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June 26, 2002

SMB-1541
040-08980

Mr. Craig Gordon
U.S. Nuclear Regulatory Commission
475 Allendale Road
King of Prussia, PA 19406

Dear Craig:

Attached is an analysis of ORISE's beta "overcounting" prepared by SENES, (see attached CV) which agrees with RSI's analysis that was submitted to you at our last meeting in King of Prussia. The likelihood of significant beta overcounting could have profound implications for decontamination and decommissioning of the mill buildings and the equipment therein.

John Lord is preparing a "mass balance" analysis along with a report of operational history which we believe will demonstrate with reasonable assurance that the NRC licensed SDMP monazite has gone to IUC. All remaining material with elevated radionuclide concentrations is the result of pre-NRC license activities of HMI or its predecessors. Of course, HMI will have to address any *licensable* source material concentrations but, that would be a separate (non-SDMP) licensing matter. HMI expects to have this analysis in final form by the end of July or sooner.

Edele Hovnanian is reviewing a draft sample protocol from RSI, which will be submitted to NRC for review within the next ten days. As soon as NRC approval is received RSI will begin the sampling.

HMI has sent out RFP's to salvage companies regarding demolition and/or removal of the equipment in the mill structures and/or the mill structures themselves. Meetings to discuss such activities are being set up at the site. HMI expects to complete this process by the end of August or sooner.

Thus, as you can see things are moving, so we can still hope to satisfy SDMP timelines.

Sincerely,

Tony

Anthony J. Thompson

(letter to c.gordon(june))

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DOUGLAS B. CHAMBERS

Vice-President, Director of Radioactivity and Risk Studies

EDUCATION

B.Sc. (Honours), Physics, 1968, University of Waterloo (University of Waterloo Tuition Scholarship)
Ph.D., Physics, 1973, McMaster University (National Research Council Science Scholarship)
Two Sessions at the Advanced School for Statistical Mechanics and Thermodynamics, University of Texas, Austin, 1970 and 1971
Air Pollution Diffusion, U.S. EPA, Research Triangle Park, 1974
Annual Health Physics Course, Chalk River Nuclear Laboratories, 1974
Observations on Human Populations, School of Hygiene, University of Toronto, 1979

PROFESSIONAL AFFILIATIONS

Advisory Committee on Radiation Protection (1993 to 2002 - committee advises the Canadian Nuclear Safety Commission on matters concerning radiation protection)
American Nuclear Society
Canadian Standards Association, Member of Technical Committee on Environmental Radiation Protection (1978 to 1994, Chairman 1987 to 1994)
Canadian Standards Association, Member of Technical Committee on Risk Analysis (1989 to present)
Canadian Radiation Protection Association
Health Physics Society (U.S.)
Society for Risk Analysis (U.S.)
U.S. National Council on Radiation Protection and Measurements, Scientific Committee 85 on Risk of Lung Cancer from Radon (1991 to date)
United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR), Member 1998 to date, Canadian delegation
Consultant to UNSCEAR for preparation of "Sources-to-Effect Assessment of Radon in Homes and Workplaces".

AWARDS

1997 W.B. Lewis Award (Canadian Nuclear Association) for achievements in environmental radioactivity.

2002 Health Physics Society Morgan Lecturer
"Perspectives on Radioactive Waste Management in Canada. Joint Midyear Meeting. Orlando, February 2002.

EXPERIENCE

1980 to date - SENES Consultants Limited
Vice-President and Director of Risk and Radioactivity Studies. Technical responsibilities include management and technical direction of multi-disciplinary studies including: human health risk assessments; radioactivity exposure evaluations; environment impact assessments; environmental pathways and dose assessments; air dispersion modelling studies of radon and dense/reactive gases; ecological risk assessments; mine waste management; geochemical modelling assessments; low-level radioactive waste management; and risk (cost) - benefit analyses.

Dr. Chambers has contributed to the development of, and made extensive use of the methods of uncertainty analysis for: exposure pathways analysis; dose reconstruction and epidemiological investigations; risk assessments; and application of environmental statistics. While at SENES, Dr. Chambers has directed or contributed to more than 300 projects, examples of which are given below.

Human Health Risk Assessment - Numerous studies including: risks from exposure to radon; investigations into harmonization of cancer and non-cancer risk; integrating quality of life issues in cost-benefit analyses; studies of the effect of uncertainty in exposure (dose) on the feasibility of epidemiological investigations, pharmacokinetic modelling and toxicological assessments of uranium, arsenic and other toxins; and evaluation of the risks associated with nickel in soils at contaminated sites proximate to nickel production facilities.

Risk assessments performed under Dr. Chambers' direction include evaluation of risks from: naturally occurring radioactivity in phosphogypsum arising from use in agriculture and road construction; radioactivity, and various metals in drinking water; reuse of industrial contaminated sites; incineration of municipal wastes and accidental release of chlorine from waste water treatment facilities. Other projects include: LNG storage facility; blood mercury levels and water level regulation in respect to low-head hydro projects; release of volatile organics from waste water treatment plant; risks for alternative uses of sewage sludge; and exposure to fugitive dust emissions from mining, municipal, radioactive and hazardous waste management activities.

Ecological Risk Assessment - Dr. Chambers has played a key role in the development of ecological risk assessment methodologies for mining regions in northern Saskatchewan and northern Ontario, and in

support of decontamination planning for contaminated industrial sites. Dr. Chambers also completed an ecological risk assessment for the use of slag from refining operations as construction fill. He has directed numerous risk assessments for industrial contaminated sites.

Environmental Assessment – Numerous, assessments including: the preparation of an environmental impact statement for the decommissioning of uranium tailings facilities in Ontario and northern Saskatchewan, the United States and elsewhere; and a risk (cost) - benefit analysis for the reclamation of an *in situ* leach property in Texas. Dr. Chambers has also contributed to environmental assessments of nuclear power plants, thermal power plants and other industrial and mining facilities.

Facility Risk Assessment – Dr. Chambers has been involved in numerous facility risk assessments involving petrochemicals, ammonia, uranium hexafluroide, and chlorine amongst others. He has supervised a number of transportation risk studies involving petrochemicals, acids, radioactive waste, sludge and ore slurry. He has also been involved in a health and safety risk analysis for oxygen and nitrogen pipelines. These projects have been conducted in Ontario, British Columbia, Saskatchewan, South Africa and Trinidad.

Geochemical Modelling and Assessment - Dr. Chambers is active in the development and application of geochemical models for evaluation of management options for mine waste rock and tailings. He was a senior scientist in a multi-disciplinary study team assisting the Federal German Environment Ministry with the decommissioning of uranium mining and processing sites in Saxonia and Thüringia, where geochemical modelling was employed to perform a comparative evaluation of rehabilitation options for multiple surface waste rock heaps, including evaluation of specific criteria for relocation of waste rock to a large open pit mine, and geochemical simulation of the backfilled pit as well as the flooding of the entire mining area. Other geochemical assessments include evaluation of alternatives for reducing acid generation of mine waste heaps in South Africa.

Radioactivity - Director or senior health physics advisor for numerous studies pertaining to radiation protection including: dose reconstruction and epidemiologic analyses of persons exposed to elevated radon progeny concentrations including residents of Port Hope Ontario and uranium miners of Beaverlodge, Port Radium and Colorado Plateau; reconstruction of environmental exposures and doses from radioactive contaminated sites, decommissioning of uranium and thorium facilities; review of thorium metabolism data; and uranium biokinetic models; development of decommissioning criteria and guidelines; assessment of the potential risks from naturally occurring radioactivity (NORM);dose assessment and the development of health and safety practices for uranium mine workers; and the application of the ALARA optimization principal.

Remedial Actions and Decommissioning - Directed and participated in numerous decommissioning and remedial action programs for NORM (naturally occurring radioactive material) wastes and low-level radioactive waste (LLRW) management sites, uranium mining facilities in Canada, United States and overseas. Dr. Chambers directed conceptual design studies for disposal of LLRW in near-surface facilities and engineered underground caverns. He also directed a study to investigate the technical and economic feasibility of a commercial LLRW facility in Canada.

Air Quality Assessment - Provided technical direction to atmospheric dispersion studies involving dense/reactive gases such as ammonia, chlorine, anhydrous hydrogen fluoride and N_2/O_2 and uranium hexafluoride releases. Dr. Chambers developed a detailed physical/chemical model for the release, atmospheric transport and deposition of uranium hexafluoride for an accident at a uranium hexafluoride facility in Gore Oklahoma. He has carried out numerous site-specific modelling studies of thermal power stations, numerical air quality modelling for complex terrain, calibration/verification studies, and development of long-range transport models.

1973-1980 - James F. MacLaren Limited

General Manager, Nuclear Projects Division from 1977 to 1980. Responsible for the development of the firm's capabilities in environmental radioactivity and radiation protection. Project Manager for the Air Environment Division from 1973 to 1977.

Environmental specialist on matters pertaining to the air environment and/or radioactivity on numerous environmental impact assessments across Canada and internationally.

Specialist input to the development, implementation and interpretation of results from air quality and meteorological surveys, air dispersion analyses and noise assessments at several types of industrial projects at locations across Canada. Developed a meteorological control system for large oil fired power plant in New Brunswick.

TECHNICAL PAPERS AND PRESENTATIONS

More than 100 technical papers, reports publications and presentations (list available upon request). He has also presented seminars and workshops on a variety of topics, in Canada, the United States, Europe, South America and Africa.

ACRP-22, Protection of Non-Human Biota from Ionizing Radiation Former Advisory Committee on Radiological Protection for the CNSC, INFO 0703 CNSC April 2002. (Chairman of Working Group).

Research on Selected Aspects of a Rapid Surveillance System Prepared for Cancer Care Ontario November 2001 (with R. Stager).

The Current Status of Biological Dosimeters Chapter 40 of Second Edition of Medical Management of Radiation Accidents eds. I.A.. Gusev, A.K. Gushkera and F.A. Mettler Jr. CRC Press 2001 (with H.A. Phillips).

Environmental Issues in the 21st Century. Invited keynote address at International Symposium on the Uranium Production Cycle and the environment, International Atomic Energy Agency, Vienna, Austria, 2-6 October 2000.

Remediation During Changing Regulatory Requirements for Characterization Surveys. Uranium 2000, September. (R.H. Stager).

Uravan – A Case History of Decommissioning a Large U.S. Title II Uranium Site Illustrating the Practical Application of Risk Assessment Principles. September 2000. (G.M. Wiatzka, C. Sealy and J. Hamrick).

Metal Leaching of Sulphide Mine Wastes Under Neutral pH Conditions. ICARD, Denver 2000. (J.M. Scharer, C.M. Pettit, J.L. Kirkaldy, L. Bolduc and B.E. Halbert).

Perspectives on Molecular Epidemiology. Presented to the 2000 Canadian Radiation Protection Association Annual Conference, Montreal, Quebec, May 2000. (N.E. Gentner).

Environmental Risk Assessment – A Practitioner's Perspective. Canadian Nuclear Society, 21st Annual Conference, 11-14 June 2000, Toronto, ON. (M.W. Davis).

Risk – What It is, and How to Manage it. Invited presentation Mining Millenium 2000, CIMM Annual Meeting March 2000. (G.M. Wiatzka).

Screening Level Dose Assessment of Aquatic Biota Downstream of the Marcoule Nuclear Complex in Southern France. Health Physics 77(3): 313-321, September 1999 (with S. St-Pierre, L.M. Lowe and J.G. Bontoux).

Radiation (Protection) in the 21st Century. Invited Presentation Canadian Radiation Protection Association, June 1999, Saskatoon, SK.

LNG and Risk Based Standards, LNG 12, International Conference, Perth Australia, 1995. (With J. P. Lewis, R.B. Felder, S.J. Wiersma and R.G. (Charlwood).

Uncertainty is Part of Making Decisions. Invited paper, Human and Ecological Risk Assessment (HERA), 5 (2): 255-261, 1998 (with F.O. Hoffman and R.H. Stager).

Practical Issues in the Risk Management of Low Dose Radiation. Presented at The Nineteenth Annual Conference of the Canadian Nuclear Society, Toronto, ON, 18-21 October 1998 (with M.W. Davis, N.C. Garisto and L.M. Lowe).

Long Term Population Dose Due to Radon from Uranium Mill Tailings. Presented at The Uranium Institute Twenty-Third Annual Symposium, London, U.K., 10-11 September 1998. (Available at www.uilondon.org) (with L.M. Lowe and R.H. Stager).

Steps Towards Harmonization of Risk From Chemical and Radioactive Contaminants Spectrum '98 – International Conference on Nuclear and Hazardous Waste Management, 13-17 September 1998 (with N.C. Garisto, S.L. Fernandes, H.A. Phillips and G.W. Wiatzka).

Transport, Chemistry, and Thermodynamics of Uranium Hexafluoride in the Atmosphere-Evaluation of Models Using Field Data. Atmospheric Environment 32 (10): 1729-1741, 1998 (with S.K. Nair, Z.R. Radonjic and S. Park.

Long Term Contaminant Migration and Impacts From Uranium Mill Tailings. 1998. Journal of Environmental Radioactivity 42:289-304, 1999 (with H. Camus, R. Little, D. Acton, A. Agüero, L. Chamney, J.L. Daroussin, J. Droppo, C. Ferry, E. Gnanapragasam, C. Hallam, J. Horyna, D. Lush, D. Stammose, T. Takahashi, L. Toro and C. Yu).

Trade-off Analysis of Risk, Cost and Quality of Life in the Risk Management of Contaminated Sites Mixed Wastes. Society for Risk Analysis annual meeting, Dec. 1997 (with N.C. Garisto, G.M. Wiatzka, A.J. Thompson, W. Goldammer).

Risk Based Decision Model for Community Water Systems. Society for Risk Analysis Annual Meeting, Dec. 1997. (with N.C. Garisto, R. Copes, V. Carmichael, B. Willoughby).

Review of Models Used for Determining Consequences of UF_6 Release – Development of Model Evaluation Criteria. NUREG/CR-6481, Vol. 1,November 1997 (with S.K. Nair, S.H. Park and F.O.Hoffman).

The Effect of Uncertainty in WLM (Dose) on Risks of Lung Cancer in the Beaverlodge Miner Cohort. Invited Presentation to NIH Workshop on Uncertainties in Radiation Dosimetry and Their Impact on Dose-Response Analyses, NIH Workshop, Washington DC, September 1997 (with R.H. Stager and S.E. Frost).

Low Dose Linearity – A Practitioner's Review of Its Science and Applications. Invited presentation by D.B. Chambers at the joint Nuclear Regulatory Commission (NRC) – National Mining Association (NMA) Workshop, Denver, CO, 3 June 1997 (with M.W. Davis and L.M. Lowe).

Probabilistic Assessment of Accidental Exposures to Inorganic Arsenic in Drinking Water. Presented to the American Industrial Hygiene Conference and Exposition, Dallas, TX, May 1997 (with M.W. Davis and H.A. Phillips).

Ecological Risk Assessment for a Contaminated Truck Maintenance Site. Presented at 18th Annual SETAC Meeting, November 1997 (with S.L. Wilkinson, H.A. Phillips and R.B. German).

Assessment of Radiation Effects on Biota in Proximity to Uranium Mining and Milling Sites in Canada: Field Observations and Model Predictions. In: Symposium on Radiological Impacts from Nuclear Facilities on Non-Human Species, Ottawa, 2-3 December 1996 (with N.C. Garisto, M.W. Davis, J.M. Takala, D. Krochak, R.G. Barsi and S.M. Bartell).

Operational Use of Mathematical Modelling; Prediction of Acid Mine Drainage. Presented at MEND Vancouver Workshop, November 1996 (with C.M. Pettit).

Review of J.E. Hicks and L. Beard (1990). *Exposure Assessment of Local Community to Airborne Emissions of Dioxins and Furans: Technical Communications Issue. Colloquium on Technical Risk Assessment in Business and Regulatory Decision Making.* Institute for Risk Research Calgary, Alberta, 19-20 September 1996 (with N.C. Garisto and S.L. Wilkinson).

Risk/Cost Analysis: A Case Scenario in the Decommissioning of a Radiological Site. Presented at Probabilistic Safety Assessment '96, Park City, Utah, 29 September - 3 October 1996 (with A.J. Thompson and G.M. Wiatzka).

Comment on ICRP Recommendations on Radon, and Revised Background Doses from Radon. Sixth International Symposium on the Natural Radiation Environment (NRE-VI), 5-9 June, 1995, Montréal, Quebec. In: Environment International Vol. 22 (Suppl. 1): S1037-S1044, 1996 (with L.M. Lowe).

Implications of Naturally Occurring Radioactive Materials (NORM) on the Decommissioning of an Elemental Phosphorus Refinery. Presented at the Sixteenth Annual Conference of the Canadian Radiation Protection Association, Trois-Rivières, June 1996 (with S. St-Pierre and L.M. Lowe).

Investigations Into the Effect of Uncertainty in the Exposure Variable on the Feasibility of Epidemiological Investigations. Prepared for Centers for Disease Control (Atlanta), April 1996 (with M. Tai, R.H. Stager and P. Reilly).

Development of Cleanup Criteria for Historic Low-Level Radioactive Waste Sites in Canada. In: Proceedings of The Fifth International Conference on Radioactive Waste Management and Environmental Remediation (ICEM '95) Vol. 2 Management of Low-Level Waste and Remediation of Contaminated Sites and Facilities, pp. 1433-1437 (ASME), Berlin, Germany 3-8 September 1995 (with R.W. Pollock and L.M. Lowe).

Factors Affecting ARD Production: Kinetics of Sulphide Oxidation. To be presented at Sudbury '95, Mining and the Environment, 28 May - 1 June 1995, Sudbury, Ontario (with J.M. Scharer, E.C.M. Kwong, R.V. Nicholson and C.M. Pettit).

Approach to Mine Decommissioning in Europe: Decommissioning the Former East German Uranium Industry. To be presented at Sudbury '95, Mining and the Environment, 28 May - 1 June 1995, Sudbury, Ontario (with G.M. Wiatzka and C.M. Pettit).

Ecological Risk Analysis of Uranium Mining in Northern Saskatchewan. Presented at Sudbury '95, Mining and the Environment, 28 May - 1 June 1995, Sudbury, Ontario (with D.K. Krochak, S.M. Bartell and M.B. Wittrup).

Ecological Risk Analysis of Uranium Mining in Northern Saskatchewan, Canada. Presented at the Society for Risk Analysis Annual Meeting, 5-8 December 1993 in Ottawa, Ontario (with S.M.

Bartell, D.K. Krochak, M. Wittrup, H.A. Spankie and T. Collins).

Impact of Radon Emanation on the ALIs for ^{226}Ra and Uranium Ore Dust. Health Physics 65(1): 104, July 1993 (with L.M. Lowe and M.W. Davis).

Mathematical Simulation of a Waste Rock Heap. Presented at the International Land Reclamation and Mine Drainage Conference and the Third International Conference on Abatement of Acidic Drainage, Pittsburgh, PA, 24-29 April 1993 (with J.M. Scharer, C.M. Pettit and E.C. Kwong).

International Perspective on the Role of Acid Generation in Selecting Decommissioning Techniques for Uranium Mining Sites in Eastern Germany. Presented at the Third International Conference on Abatement of Acidic Drainage, Pittsburgh, PA, 25-29 April 1993 (with D.G. Feasby, J.M. Scharer, C.M. Pettit, R.G. Dakers and M.H. Goldsworthy).

Implications for Underground Uranium Mining of the ICRP 1990 and C-122 Recommended Dose Limits. Presented at the International Conference on Radiation Safety in Uranium Mining, Saskatoon, SK, 25-28 May 1992 (with L.M. Lowe and R.H. Stager).

Radiological Implications of Naturally Occurring Radioactivity in an Elemental Phosphorus Refinery. In: Proceedings of the Eighth International Congress of the International Radiation Protection Association (IRPA8), Montréal, Quebec, Vol. II: 1375-1378, 17-22 May 1992 (with L.M. Lowe).

Reconstruction of the Radon Daughter Exposure of Beaverlodge Uranium Workers. In: Proceedings of the Eighth International Congress of the International Radiation Protection Association (IRPA8), Montréal, Quebec, Vol. II: 1586-1589, 17-22 May 1992 (with R.H. Stager, F.D. Bernard and L.M. Lowe).

Risk - Experience from the Nuclear Industry. Presented at the CIRAC/AWMA-OS Joint International Conference on Atmospheric Chemistry, Toronto, Ontario, 26-28 January 1992.

Radiological Significance of ^{227}Ac and ^{231}Pa in Inhaled Natural Uranium. Health Physics 61(6): 918, December 1991 (with L.M. Lowe and M.W. Davis).

Preparing Environmental Impact Statements. Presented at the 1991 Conference on Environmental Management in Mining, Saskatoon, Saskatchewan, November 1991 (with C.M. Pettit and B.E. Halbert).

Effects of Exposure Uncertainty on Estimation of Radon Risks. In: " Twenty-Ninth Hanford Symposium on Health and the Environment, Indoor Radon and Lung Cancer: Reality or Myth? – Part 2" (ed. F.T. Cross) Battelle Press, pp. 987-1012, 15-19 October 1990 (with P. Reilly, R.H. Stager, L.M. Lowe and P. Duport).

Communicating Risks to the Community: A Tale of Two Incinerators. Presented to the 1990 Annual Meeting of the Society for Risk Analyses (with J.F. Peters and J.M. Southwood).

Environmental Assessment Modelling. Published as Section 8.1 of the IAEA Monograph "Environmental Behaviour of Radium." Technical Report Series No. 310, 1990 (with B.E. Halbert, V.J. Cassaday and F.O. Hoffman).

Examples of Dose Assessment: Mining and Milling in Canada. In: "The Environmental Behaviour of Radium – Vol.2". IAEA Technical Report Series No. 310, pp. 419-439, 1990 (with L.M. Lowe and R. John).

Assessing Risks From Incineration of Municipal Solid Wastes. Published in proceedings of EPA/ORNL Workshop on Risk Assessment for Municipal Waste Combustion, Deposition, Food Chain Impact, Uncertainty and Research Needs. 1989 (with B. Ibbotson and B. Powers).

Risk Assessment as an Environmental Tool. Presented at the American Mining Congress Convention, San Francisco, CA September 1989.

Radon in the Uranium Mine Environment: Exposure Estimation and Risk Prediction. Presented at Workshop/ Symposium on: Radiation Protection: Past and Future ("Marko" Conference), Chalk River, ON, 20-22 March 1989. Published as AECL-9959, June 1989 (with L.M. Lowe).

Exposures from Mining and Mine Tailings. Invited paper in special issue on "Radionuclides In The Environment", Radiation Physics and Chemistry 34(2): 295-307, 1989 (with L.M. Lowe and V.J. Cassaday).

The Assessment of Incineration Risks (A.I.R.) Model. Presented at the 1988 Annual Conference, Society for Risk Analysis, Washington, DC. (with J.D. Phyper, B. Powers, M. Rawlings and R. Willes)

A Primer on Radon and Potential Health Risks from Exposure to Radon Daughters. Prepared for International Symposium on Uranium and Electricity -

Teachers' Program. Saskatoon, SK, September 1988 (with L. M. Lowe).

Canadian Perspectives on the Management of Low-Level Radioactive Wastes. Keynote Address, International Symposium on Uranium and Electricity, Toronto, September 1988 (with R.A. Knapp and G.G. Case).

The Potential Radiological Impacts of Phosphogypsum Stacks. Presented at the Ninth Annual Conference of the Canadian Radiation Protection Association, Montebello, Quebec, 11-13 May 1988 (Abstract in Health Physics 56(4): 581, April, 1989.) (with L.M. Lowe and M.W. Davis).

Development of Clean-up Criteria For The Port Hope Remedial Program. In: Proceedings of the Annual Meeting of the Society for Risk Analysis, 1-4 November, 1987 Houston, Texas. Published as "Risk Assessment in Setting National Priorities" (eds. J.J. Bonin and D. E. Stevenson), Plenum Press, New York, pp. 25-41, 1989 (with L.M. Lowe, G.G. Case and R.W. Pollock).

Estimation of Long-Term Risk from Canadian Uranium Mill Tailings. Risk Analysis, Vol. 7, No. 3, 1987, pp. 287-298 (with R.A. Knapp and S. Kaplan).

Risks and Consequences of Occupational Exposure to Radon Daughters. Presented at the Eighth Annual Conference of the Canadian Radiation Protection Association, Saskatoon, SK, 27-29 May 1987 (abstract in conference proceedings) (with L.M. Lowe).

An Assessment of the Potential Health Risks From Exposure to Radon Daughters. Prepared for the Health Protection Branch, Department of National Health and Welfare, May 1987 (with L.M. Lowe).

Assessment of Risk from Uranium Mining in Virginia. In: "Environmental Health Risks: Assessment and Management." (ed. R.S. McColl) Waterloo, University of Waterloo Press, 1987, pp. 237-258 (Proceedings of symposium held on 29 May 1985) (with L.M. Lowe and V.J. Cassaday).

An Approach to Risk Assessment for Canadian Uranium Mill Tailings. Presented at the Second International Conference on Radioactive Waste Management, Winnipeg, Manitoba, September 1986 (with M.L. Murray, R.A. Knapp, and R.W. Holmes).

Probabilistic Assessment of the Long-Term Effects of Uranium Mill Tailings. Presented at the Second International Conference on Radioactive Waste Management, Winnipeg, Manitoba, September 1986 (with B.E. Halbert, M.L. Murray and D.I. Beals).

Probabilistic Analysis of the Environmental Behaviour of Uranium Mill Tailings. Presented to the Society for Computer Simulation, San Diego, January 1986 (with B.E. Halbert, M.L. Murray and D.I. Beals).

Health Effects of Radon. Presented at Workshop on Information Needs for Risk Assessment in Canada, Toronto, ON, September 1985. In: "Information Needs For Risk Management" (eds. C.D. Fowle, A.P. Grima and R.E. Munn), Environmental Monograph No. 8, Institute for Environmental Studies, University of Toronto, pp. 177-192, November 1988 (with L.M. Lowe).

Probabilistic Analysis of Radon Released from Uranium Mill Tailings. Presented at the Sixth Annual Meeting of the Canadian Radiation Protection Association, Saint John, NB, 11-13 June 1985 (with L.M. Lowe and M.L. Murray).

Safety Assessment of Uranium Mill Tailings: The National Uranium Tailings Program. Presented at the annual meeting of the Canadian Nuclear Society, Ottawa, ON, June 1985 (with W.C. Harrison and B.E. Halbert).

Conceptual Design Study of a Low-Level Radioactive Disposal Facility. Presented at the Health Physics Society annual meeting, Chicago, IL, May 1985 (with G.G. Case and R.A. Knapp).

Pilot ALARA Analysis Applied to Dose Reduction in an Underground Uranium Mine. In: Occupational Radiation Safety in Mining, Proceedings of the International Conference, Toronto, ON, 14-18 October 1984, Vol. 1, pp. 45-51. (Published by the Canadian Nuclear Association 1985) (with L.M. Lowe, J.L. Chakravatti, D. Lahoux,K. Black and K. Culver).

Beta Radiation Considerations in the Mining and Milling of High Grade Uranium Ore. To be presented at the International Conference on Occupational Radiation Safety in Mining. Toronto, ON, October 1984 (with J.R. Mernagh).

Potential Co Carcinogens in the Uranium Mine Environment. Presented at the International Conference on Occupational Radiation Safety in Mining, Toronto, ON, October 1984 (with R. Marchant).

Conceptual Design for Disposal of Uranium Refinery Wastes in Mined Limestone Caverns. Presented at Health Physics Society Annual Meeting, New Orleans, LA, June 1984 (with G. Case, J. Davis, D. Moffet).

ALARA Analysis for the Decommissioning of the Beaverlodge Uranium Mine and Mill Site. Presented at the Twenty-Ninth Annual Meeting of the Health Physics Society, New Orleans, LA, 3-8 June 1984 (with V.J. Cassaday, R.A. Knapp, L.M. Lowe, M.P. Filion).

Critical Receptor Pathways Analysis for the Decommissioning of the Beaverlodge Uranium Mine and Mill. Presented at the Fifth Annual Conference of the Canadian Radiation Protection Association, Banff, AB, 30 April – 3 May 1984 (with V.J. Cassaday, L.M. Lowe and M.P. Filion).

Design for Radiation Protection in a High Grade Underground Uranium Mine. Presented at Fifth Annual Conference, Canadian Radiation Protection Association, Banff, AB, May 1984.

TLV's for Non-Standard Work Schedules. Pollution Engineering, November 1983 (with L.M. Lowe).

Long Term Dose Implications of Accidental Releases from Nuclear Facilities. Presented at the Fall Meeting of the Ontario Section of the APCA on "Accidental Atmospheric Releases of Radionuclides and Toxic Chemicals", Minette, ON, 11-13 September 1983 (with D.W. Hopper and L.M. Lowe).

Air Quality Model Validation Study. Presented at the Seventy-Sixth Annual Meeting of the Air Pollution Control Association, Atlanta, GA, June 1983 (with D.W. Hopper and J.P. Jarrell).

A Model for the Regional Transport and Environmental Cycling of Carbon-14. Presented at the Twenty-Eighth Annual Meeting of the Health Physics Society, Baltimore, MA, 19-23 June 1983 (Abstract in Health Physics 45(1): 209, July 1983) (with J.M. Scharer and L.M. Lowe).

Accident Dispersion Modelling - A Simplified Approach. Presented at the Seventy-Sixth Annual Meeting of the Air Pollution Control Association, Atlanta, GA, June 1983 (with D.W. Hopper).

Calculation of Radiation Exposure in a Case-Control Study of Lung Cancers in Port Hope, Ontario. Presented at the Fourth Annual Conference of the Canadian Radiation Protection Association, Toronto, ON, 3-5 May 1983 (with G. Case and L.M. Lowe).

Environmental Issues Related to Uranium Mining. Presented at the Canadian Nuclear Association Seminar on Uranium and Nuclear Issues, Toronto, ON, November 1983 (with D.M. Gorber).

Design for Radiation Protection in the Mining of High Grade Uranium Ore. Chapter 70 of "Radiation Hazards in Mining - Control, Measurements and Medical Aspects", the Proceedings of the First International Conference, Colorado School of Mines, Golden, CO, October 1982 (with J. Mernagh and R.T. Torrie).

Overview of Uranium Tailings Management Practice. Presented at the International Conference on Radioactive Waste Management, Winnipeg, Man., September 1982 (with L.M. Lowe, R.A. Knapp and B.G. Ibbotson).

Assessment of Hypothetical Disposal Facilities for Canada's Low-Level Radioactive Waste. Presented at the Third International Conference on Radioactive Waste Management, Winnipeg, MB, September 1982 (with L.M. Lowe, A. Buchnea, L. Cabeza and E.J. Chart).

Environmental Considerations Related to Uranium Exploration. Presented at the Third Annual Conference of the Canadian Nuclear Society, Toronto, ON, June 1982 (with B.G. Ibbotson and V.J. Cassaday).

Public Health Effects of Radon from Uranium Mining and Milling. Presented at the Twenty-Sixth Annual Meeting of the Health Physics Society, Louisville, KY, 21-26 June 1981. (Abstract (slightly different title) in Health Physics 41(6): 874, December 1981) (with L.M. Lowe and R.B. Sutherland).

Fuel Cycle Risks - The Front End. Presented to the Canadian Nuclear Association Seminar on Nuclear Power Risks in Perspective, Toronto, ON, May 1981 (with S.E. Frost and V.J. Cassaday).

Potential Health Impacts of Enhanced Radiation Levels in Port Hope. Presented at the Second Annual Meeting of the Canadian Radiation Protection Association, Ottawa, ON, May 1981 (with L.M. Lowe, R.B. Sutherland and E.J. Chart).

The Canadian Experience - A Review of Environmental Considerations Associated with Uranium Mining Operations in Elliot Lake. Presented at the operation Action UP Conference on Uranium Mining and Radiation Safety at Michigan Tech University,

Houghton, MI, September 1980 (with D.M. Gorber and B.G. Ibbotson).

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Industrial Hygiene Survey of Uranium Mining and Milling Industry in Canada. Seminar at Canada Centre for Mineral and Energy Technology, Ottawa, ON, July 1977.

Taught Course in Air Pollution Control Engineering at University of Toronto (Spring 1976, Spring 1977). Offered by Department of Civil Engineering to fourth year and graduate students.

The Role of Noise in Environmental Impact Statements. Presented to a joint meeting of the PCAO and Ontario APCA, Toronto, ON, November 1976.

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Air Environment Review of Asbestos, Mercury and Lead. Presented at the Industrial Waste Conference, Toronto, ON, June 1975 (with D.M. Gorber and E. Koczkur).

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Stack Testing, Odour Measurement and In-plant Measurements. Joint seminar of the MOE and PCAO, Toronto, ON, 1974 (with E. Koczkur).

Review of Industrial and Environmental Noise Concerns. Presented at the AIME Fall Meeting, Hamilton, ON, 1973 (with E. Koczkur).

April 2002

SENES Consultants Limited

MEMORANDUM

TO: A.J. Thompson 33291

FROM: Doug Chambers 21June 2002

SUBJ: Overestimate of Beta Surface Activity in the ORISE report on Heritage Minerals

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ORISE carried out a confirmatory survey at Heritage Minerals Inc. and reported "survey activities including gamma, alpha plus beta, and beta surface scans, direct measurements, soil sampling, miscellaneous sampling, and exposure rate measurements." (p.6 (ORISE 2002). This memo focuses on alpha, and alpha/beta surface scans carried out on construction material using gas proportional counters, specifically the Ludlum Gas Proportional Detector Model 43-68 (p. 7 and Appendix A ORISE 2002)

We expect that the alpha/beta surface scan measurements of building materials reported by ORISE overestimate the true beta activity for the following reasons:

1. The gamma background has not been properly subtracted out of the alpha/beta measurements (alpha/beta measurements were made at gamma exposure rates that were at least four times higher than the gamma exposure rate in which the alpha/beta background was measured);
2. The alpha activity has not been subtracted out of the alpha/beta count; and
3. The contribution of low energy gamma and x-rays to the alpha/beta count has not been subtracted in the calculation of the beta activity.

1. Overestimate of Beta Activity Attributable to Underestimate of Gamma Background

Using the gas flow proportional counter, ORISE measured alpha/beta surface contamination in the laboratory, wet and dry mills and reported the results in Table 1 (p.43-49, ORISE 2002). Also, ORISE reported gamma exposure rates up to 10 μR/h in the centre of rooms in the laboratory, and up to 17 and 14 μR/h at 1 m above surfaces in the wet and dry mills, respectively (Table 2 p. 50, p. 8, ORISE 2002). The gamma exposure rates at the gas proportional counter in contact with surfaces in the laboratory, wet and dry mills are expected to have been higher than the reported values of 10, 17 and 14 μR/h.

ORISE reported that the background for the gas proportional detector operating on the alpha/beta plateau ranged from 236 cpm on wood to 303 cpm on poured concrete. Also, ORISE reported that the "background rates were determined for each material encountered in the surveyed area at a location of similar construction and **having no known radiological history**" (p. B-4 ORISE 2002) bolding added here for emphasis. It is reasonable to expect that the gamma exposure rate in the area

having no known radiological history were similar to "Background exposure rates ranged from 3 to 7 μR/h and averaged 4μR/h" (p. 12, ORISE 2002).

Ludlum Measurements Inc. reports that the background on the alpha/beta plateau of the Model 43-68 gas proportional detector is "typically 400 cpm or less (10 microR/hr field)" (Ludlum 2002). ORISE's background measurements ranging from 236 to 303 cpm are consistent with the specification by Ludlum. However, ORISE's values underestimate the true background for subtraction where gross alpha/beta measurements were made in gamma exposure rates of 17 μR/h and higher. Therefore, ORISE overestimated the beta surface contamination levels by subtracting the underestimated background from the gross alpha/beta proportional counts made in contact with the high gamma exposure rates.

2. The alpha activity has not been subtracted out of the alpha/beta count; and

The results of the alpha/beta surface scans are reported in the third column from the left in Table 2 (p. 43-49, ORISE 2002). It appears that ORISE has overestimated the beta activity by concluding that it is equal to the alpha/beta total activity. ORISE reports that "the alpha contribution to the alpha plus beta surface activity measurement count rate was consistently less than ten percent". The alpha activity is not less than 10% in the following examples: I-Beam-42A (p. 49); SU40-24 and Floor-34A (p. 48); etc. Therefore, ORISE has overestimated the beta activity on surfaces, if they have not subtracted the alpha activity from the alpha/beta activity in Table 2 (p. 43-49, ORISE 2002).

3. Contribution of low energy Gamma and X-rays to the Alpha/beta Count

RSI estimated that the beta contamination levels on surfaces are overestimated by reference to the alpha/beta measurements by gas proportional counter reported by ORISE. RSI reached their conclusion by observing that approximately 33% of the alpha/beta count rate remained after placing a ¼" plexiglass shield to intercept the beta particles between the contaminated surface and the detector. The remaining counts in the gas proportional detector are attributable to:

- gamma radiation from the contaminated surface that penetrates the plexiglass;
- gamma radiation from the surroundings that penetrates the sides and back of the detector; and
- intrinsic background in the detector.

We expect that the 67% of the count rate that was intercepted by the plexiglass is not composed only of beta particles. It comprises alpha particles as discussed in 2 above, and a fraction of the low energy gamma and x-rays that contributed to the alpha/beta count are also intercepted by the plexiglass. For example, more than 10% of the low energy gamma rays at 50 keV are attenuated by the plexiglass, and this value approaches 30% as the energy decreases to 30 keV. Based on the measurements using plexiglass reported by RSI, we expect that the beta contamination levels estimated by ORISE from the alpha/beta proportional counting are overestimates of the true beta contamination levels by more than 33%.

To develop an estimate of the contribution of low energy gamma and x-rays to the alpha/beta count rate and the corresponding reduction by absorbers such as a piece of plexiglass requires an experimental program at the site or under rigorously similar circumstances that duplicate all of the essential characteristics of the measurements. The problem is too complex to investigate using a theoretical approach alone. We would be pleased to work with RSI, or others, to develop an experimental program that would address these issues.

References:

Oak Ridge Institute for Science and Education (ORISE) 2002 Confirmatory survey of portions of the Heritage Minerals Incorporated facility Lakehurst, New Jersey. Docket No. 040-8980; RFTA No. 01-012

Ludlum Measurements Inc. 2002 web site www.ludlums.com/product/m43-68.htm

RSI

Radiation Science Inc.
10 South River Road
Cranbury, NJ 08512

April 22, 2002

Mr. John Lord
Hovnanian Industries
One Hovchild Plaza
4000 Rt. 66
Tinton Falls, NJ 07753

Re: Response to the ORISE Report

Dear Mr. Lord:

This letter provides our response to the ORISE report with regard to the mill buildings at the HMI facility. We conclude that ORISE has overstated the activity of any remaining materials, but demonstrated the need for additional cleaning and decommissioning activities prior to the release these facilities. The following paragraphs present our technical arguments and propose an alternative method for proceeding with the release of these facilities.

The mill buildings at Heritage Minerals, Inc. were surveyed for final release by detection of the alpha emission rate to quantify direct and removable characteristics of radioactive contamination. Measurement of the alpha emission rate was chosen to make a practical determination of the activity for comparison against the release criteria in Regulatory Guide 1.86. This simplification is possible for two reasons: 1) alpha particles are easy to distinguish from other radiation using standard survey methods (utilizing energy discrimination), and 2) once corrected for detector efficiency, the conversion between the alpha emission rate and isotopic activity is one-to-one.

ORISE argues however that because the alpha radiation can theoretically be shielded more readily than other types of radiation by rust, paint, or minor debris on the surface of potentially contaminated equipment, and therefore adversely affect detector efficiency, the measurement of alpha radiation alone is insufficient to account for all radioactive material present. ORISE attempts to correct for this problem by using instrumentation setup to detect beta radiation, which is not subject to the same shielding characteristics. Since only the alpha and beta radiation correspond uniquely with decay events, counting hits radiation alone would represent an accurate determination of the activity for comparison against the release criteria. The concept deserves merit but the ORISE procedure is inherently flawed because their methods lack ability to distinguish between concurrent beta and gamma radiation.

Because gamma radiation varies with yield (there can be as many as 200 gamma rays emitted per decay event) and energy (most of the gamma rays are emitted in the low energy spectrum), it is only possible to associate gamma rays with individual decay events using proportional counting methods. Although ORISE used gas proportional detectors to perform their survey, ORISE employed single channel analyzers, with no energy threshold or window to process the proportional signal. Thus, ORISE cannot distinguish between beta particles that deposit their energy in the gas volume of the detector and electrons that are "knocked" into the gas volume as a result of gamma rays "striking" the detector wall. Therefore, it is our opinion that the activity measured by the ORISE technique "counts" multiple gamma ray emissions and interprets these counts as individual decay events, hence grossly overstating the true activity.

A crude approximation of the overstatement can be obtained by a simple experiment (described in more detail below). Placing a 3/8" Plexiglas shield between the detector and source while maintaining the source to detector geometry will eliminate the beta component and allow an estimation of the overstatement. The results of estimating the gamma contribution by this method imply that the measured

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count rate is overstated by as much as 33%. If we take 33% off the ORISE numbers, the picture looks much different inside the mills. Instead of the broad conclusion that nothing is releasable, the picture is one of a few isolated hotspots or accumulations of material in hard to reach places.

Still, both ORISE's and RSI's data raise the question of what efficiency to apply to the count rate to properly convert the measured count rate to dpm. Alpha counting raises the issue of geometric efficiency (a practical concern), while attempting to count beta radiation raises questions regarding the more theoretical concerns of energy efficiency and detector response. It seems that neither is sufficient alone to determine an acceptable release.

Perhaps the most practical solution is presented in the ORISE report itself. The report quotes the 1991 NRC guideline for exposure rates at one meter above building surfaces as being 5 μR/h above ambient background. Since this methodology measures only the gamma emissions that are not affected by shielding concerns and the acceptable exposure rate has been determined based on the NRC's radiological considerations, then perhaps this should be used as the criteria for release of equipment from the mills.

Applying this criterion to the standing buildings and equipment will be a daunting task. From a practical sense, the mill buildings probably present more of an OSHA hazard to workers than a radiation hazard to the general public. Structurally speaking, the aging portions of the mill buildings probably have not been accessed in years. Many of the obvious construction methods are questionable. Walking on the elevated platforms with missing floor grates alone pose a worker safety issue let alone crawling and climbing over equipment and unsecured work areas. It could be unsafe to perform the cleaning and survey work necessary to free release the mill buildings according to these standards. However, it is practical and possible to disassemble the mill buildings through a process of controlled demolition. Once disassembled with pieces staged in a safe and workable fashion, each piece can be surveyed and cleaned as necessary to warrant free release. Using the 5 μR/h standard, a radiological survey can be performed at ground level in a practical, accurate, and safe manor using a micro-rem meter. If contamination were found, the ground level staging of the piece would make it amenable to rapid disassembly and further cleaning. This would provide the efficiency necessary to continue the demolition process using conventional demolition equipment.

Once the buildings and equipment have been removed, the remaining open slabs could be surveyed according to the same criteria as has been found acceptable for the monazite pile, chiefly to demonstrate that the dose contribution due to any radioactive materials remaining on the slabs is below 10 μR/h above background at one meter.

SUMMARY

It is the opinion of RSI that the mill buildings should be torn down using conventional demolition techniques; the pieces surveyed and further disassembled and cleaned as necessary using power washing equipment. The cleaned pieces should be released and removed from the site as scrap. Any radioactive material collected during the demolition and cleaning process should be removed along with any materials, if any, removed from the monazite pile footprint.

The monazite pile footprint and surrounding area should be further characterized according to the plan set forth by RSI. Any additional materials identified by that process and that contain licensable source material and which HMI cannot reasonably demonstrate were not due to the stored monazite must be addressed by HMI with NRC concurrence.

Once these materials, including any source material collected from the demolition of the mill buildings, have been removed, a dose assessment and final survey should be performed by RSI to

RSI

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demonstrate that the remaining licensed property no longer meets the NRC's SDMP criteria and should be removed from that listing and the source material license terminated.

Notes: The overstatement was determined by using the identical equipment used by ORISE under identical operating conditions. That is by using a Ludlum 44-68 gas proportional detector operating at 1700 volts HV and a Ludlum model 12 Survey meter. Note that use of a "gas proportional detector" does not in itself constitute proportional analysis, which is in this case a function of the meter electronics. Rather a simple acrylic shield (approx. 3/8" thickness) is used to shield the alpha and beta radiations, allowing only the gamma component to be counted. Alpha/beta activity is determined by subtracting the gamma component from the total count rate as determined without the shield in place. This is a conservative estimate of the true count rate because the acrylic shield and geometry attenuate some of the low energy gamma and x-rays, understating their contribution to the total count rate.

Sincerely,

Thomas P. Bracke P.E.
cc: Craig Gordon, Anthony Thompson

Phone: 609 395-1996 email: staff@radsci.com fax: 609 395-1178

This is to acknowledge the receipt of your letter/application dated
06/26/02 & rec'd @ NRC/LAT 07/17/02., and to inform you that the initial processing which includes an administrative review has been performed.

☒ NOTIF. 040-08980
There were no administrative omissions. Your application was assigned to a technical reviewer. Please note that the technical review may identify additional omissions or require additional information.

☐ Please provide to this office within 30 days of your receipt of this card

_____.

A copy of your action has been forwarded to our License Fee & Accounts Receivable Branch, who will contact you separately if there is a fee issue involved.

Your action has been assigned **Mail Control Number** 131796.
When calling to inquire about this action, please refer to this control number.
You may call us on (610) 337-5398, or 337-5260.

NRC FORM 532 (RI)
(6-96)

Sincerely,
Licensing Assistance Team Leader

	:	(FOR LFMS USE)
	:	INFORMATION FROM LTS
BETWEEN:	:	----------
	:	
License Fee Management Branch, ARM	:	Program Code: 11800
and	:	Status Code: 0
Regional Licensing Sections	:	Fee Category: 14
	:	Exp. Date: 20030630
	:	Fee Comments: SEE 3/12/91 NOTE
	:	Decom Fin Assur Reqd: Y

LICENSE FEE TRANSMITTAL

A. REGION

1. APPLICATION ATTACHED
   Applicant/Licensee: HERITAGE MINERALS, INC.
   Received Date: 20020717
   Docket No: 4008980
   Control No.: 131796
   License No.: SMB-1541
   Action Type: Notifications

2. FEE ATTACHED
   Amount: ~~____~~
   Check No.: ~~____~~

3. COMMENTS

Signed R. J. Brown
Date 07-30-02

B. LICENSE FEE MANAGEMENT BRANCH (Check when milestone 03 is entered /__/)

1. Fee Category and Amount: _____

2. Correct Fee Paid. Application may be processed for:
   Amendment _____
   Renewal _____
   License _____

3. OTHER _____
   _____

Signed _____
Date _____