

Bibliography Of Reports, Papers, and Presentations On Naturally Occurring
Radioactive Material (NORM) In Petroleum Industry Wastes

NORM Report

By
K. P. Smith
M. L. Wilkey
R. D. Hames

July 1997

Work Performed Under Contract No. W-31-109-Eng-38

Prepared for
U.S. Department of Energy
Assistant Secretary for Fossil Energy

John Ford, Project Manager
National Petroleum Technology Office
P.O. Box 3628
Tulsa, OK 74101

Prepared by:
Environmental Assessment Division and Energy Systems Division
and Energy Systems Division
Argonne National Laboratory

PREFACE

This bibliography was created to support projects conducted by Argonne National Laboratory (ANL) addressing issues related to naturally occurring radioactive material (NORM) in petroleum industry wastes. Each of these projects was conducted under the direction and funding of the U.S. Department of Energy (DOE). Through the course of a specific project, the DOE tasked ANL to prepare the bibliography for publication and distribution. Woodward-Clyde Federal Services assisted ANL in this effort.

The bibliography provides citations for many of the available published reports, papers, articles, and presentations on petroleum industry NORM. In the past few years, the rapid expansion of NORM treatment and disposal technologies, the efforts to characterize NORM wastes and their associated potential risks, and the promulgation of state-level NORM regulatory programs have been well-documented in project reports and in papers presented at technical conferences and symposia. In compiling this bibliography, we endeavored to include as many of these publications as possible. Undoubtedly, we have missed some, and we apologize to those individuals whose work is not represented in this bibliography.

Karen P. Smith
Environmental Assessment Division
Argonne National Laboratory

Michael L. Wilkey
Energy Systems Division
Argonne National Laboratory

Rodney D. Hames
Woodward-Clyde Federal Services

**Bibliography of Reports, Papers, and Presentations on
Naturally Occurring Radioactive Material (NORM)
in Petroleum Industry Wastes**

Alvarez, J.L., R. Gedes, and J.R. Rice, 1996, "Methods for Estimating Dose to Individuals from NORM," *Proceedings of the 1995 American Petroleum Institute and Gas Research Institute Naturally Occurring Radioactive Material Conference*, Houston, Texas, Oct. 17-18, pp. 35-46.

American Petroleum Institute, 1988, *NORM Regulatory Analysis Report*, Washington, D.C.

American Petroleum Institute, 1992, *Bulletin on Management of Naturally Occurring Radioactive Materials (NORM) in Oil and Gas Production*, API Bulletin E2, Washington, D.C.

American Petroleum Institute, 1996, *A Naturally Occurring Radioactive Materials (NORM) Disposal Cost Study*, API Publication 7100, Washington, D.C.

Anderson, B., 1990, "Dealing With Radioactive Scale in Offshore Production," *Ocean Industry* 25(9):33-48.

Ansari, A.J., J.R. Frazier, and J.D. Berger, 1996, "Assessment of Dose from External Exposure at NORM-Impacted Sites," *NORM/NARM: Regulation and Risk Assessment*, proceedings of the 29th Midyear Topical Meetings of the Health Physics Society, Scottsdale, Ariz., Jan. 7-10, pp. 225-230.

Armbrust, B.F., and P.K. Kuroda, 1956, "On the Isotopic Constitution of Radium (Ra-224/Ra-226 and Ra-228/Ra-226) in Petroleum Brines," *American Geophysical Union Transactions* 37(2):216-220.

Ashland Exploration, Inc., 1993, *Martha Reclamation Program*, Houston, Texas.

Ashland Exploration, Inc., 1994, *Technical Support Addendum to the Martha Reclamation Program*, Houston, Texas.

Ashland Exploration, Inc., 1995, *Technical Implementation Plan for the Martha Reclamation Program*, Houston, Texas.

Auxier & Associates, Inc., 1996, *Assessment of the Potential Radiological Impacts from the Disposal of Solid Wastes with Small Quantities of NORM in a Solid Waste Disposal Facility*, prepared for Ashland Exploration, Inc., Houston, Texas.

Auxier & Associates, Inc., 1996, *Leachate Analysis of Martha Oil Field Wastes, Martha, Kentucky*, prepared for Ashland Exploration, Inc., Houston, Texas.

- Auxier & Associates, Inc., 1997, *Soil Sampling Report, Temporary Storage Facility, Martha Oil Field, Martha, Kentucky*, prepared for Ashland Exploration, Inc., Houston, Texas.
- Azrak, R.G., 1996, "Corpex NORM Decontamination Process," presented at the Fourth Annual Conference on the Recycle and Reuse of Radioactive Scrap Metal, sponsored by the Energy, Environment, and Resources Center, University of Tennessee and the Center for Risk Management, Oak Ridge National Laboratory, Knoxville, Tenn., Oct. 22-24.
- Bader, M.S.H., 1995, "A Novel Process for Precipitation and Separation of Salts, Scale Salts and NORM Salts from Saline Waters and Saline Solutions," *Environmental Issues and Solutions in Exploration, Production and Refining*, proceedings of the Second International Petroleum Environmental Conference, sponsored by the U.S. Department of Energy and others, New Orleans, La., Sept. 25-27, pp. 717-728.
- Baird, R.D., G.B. Merrell, R.B. Klein, V.C. Rogers, and K.K. Nielson, 1990, *Management and Disposal Alternatives for NORM Wastes in Oil Production and Gas Plant Equipment*, RAE-8837/2-1, prepared for American Petroleum Institute, Dallas, Texas, by Rogers and Associates Engineering Corp, Salt Lake City, Nev.
- Bassignani, A., G. DiLuise, A. Fenzi, and P.B. Finazzi, 1991, "Radioactive Scales in Oil and Gas Production Centers," SPE Paper 23380, presented at the First International Conference on Health, Safety and Environment, sponsored by Society of Petroleum Engineers, The Hague, The Netherlands, Nov. 10-14, pp. 527-532.
- Bernhardt, D.E., D.H. Owen, and V.C. Rogers, 1996, "Assessments of NORM in Pipe from Oil and Gas Production," *NORM/NARM: Regulation and Risk Assessment*, proceedings of the 29th Midyear Topical Meetings of the Health Physics Society, Scottsdale, Ariz., Jan. 7-10, pp. 133-138.
- Blanchard, A.D.H., 1994, "NORM Misconceptions: Responsibilities and Sensibilities," *Environmental Issues and Solutions in Petroleum Exploration, Production and Refining*, proceedings of the International Petroleum Environmental Conference, sponsored by the University of Tulsa and PennWell Publishing Co., Houston, Texas, March 2-4.
- Blanchard, A.D.H., 1997, "Negotiating NORM Cleanup and Land Use Limits: Practical Use of Dose Assessment and Cost Benefit Analysis," *Energy Week '97 — Petro-Safe '97, Volume I*, proceedings of the Energy Week Conference and Exhibition, sponsored by PennWell Conferences and Exhibitions, Houston, Texas, Jan. 28-30.

- Blanchard, W.P., 1996, "Surveys, Sampling, and Field Analysis of Radium 226 and Radium 228 Applications to Soil Remediation and Containerized NORM Waste," *Energy Week '96 — Petro-Safe '96*, proceedings of the Energy Week Conference and Exhibition, sponsored by PennWell Conferences and Exhibitions, Houston, Texas, Jan. 29-Feb. 2, pp. 135-139.
- ✓ Bloch, S., and R.M. Key, 1981, "Modes of Formation of Anomalously High Radioactivity in Oil-Field Brines," *AAPG Bulletin* 65(1):154-159.
- Blunt, D.L., and K.P. Smith, 1995, "Dose Assessment for Management Alternatives for NORM-Contaminated Equipment Within the Petroleum Industry," *Beneficial Reuse '95, The Third Annual Conference on the Recycle and Reuse of Radioactive Scrap Metal*, sponsored by the Energy, Environment, and Resources Center, University of Tennessee and the Center for Risk Management, Oak Ridge National Laboratory, Knoxville, Tenn., July 31-Aug. 3.
- Bohlinger, L.H., 1990, "Regulation of Naturally Occurring Radioactive Material in Louisiana," *Proceedings of the First International Symposium on Oil and Gas Exploration and Production Waste Management Practices*, sponsored by the U.S. Environmental Protection Agency, New Orleans, La., Sept. 10-13, pp. 833-839.
- ✓ Bradley, F.J., 1996, "Radium Usage and Cleanup: Past and Present," *NORM/NARM: Regulation and Risk Assessment*, proceedings of the 29th Midyear Topical Meeting of the Health Physics Society, Scottsdale, Ariz., Jan. 7-10, pp. 47-52.
- Brookins, D.G., 1990, *Geochemical Aspects of Radioactive Waste Disposal*, Springer-Verlag, New York, N.Y.
- ✓ Buchanan, R.J., 1996, "Meaningful Analysis and Reporting of NORM Sampling Results," *NORM/NARM: Regulation and Risk Assessment*, proceedings of the 29th Midyear Topical Meeting of the Health Physics Society, Scottsdale, Ariz., Jan. 7-10, pp. 193-196.
- ✓ California Department of Health Services and California Department of Conservation, 1996, *A Study of NORM Associated with Oil and Gas Production Operations in California*, Sacramento, Calif.
- ✓ Cameron, F.X., 1996, "The Odyssey of the Good Ship NORM: The Search for a Regulatory Safe Harbor," *NORM/NARM: Regulation and Risk Assessment*, proceedings of the 29th Midyear Topical Meeting of the Health Physics Society, Scottsdale, Ariz., Jan. 7-10, pp. 13-18.

- Capone, D.W., 1996, "Results from Bench-Scale Testing of a Mobile NORM Treatment and Disposal System," *Environmental Issues and Solutions in Petroleum Exploration, Production and Refining*, proceedings of the 3rd International Petroleum Environmental Conference, sponsored by the U.S. Department of Energy, University of Tulsa, and others, Albuquerque, N.M., Sept. 24-27.
- Carriker, A.W., and J.G. Albright, 1996, "Transportation Regulations for LSA NORM," *Proceedings of the 1995 American Petroleum Institute and Gas Research Institute Naturally Occurring Radioactive Material Conference*, Houston, Texas, Oct. 17-18, pp. 79-94.
- Carroll, J.F., H.D. Scott, R.A. Gunn, and M.S. O'Brien, 1990, "Naturally Occurring Radioactive Material Logging," SPE Paper 20616, presented at the 65th Annual Technical Conference and Exhibition, sponsored by the Society of Petroleum Engineers, New Orleans, La., Sept. 23-26, pp. 35-42.
- Caswell, P.C., 1992, *Contaminant Removal and Toxicity Reduction in a Pilot Scale Surface Flow/Wetlands System for the Treatment of Oilfield Produced Water*, Master's thesis, Colorado School of Mines, Golden, Colo.
- Caswell, P.C., D. Gelb, S.A. Marinello, J.C. Emerick, and R.R. Cohen, 1992, "Evaluation of Constructed Surface Flow and Wetlands Systems for the Treatment of Discharged Waters from Oil and Gas Operations in Wyoming," SPE Paper 24331, presented at the SPE Rocky Mountain Regional Conference, sponsored by the Society of Petroleum Engineers, Casper, Wyo., May 18-21.
- Cayias, J.L., and R.D. Gordon, 1994, "Bounded Risk Associated with NORM in Oil and Gas Operations," *Environmental Issues and Solutions in Petroleum Exploration, Production and Refining*, proceedings of the International Petroleum Environmental Conference, sponsored by the University of Tulsa and PennWell Publishing Co., Houston, Texas, March 2-4, pp.750-765.
- Cayias, J.L., R.D. Gordon, and K.B. Davidson, 1993, "NORM Waste in Oil and Gas Operations: Management, Regulations and Disposal," *Petro-Safe '93*, sponsored by PennWell Conferences and Exhibitions, Houston, Texas, Jan. 26-28, pp. 417-432.
- Chapman, C., 1994, "Vitrification of NORM Wastes," *Environmental Issues and Solutions in Petroleum Exploration, Production and Refining*, proceedings of the International Petroleum Environmental Conference, sponsored by the University of Tulsa and PennWell Publishing Co., Houston, Texas, March 2-4.

- Chen, S.Y., 1997, "Issues Related to Regulatory Control of Naturally Occurring Radioactive Materials," presented at the 1997 International Conference of Radiation Dosimetry and Safety, sponsored by the Taiwan Atomic Energy Council, the American Nuclear Society, the U.S. Health Physics Society, and others, Taipei, Taiwan, Republic of China.
- Collins, J.W., L.M. Scott, and D.L. Van Gent, 1995, "The Health Risk Associated with the Uptake of Radium 226 in Vegetation," *Environmental Issues and Solutions in Exploration, Production and Refining*, proceedings of the Second International Petroleum Environmental Conference, sponsored by the U.S. Department of Energy and others, New Orleans, La., Sept. 25-27.
- Conference of Radiation Control Program Directors, Inc., 1978, *Natural Radioactivity Contamination Problems*, EPA-520/4-77-015, prepared for the Office of Radiation Programs, U.S. Environmental Protection Agency, Washington, D.C.
- Conference of Radiation Control Program Directors, Inc., 1994, *Report of the E-4 Committee on NORM Contamination and Decontamination/ Decommissioning — Report 3*, Frankfort, Ky.
- Connor, J.A., and D.A. Clifford, 1994, "NORM Waste Minimization Using In-Situ Treatment Method," *Environmental Issues and Solutions in Petroleum Exploration, Production and Refining*, proceedings of the International Petroleum Environmental Conference, sponsored by the University of Tulsa and PennWell Publishing Co., Houston, Texas, March 2-4, p. 862-874.
- Connor, J.A., D.A. Clifford, and P.T. King, 1993, "In Situ Method for Reducing the Production of Naturally Occurring Radioactive Materials (NORM) from Subsurface Reservoirs," *Petro-Safe '93*, sponsored by PennWell Conferences and Exhibitions, Houston, Texas, Jan. 26-28.
- Cox, J.R., 1993, "Naturally Occurring Radioactive Material in the Oil Field: Changing the NORM," *Tulane Law Review* 67(4):1197-1230.
- Davis, M.W., and D.L. Coleman, 1996, "A Comparison of Radium 226 Concentrations in Oilfield Wastes Using Gamma Spectroscopy vs. Single Channel Sodium Iodide Scintillators and Portable Exposure Rate Instruments," presented at the 89th Annual Meeting & Exhibition of the Air & Waste Management Association, Nashville, Tenn., June 23-28.
- Dehmel, J-C., T. McNulty, and D. Johnson, 1992, *Scrap Metal Recycling of NORM Contaminated Petroleum Equipment*, prepared for the Petroleum Environmental Research Forum, Ponca City, Okla.

- Demorest, D.L., and E.S. Wallace, 1992, "Radiochemical Determination of NORM in Produced Water Utilizing Wet Chemistry Separation Followed by Radiochemical Analysis," *Produced Water Technical/Environmental Issues and Solutions*, edited by J.P. Ray and F.R. Englehart, Plenum Press, New York, N.Y., pp. 257-266.
- Deuel, L.E., and G.H. Holliday, 1994, *Soil Remediation for Petroleum Extraction Industry*, PennWell Publishing Co., Tulsa, Okla.
- Diyashev, R.N., S.F. Takhautdinov, G.P. Antonov, I.R. Diyashev, V.I. Zaitsev, and F.M. Sattarova, 1994, "Disposal of Naturally Occurring Radioactive Materials in Oil Production," SPE Paper 27216, presented at the Second International Conference on Health, Safety and Environment in Oil and Gas Production, sponsored by the Society of Petroleum Engineers, Jakarta, Indonesia, Jan. 25-27.
- Djahanguiri, J., G.M. Reimer, R. Holub, C.S. Aliiev, and T. Zolotovitskaya, 1997, "Radioactive Pollution at the Oil Fields of the Apsheron Peninsula, Caspian Sea, Azerbaijan," SPE Paper 38389, presented at the SPE/EPA Exploration and Production Environmental Conference, sponsored by the Society of Petroleum Engineers and the U.S. Environmental Protection Agency, Dallas, Texas, March 3-5.
- Drummond, I., P. Boucher, B. Bradford, H. Evans, J. McLean, E. Reczek, and H. Thunem, 1990, "Occurrence of ^{222}Rn and Progeny in Natural Gas Processing Plants in Western Canada," *Health Physics Journal* 59(1):133-137.
- Fisher, J.B., 1994, "Geochemistry of Radium and Environmental Risk," *Environmental Issues and Solutions in Petroleum Exploration, Production and Refining*, proceedings of the International Petroleum Environmental Conference, sponsored by the University of Tulsa and PennWell Publishing Co., Houston, Texas, March 2-4.
- Fisher, J.B., and D.S. Gooden, 1995, "Application of LiF Crystal Thermoluminescence Detectors to Determine Radon in Natural Gas," *Environmental Issues and Solutions in Exploration, Production and Refining*, proceedings of the Second International Petroleum Environmental Conference, sponsored by the U.S. Department of Energy and others, New Orleans, La., Sept. 25-27, pp. 729-737.
- Fisher, J.B., and M. Hammond, 1994, "Characterization of NORM Vessel Solids," *Environmental Issues and Solutions in Petroleum Exploration, Production and Refining*, proceedings of the International Petroleum Environmental Conference, sponsored by the University of Tulsa and PennWell Publishing Co., Houston, Texas, March 2-4, pp. 801-822.

- Fisher, R.S., 1995, "Geologic, Geochemical, and Geographic Controls on NORM in Produced Water from Texas Oil, Gas, and Geothermal Reservoirs," SPE Paper 29709, presented at the SPE/EPA Exploration and Production Environmental Conference 95, sponsored by the Society of Petroleum Engineers and the U.S. Environmental Protection Agency, Houston, Texas, March 27-29, pp. 195-205.
- Fisher, R.S., 1996, "Natural Controls on NORM in Produced Water from Texas Reservoirs," SPE Paper 29709, *Society of Petroleum Engineers Advanced Technology Series* 4(2):94-100.
- Fletcher, P.A., C.A. Cornette, D.R. Sustala, and T.W. Dolence, 1995, "Preparation of Naturally Occurring Radioactive Material (NORM) for Hydraulic Fracturing Disposal: A Case Study," SPE Paper 29765, presented at the SPE/EPA Exploration and Production Environmental Conference 95, sponsored by the Society of Petroleum Engineers and the U.S. Environmental Protection Agency, Houston, Texas, March 27-29, pp. 737-747.
- Flynn, C.R., M.S. Blair, and R.R. Highfill, 1996, "High Density Radiological Site Characterization Surveys for NORM Sites," *Proceedings of the 1995 American Petroleum Institute and Gas Research Institute Naturally Occurring Radioactive Material Conference*, Houston, Texas, Oct. 17-18, pp. 23-34.
- Ford, W.G.F., L.L. Gadeken, T.J. Callahan, and D. Jackson, 1996, "Solvent Removes Downhole NORM-Contaminated BaSO₄ Scale," *Oil and Gas Journal* 94(17):65-68, (April 22).
- Fotenot, S.T., 1992, "Dealing with Naturally Occurring Radioactive Material in the Oil and Gas Industry," *Petro-Safe '92, Volume I*, sponsored by PennWell Conferences and Exhibitions, Houston, Texas, Jan. 27-29, pp. 93-103.
- Fuller, K.C., 1996, "Technical Profile of the Envirocare of Utah, Inc., NORM Disposal Operation," *Proceedings of the 1995 American Petroleum Institute and Gas Research Institute Naturally Occurring Radioactive Material Conference*, Houston, Texas, Oct. 17-18, pp. 103-108.
- Gallup, D.L., 1996, "A Comparison of NORM Scale Dissolvers," *Proceedings of the 1995 American Petroleum Institute and Gas Research Institute Naturally Occurring Radioactive Material Conference*, Houston, Texas, Oct. 17-18, pp. 163-178.
- Galpin, F.L., and V.C. Rogers, 1996, "NORM Classifications: Their Ethical and Regulatory Implications," *NORMINARM: Regulation and Risk Assessment*, proceedings of the 29th Midyear Topical Meetings of the Health Physics Society, Scottsdale, Ariz., Jan. 7-10, pp. 3-8.

- Gardiner, N.H., 1994, "NORM Scale Safely Disposed of by Fracturing," *Oil and Gas Journal* 92(21):68-71, (May 23).
- Gelb, D., 1992, *Oilfield Produced Water Treatment Using Constructed Surface Flow and Wetland Systems*, Master's thesis, Colorado School of Mines, Golden, Colo.
- Gerbino, A.J., S.J. Saunders, and M. Rafal, 1996, "Computer Aided Prediction of NORM Associated Scale," *Proceedings of the 1995 American Petroleum Institute and Gas Research Institute Naturally Occurring Radioactive Material Conference*, Houston, Texas, Oct. 17-18.
- Gesell, T.F., 1996, "Graded Decision Guidelines for Individuals Exposed to Natural Radiation from Slag," *NORM/NARM: Regulation and Risk Assessment*, proceedings of the 29th Midyear Topical Meeting of the Health Physics Society, Scottsdale, Ariz., Jan. 7-10, pp. 175-182.
- Gibson, M.M., and D.P. Young, 1992, "The Environmental Dilemma over Naturally Occurring Radioactive Material," *Journal of Environmental Regulation*, Winter 1991-92, pp. 195-201.
- Gordon, B.A., 1992, "A Systematic Approach to Setting Up Barium Sulfate Scale Inhibition Programs," Paper 29, presented at Corrosion '92, sponsored by the National Association of Corrosion Engineers.
- ✓ Gott, G.B., and J.W. Hill, 1953, "Radioactivity in Some Oil Fields of Southern Kansas," *Contributions to the Geology of Uranium*, U.S. Geological Survey Bulletin 988, Washington, D.C.
- Gray, P.R., 1990, "Radioactive Materials Could Pose Problems for the Gas Industry," *Oil and Gas Journal* 88(26):45-48 (June 25).
- Gray, P.R., 1991, "NORM Contamination in the Petroleum Industry," SPE Paper 22880, presented at the 66th Annual Technical Conference and Exhibition, sponsored by the Society of Petroleum Engineers, Dallas, Texas, Oct. 6-9, pp. 637-644.
- Gray, P.R., 1993, "NORM Contamination in the Petroleum Industry," *Journal of Petroleum Technology* 45(1):12-16.
- Gray, P.R., 1993, "Regulations for the Control of NORM," SPE Paper 26272, presented at the SPE/EPA Exploration and Production Environmental Conference 93, sponsored by the Society of Petroleum Engineers and the U.S. Environmental Protection Agency, San Antonio, Texas, March 7-10.

- Gray, P.R., 1995, "Regulation of Naturally Occurring Radioactive Materials (NORM) With Emphasis on NORM Disposal Options," *Energy Week '95 — Petro-Safe '95*, proceedings of the Energy Week Conference and Exhibition, sponsored by PennWell Conferences and Exhibitions, Houston, Texas, Jan. 31-Feb. 2, pp. 266-277.
- Greer, C.R., and M.R. Landress, 1995, "In-Situ Radium Activity Measurements for NORM Assessment and Remediation," SPE Paper 29714, presented at the SPE/EPA Exploration and Production Environmental Conference 95, sponsored by the Society of Petroleum Engineers and the U.S. Environmental Protection Agency, Houston, Texas, March 27-29, pp. 253-260.
- Greer, C.R., and M.R. Landress, 1997, "Assessment and Remediation of NORM Contaminated Sites in Wetland, Marsh, and Underwater Environments," presented at the SPE/EPA Exploration and Production Environmental Conference, sponsored by the Society of Petroleum Engineers and the U.S. Environmental Protection Agency, Dallas, Texas, March 3-5, pp. 121-130.
- Grice, K.J., 1989, "Naturally Occurring Radioactive Materials in Oil and Gas Production," *Petro-Safe '89*, sponsored by PennWell Conferences and Exhibitions, Houston, Texas, Oct. 3-5, pp. 153-169.
- Grice, K.J., 1991, "Naturally Occurring Radioactive Materials (NORM) in the Oil and Gas Industry: A New Management Challenge," SPE Paper 23384, presented at the First International Conference on Health, Safety and Environment, sponsored by the Society of Petroleum Engineers, The Hague, The Netherlands, Nov. 10-14, pp. 559-567.
- Grice, K.J., 1994, "Oil Industry Perspective on NORM Regulation," *1994 Annual Bulletin, Volume III*, Interstate Oil and Gas Compact Commission, Oklahoma City, Okla., pp. 24-33.
- Haaker, R.F., 1996, "Methods, Approaches, and Uncertainties in Assessing NORM Exposures," *NORM/NARM: Regulation and Risk Assessment*, proceedings of the 29th Midyear Topical Meeting of the Health Physics Society, Scottsdale, Ariz., Jan. 7-10, pp. 203-208.
- Hadley, R.K., 1997, "Managing a Potentially High Profile NORM Containing Remediation Project," *Energy Week '97 — Petro-Safe '97, Volume I*, proceedings of the Energy Week Conference and Exhibition, sponsored by PennWell Conferences and Exhibitions, Houston, Texas, Jan. 28-30.
- Hamilton, L.D., A.F. Meinhold, and J. Nagy, 1991, *Produced Water Radionuclide Hazard/Risk Assessment — Phase I*, BNL-47403, Brookhaven National Laboratory, Upton, N.Y.

- Hamilton, L.D., A.F. Meinhold, and J. Nagy, 1992, "Health Risk Assessment for Radium Discharged in Produced Waters, *Produced Water Technical/Environmental Issues and Solutions*, edited by J.P. Ray and F.R. Englehart, Plenum Press, New York, N.Y., pp. 303-314.
- Hanan, M.A., 1981, *Geochemistry and Mobility of Radium from Oil-Field Production Brine, Plaquemines Parish, Louisiana*, Master's thesis, University of New Orleans, New Orleans, La.
- Hardy, G.H., and Z.I. Khatib, 1996, "Treatment and Disposal Options for NORM Oil Field Waste," SPE Paper 36586, presented at the Annual Technical Conference and Exhibition, sponsored by the Society of Petroleum Engineers, Denver, Colo., Oct. 6-9.
- Harley, N.H., 1996, "Radon: Over- or Under-Regulated?" *NORM/NARM: Regulation and Risk Assessment*, proceedings of the 29th Midyear Topical Meeting of the Health Physics Society, Scottsdale, Ariz., Jan. 7-10, pp. 39-46.
- Harris, T.M., and J.B. Fisher, 1994, "Segregation of Radium from Scales and Process Vessel Solids," *Environmental Issues and Solutions in Petroleum Exploration, Production and Refining*, proceedings of the International Petroleum Environmental Conference, sponsored by the University of Tulsa and PennWell Publishing Co., Houston, Texas, March 2-4, pp. 851-861.
- Hartog, F.A., W.A.I. Knaepen, and G. Jonkers, 1996, "Radioactive Lead: An Underestimated NORM Issue?" *Proceedings of the 1995 American Petroleum Institute and Gas Research Institute Naturally Occurring Radioactive Material Conference*, Houston, Texas, Oct. 17-18, pp. 59-72.
- Hayden, C.G., 1995, "Dissolution/Recrystallization Process to Treat NORM Waste," *Environmental Issues and Solutions in Exploration, Production and Refining*, proceedings of the Second International Petroleum Environmental Conference, sponsored by the U.S. Department of Energy and others, New Orleans, La., Sept. 25-27.
- Hebert, M.B., 1993, *A Radiological Evaluation of Naturally Occurring Radioactive Material (NORM) Associated with the Production of Crude Petroleum*, Master's thesis, Louisiana State University, Baton Rouge, La.
- Hebert, M.B., L.M. Scott, and S.J. Zrake, 1995, "A Radiological Characterization of Remediated Tank Battery Sites," *Health Physics* 68(3):406-410.
- Hebert, M.B., A.H.D. Alexander, and F.L. Lyon, 1995, "Radiological Monitoring of a Commercial NORM Processing Facility," *Environmental Issues and Solutions in Exploration, Production and Refining*, proceedings of the Second International Petroleum Environmental Conference, sponsored by the U.S. Department of Energy and others, New Orleans, La., Sept. 25-27.

- Hoover, J., 1994, "NORM Waste Technologies Used in Decontamination and Waste Handling — An Overview," *Environmental Issues and Solutions in Petroleum Exploration, Production and Refining*, proceedings of the International Petroleum Environmental Conference, sponsored by the University of Tulsa and PennWell Publishing Co., Houston, Texas, March 2-4.
- Hoover, J., and M.B. Hebert, 1994, "NORM Waste Technologies Used in Decontamination and Waste Handling: An Overview," *Environmental Issues and Solutions in Petroleum Exploration, Production and Refining*, proceedings of the International Petroleum Environmental Conference, sponsored by the University of Tulsa and PennWell Publishing Co., Houston, Texas, March 2-4.
- Huck, P.M., and R. John, 1989, "Factors Affecting the Leaching of Radium-226 from Barium-Radium Sulphate Sludges," *The Canadian Mining and Metallurgical Bulletin* 82(928):60-66.
- Huck, P.M., G.L. McClymont, F.W. Schwartz, B.E. Nesbitt, W.B. Anderson, and B. Kratochvil, 1989, "Modeling of Radium-226 Leaching from Barium-Radium Sulfate Sludges," *Waste Management* 9(3):157-163.
- Institute of Scrap Recycling Industries, Inc., 1993, *Radioactivity in the Scrap Recycling Process*, Washington, D.C.
- Interstate Oil and Gas Compact Commission, 1994, *Summary of IOGCC Member States' Regulation of Naturally Occurring Radioactive Material*, Oklahoma City, Okla.
- Johnson, P.S., 1996, "NORM Decontamination During Plant and Refinery Maintenance Operations," *Energy Week '96 — Petro-Safe '96*, proceedings of the Energy Week Conference and Exhibition, sponsored by PennWell Conferences and Exhibitions, Houston, Texas, Jan. 29-Feb. 2, pp. 390-395.
- Johnson, P.S., 1996, "Treating and Disposing of Various NORM-Contaminated Equipment and Wastes Generated During Exploration and Production Operations," *Environmental Issues and Solutions in Petroleum Exploration, Production and Refining*, proceedings of the 3rd International Petroleum Environmental Conference, sponsored by the U.S. Department of Energy, University of Tulsa, and others, Albuquerque, N.M., Sept. 24-27.
- Johnson, P.S., and S.J. Winters, 1996, "Management of NORM and NORM Waste Associated with Petrochemical Plant and Refinery Maintenance Operations," presented at the 89th Annual Meeting & Exhibition of the Air & Waste Management Association, Nashville, Tenn., June 23-28.
- Johnson, R.H., Jr., 1996, "Radon Health Risks and the HPS Position," *NORM/NARM: Regulation and Risk Assessment*, proceedings of the 29th Midyear Topical Meeting of the Health Physics Society, Scottsdale, Ariz., Jan. 7-10, pp. 53-64.

- Johnson, R.H., Jr., 1996, Why Some Scientists and the Public Do Not Believe in Radon Risks, *NORM/NARM: Regulation and Risk Assessment*, proceedings of the 29th Midyear Topical Meeting of the Health Physics Society, Scottsdale, Ariz., Jan. 7-10, pp. 65-78.
- Johnson, T.S., and R.O. Hoffland, 1993, "NORM in Produced Water Offshore," presented at the Produced Water Seminar 1993, sponsored by the American Filtration Society, Texas Chapter, League City, Texas, Jan. 21-22.
- Knaepen, W.A.L., W. Bergwerf, P.F.J. Lancée, and G. Jonkers, 1996, "Determination of Naturally Occurring Radionuclides in Samples from the Oil and Gas Industry," *Proceedings of the 1995 American Petroleum Institute and Gas Research Institute Naturally Occurring Radioactive Material Conference*, Houston, Texas, Oct. 17-18, pp. 3-16.
- Knaus, R.M., 1993, *Preliminary Assessment of Naturally Occurring Radioactive Material at Selected Production Sites, Part II: Radiochemical Analysis of Plant Material*, prepared for the American Petroleum Institute, Dallas, Texas.
- Kolb, W.A., and M. Wojcik, 1985, "Enhanced Radioactivity Due to Natural Oil and Gas Production and Related Radiological Problems," *Science of the Total Environment* Vol. 45:77-84.
- Kraemer, T.F., and D.F. Reid, 1984, "The Occurrence and Behavior of Radium in Saline Formation Water of the U.S. Gulf Coast Region," *Isotope Geoscience* 2:153-174.
- Ladle, G.H., 1995, "Geologic Considerations for the Subsurface Injection of Naturally Occurring Radioactive Materials (NORM): A Case Study," *Energy Week '95 — Petro-Safe '95*, proceedings of the Energy Week Conference and Exhibition, sponsored by PennWell Conferences and Exhibitions, Houston, Texas, Jan. 31-Feb. 2, pp. 288-295.
- Landa, E.R., and D.F. Reid, 1982, "Sorpton of Radium-226 from Oil-Production Brine by Sediments and Soils," *Environmental Geology* 5(1):1-8.
- Landis, M.R., J.R. Frazier, and J.D. Berger, 1996, "Lessons Learned During NORM Surveys," *NORM/NARM: Regulation and Risk Assessment*, proceedings of the 29th Midyear Topical Meeting of the Health Physics Society, Scottsdale, Ariz., Jan. 7-10, pp. 209-212.
- Landress, M.R., 1997, "On-Site Treatment of NORM for Surface Waste Disposal in Texas Under Texas Railroad Commission Rule 94," *Energy Week '97 — Petro-Safe '97, Volume I*, proceedings of the Energy Week Conference and Exhibition, sponsored by PennWell Conferences and Exhibitions, Houston, Texas, Jan. 28-30.

- Landress, M.R., and G. Morro, 1995, "What's New in NORM Remediation Technologies," *Energy Week '95 — Petro-Safe '95*, proceedings of the Energy Week Conference and Exhibition, sponsored by PennWell Conferences and Exhibitions, Houston, Texas, Jan. 31-Feb. 2, pp. 263-265.
- LeLeux, D.E., 1995, "Dissolution — A New Approach to NORM Processing and Disposal," *World Oil* 216(11):103-106.
- Lowe, D.J., 1993, "NORM Cleaning and Disposal Using Closed-Loop Hydroblasting or Solvent Bath and Underground Injection System," SPE Paper 25935, presented at the SPE/EPA Exploration and Production Environmental Conference 93, sponsored by the Society of Petroleum Engineers and the U.S. Environmental Protection Agency, San Antonio, Texas, March 7-10, pp. 77-81.
- Lubenau, J.O., and J.G. Yusko, 1995, "Radioactive Materials in Recycled Metals," *Health Physics* 68(4):440-451.
- Lyon, F.L., M.B. Hebert, and S.A. Marinello, 1997, "An Evaluation of the Radiation Health Physics Data Collected at a Commercial NORM Oilfield Waste Disposal Facility With Application to Field Production Facilities," SPE Paper 37893, presented at the SPE/EPA Exploration and Production Environmental Conference, sponsored by the Society of Petroleum Engineers and the U.S. Environmental Protection Agency, Dallas, Texas, March 3-5, pp. 93-97.
- Marinello, S.A., 1994, *Understanding the Basics of Naturally Occurring Radioactive Material (NORM) in the Oil and Gas Industry*, prepared for the Interstate Oil and Gas Compact Commission, Oklahoma City, Okla.
- Mason, J.Y., R.J. Block, and M.L. Knippers, 1992, "Reduction of Naturally Occurring Radioactive Material Disposal Volume by Chemical and Physical Treatment," SPE Paper 24563, presented at the 67th Annual Technical Conference and Exhibition, sponsored by the Society of Petroleum Engineers, Washington, D.C., Oct. 4-7.
- McArthur, A., M. Major, and D.J. Lowe, 1995, "NORM Disposal in Class II Well," SPE Paper 29713, presented at the SPE/EPA Exploration and Production Environmental Conference 95, sponsored by the Society of Petroleum Engineers and the U.S. Environmental Protection Agency, Houston, Texas, March 27-29.
- McArthur, A., S. Schroeder, and W. Lemons, 1996, "Evaluation of NORM Site Release Criteria for Unrestricted Use," *Proceedings of the 1995 American Petroleum Institute and Gas Research Institute Naturally Occurring Radioactive Material Conference*, Houston, Texas, Oct. 17-18, pp. 47-58.

✓
 McBurney, R.E., 1996, "Management and Regulations of NORM in Texas,"
NORM/NARM: Regulation and Risk Assessment, proceedings of the 29th Midyear
 Topical Meeting of the Health Physics Society, Scottsdale, Ariz., Jan. 7-10,
 pp. 19-24.

McKenzie, M.J., S. He, C. Hinrichsen, J.E. Oddo, A.J. Gerbino, A.T. Kan, and
 M.B. Tomson, 1996, "Controlling Barium Sulfate Scale Deposition by Inhibitor
 Squeeze at the Guerra Well in South Texas," *Proceedings of the 1995 American
 Petroleum Institute and Gas Research Institute Naturally Occurring Radioactive
 Material Conference*, Houston, Texas, Oct. 17-18, pp. 125-132.

McReady, R.G.L., C.J. Bland, and D.E. Gonzales, 1980, "Preliminary Studies on the
 Chemical, Physical, and Biological Stability of Ba/RaSO₄ Precipitates,"
Hydrometallurgy 5:109-116.

Meinhold, A.F., and L.D. Hamilton, 1992, "Radium Concentration Factors and Their Use
 in Health and Environmental Risk Assessment," *Produced Water
 Technical/Environmental Issues and Solutions*, edited by J.P. Ray and
 F.R. Englehart, Plenum Press, New York, N.Y., pp. 293-302.

Meinhold, A.F., L.D. Hamilton, S. Holtzman, and S.L. Baxter, 1993, *Human Health Risk
 Assessment for Radium Discharged in Produced Water Offshore — Phase II*,
 BNL-60107, Brookhaven National Laboratory, Upton, N.Y.

Meinhold, A.F., S. Holtzman, and L.D. Hamilton, 1995, "Health Risk Assessment for
 Radium Discharged Offshore in Produced Water," SPE Paper 29728, presented at
 the SPE/EPA Exploration and Production Environmental Conference 95,
 sponsored by the Society of Petroleum Engineers and the U.S. Environmental
 Protection Agency, Houston, Texas, March 27-29, pp. 357-372.

Michigan Department of Natural Resources and Michigan Department of Public Health,
 1991, *Naturally Occurring Radioactive Material (NORM), Michigan Oil and Gas
 Field Sites: Preliminary Survey Results*, Lansing, Mich.

Miller, H.T., and E.D. Bruce, 1990, "Pathway Exposure Analysis and the Identification of
 Waste Disposal Options for Petroleum Production Wastes Containing Naturally
 Occurring Radioactive Materials," *Proceedings of the First International
 Symposium on Oil and Gas Exploration and Production Waste Management
 Practices*, sponsored by the U.S. Environmental Protection Agency, New Orleans,
 La., Sept. 10-13, pp. 731-744.

- Miller, H.T., E.D. Bruce, and L.M. Cook, 1991, "Environmental Health and Safety Decision-Making for Naturally Occurring Radioactive Materials in Producing Operations Using Pathway Exposure Analysis," SPE Paper 23381, presented at the First International Conference on Health, Safety and Environment, sponsored by the Society of Petroleum Engineers, The Hague, The Netherlands, Nov. 10-14, pp. 539-547.
- Miller, H.T., E.D. Bruce, and L.M. Cook, 1991, "The Management of Occupational and Environmental Exposure to Naturally Occurring Radioactive Materials (NORM)," SPE Paper 22879, presented at the 66th Annual Technical Conference and Exhibition, sponsored by the Society of Petroleum Engineers, Dallas, Texas, Oct. 6-9, pp. 627-636.
- Miller, H.T., E.D. Bruce, and L.M. Scott, 1990, "A Rapid Method for the Determination of the Radium Content of Petroleum Production Wastes," *Proceedings of the First International Symposium on Oil and Gas Exploration and Production Waste Management Practices*, sponsored by the U.S. Environmental Protection Agency, New Orleans, La., Sept. 10-13, pp. 809-819.
- Morse, R.E., 1991, "Regulatory Aspects of NORM in the Oil Patch," *Petro-Safe '91*, sponsored by PennWell Conferences and Exhibitions, Houston, Texas.
- Mullino, M.M., and M.F. Rayle, 1992, "Produced Water Radionuclides Fate and Effects," *Produced Water Technical/Environmental Issues and Solutions*, edited by J.P. Ray and F.R. Englehart, Plenum Press, New York, N.Y., pp. 281-292.
- Nielson, K.K., V.C. Rogers, and M.K. Bollenbacher, 1988, *Safety Analysis for the Disposal of Naturally-Occurring Radioactive Materials in Texas*, RAE 8818-1, prepared for the Texas Low-Level Radioactive Waste Disposal Authority, by Rogers and Associates Engineering Corp, Salt Lake City, Nev.
- Nielson, K.K., and V.C. Rogers, 1991, *Calibration of a Gamma Ray Scintillometer for Field Measurements of ²²⁶Ra Concentrations*, RAE-9025/1-1, Rogers and Associates Engineering Corp, Salt Lake City, Nev.
- Nielson, K.K., and V.C. Rogers, 1991, *Ocean Discharge of Naturally-Occurring Radioactive Materials from Oil and Gas Production Equipment*, RAE-9026/1-1, Rogers and Associates Engineering Corp, Salt Lake City, Nev.
- Oddo, J.E., A.Y. Al-Borno, I. Ortiz, R. Anthony, D. Pope, D. Hill, D. Linz, J. Frank, D. Becker, and M.B. Tomson, 1993, "The Chemistry Prediction and Treatment of Scale Containing Naturally Occurring Radioactive Materials (NORM) in Antrim Gas Fields, Northern Michigan," SPE Paper 25485, presented at the Society of Petroleum Engineers Productions Operations Symposium, Oklahoma City, Okla., Mar 21-23.

- Oddo, J.E., C.D. Sitz, I. Ortiz, D.G. Linz, A.W. Lawrence, A.T. Kan, and M.B. Tomson, 1993, "NORM Scale Formation: A Case Study of the Chemistry Prediction, Remediation, and Treatment in Wells of the Antrim Gas Field," SPE Paper 25937, presented at the SPE/EPA Exploration and Production Environmental Conference 93, sponsored by the Society of Petroleum Engineers and the U.S. Environmental Protection Agency, San Antonio, Texas, March 7-10, pp. 91-100.
- Oddo, J.E., and M.B. Tomson, 1994, "Algorithms Can Predict; Inhibitors Can Control NORM Scale," *Oil and Gas Journal* 92(1):33-37 (Jan. 3).
- Oddo, J.E., X. Zhou, D.G. Linz, S. He, and M.B. Tomson, 1995, "The Mitigation of NORM Scale in the Gulf Coast Regions of Texas and Louisiana: A Laboratory and Field Study, SPE Paper 29710, presented at the SPE/EPA Exploration and Production Environmental Conference 95, sponsored by the Society of Petroleum Engineers and the U.S. Environmental Protection Agency, Houston, Texas, March 27-29, pp. 207-217.
- Ortiz, I., and R.V. Anthony, 1993, "Study of Mechanisms for NORM in Gas Production Facilities in the Antrim Shale of the Michigan Basin," SPE Paper 26886, presented at the SPE Eastern Regional Conference and Exhibition, sponsored by the Society of Petroleum Engineers, Pittsburgh, Penn., Nov. 2-4, pp. 7-24.
- Orum, J., D. Baudoin, and O. Briscoe, 1995, "Remediation of Normally Occurring Radioactive Material (NORM): A Field Trial," *Environmental Issues and Solutions in Exploration, Production and Refining*, the Second International Petroleum Environmental Conference, sponsored by the U.S. Department of Energy and others, New Orleans, La., Sept. 25-27, pp. 739-752.
- ✓ Otto, G.H., 1989, *A National Survey on Naturally Occurring Radioactive Materials (NORM) in Petroleum Producing and Gas Processing Facilities*, prepared for the American Petroleum Institute, Dallas, Texas.
- ✓ Otton, J.K., 1996, "Use of Gamma-Ray Spectrometer Data to Estimate NORM Contamination at Oil and Gas Production Sites," *Environmental Issues and Solutions in Petroleum Exploration, Production and Refining*, proceedings of the 3rd International Petroleum Environmental Conference, sponsored by the U.S. Department of Energy, University of Tulsa, and others, Albuquerque, N.M., Sept. 24-27.
- ✓ Otton, J.K., S. Asher-Bolinder, D.E. Owen, and L. Hall, 1997, *Effects of Produced Waters at Oilfield Production Sites on the Osage Indian Reservation, Northeastern Oklahoma*, U.S. Geological Survey Open File Report 97-28, Denver, Colo.

- Pierce, A.P., J.W. Mytton, and G.B. Gott, 1955, "Radioactive Elements and Their Radioactive Daughter Products in the Texas Panhandle and Other Oil and Gas Fields in the United States," *Contributions to the Geology of Uranium and Thorium by the United States Geological Survey and Atomic Energy Commission for the United Nations International Conference on Peaceful Uses of Atomic Energy, Geneva, Switzerland, 1955*, U.S. Geological Survey Professional Paper 300, Washington, D.C., pp. 527-532.
- Powell, R.W., and R. O'Donel, 1997, "Managing NORM in a Petrochemical Plant," *Energy Week '97 — Petro-Safe '97, Volume I*, proceedings of the Energy Week Conference and Exhibition, sponsored by PennWell Conferences and Exhibitions, Houston, Texas, Jan. 28-30.
- Raabe, O.G., 1996, "Studies of the Solubility of Naturally-Occurring Radionuclides in Petroleum Pipe Scale," *NORM/NARM: Regulation and Risk Assessment*, proceedings of the 29th Midyear Topical Meeting of the Health Physics Society, Scottsdale, Ariz., Jan. 7-10, pp. 121-128.
- Rajaretnam, G., C. Blasio, K. Lovins, and H.B. Spitz, 1996, "Effect of Leachability on Environmental Risk Assessment for Naturally Occurring Radioactive Materials (NORM) in Petroleum Oil Fields," abstract presented at the Annual Meeting of the Health Physics Society, Seattle, Wash., July 21-25, *Health Physics* 70(6):36a.
- Rajtar, J.M., 1995, "NORM in the Petroleum Industry: Problems and Practical Solutions," *Environmental Issues and Solutions in Exploration, Production and Refining*, proceedings of the Second International Petroleum Environmental Conference, sponsored by the U.S. Department of Energy and others, New Orleans, La., Sept. 25-27, pp. 753-764.
- Raloff, J., 1991, "NORM: The New Hot Wastes," *Science News* 140(17):264-267.
- Ramirez, P., Jr., 1993, *Contaminants in Oil Field Produced Waters Discharged into the Loch Katrine Wetland Complex, Park County, Wyoming, and Their Bioconcentration in the Aquatic Bird Food Chain*, U.S. Fish and Wildlife Service Contaminant Report Number R6/706C/93, Cheyenne, Wyoming.
- Randolph, T.M., R.C. Ayers, R.A. Shaul, A.D. Hart, W.T. Shebs, J.P. Ray, S.A. Savant-Malhiet, and R.V. Rivera, 1992, "Radium Fate and Oil Removal for Discharged Produced Sand," *Produced Water Technical/Environmental Issues and Solutions*, edited by J.P. Ray and F.R. Englehart, Plenum Press, New York, N.Y., pp. 267-279.
- Rayle, M.F., and M.M. Mullino, 1992, "Produced Water Impacts in Louisiana Coastal Waters," *Produced Water Technical/Environmental Issues and Solutions*, edited by J.P. Ray and F.R. Englehart, Plenum Press, New York, N.Y., pp. 343-354.

- Reed, G., B. Holland, and A. McArthur, 1991, "Evaluating the Real Risks of Radioactive Scale in Oil and Gas," SPE Paper 23383, presented at the First International Conference on Health, Safety and Environment, sponsored by the Society of Petroleum Engineers, The Hague, The Netherlands, Nov. 10-14, pp. 549-558.
- Reynolds, J.P., 1996, "The New NORM Rule: A Health-Based Approach to the Regulations of Naturally Occurring Radioactive Materials," *Environmental Issues and Solutions in Petroleum Exploration, Production and Refining*, proceedings of the 3rd International Petroleum Environmental Conference, sponsored by the U.S. Department of Energy, University of Tulsa, and others, Albuquerque, N.M., Sept. 24-27.
- Rittiger, C.L., and Yusko, J. G., 1996, "An Overview of NORM Data Collected in Pennsylvania Specific to Oil and Gas Production," *NORM/NARM: Regulation and Risk Assessment*, proceedings of the 29th Midyear Topical Meeting of the Health Physics Society, Scottsdale, Ariz., Jan. 7-10, pp. 129-132.
- Rogers, V., and D.E. Bernhardt, 1995, "Experience with Risk-Based Residual Soil Concentration Limits for Oil and Gas NORM," *Environmental Issues and Solutions in Exploration, Production and Refining*, proceedings of the Second International Petroleum Environmental Conference, sponsored by the U.S. Department of Energy and others, New Orleans, La., Sept. 25-27, pp. 811-820.
- Rogers, V., and V.C. Rogers, 1995, "Potential Doses from the Reuse of Oil and Gas NORM Contaminated Equipment," *Beneficial Reuse '95, The Third Annual Conference on the Recycle and Reuse of Radioactive Scrap Metal*, sponsored by the Energy, Environment, and Resources Center, University of Tennessee and the Center for Risk Management, Oak Ridge National Laboratory, Knoxville, Tenn., July 31-Aug. 3.
- Rogers, V.C., D.E. Bernhardt, D.H. Owen, K.K. Nielson, and E.S. Murphy, 1989, *Correlations for NORM Deposits in Oil and Gas Field and Gas Plant Equipment*, RAE-8834-1, Rogers and Associates Engineering Corp, Salt Lake City, Nev.
- Rogers, V.C., K.K. Nielson, and M.K. Bollenbacher, 1989, *Methods for Measuring Naturally-Occurring Radioactive Materials in Petroleum Production Equipment*, RAE-8837/1-1, prepared for the American Petroleum Institute, Dallas, Texas, by Rogers and Associates Engineering Corp, Salt Lake City, Nev.
- Rogers, V.C., and K.K. Nielson, 1995, "Surveying for Oil and Gas NORM: What Can Be Learned From Gamma Radiation Measurements?" *Environmental Issues and Solutions in Exploration, Production and Refining*, proceedings of the Second International Petroleum Environmental Conference, sponsored by the U.S. Department of Energy and others, New Orleans, La., Sept. 25-27, pp. 799-809.

Rood, A.S., and D.T. Kendrick, 1996, "Measurement of ^{222}Rn Flux, ^{222}Rn Emanation, and ^{226}Ra Concentration from Injection Well Pipe Scale," *NORM/NARM: Regulation and Risk Assessment*, proceedings of the 29th Midyear Topical Meeting of the Health Physics Society, Scottsdale, Ariz., Jan. 7-10, pp. 139-144.

Rutherford, G.J., and G.E. Richardson, 1993, "Disposal of Naturally Occurring Radioactive Material from Operations on Federal Leases in the Gulf of Mexico," SPE Paper 25940, presented at the SPE/EPA Exploration and Production Environmental Conference 93, sponsored by the Society of Petroleum Engineers and the U.S. Environmental Protection Agency, San Antonio, Texas, March 7-10, pp. 101-110.

Saunders, J.A., and E.L. Rowan, 1990, "Mineralogy and Geochemistry of Metallic Well Scale, Raleigh and Boykin Church Oilfields, Mississippi, USA," *Transactions of the Institution of Mining and Metallurgy* 99:B54-B58.

Scaife, W.M., and S.G. Mueller, 1994, "Downhole Disposal of NORM Wastes in an Offshore Setting: Lessons Learned," *Environmental Issues and Solutions in Petroleum Exploration, Production and Refining*, proceedings of the International Petroleum Environmental Conference, sponsored by the University of Tulsa and PennWell Publishing Co., Houston, Texas, March 2-4.

Scott, L.M., 1989, *Radioactive Scale in Petroleum Production Equipment and Pipe*, Louisiana State University Press, Baton Rouge, La.

Scott, L.M., 1994, "On-Site and Off-Site Exposure from Naturally Occurring Radioactive Material (NORM) in or on Soil," *Environmental Issues and Solutions in Petroleum Exploration, Production and Refining*, proceedings of the International Petroleum Environmental Conference, sponsored by the University of Tulsa and PennWell Publishing Co., Houston, Texas, March 2-4.

Scott, L.M., D.L. Van Gent, and M.B. Hebert, 1994, *Preliminary Assessment of Naturally Occurring Radioactive Material at Selected Production Sites, Part I*, prepared for the American Petroleum Institute, Dallas, Texas.

Seiler, F.A., J.L. Alvarez, and S.R. Adams, 1996, "NORM and the Minimum Significant Risk," *NORM/NARM: Regulation and Risk Assessment*, proceedings of the 29th Midyear Topical Meeting of the Health Physics Society, Scottsdale, Ariz., Jan. 7-10, pp. 255-262.

Sells, S.L., 1994, "Discussion Paper on NORM Regulation in the Oil and Gas Industry," presented at the Rocky Mountain Symposium on Environmental Issues in Oil and Gas Operations, sponsored by the Colorado School of Mines, Golden, Colo., July 11-13.

- SENES Consultants Limited, 1993, *Critical Review of A Preliminary Risk Assessment of Management and Disposal Options for Oil Field Wastes and Piping Contaminated with NORM in the State of Louisiana*, prepared for the American Petroleum Institute, Dallas, Texas.
- Shannon, B.E., 1993, "An Operational Perspective on the Handling and Disposal of NORM in the Gulf of Mexico," SPE Paper 25936, presented at the SPE/EPA Exploration and Production Environmental Conference 93, sponsored by the Society of Petroleum Engineers and the U.S. Environmental Protection Agency, San Antonio, Texas, March 7-10, pp. 83-90.
- Shinkle, P., 1994, "China Gets Radioactive Scrap Equipment," *The Advocate*, Baton Rouge, La., April 4.
- Shuler, P.J., J.A. Baudoin, and D.J. Weintritt, 1995, "Diagnosis and Prevention of NORM at Eugene Island 341-A," SPE Paper 29711, presented at the SPE/EPA Exploration and Production Environmental Conference 95, sponsored by the Society of Petroleum Engineers and the U.S. Environmental Protection Agency, Houston, Texas, March 27-29, pp. 219-230.
- Sielhan, K.A., A.S. Curry, and C.A. LaBlanc, 1994, "Downhole NORM Disposal Through PVC Encapsulation," *Environmental Issues and Solutions in Petroleum Exploration, Production and Refining*, proceedings of the International Petroleum Environmental Conference, sponsored by the University of Tulsa and PennWell Publishing Co., Houston, Texas, March 2-4.
- Smith, A.L., 1987, "Radioactive-Scale Formation," *Journal of Petroleum Technology* 39(6):697-706.
- Smith, G.E., T. Fitzgibbon, and S. Karp, 1995, "Economic Impact of Potential NORM Regulations," SPE Paper 29708, presented at the SPE/EPA Exploration and Production Environmental Conference 95, sponsored by the Society of Petroleum Engineers and the U.S. Environmental Protection Agency, Houston, Texas, March 27-29, pp. 181-194.
- Smith, K.P., 1992, *An Overview of Naturally Occurring Radioactive Materials (NORM) in the Petroleum Industry*, ANL/EAIS-7, Argonne National Laboratory, Argonne, Ill.
- Smith, K.P., 1993, *Disposal and Treatment Technologies for Naturally Occurring Radioactive Materials (NORM) Produced by the Petroleum Industry*, prepared for U.S. Department of Energy, Office of Domestic and International Policy, Washington, D.C.

- Smith, K.P., and D.L. Blunt, 1995, "Scrap Metal Management Issues Associated with Naturally Occurring Radioactive Material," *Beneficial Reuse '95, The Third Annual Conference on the Recycle and Reuse of Radioactive Scrap Metal*, sponsored by the Energy, Environment, and Resources Center, University of Tennessee and the Center for Risk Management, Oak Ridge National Laboratory, Knoxville, Tenn., July 31-Aug. 3.
- Smith, K.P., D.L. Blunt, G.P. Williams, and C.L. Tebes, 1995, "Radiological Dose Assessment Related to Management of Naturally Occurring Radioactive Materials Generated by the Petroleum Industry," SPE Paper 29712, presented at the SPE/EPA Exploration and Production Environmental Conference 95, sponsored by the Society of Petroleum Engineers and the U.S. Environmental Protection Agency, Houston, Texas, March 27-29, pp. 231-238.
- Smith, K.P., D.L. Blunt, G.P. Williams, and C.L. Tebes, 1996, *Radiological Dose Assessment Related to Management of Naturally Occurring Radioactive Materials Generated by the Petroleum Industry*, ANL/EAD-2, Argonne National Laboratory, Argonne, Ill.
- Snavely, E.S., 1989, *Radionuclides in Produced Water — A Literature Review*, American Petroleum Institute Report No. 4504, Dallas, Texas.
- Spaite, P.W., and G.R. Smithson, 1992, *Technical and Regulatory Issues Associated with Naturally Occurring Radioactive Materials (NORM) in the Gas and Oil Industry*, GRI-92/0178, Gas Research Institute, Chicago, Ill.
- Spitz, H., K. Lovins, and C. Becker, 1997, "Evaluation of Residual Soil Contamination from Commercial Oil Well Drilling Activities and its Impact on the Naturally Occurring Background Radiation Environment," *Journal of Soil Contamination* 61(1):37-59.
- Steele, A., and H.I. Hodges, 1996, "Recent Changes in Louisiana NORM Regulations," *Energy Week '96 — Petro-Safe '96*, proceedings of the Energy Week Conference and Exhibition, sponsored by PennWell Conferences and Exhibitions, Houston, Texas, Jan. 29-Feb. 2.
- Steingraber, B., 1991, *Industry Perspective on Naturally Occurring Radioactive Material (NORM)*, Interstate Oil and Gas Compact Commission Bulletin 5(1):26-30.
- Takhautdinov, Sh.F., B.A. Sizov, R.N. Diyashev, V.I. Zaitsev, and G.P. Antonov, 1996, "Influence of Radon and Decay Products on Field Equipment Service Personnel," SPE Paper 35867, presented at the Third International Conference on Health, Safety and Environment in Oil and Gas Exploration and Production, sponsored by the Society of Petroleum Engineers, New Orleans, La., June 9-12.

- Testa, C., D. Desideri, M.A. Meli, C. Roselli, A. Bassignani, and P. Finazzi, 1993, "Radium, Uranium, and Thorium Concentrations in Low-Specific Activity Scales and in Waters of Some Oil and Gas Production Plants," *Journal of Radioanalytical and Nuclear Chemistry* 170(1):117-124.
- Testa, C., D. Desideri, M.A. Meli, C. Roselli, A. Bassignani, G. Colombo, and R.F. Fantoni, 1994, "Radiation Protection and Radioactive Scales in Oil and Gas Production," *Health Physics* 67(1):34-38.
- Texas Chemical Council, 1992, *A Guide to NORM in the Texas Petrochemical Industry*, Austin, Texas.
- Thayer, E.C., and L.M. Racioppi, 1991, "Naturally Occurring Radioactive Materials: The Next Step," SPE Paper 23500, presented at the First International Conference on Health, Safety and Environment, sponsored by the Society of Petroleum Engineers, The Hague, The Netherlands, Nov. 10-14, pp. 735-742.
- Thayer, E.C., and L.M. Racioppi, 1994, "Naturally Occurring Radiation Materials Control Experience at a Production Platform Turnaround," SPE Paper 27218, presented at the Second International Conference on Health, Safety and Environment in Oil and Gas Exploration and Production, sponsored by the Society of Petroleum Engineers, Jakarta, Indonesia, Jan. 25-27.
- Underhill, P.T., 1992, *Naturally Occurring Radioactive Material: Principles and Practices*, St. Lucie Press, Delray Beach, Fla.
- U.S. Environmental Protection Agency, 1973, *Assessment of Potential Radiological Health Effects from Radon in Natural Gas*, EPA 520/1-73-004, Washington, D.C.
- U.S. Environmental Protection Agency, 1977, *Assessment of Potential Radiological Health Effects from Radon in Liquefied Natural Gas*, EPA 520/1-75-002, Washington, D.C.
- U.S. Environmental Protection Agency, 1993, *DRAFT Diffuse NORM Wastes — Waste Characterization and Preliminary Risk Assessment*, Office of Radiation and Indoor Air, Washington, D.C.
- U.S. Environmental Protection Agency, 1993, *A Preliminary Risk Assessment of Management and Disposal Options for Oil Field Wastes and Piping Contaminated with NORM in the State of Louisiana*, Office of Radiation and Indoor Air, Washington, D.C.
- U.S. Environmental Protection Agency, 1994, *An SAB Report: Review of Diffuse NORM Draft Scoping Document*, EPA-SAB-RAC-94-013, Science Advisory Board, Washington, D.C.

- U.S. Environmental Protection Agency, 1995, *Produced Water Radioactivity Study — Final Draft*, Office of Science and Technology, Office of Water, Washington, D.C.
- Van Gent, D.L., B. Fu, P. Aharon, and L.M. Scott, 1996, "Radium Anomalies in the Gulf of Mexico Offshore Louisiana," *Environmental Issues and Solutions in Petroleum Exploration, Production and Refining*, proceedings of the 3rd International Petroleum Environmental Conference, sponsored by the U.S. Department of Energy, University of Tulsa, and others, Albuquerque, N.M., Sept. 24-27.
- Van Gent, D.L., B. Fu, P. Aharon, and L.M. Scott, 1995, "Radium Decay Series Dating of Barite Deposition in the Gulf of Mexico: Initial Results," *Environmental Issues and Solutions in Exploration, Production and Refining*, proceedings of the Second International Petroleum Environmental Conference, sponsored by the U.S. Department of Energy and others, New Orleans, La., Sept. 25-27, pp. 821-829.
- Vetter, O.J.G., 1975, "How Radium Sulfate is Formed: An Interpretation," *Journal of Petroleum Technology* 27:1515-1524 (December).
- Wagner, J.F., 1990, "Toxicity and Radium 226 in Produced Water — Wyoming's Regulatory Approach," *Proceedings of the First International Symposium on Oil and Gas Exploration and Production Waste Management Practices*, sponsored by the U.S. Environmental Protection Agency, New Orleans, La., Sept. 10-13, pp. 987-994.
- Waligora, S.J., Jr., 1996, "Dose Reconstruction at a NORM Site," *NORM/NARM: Regulation and Risk Assessment*, proceedings of the 29th Midyear Topical Meeting of the Health Physics Society, Scottsdale, Ariz., Jan. 7-10, pp. 243-254.
- Wascom, C.D., 1994, "NORM Disposal Options of the State of Louisiana," presented at the Rocky Mountain Symposium on Environmental Issues in Oil and Gas Operations, sponsored by the Colorado School of Mines, Golden, Colo., July 11-13.
- Waste Management of Kentucky, L.L.C., 1996, *Blue Ridge Recycling and Disposal Facility Resubmittal of Minor Permit Modification for Acceptance of Martha Oil Field Materials September 1996*, permit modification request prepared for Ashland Exploration, Inc., Houston, Texas.
- Welther, P., and J. Burton, 1994, "Volume Reduction and Decontamination of NORM," *Environmental Issues and Solutions in Petroleum Exploration, Production and Refining*, proceedings of the International Petroleum Environmental Conference, sponsored by the University of Tulsa and PennWell Publishing Co., Houston, Texas, March 2-4, pp. 823-832.

- White, G.J., 1992, *Naturally Occurring Radioactive Materials (NORM) in Oil and Gas Industry Equipment and Wastes — A Literature Review*, Idaho National Engineering Laboratory, Idaho Falls, Idaho.
- Williams, G. P., K.P. Smith, D.L. Blunt, and C.L. Tebes, 1995, "Modeling and Risk Assessment of Underground Injection of Naturally Occurring Radioactive Materials (NORM)," *Environmental Issues and Solutions in Exploration, Production and Refining*, proceedings of the Second International Petroleum Environmental Conference, sponsored by the U.S. Department of Energy and others, New Orleans, La., Sept. 25-27.
- Williams, T.M., 1995, "Detecting NORM Contaminated Tubing During Pulling Operations," *Proceedings of the 1995 American Petroleum Institute and Gas Research Institute Naturally Occurring Radioactive Material Conference*, Houston, Texas, Oct. 17-18, pp. 17-22.
- Wilson, A.J., 1989, *An Evaluation of Radiation Hazards of Oil Field Piping Scale*, Master's thesis, Louisiana State University, Baton Rouge, La.
- Wilson, A.J., and L.M. Scott, 1992, "Characterization of Radioactive Petroleum Piping Scale with an Evaluation of Subsequent Land Contamination," *Health Physics* 63(6):681-685.
- Wilson, W.F., 1994, *NORM, A Guide To Naturally Occurring Radioactive Material*, PennWell Publishing Company, Tulsa, Okla.
- Wilson, W.F., 1994, "NORM Disposal Options," *Environmental Issues and Solutions in Petroleum Exploration, Production and Refining*, proceedings of the International Petroleum Environmental Conference, sponsored by the University of Tulsa and PennWell Publishing Co., Houston, Texas, March 2-4, pp. 775-800.
- Wilson, W.F., 1995, "Geology and Genesis of NORM: Industrial Links and Depositional Processes," *Energy Week '95 — Petro-Safe '95*, proceedings of the Energy Week Conference and Exhibition, sponsored by PennWell Conferences and Exhibitions, Houston, Texas, Jan. 31-Feb. 2, pp. 278-287.
- Winters, S.J., 1996, "Industrial Radiation Safety Management for Naturally Occurring Radioactive Materials (NORM)," *Environmental Issues and Solutions in Exploration, Production and Refining*, proceedings of the 3rd International Petroleum Environmental Conference, sponsored by the U.S. Department of Energy, University of Tulsa, and others, Albuquerque, N.M., Sept. 24-27.
- Woods, S., S. Abernathy, and P. Johnson, 1996, "Development of a Comprehensive NORM Program," *Proceedings of the 1995 American Petroleum Institute and Gas Research Institute Naturally Occurring Radioactive Material Conference*, Houston, Texas, Oct. 17-18, pp. 73-78.