
10.	.0246

MFG 13 uR/hr = 34.5

Sputnik-1 tie in

	uR/hr	MFG-13
Left	34.7	35.6
Center	35.7	36.9
Right	35.4	37.0

Location 5 N 42.23392 W 107.64408

1 .0216
2 .0228
3 .0234
4 .0206
5 .0210
6 .0212
7 .0216
8 .0228
9 .0246
10 .0228

MFG13
uR/hr = 29.9
Sputnik-1 tie in

	uR/hr	MFG13
Left	29.7	32.7
Center	29.4	31.1
Right	29.1	29.9

Location 6 N 42.23128 W 107.64904

1 .0177
2 .0165
3 .0157
4 .0163
5 .0169
6 .0173
7 .0175
8 .0159
9 .0148
10 .0150

MFG 13
uR/hr 21.1
Sputnik-1 tie-in

	uR/hr	MFG13
Left	23.3	24.7
Center	21.1	22.1
Right	24.3	25.7

Collected soil samples
LS-1 through LS-4
with correlation grid scans
CATV + backpack

QC: Rhino-1 Bkg Source
Left MFG-12 19.1 119
Center "-16 18.4 111
Right "-15 19.2 117

9-28-06 RW SUNNY ≈ 65°F

QC: Rhino-1 Bkg Source
Left MFG-12 20.3 113
Center "-16 19.5 113
Right "-15 20.3 119

11-2-06 RW P Sunny ≈ 45°F
- PIC x-calibrations (Lost soldier)
QC: new control limits inside Hotel: mean of 20 + std. dev.

	R1-L	R1-C	R1-R	R2-L	R2-C	R2-R
B	6.5	6.4	6.7	6.6	6.4	6.8
σ	0.35	0.47	0.62	0.51	0.38	0.72
S	112	105	113	97	107	114
G	1.8	2.7	1.9	2.5	2.7	2.0

Bkgd Standards	MFG-12	MFG-16	MFG-15	MFG-1	MFG-5	MFG-8
	20.84	21.19	20.59	19.09	19.54	19.75

11-2 cont....

Location 1 42.23560 107.64158

Switched R2-R to MFG-17

PIC	mR/hr		4.5ft uR/hr	3ft uR/hr
1	.0305	R1-L	40.6	40.22
2	.0282	R1-C	39.41	39.40
3	.0268	R1-R	39.82	40.13
4	.0266	R2-L	37.47	36.95
5	.0293	R2-C	39.10	38.28
6	.0280	R2-R	42.59	42.49
7	.0305			
8	.0295			
9	.0299			
10	.0278			

Location 2 42.23552 107.64164

PIC			4.5ft uR/hr	3ft uR/hr
1	.0561			
2	.0545			
3	.0539			
4	.0528			
5	.0530	R1-L	69.51	76.69
6	.0541	R1-C	71.62	80.64
7	.0530	R1-R	69.75	76.64
8	.0516	R2-L	66.00	74.01
9	.0530	R2-C	68.87	77.02
10	.0522	R2-R	74.37	81.83

11-3-06

Location 3 42.25348 107.62907

PIC	mR/hr		4.5ft uR/hr	3ft uR/hr
1	.0217			
2	.0211			
3	.0189	R1-L	22.09	22.11
4	.0195	R1-C	21.40	21.32
5	.0199	R1-R	21.22	21.69
6	.0191	R2-L	20.49	20.26
7	.0191	R2-C	23.22	23.11
8	.0209	R2-R	21.27	20.44
9	.0193			
10	.0205			

Location 4 ~~42.25344~~ 107.63345

PIC	mR/hr		4.5ft uR/hr	3ft uR/hr
1	.0325			
2	.0313			
3	.0315			
4	.0341	R1-L	42.20	43.23
5	.0331	R1-C	41.9	43.99
6	.0323	R1-R	41.56	43.80
7	.0339	R2-L	39.41	41.58
8	.0317	R2-C	40.12	42.13
9	.0319	R2-R	43.61	46.38
10	.0307			

18 11-3-06 Cont. 42.24326 107.62296

Location 5

PIC	mR/hr		4.5ft uR/hr	3-ft uR/hr
1	.0248			
2	.0248			
3	.0234	R1-L	36.37	36.70
4	.0223	R1-C	36.08	35.73
5	.0254	R1-R	35.78	36.13
6	.0264	R2-L	33.48	34.76
7	.0252	R2-C	35.32	35.71
8	.0248	R2-R	38.81	37.94
9	.0262			
10	.0256			

Location 6 42.23880 107.62864

PIC	mR/hr		4.5ft uR/hr	3-ft uR/hr
1	.0238			
2	.0240			
3	.0229			
4	.0221	R1-L	28.71	29.69
5	.0238	R1-C	28.27	28.37
6	.0244	R1-R	28.30	28.36
7	.0240	R2-L	26.58	27.38
8	.0234	R2-C	28.36	28.28
9	.0240	R2-R	30.46	30.65
10	.0225			

Location 7 42.23643 107.63219 19

PIC	mR/hr		4.5ft uR/hr	3ft uR/hr
1	.0278 .0219			
2	.0274 .0246			
3	.0256 .0242			
4	.0272 .0252	R1-L	34.74	36.08
5	.0295 .0244	R1-C	35.32	35.96
6	.0211 .0236	R1-R	34.21	35.56
7	.0221 .0211	R2-L	32.63	33.95
8	.0211 .0266	R2-C	34.79	35.03
9	.0223 .0284	R2-R	36.97	37.79
10	.0205 .0252			

Location 8 42.23540 107.62983 potential hot spot location

PIC	mR/hr		4.5ft uR/hr	3-ft uR/hr
1	.0333			
2	.0331			
3	.0325			
4	.0329	R1-L	44.16	47.16
5	.0327	R1-C	44.12	47.09
6	.0329	R1-R	42.76	46.12
7	.0329	R2-L	41.65	44.35
8	.0335	R2-C	42.35	45.92
9	.0339	R2-R	45.46	48.73
10	.0348			

20 11-3-06 Cont 42.22758 107.63505

Location 9

PIC	mR/hr		4.5ft uR/hr	3-ft uR/hr
1	.0128 .0185			
2	.0126 .0172			
3	.0138 .0187			
4	.0140 .0175	R1-L	24.65	24.83
5	.0144 .0183	R1-C	23.41	24.18
6	.0115 .0183	R1-R	24.06	23.69
7	.0174 .0197	R2-L	22.58	23.02
8	.0175 .0199	R2-C	23.80	23.49
9	.0187 .0201	R2-R	25.94	25.59
10	.0183 .0177			

Location 10 42.23467 107.62006

PIC	mR/hr		4.5ft uR/hr	3ft uR/hr
1	.0425			
2	.0408			
3	.0392			
4	.0386	R1-L	62.80	66.26
5	.0402	R1-C	63.03	65.43
6	.0400	R1-R	62.91	64.68
7	.0390	R2-L	60.07	63.70
8	.0376	R2-C	62.43	64.05
9	.0380	R2-R	66.99	68.79
10	.0406			

11-3-06 RW cloudy ≈ 45°F 21
QC lost soldier

	R1-L	R1-C	R1-R	R2-L	R2-C	R2-R
B	6.7	6.6	6.7	6.8	6.7	7.0±0.6
S	112	105	114	97	107	106±20
						MFG-17 (new detected)
Field	20.22	18.75	20.17	18.75	18.72	20.46

– PIC vs. 3' vs. 4.5' correlation measurements

11-4-06 RW P. Sunny ≈ 45°F
QC lost soldier

	R1-L	R1-C	R1-R	R2-L	R2-C	R2R
B	7.2	6.8	6.5	6.3	6.5	7.2
S	112	107	115	98	105	106
Field	20.07	19.74	20.92	20.01	20.64	19.32

– Re-scans of central & west border areas

11-5-06 RW Lost Creek PIC vs. 4.5' vs. 3' mas.
QC:

	R1-L	R1-C	R1-R	R2-L	R2-C	R2-R
B	6.5	6.5	6.7	6.3	6.5	6.9
S	111	106	114	96	106	106
F	21.81	22.01	22.24	20.[illegible]	21.46	23.12

Lost creek
11-5-06 Cont....

42.11733
107.86353

Location 1

PIC	mR/hr
1	.0219
2	.0227
3	.0225
4	.0235
5	.0254
6	.0248
7	.0245
8	.0253
9	.0223
10	.0233

	4.5ft uR/hr	3 ft uR/hr
R1-L	30.71	31.76
R1-C	30.12	31.23
R1-R	30.34	30.91
R2-L	29.06	30.34
R2-C	29.19	30.87
R2-R	32.03	33.14

Location 2 Local outcrop of source material (colored) in wash

42.10687
107.87045

PIC	mR/hr
1	.0341
2	.0327
3	.0327
4	.0321
5	.0321
6	.0315
7	.0329
8	.0339
9	.0341
10	.0335

	uR/hr 4.5ft	uR/hr 3 ft
R1-L	40.98	43.97
R1-C	42.48	44.75
R1-R	40.91	43.17
R2-L	39.88	42.62
R2-C	40.50	43.34
R2-R	43.45	46.01

Location 3

42.12827
107.87157

PIC	uR/hr
1	.0207
2	.0211
3	.0209
4	.0205
5	.0207
6	.0221
7	.0225
8	.0209
9	.0193
10	.0185

	4.5ft uR/hr	3 ft uR/hr
R1-L	22.66	22.62
R1-C	21.71	21.83
R1-R	22.53	21.71
R2-L	21.04	20.56
R2-C	21.80	22.21
R2-R	23.49	23.95

Location 4

42.13095
107.85934

PIC	mR/hr
1	.0260
2	.0254
3	.0240
4	.0248
5	.0264
6	.0266
7	.0262
8	.0260
9	.0252
10	.0262

	4.5ft uR/hr	3 ft uR/hr
R1-L	34.43	36.07
R1-C	34.43	35.21
R1-R	33.97	35.06
R2-L	32.39	33.65
R2-C	34.09	35.29
R2-R	36.59	37.67

Location 5

42.13122
107.85960

PIC	mR/hr
1	.0386
2	.0382
3	.0378
4	.0380
5	.0372
6	.0384
7	.0378
8	.0372
9	.0366
10	.0370

	4.5ft uR/hr	3ft uR/hr
R1-L	51.54	54.98
R1-C	50.37	53.97
R1-R	49.88	52.23
R2-L	49.42	52.64
R2-C	49.55	51.94
R2-R	52.23	54.89

Location 6

42.13195
107.84903

PIC	mR/hr
1	.0237
2	.0221
3	.0213
4	.0209
5	.0215
6	.0219
7	.0211
8	.0215
9	.0211
10	.0219

	4.5ft uR/hr	3ft uR/hr
R1-L	25.49	25.88
R1-C	24.99	25.82
R1-R	24.29	25.10
R2-L	23.47	24.01
R2-C	24.37	24.73
R2-R	26.53	26.53