

February 19, 1999

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

ATOMIC SAFETY AND LICENSING BOARD PANEL

Before Administrative Judges:
Peter B. Bloch, Presiding Officer
Thomas D. Murphy, Special Agent

_____)	
In the Matter of:)	
)	
HYDRO RESOURCES, INC.)	Docket No. 40-8968-ML
2929 Coors Road, Suite 101)	ASLBP No. 95-706-01-ML
Albuquerque, NM 87120)	
_____)	

AFFIDAVIT OF DAN W. McCARN

1. My name is Dan W. McCarn. The factual statements herein are true and correct to the best of my knowledge, and the opinions expressed herein are based on my best professional judgment.

2. My professional qualifications are summarized here and in the attached Statement of Qualifications (Exhibit A). I have a Bachelors of Science Degree in Geology from Birmingham-Southern College (1975). I am currently completing my dissertation for a Doctorate of Geology at Leoben Mining University, Leoben, Austria. In addition, I am completing a Masters Degree in Civil Engineering (Environmental) from University of New Mexico. I have over 20 experience in

contaminant hydrogeology, geostatistics, nuclear waste management, hydrologic modeling, uranium geology, and development of geostastical and groundwater computer codes.

3. My testimony is based on my professional judgement and the following publications:

Written Testimony of Michael G. Wallace and specifically Exhibit D to that testimony.

McCarn, D.W., 1997, *The Crownpoint and Churchrock Uranium Deposits, San Juan Basin, New Mexico: An ISL Mining Perspective*, IAEA, Technical Committee Meeting on Recent Developments in Uranium Resources, Production and Demand – Vienna, 10-13 June, 1997.

4. Exhibit D of Mr. Wallace's testimony concerns a figure from a paper written by me describing uranium deposits at HRI, Inc.'s Crownpoint proposed production site. It is my affidavit that the statement made by Mr. Wallace describing Figure 8 (attached) as "depicting stacked roll fronts at the Crownpoint site, which obviously correspond to sand channel morphology" is incorrect. The exhibit in my paper (Exhibit B here) does depict stacked uranium "roll fronts" but is well known that "roll fronts" in the San Juan Basin in general, and at HRI, Inc.'s project sites specifically, are not contained by channel sands, but instead are contained in wide spread, continuous sandstone host rocks.

I declare on this 18 day of February 1998, at Albuquerque
New Mexico, under penalty of perjury that the foregoing is true and correct.

[Signature]

Sworn and subscribed before me, the undersigned, a Notary Public in and for the
State of New Mexico, on this 18th day of February 1998, at Albuquerque
New Mexico. My commission expires on 10/2002

[Signature]
Notary

(SEAL)



Dan W. McCarn, CPG
10228A Admiral Halsey NE; Albuquerque, NM 87111
Tel/Fax: 1-505-822-1323; Email: dwmccarn@aol.com

Social Security No. 424-72-6622; Citizenship: USA

Preferred Locations: North America, Latin America, Central Europe, and Former Soviet Union

Profile

Twenty-two years experience in the minerals, environmental, and nuclear industries with focus on Performance Assessment of nuclear waste repositories, mathematical programming, numerical modeling & geostatistics, project management of hydrogeological and water-quality investigations, pollution prevention, consulting on mine / mill licensing and decommissioning. Twelve years of international experience in Central & Eastern Europe and Latin America.

Present Focus

Development of civil, environmental, and mineral engineering skills to complement experience in environmental and minerals geology.

Education

1997-Present: Doctoral Candidate (Geology), Leoben Mining University

1998-Present: Studies in Civil Engineering, University of New Mexico

1968-1975: B.Sc. Geology, Birmingham-Southern College, Birmingham, Alabama

Certification / Membership / Training

AIPG Certified Professional Geologist CPG-10245

Wyoming Professional Geologist PG-3031

OSHA 40-Hour Hazmat Certification; Medically certified for full-face respirator

University of New Mexico: Radiation Safety Training

Member: Society for Mining, Metallurgy, and Exploration (SME)

New Mexico "Green Zia" Environmental Excellence Advisory Council & Pollution Prevention Training

Professional Experience

1995-Present: IPI Consulting, Albuquerque, New Mexico, USA

1998-Present: Guest Professor, Albuquerque Technical Vocational Institute, Albuquerque, NM, USA

1/1998-8/1998: TSR, Sandia National Laboratories (Staff Augmentation), Albuquerque, NM, USA

1992-1995: Senior Staff Consultant, INTERA, Inc., Albuquerque, NM, USA

1991-1992: Project Manager, P.E. LaMoreaux and Assoc., Tuscaloosa, AL, USA

1988-1990: Guest Scientist, Joanneum Research / Leoben Mining University, Austria

1980-1988: Tech. Officer, Nuclear Fuel Cycle Div., International Atomic Energy Agency, Austria

1975-1980: Geologist III, Bendix Field Engineering Corp., Grand Junction, Colorado, USA

Skills

Significant experience in Performance Assessment (PA) of nuclear waste repositories, nuclear fuel cycle, hydrogeology, geology, geochemistry, geostatistics, and mathematical programming. Fluent in German, conversational in Russian. Twelve years international experience including eight years at the International Atomic Energy Agency, three years at the Leoben Mining University, Austria, one year in the Former Soviet Union, and projects in Austria, Belarus, Brazil, Czech Republic, and Mexico. Extensive travel and working contacts in Central & Eastern Europe from 1980 to present.

Current Studies

Civil / environmental engineering course-work at the University of New Mexico for a Masters in Civil Engineering. Doctoral candidate at Institut für Geowissenschaften, Leoben Mining University, Austria. Focus on "*Development and application of stochastic methods in estimation of multi-pathway natural risk from discovered and undiscovered mineral deposits*". GPA for all graduate work to date: 3.9.

Performance Assessment

- Technical review of the Nebraska LLRW repository including depositional framework, critique of ground water modeling, geochemical sampling design, and geochemistry of natural radionuclides.
- IAEA expert mission to Mexico (MEX/9/035-2) to review status of the proposed LLRW repository at the Laguna Verde Reactor and the Maquixco repository north of Mexico City. Mission resulted in recommendation by the IAEA to close and remove waste from Maquixco.
- IAEA expert mission to Czech Republic (CZR/3/002-01) to review plans for decommissioning of two uranium production facilities (Rožná, Central Moravia, and Stráž, Northern Bohemia) including alternatives for tailings free water disposal and ISL mine remediation.
- Fuel-cycle analysis, economics, and policy of utilization of Chernobyl-contaminated forest biomass power options. Included review of disposal options of ^{137}Cs effluent. Recommended study of 3000-m Devonian intra-salt dolomites in the Gomel trough (30 km north of Chernobyl) as a potential deep well disposal option.
- Extensive experience in the WIPP Performance Assessment including development of geostatistical methods (EDAVAR & AKRIP II) and modification of the GRASPINV codes to utilize geostatistical models in the development of conditionally simulated Culebra transmissivity fields.
- Development of geochemical models using PHRQPITZ and LEHGC and spreadsheets for brine mixing scoping calculations for the E1 brine intrusion scenario in the Culebra Dolomite.
- Review of archeological artifacts from Natural History Museum, Vienna, of Bronze-age Austrian salt mines for evidence of preservation of metal (bronze) and organic material (clothing, leather, wood) in saturated brine. Brine chemistries included both reducing (methanogenic) and oxidizing environments.
- Provision of potential uranium mineralization models for the Yucca Mountain repository including review of uranium mineralogy and associated elements.
- Dissertation focus (geology) on mineral deposit analogues to repositories for stochastic modeling and estimation of multi-pathway natural risk from undiscovered and discovered mineral deposits.
- Master's thesis (engineering) focus on coupled groundwater-geochemical modeling of uranium in situ leach (ISL) mining and remediation.

Scientific Programming & Database Management

Significant mathematical programming experience on VAX and PC environments with geostatistical codes (UVKRIG 2.0, EDAVAR, AKRIP II), geochemistry (LEHGC, HYDROGEOCHEM 2.0, PHRQPITZ), and groundwater codes (SWIFT, HST3D & GRASPINV. Relational database design (INTURGEO, NFCIS, Uranium database) and management (Adabas/Natural, ISIS, Access). Numerical systems for uranium supply / demand modeling (RAPP3D), uranium ore reserve calculation (URAD), uranium database (INTURGEO) & nuclear fuel cycle database (NFCIS). Significant experience in Fortran-90, SAS, Adabas/Natural, Basic, Windows 95 & NT, UNIX, VMS, Access 97, Excel, Outlook, Word 97, WordPerfect 7, Quattro Pro 7, Surfer 6, ARC-View 3.0, FORTRAN graphics libraries (PLOTS, INGRAF, GDDM), mathematical libraries (Numerical Recipes, IMSL, GSLIB), and wide knowledge of numerical / mathematical methods.

Spatial Data Analysis, Geostatistics, and Groundwater Modeling

Exceptional abilities in development of geostatistical, spatial visualization, numerical modeling software for variography (EDAVAR) & kriging (AKKRIP II). EDAVAR, based on GeoEAS 1.2.1 and earlier work at the Leoben Mining University, uses Exploratory Data Analysis (EDA) techniques on spatial data. EDAVAR provides 11 different variogram, alternative variogram, and cross-variogram estimators, and several measures of central tendency (e.g. mean, median, trimean, etc.). EDAVAR performs equal-N or equidistant lag calculation, semi-automatic management of geometric anisotropism, semi-automatic fitting of 10 different models (e.g. spherical, gaussian, exponential, etc. including a General Covariance Function) using non-linear weighted least squared error (L2) and weighted least absolute error (L1) techniques, and EDA methods such as median-polish for complex external drift removal and analysis. Selection of data based on a user-defined classification, outlier rejection, and Winsoring. Structural analysis of modeled variogram residuals as well as nested models.

AKRIP II, developed from UVKRIG V2.0 and the older MIT AKRIP code provides a complete package for ordinary and universal, point and block kriging using both equidistant and Gauss point quadrature for block kriging, nested

variogram structures, modeling of geometric and zonal anisotropism, selection of individual monomials in universal kriging, spatial probability estimators for exceedence of a criteria, cross-validation, and interface with EDVAR as well as SWIFT and other groundwater codes.

Familiarity with finite difference and finite element groundwater codes including HST3D, SWIFT, MODFLOW, and VAM3D. Familiarity with HST3D and SWIFT includes programming and redevelopment of these codes to meet hydrologic modeling requirements. Redeveloped GRASPINV code to allow for enhanced numerical precision as well as inclusion of geostatistical estimation codes in the model. Involved in the development of an inverse groundwater model (GRASPINV) for transient calibration of heads with transmissivities using a synthetic "pilot point" technique for the Waste Isolation Pilot Plant Performance Assessment (WIPP PA) group.

Environmental Experience

■ Experience in environmental litigations including expert testimony. ■ Mine licensing and environmental review. ■ Phase I & II environmental site assessments and pollution prevention studies. ■ Soil, water, & geomeia sampling programs. ■ Environmental & minerals drilling. ■ Monitoring well system design, drilling, and well construction & development. ■ Negotiation with regulators. ■ Technical & environmental aspects of in situ leach mining, decommissioning, restoration, and uranium mine life cycle planning. ■ Knowledge of water rights.

Environmental Projects

■ Project management, cost estimation, sub-contracting, supervision, and billing of environmental investigations. ■ Assessment of groundwater quality in heterogeneous basins (Tullner Feld, Mittendorfer Senke) in Austria. ■ Project management for the Acustar Facility, Huntsville, Alabama (TCA storage tank spill) and interpretation of hydrogeologic framework in a laterized residual soil from a carbonate host. ■ Development of a 1D mathematical model of reductive dechlorination reactions in reducing groundwater to describe fate of contaminants from TCA degradation including DCE, VC, acetic acid and chloride ion. ■ Performance assessment of four nuclear waste repositories. ■ Expert testimony of hydrogeologic and structural setting of septic tank discharge from a chicken hatchery in faulted limestone terrains of Northwest Georgia. ■ Chlorinated solvent contamination of public water wells in laterized high-grade metamorphics of the inner-piedmont block in Georgia. ■ Expert testimony of results of a tidal monitoring network for a partially closed intertributary embayment in the Mobile Delta and interpretation of the modern depositional environments. ■ Depositional framework model for the Lowry Landfill, Colorado. ■ Preparation of expert testimony of flooding (N. Alabama) caused by changing land use and erosion; Oversaw detailed topographic survey, performed field investigations, and interpreted aerial photographic data. ■ Environmental coordinator for HRI involved in licensing of the Crownpoint / Churchrock uranium ISL mines.

Subsurface Work:

Subsurface studies in USA, Central and Eastern Europe involved interpretation of geophysical log data, driller's logs, hydrologic data, and included preparation of isopachus, net sand, sand-shale ratio and analysis of depositional environments as well as interpretation of hydrogeological and geochemical data.

Sites include: ■ Tullner Feld (Danube Valley) including Tertiary disturbed and undisturbed Mollasse and Quaternary sediments, Austria, ■ Devonian bedded salts of the Gomel Trough, Belarus, ■ Hugoton Embayment of the Anadarko Basin, ■ Sierra Grande-Apishapa Uplift, ■ Raton Basin, ■ Denver Basin, ■ Los Animas Arch, ■ Sangre de Cristo Mtns, ■ San Juan Basin, ■ Alamosa Basin, Colorado, ■ Red Desert, Wyoming, ■ Delaware Basin, New Mexico, and ■ Laterized residuum in Mississippian carbonate terrains in North Alabama.

Geochemistry / Modeling / Field Mapping & Sampling

Mineral-solution equilibria and transport modeling (LEHGC, PHREEQC, PHRQPITZ, HYDRAQL) with applied experience in Performance Assessment of repositories, minerals exploration, natural attenuation for in situ leach mining projects, and groundwater quality / chemistry of large basins. Extensive experience in organization and execution of field campaigns for collection, preservation, QA, and chain-of-custody of exploration geochemical and environmental samples. Extensive geological mapping an exploration in southern and southeastern Colorado, northwestern New Mexico, panhandle Oklahoma, and Wyoming (Red Desert). Exploration for and evaluation of favorable environments and targets for uranium. Resource assessment of 60,000 km² for uranium utilizing subjective probabilistic resource endowment methods.

Lecturing / Training

Experience in HAZMAT training including occasional invited lectures at the Albuquerque Technical Vocational Institute (TVI) focused on groundwater issues and problems. Occasional lectures in the Department of Nuclear Engineering for graduate seminars on environmental issues related to uranium mining.

Reports & Publications

- 1) McCarn, Dan W., (In Progress): Uranium In Situ Leach Mining: Methodology, Economics, and Cost, IPI Uranium Fact Sheets.
- 2) McCarn, Dan W. (In review): Natural Attenuation Processes in Cenomanian & Turonian Sediments following Acid In Situ Leach Mining of Uranium, Stráz pod Ralskem, Northern Bohemia, Czech Republic, Presentation & paper for course requirement at University of New Mexico, CE-551-005.
- 3) McCarn, Dan W., (In Review): Uranium By-Product Recovery from Phosphoric Acid: Methodology, Economics, and Cost, IPI Uranium Fact Sheets.
- 4) McCarn, Dan W., (In progress): Uranium Supply-Demand Scenarios for the Millenium, IPI Uranium Fact Sheets.
- 5) McCarn, Dan W., (On-going): Summary of Major Uranium Deposit Types, IPI Uranium Fact Sheets. (Used as lecture notes and materials for a graduate seminar for the Nuclear Engineering Department, University of New Mexico).
- 6) McCarn, Dan W. (In Review): LEHGC 1.2 Modifications and Sample Problems, Sandia National Laboratories Internal Report, July 5, 1998.
- 7) McCarn, Dan W. (In Review): Program PHRQPITZ V1.1: Modifications and Sample Problems, Sandia National Laboratories Internal Report, July 6, 1998. (Also four additional QA reports to support PHRQPITZ).
- 8) McCarn, Dan W. (In Review): Brine Mixing Scoping Calculations for the E1 Brine Intrusion Scenario in the Culebra Dolomite, Appendix 1, Waste Isolation Pilot Plant (WIPP), WBS1.1.10.3.5, Effective Date: June 22, 1998.
- 9) McCarn, Dan W. (1997): Evaluation of proposed strategies for mill tailings wastewater disposal at Stráz, Northeast Bohemia, and Rožná, Southern Moravia, DIAMO Uranium Production Facilities, Czech Republic: Final Report of Mission for the International Atomic Energy Agency, Technical Cooperation Project CZR/3/002-01, September 26 - October 6, 1997, IPI Consulting, Albuquerque, New Mexico, October 24, 1997, (Confidential).
- 10) McCarn, D.W., (1997): The Crownpoint and Churchrock Uranium Deposits, San Juan Basin, New Mexico: An ISL Mining Perspective, Technical Committee Meeting on Uranium Resources, Production, and Demand, International Atomic Energy Agency, June 10-13, 1997.
- 11) McCarn, D., Dubovik, L., Iakoushev, A., and Grebenkov, A. (1996): The Ecological-Commerce (ECO-COM) Zone Concept for Developing Biomass Energy from Contaminated Resources: A New Demonstration Zone for the Republic of Belarus, in International Topical Meeting on Nuclear and Hazardous Waste Management, Seattle, Washington, August 18-23, 1996, pp. 1417-1424.
- 12) Grebenkov, A. and McCarn, D.W. (1996): The US-Belarus Joint Projects Associated with Remediation of the Chernobyl Contaminated Sites, Environmental Opportunities in Central and Eastern Europe and the Newly Independent States, in Partnerships for Solutions Forum, Colorado School of Mines, Golden, Colorado, p. 19-35.
- 13) McCarn, D.W. (1995): EDAVAR - Exploratory Data Analysis Variography for Spatial Data, User's and Programmer's guide for the WIPP Performance Assessment Group, INTERA, Inc, Albuquerque.
- 14) McCarn, D.W. (1994): The AKRIP II Code Documentation and User's Manual: Ordinary and Universal Kriging. Internal Report for INTERA, Inc.
- 15) McCarn, D.W. (1994): Current Trends in the Uranium Market: The Issue of Uncommitted Demand, Presentation to the Waste-Management Education & Research Consortium, Las Cruces, New Mexico, Advisory Group Meeting, November 10-11, 1994.
- 16) McCarn, D.W. and Kaplan, P. (1994): Probabilistic Geotechnical Decision Modeling and Data Worth, Presentation to the Belarus State Chernobyl Committee and International Atomic Energy Agency.
- 17) LaVenue, M. and McCarn, D.W. (1993): Analysis of 1992 Conditionally Simulated Culebra Transmissivity Fields, Report to the WIPP Geostatistics Committee (GXG) on March 23, 1993 by INTERA, Inc.
- 18) McCarn, D.W. and Carr, J.R. (1992): Influence of Numerical Precision and Equation Solution Algorithm on Computation of Kriging Weights, Computers & Geosciences, V. 18, No. 9, pp.1127-1167.
- 19) McCarn, D.W. (1992): IAEA Technical Cooperation Project MEX/9/035-2: Nuclear Waste Management: Permanent Repository for Low- and Intermediate-Level Waste, Report of Mission Laguna Verde (Veracruz) and Mexico City, October 5-17, 1992. Contracted through P.E. LaMoreaux and Associates. Report approved and transmitted to Mexico in 1993.

- 20) Wolfbauer, J. & Others (1991): Qualitätsmeßstellennetz Tullner Feld Auswertung, BMLF, GZ 41.032/20-IV 1/89, Endbericht, Leoben, Im Juni 1991, Forschungsinstitut für Geo- Datenerfassung und -Systemanalyse, Montanuniversität Leoben.
- 21) McCarn, D.W., Stibitz, M. and Weinzierl, O. (1990): Tullner Feld Zusatzbeprobung zur Feststellung der Ursache der gelösten Festofferrhöhung im Grundwasser 10 km östlich von Tulln, Interner Bericht, Forschungsinstitut für Geo-Datenerfassung und -Systemanalyse an der Montanuniversität Leoben.
- 22) McCarn, D. (1989): Development of an Austrian Data Management System for the Cleanup of Contaminated Areas Caused by Chemical or Industrial Accidents, in Proceedings: Policy Responses to Large Accidents - International Institute of Applied Systems Analysis, Laxenburg, Austria, p. 17-35.
- 23) McCarn, D.W. (1989): Modification and Updating the RAPP3C Computer Program (Resource and Production Projection), Consultant's Report, 6-10 November, 1989, IAEA Internal Report, International Atomic Energy Agency, Vienna, Austria.
- 24) DeVergie, P. and McCarn, D. (1988): User's guide for the uranium ore reserve calculation system (URAD), IAEA-TECDOC-484, Vienna.
- 25) McCarn, D. (Editor) (1988): Geological Data Integration Techniques, Proceedings of a IAEA Technical Committee, IAEA-TECDOC-472, Vienna.
- 26) Dahlkamp, F., McCammon, R. and McCarn, D. (1988): Recommendations for a Revised Uranium Deposit Classification System and the Development of Related Deposit Recognition Criteria, IAEA Internal Report, Vienna.
- 27) Ajuria, S. and McCarn, D. (1988): The Nuclear Fuel Cycle Information System: A Directory of Nuclear Fuel Cycle Facilities, STI/PUB/794, IAEA, Vienna, 144 p.
- 28) McCarn, D.W. and others (1988): INTURGEO: The International Uranium Geology Information System - A World Atlas of Uranium Occurrences and Deposits, IAEA-TECDOC-471, Vienna, 493 p.
- 29) Ajuria, S., and McCarn, D. (1987): The Nuclear Fuel Cycle Information System, IAEA TECDOC-408, Vienna, 123p.
- 30) McCarn, D. and Mueller-Kahle, E. (1986): Long-Term Uranium Supply-Demand Analysis, IAEA-TECDOC-395, Vienna, 91 p.
- 31) DeVergie, P. and McCarn, D. (1985): The RAPP3B Resource and Production Projection Modeling Systems User's Guide, IAEA Internal Report, Vienna.
- 32) Paterson and others (1984): World Speculative Uranium Resources - Revised IUREP (International Uranium Resource Evaluation Programme) Estimates 1983, Internal Report, International Atomic Energy Agency, Vienna, November 1984.
- 33) McCarn, D. (1983): Recommendations for INTURGEO System Implementation for IAEA Project BRA/3/010 to the Comissio Nacional de Energia Nuclear, Rio de Janeiro, Brazil.
- 34) Johnson, V.C., McCarn, D.W., Kocis, D. (1982): National Uranium Resource Evaluation, Trinidad Quadrangle, Colorado, U.S. Department of Energy, PGJ/F-034 (82), Grand Junction, Colorado.
- 35) McCarn, D.W., Johnson, V.C. and Theiss, N.T. (1982): National Uranium Resource Evaluation, La Junta Quadrangle, Colorado and Kansas, U.S. Department of Energy, PGJ/F-100 (82), Grand Junction, Colorado.
- 36) McCarn, D.W. and Freeman, R.W. (1976): Chemical Analyses of Ground and Surface Water Samples from Parts of the United States 1956-1975, U.S. Energy Research and Development Administration, GJBX-51 (75), 541p., Grand Junction, Colorado.

References

Richard Clement, President
Hydro Resources, Inc.
2929 Coors Road NW; Suite 101
Albuquerque, NM 87120-2929 USA
Toyah@ix.netcom.com
Tel: 1-505-833-1777; Fax: 1-505-833-0777

Dr. Alexander (Sasha) Grebenkov
Institute of Power Engineering Problems
220109 Minsk, Sosny, Belarus
greb@sosny.bas-net.by
Work: +375-172-46-7542
Home: +375-172-59-7289

Donald Clark (Former IAEA)
2519 Cordova Ct.
Richland, WA 99352 USA
DonClark@GTE.NET
Tel: 1-509-375-0352

Barry King, T&SO
Albuquerque Technical-Vocational Institute
525 Buena Vista SE
Albuquerque, NM 87106 USA
bking@tvi.cc.nm.us
Work: +1 (505) 224-3785
Home: +1 (505) 836-6044

Fig. 8: Stacked Roll Fronts in the SE ¼ of Section 24 at Crownpoint

