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III Exh. 5

STATEMENT REGARDING INFILTRATION RATE ISSUE RAISED BY CONTENTION 4(a) AS SET FORTH IN THE NOVEMBER 14, 1989 MEMORANDUM AND ORDER OF THE ATOMIC SAFETY AND LICENSING BOARD OF THE US NRC

Ref for ID

by

Gerald R. Thiers

The Memorandum and Order cited above states the need to resolve the difference between two infiltration rates published for the cell: The Kerr-McGee Engineering Report estimate of 0.025 cm/year (Vol. II, p. 2-80) and the SFES value of 3 cm/year (SFES, p. E10).

Subsequent testimony by expert witnesses results in the following estimates:

1. Charley Yu, in answer to the question on Page 2 of his testimony, "What is the most probable value of infiltration rate and what is its uncertainty?", states:

   "The actual value of infiltration rate depends on the construction of the disposal cell and <u>the integrity of the cell in the long-term</u> (Emphasis added). For the analysis of the long-term impacts, a reasonably conservative infiltration rate was estimated by the staff. This conservatism is consistent for all alternatives. Cell infiltration rate may vary from time to time. The value of <u>3 cm per year</u> (Emphasis added) represents the "time-averaged" annual infiltrate rate; it was estimated based on site-specific annual precipitation, evaportranspiration and runoff."

2. On page 7 of testimony submitted by a panel composed of Charles W. Fetter, Jr., James L. Grant and John C. Stauter, the testimony reads:

   "Kerr-McGee allowed for increased infiltration through the root zone into the cell by increasing the assumed hydraulic conductivity of the surface

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soil layer by a factor of 10 - a very conservative adjustment that serves to over-estimate predicted infiltration. Under these conditions, cell infiltration was calculated to be about 0.1 inches (0.254 cm) per year (Emphasis added)."

These two testimony statements reduce the range of infiltration rates presented by Kerr-McGee to approximately 0.3 to 3.0 cm/year.

Limiting the infiltration rate to the range cited above depends on the clay layer remaining intact and unaffected by weather, including erosive forces due to storm water runoff. The acceptable design storm for uranium tailings disposal cells is given by the U.S. Nuclear Regulatory Commission in their document, "Standard Review Plan of UMTRCA Title I Mill Tailings Remedial Action Plans," October, 1985, as the probable maximum precipitation (PMP). Kerr-McGee has agreed (IX-Eng. Rep. 9-13) that the PMP storm event is "generally accepted by the NRC." This is in fact the state-of-the-art for design of covers for uranium tailings disposal cells, as indicated by the US NCR staff in "Uranium Mill Tailings Management Position," 1989.

Unfortunately the cell cover proposed by Kerr-McGee is designed using only "storm-specific forms of the USLE [Universal Soil Loss Equation] and the MUSLE [Modified USLE]" (VI Eng. Rep 6-9 to 6-18). These equations, which do not include snow-melt or storms as large as the PMP, and do not consider gully erosion*, are not the equations approved by NRC for the design of covers for uranium tailings repositories (See US NRC staff Technical Position, "Design of Erosion Protection Covers for Stablization of Uranium Mill Tailings Sites," August, 1989, p. A-2). The approved method is the Horton method described on pages A-2 through A-6 in this reference. This method should be used for design of the cover. NRC specifically states that the cover should be designed for gully erosion (above ref., p. 6)

*Ref. "Erosion Control During Highway Construction," National Cooperative Highway Research Program Report 221, April 1980, pp. 5 and 6.

using the PMP storm (same ref., p. 4-6). (See also US NRC, Overland Erosion of Uranium Mill Tailings Impoundments: Physical Processes and Computational Method, NUREG/CR-3027, March 1982, and US NRC, Design Considerations for Long-Term Stabilization of Uranium Mill Tailings Impoundments, NUREG/CR-3397, October 1983).

Because the cover is not designed to resist large storms and is not designed to prevent the formation of gullies, which concentrate runoff, deep and extensive erosion will develop. This will constitute major damage, and could lead to total removal of the cover. Unless the cover is designed to resist these phenomena it cannot be relied on to protect the clay layer. This means the clay layer can be eroded or subjected to other forms of deterioration, causing the infiltration rate to increase beyond the range estimated for an intact, undisturbed clay layer. As a minimum the infiltration rate would then revert to the natural value for the West Chicago area, of approximately 3 to 4 inches/year.

Even if portions of the clay remained intact, gullies which extend through the clay to the tailings would allow direct inflow of runoff. In this case the infiltration rate would be greater than the natural value and would be bounded only by the annual precipitation of 30 + inches per year. Unless the cover is designed using state-of-the-art criteria for uranium tailings cells, as required by the NRC, an infiltration rate that is significantly higher than that used in the SFES should be used in computing potential impacts on groundwater quality.

GERALD R. THIERS
Principal Engineer

EXPERIENCE SUMMARY

Jerry Thiers has more than 33 years of experience in geotechnical engineering, specializing in environmentally sensitive design of foundations, dams and hazardous waste containment. He has taught, performed, and managed the various aspects of field investigations, feasibility studies, seepage and geochemical analyses and design of earth related construction.

Thiers has supervised research and design in slope stability, seismic loading, consolidation, and behavior of piles and subsurface and above grade waste repositories. He was responsible for design, testing, and performance monitoring of a 400-foot high earth dam; foundation design and construction analysis for a major fossil-fuel power plant; and preparation of criteria, drawings and specifications for uranium tailings isolation systems.

His work has included pile testing for a 1,000-pile foundation for a turbine-generator manufacturing plant, geotechnical investigations and design for the Trans-Panama pipeline, seepage cut off structures for mine waste leach facilities, shallow and deep foundations for a coal gasification plant, and seismic analyses of dams for tailings disposal, hydropower, and water supply. As consultant on the uranium tailings reclamation system for Union Carbide at Uravan, Colorado, Thiers worked on seismic, seepage and consolidation analyses for the uranium tailings pile. As Site Design Engineer for the Uranium Mill Tailings Remedial Action Project, Thiers is responsible for design procedure and final design for isolation of radioactive uranium tailings at sites ranging from 8 to over 90 acres, with tailings volumes ranging from 40,000 to 4,000,000 cubic yards. This work includes preparation of construction drawings and specifications and hydrogeologic and contaminant migration analyses for permanent repositories for the tailings. Thiers' work has led to publication of more than a dozen articles.

EDUCATION: BS (1956), MS (1959), PhD (1968), Civil Engineering; University of California, Berkeley

SOCIETY: American Society of Civil Engineers

REGISTRATIONS: Civil Engineer - California, Pennsylvania, Washington

University of Washington
Seattle, Washington
1959 - 1962

As a faculty member, Thiers conducted applied hydraulic experiments and was a consultant on a major landslide at the Portland Zoo.

U.S. Army Corps of Engineers
Seattle, Washington
1957 - 1959

Thiers participated in foundation investigations, the analysis of the stability of a major earth and rockfill embankment, and stability analyses for numerous dikes and levees.

PUBLICATIONS:

"Selection of Durable Rock for UMTRA Project Sites" with G. Lindsey and R. Rager, DOE Annual Contractors Meeting, Gaithersburg, MD, October, 1988.

"Recent Developments in Disposal and Isolation of Uranium Mill Tailings Under the UMTRA Program," with T.R. Wathen, Proceedings, Waste Management '87, Tucson, Arizona, March, 1987.

"Burying the Nuclear Past," with J.R. D'Antonio and J.A. Caldwell, Civil Engineering, February, 1987.

"Uranium Tailings Reclamation - Regulation, Design and Construction," with T.R. Wathen, Proceedings, Waste Management '86, Tucson, Arizona, March, 1986.

"Tailings Stabilization Experience at the Canonsburg UMTRA Site," with T.R. Wathen and L.L. Farnes, Proceedings, Geotechnical and Geohydrological Aspects of Waste Management, Fort Collins, Colorado, February, 1986.

"Isolation of Abandoned Uranium Mill Tailings," with E.S. Smith, Proceedings, XI International Conference on Soil Mechanics and Foundation Engineering," San Francisco, California, August, 1985

"Construction Experience at the Canonsburg UMTRA Site," Proceedings, 7th Symposium on Management of Uranium Mill Tailings, Low-Level Waste, and Hazardous Waste, Fort Collins, Colorado, February, 1985

"Seismic Design of Concrete-Faced Rockfill Dams," with F. B. Gures, T. R. Wathen, and C. E. Buckles, Proceedings, Eighth World Conference on Earthquake Engineering San Francisco, California, July, 1984.

"Radon and Leachate Control in Uranium Tailings Disposal" with J. Ikam and J. E. Long, Proceedings, AIChE Summer National 1

PUBLICATIONS: (continued)

"UMTRA Project: Canonsburg Final Design," with F. B. Guros and E. S. Smith, Proceedings, Sixth Symposium on Management of Uranium Mill Tailings, Low-Level Waste, and Hazardous Waste, Fort Collins, Colorado, February, 1984.

"Trans-Panama Pipeline System, Geotechnical Studies," with R. W. Heneks, Proceedings, ASCE Specialty Conference on Pipelines in Adverse Conditions - II, San Diego, California, April, 1983.

"Offshore Geotechnical Studies for Trans-Panama Pipeline System," with M. Al-Ausi, Proceedings, ASCE Specialty Conference on Pipelines in Adverse Conditions - II, San Diego, California, April, 1983

"Some Engineering Properties of Chiriqui Grande Silt," with M.R. Al-Alusi, Proceedings, ASCE Speciality Conference on Engineering and Construction in Tropical and Residual Soils, Honolulu, Hawaii, January, 1982.

"Dynamic Analysis of Two Tailings Dams," with C. E. Buckley and R. G. Edwards, Proceedings, ASCE National Convention, New Orleans, Louisiana, October, 1982.

"Dynamic Behavior of Tailings Materials," with A. Phukunhaphan and C. F. Tsai, Proceedings, ASCE National Convention, New Orleans, Louisiana, October, 1982.

"Field Density, Gradation and Triaxial Testing of Large-Size Rockfill for Little Blue Run Dam, with T. D. Donovan, ASTM STP 740, pp. 315-325, 1981.

"Foundation Treatment for Little Blue Run Dam," with L. W. Lobdell and B. M. Milhalcin, Proceedings, ASCE Speciality Conference on Rock Engineering for Foundations and Slopes, Vol. I, pp. 283-308, Boulder, Colorado, August 1976.

"Design of Large Slabs on Granular Material," with H. A. Salver and R.E. Gray, Proceedings of the Eighth International Conference on Soil Mechanics and Foundation Engineering, Moscow, U.S.S.R., 1973.

"Load-Deformation Mechanism for Bored Piles," with R. D. Ellison and E. D'Appolonia, Proceedings of the American Society of Civil Engineers, Vol. 97, SM4, April 1971.

Developing Priorities for Street Improvement Programs in Urban Areas, with L. Heel and J. Dettore, Highway Research Record Number 148, Planning and Evaluation of Transportation Systems, Highway Research Board, National Academy of Sciences, Washington, D.C., 1971.

Strength and Stress-Strain Characteristics of Clays Subjected to Seismic Loading Conditions, with H. B. Seed, ASTM STP 450, 1969.

"Guideway Substructure." Transportation Research Institute Report No. 1, Chap. 3, Urban Rapid Transit Concepts and Evaluation, Carnegie Mellon University, Pittsburgh, Pennsylvania, 1968.

"Cyclic Stress-Strain Characteristics of Clay." with H. B. Seed, Proceedings of the American Society of Civil Engineers, Vol. 94, SM2, March 1968.

Seismic Effects of Structures Supported on Piles Extending Through Deep Sensitive Clays, with R. A. Parmelee, J. Penzien, C. F. Scheffey, and H. B. Seed, Report to California State Division of Highways, August 1964.

Experience Details

Manager, Criteria and Standards, and Standards Manager

DOE/UMTRA Project, Various States, Headquarters in Albuquerque, N.M., Site Design Engineer; ~~Criteria and Analysis Consultant~~ As Criteria and ~~Analysis Consultant~~ reviewed design documents and developed major portions of design manual for design of uranium tailings repositories at 24 locations in 10 states, repository volumes ranging from 40,000 to ~~3.0~~ million cubic yards, over 8 to 90 acres. Supervised preparation of preliminary and final design construction drawings and specifications for Canonsburg Site, and conceptual, preliminary and final design for Burrell site, preliminary design for Slickrock site, and final design for Shiprock site. Managed engineering during construction for Canonsburgh, Shiprock, and Lakeview.

Panama Pipeline, Charco Azul to Chiriqui Grande, Panama, Task Leader: Determination of foundation design parameters and construction quality for 130-km long, 36-\and 40-inch diameter pipeline, with pumping sta- tions, oil storage tanks, and offshore tanker loading and unloading facilities. Directed geotechnical investigations, foundation studies, and construction monitoring. Prepared reports presenting results of studies and field monitoring.

Forest Lake Dam, Monterey, California, Project Manager: Managed geotechnical investigation, including drilling and laboratory testing, and seismic stability analysis of a seismic stability evaluation of 60-foot high, 70-year old earthfill dam. Directed preparation of reports on results of evaluation and conceptual designs for remedial action for the California-American Water Company.