NATIONAL RESEARCH COUNCIL

COMMISSION ON ENGINEERING AND TECHNICAL SYSTEMS GEOTECHNICAL BOARD

Mailing Address: 2101 Constitution Avenue Washington, DC 20418 FAX: (202) 334-3370

Office Location: Harris Building, Room 274 2001 Wisconsin Avenue, N.W. (202) 334-3136

July 23, 1993

MEMORANDUM

To:

Sponsors of Geotechnical Board

William G. Austin, Bureau of Reclamation Don Banks, Army Corps of Engineers Maxwell Blanchard, Department of Energy Stephan Brocoum, Department of Energy James Carney, Department of Energy Robert E. Diebold, Department of Energy

Albert F. DiMillio, Federal Highway Administration

F. Michael Jenkins, Bureau of Mines

Martin D. Lewis, Air Force Office of Scientific Research

Don A. Linger, Defense Nuclear Agency Steve Markwell, Bureau of Reclamation Francis McLean, Bureau of Reclamation

Philip G. Meikle, Bureau of Mines

Jeffrey G. Mora, Federal Transit Administration Robert B. Oswald, Army Corps of Engineers

Thomas J. Pasko, Jr., Federal Highway Administration Jacob Philip, Nuclear Regulatory Commission

John Scalzi, National Science Foundation

Lawrence L. Schulman, Federal Transit Administration

Paul Senseny, Defense Nuclear Agency

Mel Silberberg, Nuclear Regulatory Commission

William Simecka, Department of Energy Dean Stucker, Department of Energy

Mehmet T. Tumay, National Science Foundation Spencer Wu, Air Force Office of Scientific Research

From:

Peter H. Smeallie

Subject:

Annual Activities Report

I am pleased to submit to you the Geotechnical Board's Annual Activities Report for the period July 1, 1992 through June 30, 1993.

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imply its endorsement,



GEOTECHNICAL BOARD Attachment B COMMISSION ON ENGINEERING AND TECHNICAL SYSTEMS NATIONAL RESEARCH COUNCIL

GEOTECHNICAL BOARD MEETING

National Academy of Sciences'
J. Erik Jonsson Woods Hole Center
314 Quissett Avenue
Woods Hole, Massachusetts
Room 208
(508) 548-3760
Fax (508) 540-4236
July 24-26, 1992

Agenda

Friday, July 24, 1992

8:00 p.m. Dinner at Falmouth Square Inn

Saturday, July 25, 1992

7:30 a.m.	Assemble in Lobby of Falmouth Square Inn	
7:45	Buffet Breakfast	
8:30	Welcome/Review of Agenda	Attachment A
	Update of Members' Professional and Other Activities of Interest	
9:15	Presentation on Institute for Professional Practice (IPP) — Joseph Ward, President, IPP	Attachment B
9:45	Activities of and Principal Issues Facing the U.S. National Committee for Rock Mechanics — Barry Brady, Chairman, USNC/RM	Attachment C
10:15	Activities of the U.S. National Committee on Tunneling Technology — Peter Smeallie	Attachment D
10:45	Geotechnical Research Employing the Centrifuge Technique • Discussion of Charlie Babendreier's Proposal	Attachment E
11:00	Reports from Liaison Activities • ASFE, Ron Smith • ASCE, Charles Ladd • Others as appropriate	

Geotechnical Board Agenda Page two

7:45

Buffet Breakfast

11:15	Introduction to "Ongoing, Pending, and Planned Activities of the Geotechnical Board" — Peter Smeallie	Attachment F		
	Discussion of General Program Goals and Direction			
12:00 noon	Lunch			
1:00 p.m.	Discussion continues, as warranted			
1:30	 Reports on Ongoing Studies Fracture Characterization and Fluid Flow — Barry Brady Reliability Methods for Risk Mitigation in Geotechnical Engineering — Bob Schuster Symposium on Underground Construction Safety IManagement for the Superconducting Super Collider — Peter Smeallie Physical Infrastructure Technology Research Needs for the 21st Century 	Attachment G Attachment H Attachment I Attachment J		
3:00	 Jim Gould, Tom O'Rourke Reports on Pending Projects Loma Prieta: Implications for Practice Peter Smeallie, Clarence Allen Advanced Drilling and Rock Comminution Technologies Jim Mitchell, Peter Smeallie Research Opportunities in Rock Mechanics (USNC/RM) Parry Brady Procurement Practices for Underground Construction (USNC/TT) Peter Smeallie 	Attachment K Attachment L Attachment M Attachment N		
4:30	Overall Discussion of Planned Projects and Priorities			
5:30	Adjourn			
6:00	Reception/New England Clambake			
Sunday, Ju	ly 26, 1992			
7:30 a.m.	Assemble in Lobby of Falmouth Square Inn			

8:30	Continued Discussion of Planned Projects and Priorities	Attachment O
	 Effectiveness of Landfill Liner Systems Jim Mitchell 	
	 Use of the Observational Method for Cleanup of Waste Containment Sites Jim Mitchell 	Attachment P
	 Future Directions for Geophysical Engineering in Geotechnology Jean-Claude Roegiers 	Attachment Q
	 Technology Transfer Between the DOE Labs and the Bureau of Mines Francois Heuze 	Attachment R
	 Underground Excavation: Technical Assistance for the Yucca Mountain Proposed High-Level Nuclear Waste Repository Tom O'Rourke 	Attachment S
	 Research Needs in Geo-environmental Science and Engineering Peter Smeallie 	Attachment T

11:00 Next Meeting

12:00 noon Adjourn. Lunch will be available.

GEOTECHNICAL BOARD COMMISSION ON ENGINEERING AND TECHNICAL SYSTEMS NATIONAL RESEARCH COUNCIL

GEOTECHNICAL BOARD MEETING

National Academy of Sciences' Cecil and Ida Green Building 2001 Wisconsin Avenue, N.W. Washington, D.C.

December 14-16, 1992

Agenda

monday,	December	14111
Room GR	116	

6:30 p.m. Evening Business Session of the Geotechnical Boa	6·30 p.m.	Evening	Business	Session	of the	Geotechnical	Boar
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- Welcome, Announcements
 - James Mitchell, Chairman
 - Peter Smeallie, Director
- CETS Strategic Plan and the Geotechnical Board

- Arch Wood, Executive Director, CETS

- Robert Katt, Associate Director for Quality Management
- William Webster, CETS Liaison to the Geotechnical Board

Section 1

Section 2

7:30 The Second Federal Geotechnology Workshop: Update, Discussion, Introduction Assignments

- François Heuze, Workshop Chairman

8:15 Dinner at Taberna Del Alabadero, 1776 Eye Street, N.W., (202) 429-2200

Tuesday, December 15th

Room GR 130

8:00 a.m. Welcome/Introductory Remarks

- Peter Smeallie, Director, Geotechnical Board
- James K. Mitchell, Chairman, Geotechnical Board
- François Heuze, Member, Geotechnical Board, and Workshop Chairman
- 8:30 Los Alamos National Laboratory (Tom Dey, Caroline Reynolds, Ed Van Eeckout)
 - Introduction
 - Reservoir Phenomena
 - Reservoir performance prediction
 - porous flow modeling; multi-component; multiphase
 - wave propagation; dynamic compaction of porous media

- Engineering
 - caps and barriers for containing subsurface containments
 - geothermal energy
- Sensing
 - Remote sensing: satellite, airborne, surface
 - Fiber optics
 - Seismic methods: geothermal and petroleum applications

10:00 a.m. Break

10:20 Lawrence Berkeley Laboratory (Jane Long, Don DePaulo)

- Laboratory and Field Technology
 - Geothermal and petroleum reservoirs: high resolution imaging
 - Remediation of near-surface materials: transport, containment
 - Fracture characterization for high-level nuclear waste disposal
- Interpolation and Prediction Technology
 - Geothermal: well test analyses, heat and mass transfer
 - Petroleum reservoirs: fractured and porous systems, multi-phase, multi-component flow
 - Nuclear wastes: coupled heat-flow-chemical modeling
 - Remediation: capture zones, injection/extraction systems, capillary barriers

11:50 Lunch

1:30 p.m. Lawrence Livermore National Laboratory (François Heuze, Jesse Yow, Jay Zucca)

- Environmental
 - Dynamic underground stripping
 - In-situ microbial filters
 - Containment: flow and transport
 - Sensors and sensor emplacement
 - Underground imaging
- Geotechnical/Geomechanics/Geophysics
 - Coupled stress-fractures-flow reservoir stimulation models
 - Dynamics of particulate and blocky media
 - High-temperature and pressure rock testing
 - Dynamics of rock reinforcement systems
 - Dry-hole and large-hole logging
 - Integrated computational earthquake studies

3:00 Break

3:30 p.m.	Sandia National Laboratories (Wolfgang Wawersik, Joe Tillerson
	Norm Warpinski)

- Measurements and Instrumentation
 - Scope of SNLA experience
 - Issues of measurement quality
 - New techniques
 - Applications: geotechnical, energy, environment, remediation, infrastructure, transportation
- Fossil Energy Research
 - Mine-back of hydrofractures
 - Multi-Well experiment
 - geology
 - in-situ stresses
 - hydrofracturing
 - rock mechanics
 - Ekofisk: soft-rock formation mechanics
- Geotechnical Capabilities
 - Systems approach
 - Rock testing, computer simulations
 - Applications: penetrators, cross-well seismics, geoscience research, geothermal, seafloor earthquake measurements
- 5:00 Adjourn5:15 Reception / Hors d'Oeuvres7:00 Adjourn

Wednesday, December 16th

Room GR 120

8:30 a.m. Regular Business Meeting of the Geotechnical Board Continental Breakfast Available in Room

Welcome/Review and Agenda

- James Mitchell

- 8:40 Discussion of Second Federal Geotechnology Workshop
 - François Heuze
 - Robert Schuster (Comment on Future Workshop)
- 8:50 Board Membership in 1993
 - James Mitchell
 - Peter Smeallie

Section 3

9:00 a.m.	Reports from Liaison Activities ASFE, Lynne Cramer ASCE, Charles Ladd Others as Apppropriate	
9:15	Activities of and Principal Issues Facing the U.S. National Committee on Tunneling Technology — Raymond Sterling, Chairman, USNC/TT	Section 4
9:45	Activities of the U.S. National Committee for Rock Mechanics — Barry Brady, Chairman, USNC/RM	Section 5
10:00	Break	
10:15	 Fracture Characterization and Fluid Flow Jane Long, Chairman of the Study Committee Reliability Methods for Risk Mitigation in Geotechnical Engineering Wilson Tang, Chairman of the Study Committee Robert Schuster, Member of the Study Committee William Gardner, Member of the Study Committee Physical Infrastructure Technology Research Needs for the 21st Century James Gould, Chairman of the Study Committee Thomas O'Rourke, Member of the Study Committee (Comments on Japan) Symposium on Practical Lessons from the Loma Prieta Earthquake Clarence Allen, Member of the Study Committee 	Section 6
11:15	General Discussion of Current Program Discussion of Prospective Studies and the Geotechnical Board's Strategic Plan Studies identified by the Board, undertaken by a seperate committee, and supported by core support, e.g., Future	Section 7
	 Directions for Geophysical Engineering in Geotechnology Studies identified by the Board for outside agency support, e.g., the Effectiveness of Landfill Liner Systems Studies identified and undertaken by the USNCs, e.g., Research Opportunities for Rock Mechanics 	
	 Studies requested by agencies, e.g., Yucca Mountian Project Intiatives 	

12:00 noon Discussion continues through lunch

3:00

Adjourn

12:45 p.m.	Joint Meeting with the Board on Earth Sciencs and Resources Room GR 104	Section 8
	 The Board on Earth Sciencs and Resources William Fisher, Chairman of the Board The Geotechnical Board James Mitchell, Chairman of the Board Study of Advanced Drilling Technologies Neville Cook, Proposed Chairman of the Study Committee DOE's Interest in Advanced Drilling Technologies John (Ted) Mock, Director, Geotechnical Division, DOE Interest in Advanced Drilling Technologies John (Ted) Mock, Director, Geotechnical Division, DOE 	
1:30	Continuation of Prospective Studies and the Strategic Plan Need for Geotechnical Board Reports Priorities New Study Ideas (International program) 	Section 7
2:45	 1993 Meetings: April 1-2, 1993 at the Beckman Center? July 24-25, 1993 at the Woods Hole Study Center? December 13-15, 1993 at the National Academy of Sciences, Washington, D.C.? 	
	Other Venues Other Meeting Formats	

National Research Council Commission on Engineering and Technical Systems

Geotechnical Board

National Academy of Sciences Arnold and Mabel Beckman Center Board Room 100 Academy Drive Irvine, California April 1-2, 1993

AGENDA

Thursday, April 1st

8:00 a.m. Assemble in lobby of Four Seasons Hotel for transportation to the Beckman Center.

8:15 Breakfast at Beckman Center

9:00 Welcome, Introductions of New Members

Chairman's Statement

— James Mitchell

Director's Statement—State of the Board
— Peter Smeallie

Discussion

10:00 Bicoastal video link to Robert Whitman, CETS liaison representative to the board. Move to Room IId.

Perceptions of Geotechnical Board within CETS and NRC/Institutional Focus

- William Webster, Robert Whitman

Proposed Division of Energy, Infrastructure, and Environmental Engineering

- Robert Whitman, James Mitchell

Role of the U.S. National Committees

— Peter Smeallie, Thomas O'Rourke

Discussion on Each of the Above

Geotechnical Board Agenda April 1-2, 1993 Page two

11:00 a.m. Bicoastal video link ends. Move back to Board Room.

Continuation of Discussion in Light of Board's Strategic Plan

— Peter Smeallie, James Mitchell

12:00 noon Lunch

1:00 p.m. Annual Discussion of Bias

— Peter Smeallie

National Academy of Sciences/National Research Council committees consist of volunteers, such as yourselves, that are formed to achieve intellectual balance and capabilities. In order to assure this balance, each committee is required to discuss bias and composition, usually once a year. During this discussion you will be asked to describe your current job responsibilities, consultancies you hold, sources of research support, organizational affiliations, relevant financial holdings, and public positions taken relevant to the committee's charge (such as in published papers). A discussion of scientific misconduct will also be held. A confidential record will be made of the discussion.

2:00 1993 Federal Geotechnology Workshop

— François Heuzé

2:30 Fresh Ideas. Revisit seven national issues within the context of CETS Strategic Plan and NRC mission.

Each "team" of board members should prepare a ten minute presentation assessing the role of geotechnology under each national issue and identify areas of work where the board could be of service to the government.

Environmental Protection/Waste Management

— James Mitchell, Shlomo Neuman, Don Steeples

Infrastructure Development and Rehabilitation

— James Gould, Don Steeples

Construction Efficiency and Innovation

— William Gardner, Reuben Samuels

Fresh Ideas, continued

National Security

- François Heuzé

Resource Discovery and Recovery

— Charles Ladd, Don Murff

Mitigation of Natural Hazards

- Clarence Allen, François Heuzé

Frontier Exploration and Development

- Thomas O'Rourke, William Webster, Jim Mitchell

4:30 p.m. Proposals for New Initiatives

5:30 Adjourn

6:30 Dinner

Friday, April 2nd

7:30 a.m. Assemble in lobby of Four Seasons Hotel for transportation to the Beckman Center

7:45 Breakfast at Beckman Center

8:30 National Geotechnical Experimentation Sites (NGES)

- Richard Woods

9:00 Ongoing studies, activities, and reports in progress —
Discussion of status and solicitation of board advice

U.S. National Committee on Tunneling Technology

- Thomas O'Rourke

U.S. National Committee for Rock Mechanics

- Peter Smeallie

Ongoing studies, activities, and reports in progress, continued

Committee on Practical Lessons from the Loma Prieta Earthquake

- Clarence Allen

Committee on Advanced Drilling Technologies

— Peter Smeallie

Committee on Fracture Characterization and Fluid Flow

— Peter Smeallie

Committee on Reliability Methods for Risk Mitigation in Geotechnical Engineering

- Peter Smeallie

10:30 a.m. Pending Activities

Draft Proposal for the Geotechnical Borehole Sealing Workshop (FHWA)

Geotechnical News Articles

Geophysical Techniques for Geotechnical Engineering

Effectiveness of Landfill Liner Systems

Computerized Geotechnical Data Management (from Robert Schuster)

11:45 Summary, Action Items, Next Meetings

12:00 noon Adjourn with lunch

SPONSORS OF THE GEOTECHNICAL BOARD

Dr. Spencer Wu Program Manager Directorate of Aerospace Sciences Air Force Office of Scientific Research Bolling AFB Washington, D.C. 20332

Major Martin D. Lewis Directorate of Aerospace Sciences Air Force Office of Scientific Research Bolling AFB Washington, D.C. 20332

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Federal Highway Administration

Federal Transit Administration

Nuclear Regulatory Commission

Mr. Mel Silberberg
Branch Chief
Waste Management Branch
Division of Engineering
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Nuclear Regulatory Commission
Washington, D.C. 20555

Mr. Jacob Philip Office of Nuclear Regulatory Research Nuclear Regulatory Commission Washington, D.C. 20555

Dr. Mehmet T. Tumay Director, Geomechanics Program Directorate for Engineering National Science Foundation 1800 G Street, N.W. -- Room 1110 Washington, D.C. 20550

Dr. John Scalzi
Program Director, Structures and
Building Systems
Directorate for Engineering
National Science Foundation
1800 G Street, N.W. -- Room 1108
Washington, D.C. 20550

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National Science Foundation

Committee on Reliability Methods for Risk Mitigation in Geotechnical Engineering

The Committee on Reliability Methods for Risk Mitigation in Geotechnical Engineering is preparing a report on reliability methods for risk mitigation in geotechnical engineering. The report will summarize the results of a workshop held in July 1992 that examined the role of probabilistic methods in characterizing geotechnical uncertainties. The workshop consisted of invited "probabilists" (those who advocate the use of reliability methodology) and "traditionalists" who presented papers that addressed the reasons for the limited use of reliability methods in geotechnical engineering, and discussed the possibilities for deriving greater benefit from reliability methodology. The committee's report will propose ways to enhance greater communication and cooperation between probabilists and traditionalists addressing the needs of both practitioners and researchers. The report is scheduled for publication in the fall 1993. The committee comprises the following individuals:

Wilson H. Tang, CHAIRMAN University of Illinois at Urbana-Champaign

J. Michael Duncan, VICE-CHAIRMAN Virginia Polytechnic Institute and State University

C. Allin Cornell Stanford University

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William S. Gardner Woodward Clyde Consultants Emilio Rosenblueth
National Autonomous University of
Mexico

Robert L. Schuster U.S. Geological Survey

Tien H. Wu Ohio State University

Committee on Fracture Characterization and Fluid Flow

The Committee on Fracture Characterization and Fluid Flow consists of 13 experts in rock mechanics, hydrogeology, hydrofractures, geophysics, geology, statistics, and seismology. The committee has met six times over the last two years and is in the process of finishing its report, scheduled for publication in December 1993. The committee will attempt to identify the tools and methods associated with identifying fractures, describe the essential fundamentals behind the use and interpretation of the tools and methods, assess these methods and provide illustrative examples of their use. In addition, the committee will identify areas of cross fertilization between various disciplines and between applications. The committee will address three common issues that have been articulated by the sponsoring agencies and others that have made presentations to the committee. These issues are: (1) How can we identify, locate and characterize the hydraulically important fractures? (2) How do fluid flow and chemical transport occur in the fracture system? (3) How can changes to the fracture system be predicted and controlled?

The committee comprises the following individuals:

Jane C.S. Long, CHAIRMAN Lawrence Berkeley Laboratory

Attilla Aydin Purdue University

Stephen R. Brown
Sandia National Laboratories

Herbert H. Einstein Massachusetts Institute of Technology

Kevin Hestir Utah State University

Paul A. Hsieh U.S. Geological Survey

Larry R. Myer Lawrence Berkeley Laboratory Kenneth G. Nolte Dowell Schlumberger

Denis L. Norton University of Arizona, Tucson

Olle L. Olsson Conterra

Frederick L. Paillet U.S. Geological Survey

J. Leslie Smith University of British Columbia

Leon Thomsen Amoco Production Company

The Committee for the Symposium on Practical Lessons from the Loma Prieta Earthquake

The Committee for the Symposium on Practical Lessons from the Loma Prieta Earthquake is joint between the Geotechnical Board and the Board on Natural Disasters. The committee's report will be based on a symposium on the subject that was held in San Francisco, California, on March 22-23, 1993, in cooperation with the Earthquake Engineering Research Institute. The symposium focused on significant lessons learned from research conducted on the 1989 Loma Prieta earthquake. The purpose of the symposium and the subject report is to encourage the application of lessons to reduce risk during future earthquakes in vulnerable communities throughout the United States. The report is scheduled for publication in the fall of 1993. The committee that planned and organized the symposium and that is preparing the report comprises the following individuals:

Lloyd S. Cluff, CHAIRMAN
Pacific Gas & Electric Company

Clarence R. Allen California Institute of Technology

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Thomas R. Beckham South Carolina Emergency Preparedness Division

Ian G. Buckle State University of New York at Buffalo

Wilfred D. Iwan California Institute of Technology Shirley Mattingly
Emergency Management, City of Los
Angeles

Robin K. McGuire Risk Engineering, Inc.

Chris D. Poland H.J. Degenkolb Associates

Dennis E. Wenger Texas A&M University

T. Leslie Youd Brigham Young University

Committee on Advanced Drilling Technologies

The Geotechnical Board and the Board on Earth Sciences and Resources have been asked by the Geothermal Division of the Department of Energy to evaluate the technical and scientific feasibility of advanced drilling and related technologies. The Committee on Advanced Drilling Technologies, consisting of 11 members, will examine concepts for new mechanical and non-mechanical drilling applications including advances in knowledge of the tool-rock interaction, will identify potential opportunities for research, and will make recommendations in a report on the scope and direction needed to realize these opportunities for improved methods for drilling rock. The report will be released in February 1994. The committee comprises the following individuals:

Ali S. Argon, CHAIRMAN Massachusetts Institute of Technology

Neville G.W. Cook University of California, Berkeley

George A. Cooper University of California, Berkeley

Michael M. Herron Schlumberger-Doll Research

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Stephen E. Laubach Bureau of Economic Geology

William C. Maurer Maurer Engineering Inc. James E. Monsees PB/MK Team

D. Stephen Pye UNOCOL Corporation

Jean-Claude Roegiers University of Oklahoma

Eugene D. Shchukin
The Johns Hopkins University

Mark D. Zoback Stanford University

Committee for an Infrastructure Technology Research Agenda

The Committee for An Infrastructure Technology Research Agenda, conducted jointly with the Building Research Board, has been asked to advise the National Science Foundation's Division of Mechanical and Structural Systems on research needs and priorities in the technology of physical infrastructure, with particular reference to structures, geomechanics, and building systems. The committee's deliberations and subsequent report are anticipated to review (1) the definition of physical infrastructure as a unified concept, cross-cutting technologies that make the concept meaningful, and the distribution of responsibility for infrastructure technology, performance, and management; (2) the significance of physical infrastructure technology to security and quality of life in the domestic and global economy; (3) the status of modern infrastructure technology, in historic perspective, problems of current technology, and progress on new technology; and (4) a critical review of laboratories, manpower, education programs, and other resources for basic infrastructure technology research. Based on this review, the committee will recommend an agenda of high-priority opportunities for the NSF and the research community to guide basic infrastructure core research. The report is expected in December 1993. The committee comprises the following individuals:

James P. Gould, CHAIRMAN Mueser Rutledge Consulting Engineers

Edward Cohen Ammann and Whitney, Consulting Engineers

Thomas J. Eggum City of St. Paul, Minnesota

1

Ezra D. Ehrenkrantz Ehrenkrantz, Eckstut and Whitelaw

Carl Monismith University of California Berkeley

Robert S. O'Neil Parsons Transportation Group Thomas D. O'Rourke Cornell University

Joseph Perkowski Bechtel National Inc.

John Ramage CH2M Hill, Inc.

Sarah Slaughter Lehigh University

Joel Tarr Carnegie Mellon University

U.S. National Committee or Tunneling Technology

The U.S. National Committee on Tunneling Technology (USNC/TT) serves as the national organization for stimulating advancement in tunneling technology and in the effective use of the subsurface by promoting the coordination of activities such as assessment, research, development, education, training, and collection and dissemination of information. The committee represents the United States in the International Tunnelling Association and works with the American Underground Space Association and others to encourage effective participation in the ITA. Current 1993 membership comprises the following individuals:

Raymond L. Sterling, CHAIRMAN University of Minnesota

Richard W. Balcerzak Metropolitan Water District of Southern California

Lloyd A. Duscha Consulting Engineer

George A. Fox Grow Tunneling Corporation

Richard F. Harig Parsons Brinckerhoff Quade and Douglas John W. Hutchinson Harvard University

Martin N. Kelley Kiewit Engineering Company (retired)

Albert A. Mathews Al Mathews Corporation

Priscilla P. Nelson University of Texas at Austin

Harvey W. Parker, III Shannon & Wilson, Inc.

National Research Council Geotechnical Board

U.S. National Committee on Tunneling Technology Special Session July 28, 1992

Daniel Room Holiday Inn IH-35 East & Wintergreen Road DeSoto, Texas (214) 224-9100 Fax (214) 228-8238

AGENDA

Tuesday, July 28th

8:30 a.m.	Welcome — Lloyd Duscha, Chairman, Pro Tem — Peter Smeallie, Director, USNC/TT
8:40	Update on Task Items — Peter Smeallie
9:00	The Underground Construction Safety Symposium for the SSC — Priscilla Nelson
9:30	Report on ITA Congress and Developments — Harvey Parker, ITA Representative — Winfield Salter, ITA Animateur
10:00	Report from the American Underground Space Association and other Societies, as appropriate — Susan Nelson — Charles Daugherty — Thomas Iseley
10:30	Report from and discussion of the USNC Subcommittee on Procurement of Tunnel Design and Construction — Martin Kelly — Lloyd Duscha — Richard Harig
11:30	Other Business, Next Meeting
11:45	Adjourn

National Research Council Geotechnical Board

U.S. National Committee on Tunneling Technology Symposium on Underground Construction Safety for the Superconducting Super Collider (SSC)

July 28-30, 1992
Hill Room
Holiday Inn
IH-35 East & Wintergreen Road
DeSoto, Texas
(214) 224-9100
Fax (214) 228-8238

AGENDA

Tuesday, July 28th

1:00 p.m. Superconducting Super Collider Site Visit. Assemble in Lobby of Holiday Inn for Transportation to the SSC Site.

Wednesday, July 29th

8:30 a.m. SESSION I-INTRODUCTION TO THE PROJECT

Opening Remarks

- Peter Smeallie, Director, USNC/TT, National Academy of Sciences
- James Carney, Principal Engineer, OSSC/WSO, DOE
- 8:45 Welcome
 - Edward G. Cumesty, Deputy Project Director, SSC,
 Office of Energy Research, DOE

SSC Organizational Structure

- 9:00 Department of Energy

 Edward G. Cumesty, Deputy Project Director, SSC,
 Office of Energy Research, DOE

 9:20 University Research Associates, Inc. (URA)

 Jon Ives, URA

 9:45 Texas National Research Laboratory Commission (TNRLC)

 Edward Bingler, TNRLC
- 10:00 Break

10:10	Parsons Brinkerhoff-Morrison Knudsen (PB/MK) — Richard Curl, PB/MK
10:30	Questions
10:50	Introduction to the Keynote Address — Reuben Samuels, Member, Geotechnical Board, NAS
11:10	Keynote Address: "Underground Construction Safety" — Norman Nadel, Chairman, Nadel Associates, Inc.
11:45	Lunch
1:00 p.m.	SESSION II-INVITED PRESENTATIONS ON UNDERGROUND SAFETY MANAGEMENT
	U.S. Bureau of Mines — James Peay, Pittsburgh Research Center
1:45	U.S. Army Corps of Engineers — Donald A. Pittenger, Safety and Occupational Health Office
2:30	Contractor's Viewpoint — Lance de Stwolinski, Kiewit Construction Company
3:15	Break
3:30	Milwaukee Tunnel Project — John Ramage, Vice President, CH2M Hill
4:15	English Channel Tunnel Project — Keith Wilkinson, Group Director of Health and Safety, Transmanche-Link
5:00	Adjourn
7:30	Informal Discussion/No-Host Bar in the Treese Room
Thursday,	July 30th
8:30 a.m.	SESSION III-REGULATORY ISSUES AND WRAP-UP INSURANCE
	Introduction to the Day — Priscilla Nelson, Member, USNC/TT
8:40	Increasing Regulatory Impact on Underground Construction — Byron M. Ishkanian, Senior Safety Engineer, State of California

9:30	Wrap-Up Insurance Options — Earl Adams, Jr., Vice President, Johnson and Higgins
10:15	Break
10:30	Wrap-Up Insurance at the Washington Metropolitan Area Transit Authority (WMATA) — Walter Mergelsberg, Director of Construction, WMATA
11:15	Pros and Cons of Wrap-Up from a Contractor's Standpoint — Larry Parberry, SAE Civil
12:00	Lunch
1:15 p.m.	Construction Status — Gene Dretke, DOE
	SSC Safety Programs
1:30	SSC Laboratory (SSCL) — R. Benjamin Rietze, SSCL
2:00	Conventional Construction — Roy Prince, SSCL
2:30	Break
2:45	AE/CM Organization and Safety Programs — Richard Curl, PB/MK
3:45	Wrap-Up, Wrap-Around Insurance — Larry Babin, SSCL
4:15	Open Session for Questions and Discussion
5:00	Adjourn

National Research Council Geotechnical Board

Meeting of the U.S. National Committee on Tunneling Technology

Solomon Room
Hyatt Regency Cambridge
575 Memorial Drive
Cambridge, Massachusetts 02139
(617) 492-1234
Fax (617) 491-6906

October 4, 1992

AGENDA

8:00 a.m. Executive Session of the USNC/TT

Discussion of Bias

- Peter Smeallie

National Academy of Sciences/National Research Council committees consist of volunteers, such as yourselves, that are formed to achieve intellectual balance and capabilities. In order to assure this balance, each committee is required to discuss bias and composition, usually once a year. During this discussion you will be asked to describe your current job responsibilities, consultancies you hold, sources of research support, relevant financial holdings, and public positions taken relevant to the committee's charge (such as in published papers). A confidential record will be made of the discussion.

8:30 Welcome, Introductions, Review of Agenda

- Raymond Sterling, Chairman, USNC/TT
- Peter Smeallie, Director, USNC/TT

Reports Attachment A

- 8:40 Report on July 28, 1992, Special Session of USNC/TT

 Lloyd Duscha, Chairman, Pro Tem of Special Session
- 8:50 Report on the Underground Construction Safety Symposium for the SSC
 - Pris illa Nelson
- 9:10 Report on the North American Tunneling Conference '92 and AUA

 Susan Nelson

USNC/TT Meeting Agenda October 4, 1992 Page two

9:20 a.m.	Report on the USNC/TT Sponsored Lecture — Peter Smeallie	
9:30	Report on Geological Society of America — Charles Baskerville	
9:40	Report on North American Society of Trenchless Technology — Thomas Iseley	
9:50	Report on UTRC/ASCE — Harvey Parker	
10:00	Report on NRC Infrastructure Studies — Raymond Sterling — Peter Smeallie	
10:10	Break	
	<u>ITA</u>	Attachment B
10:25	Report from the ITA U.S. Representative — Harvey Parker	
10:35	Report from the Executive Council — Richard Robbins	
10:45	Report from ITA Working Group Representatives — (As appropriate)	
	Issues	Attachment C
11:00	Subcommittee on Procurement of Tunnel Design and Construction — Martin Kelley	
11:45	Initiatives with DOE on the Proposed High-Level Nuclear Waste Repository at Yucca Mountain, Nevada — Harvey Parker — Peter Smeallie	

USNC/TT Meeting Agenda October 4, 1992 Page three

12:00 noon	Lunch	
	Report on the Geotechnical Board — François Heuze, Member, Geotechnical Board — Peter Smeallie, Director, Geotechnical Board	
1:00 p.m.	Developments in Mechanics and the Relationship to Tunneling — John Hutchinson	
1:15	Discussion of Potential Technical Issues for Committee Study — Raymond Sterling	
	Committee Composition	Attachment D
2:00	Discussion of Current Composition of Committee — All	
	Suggested Nominees — All	
	Other Business	Attachment E
2:45	Update on Task Items — Raymond Sterling	
2:55	Next Meeting — Peter Smeallie	
3:00	Adjourn	
	Special Presentation Proposed "National Program for Advanced Drilling and Excavation Technologies" — Prof. Carl Peterson, MIT	

Meeting of the U.S. National Committee on Tunneling Technology Geotechnical Board

Sunday, June 13, 1993 Courier Room, 7th Floor Westin Hotel Copley Place Boston, Massachusetts

Agenda

Sunday, June 13, 1993

8:00 a.m. Introductions of New Member

- George Fox

Statement of the Chairman

- Ray Sterling

Report of the Director

- Peter Smeallie

The New Division of Infrastructure, Energy, and

Environmental Engineering

- Dev Mani

8:30 Prospective Studies

Attachment B

- Microtunneling and Trenchless Technologies
 - Ray Sterling
 - Tom Iseley
- U.S. Global Competitiveness in Underground Construction: Encouraging Technological Innovation
 - Martin Kelley
 - Harvey Parker
- 10:10 Symposium on Underground Construction Safety for the Exploratory Studies Facility at the Yucca Mountain Project
 - Ray Sterling
 - Priscilla Nelson
 - Ken Elder, Yucca Mountain Project Office
- 11:00 Follow-on to the July 1992 Symposium on Underground Construction Safety for the Superconducting Super Collider
 - Peter Smeallie
- 11:15 International Tunnelling Association
 - Report from the ITA Executive Council
 - Richard Robbins, Vice President, ITA
 - Report from 1993 ITA Annual Meeting in Amsterdam
 - Harvey Parker
 - USNC/TT Host of the September 1993 ITA Executive Council Meeting
 - Harvey Parker
 - Peter Smeallie

International Tunnelling Association, Continued

- ITA Initiatives with the United Nations
 - Harvey Parker
- Reports from ITA Working Groups
 - Bruce Beverly
 - -- Randy Essex
 - John Reilly
 - Dennis Lachel
 - Others As Appropriate
- 12:30 p.m. Lunch in the Flying Cloud Room with the Board of Directors of the American Underground-Space Association. Subject of discussion is the selection of the USNC/TT and AUA to host the 1996 International Tunnelling Association Annual Meeting in conjunction with NAT '96 in Washington, D.C.
- 1:30 Reports from Liaison Representatives
 - American Society of Civil Engineers
 - Harvey Parker
 - American Underground-Space Association
 - Susan Nelson
 - Association of Engineering Geologists
 - Charles Daugherty
 - Geological Society of America
 - Charles Baskerville
 - Institute of Shaft Drilling
 - Priscilla Nelson
 - North American Society for Trenchless Technology
 - Tom Iseley
 - Others as Appropriate

Next Meeting

2:00 EXECUTIVE SESSION — COMMITTEE MEMBERS ONLY

- Update of Bias Discussion
 - George Fox
 - Richard Harig
- Committee Composition
- New Committee Business
- USNC/TT Sponsored Lecture at AUA NAT '94
 - Ray Sterling
- 3:00 Adjourn



Activities of the International Tunnelling Association Peter Smeallie

The International Tunnelling Association held its 19th Annual Meeting in Amsterdam from April 18-22, 1993 in conjunction with the international congress on "Options for Tunnelling," which was organized by the Netherlands Tunnelling Association, KIVI. Thirty of the forty member nations were represented. The U.S. continued its strong presence; Dr. Harvey Parker led the U.S. delegation which included representatives to each of ITA's working groups.

U.S. Selected

The highlight of the meeting for the U.S. was the selection of the United States as the host nation for the 22nd ITA Annual Meeting to be held in Washington, D.C. in April 1996. Dr Parker extended the invitation on behalf of the U.S. National Committee on Tunneling Technology and the American Underground-Space Association. The ITA Annual Meeting will be held in conjunction with the North American Tunneling '96, "Tunneling, Underground Space, and Sustainable Development." In his address to the ITA General Assembly in Amsterdam, Dr. Parker stressed the 1996 conference would emphasize the planning and design needs of developing countries as they contemplate the greater use of underground space.

The 1994 ITA Annual Meeting will take place in Cairo, Egypt, from April 3-7, 1994, in conjunction with the conference on "Tunneling and Ground Conditions." The 1995 meeting will be held in Stuttgart, Germany, from May 6-11, 1995, in conjunction with the conference celebrating the 35th anniversary of STUVA.

Special Report on Immersed Tunnels

A special issue of the ITA's journal, Tunnelling and Underground Space Technology, dealing with immersed and floating tunnels was released at the ITA Amsterdam meeting by vice-animateur Ahmet Gursoy. The 300-page report examines the state of the art on immersed tunnels, with an emphasis on steel and concrete tunnels, as well as potential design configurations for floating tunnels. Particularly useful for organizations considering this tunneling option are the 92 cases given in convenient one-page chart forms. Charts include information on tunnel type and use, unusual features, fabrication methods and other helpful features in an abbreviated, but highly useful format. Copies of the report, Immersed and Floating Tunnels Working Group: State-of-the-Art Report, can be purchased for \$15.00 from TUST, Underground Space Center, University of Minnesota, 500 Pillsbury Drive, S.E., Minneapolis, Minnesota, 55455.

ITA and the United Nations

The ITA is moving considerably closer in its cooperation with the United Nations, particularly with planning a joint workshop to be held in Cairo in 1994 on the engineering and financial aspects of a tunnel as the proposed link between Europe and Africa through the Straights of Gibraltar. Also, a cooperative short course, "Technology Transfer," is being developed on the fundamental aspects of the design of underground structures. Plans are well under way to have the ITA Executive Council meeting with U.S. officials in New York City as part of the September 1993 Executive Council meeting, hosted by the U.S. National Committee on Tunneling Technology.

Working Group Reports

The ten working groups of ITA represent the heart and substance of the organization. During the annual meeting each working group-consisting of up to 20 individuals from as many countries--sets aside time to meet and report on activities undertaken throughout the year.

Birger Schmidt of Parsons Brinkerhoff attended the working group on research which is currently working on three studies: 1) subsidence in urban areas induced by tunneling, 2) noise and vibration in tunnels during operation, and 3) investigation of geological accidents.

The working group on contractual sharing of risk, chaired by Win Salter of Parsons Brinkerhoff Quade & Douglas reported that ITA member nations have been polled on the acceptance of 25 risk-sharing propositions that the group has authored over the past few years. In addition, a new topic has been added to the group's assignment: "Management of Construction."

The working group on subsurface planning, led by Michael Barker, launched a major study on planning to meet fire and life safety requirements for underground facilities.

Dennis Lachel of Lachel Piepenburg & Associates attended the meeting of the working group on health and safety which is focussing its attention on how to collect statistics on accidents. Each country represented on the working group is asked to identify a major project under construction and to identify the major cause or causes of accidents. The group will produce a synthesis report on the subject.

Joe Guertin of GZA Geoenvironmental Inc. reported that the working group on maintenance and repair of underground structures expects to publish during 1993 a summary report of non-destructive methods for systematic inspection of tunnel linings. A report on leak-sealing methods will be published in 1994.

The working group on the design of underground waste repositories, attended by the author, continues work on its report on engineering design considerations for non-nuclear underground waste repositories. It will cover the different safety barriers, the design and use of risk assessment methods for underground facilities such as caverns in rock or rock salt and abandoned mines.

The working group on shotcrete, reports Harvey Parker of Shannon and Wilson, has distributed its compilation of existing guidelines and recommendations for shotcrete use in tunnels. The group is beginning work on the health and safety aspects of shotcreting underground.

John Reilly of John Reilly Associates indicated that the working group on direct and indirect advantages of underground structures is continuing with two thrusts: 1) collection and analysis of advantages related to subsurface parking facilities, and 2) collection of basic data and case studies that help to quantify and illuminate advantages and disadvantages of locating underground.

Priscilla Nelson of the University of Texas attended the meeting of the working group on mechanized tunneling. The first task of the group is to collect project records on tunnel boring machines from member nations in order to define and clarify technical issues regarding TBM applications.

Underground Construction Safety

Between July 27 and 29, 1992, a special symposium was held outside of Dallas, Texas, at the site of the Superconducting Super Collider (SSC) project. The title of the symposium was "Safety Management and Wrap-up Insurance Issues for Underground Construction." The symposium was organized by the U. S. National Committee on Tunneling Technology (USNC/TT) at the request of the U. S. Department of Energy (DOE, Office of Energy Research). Speakers from public and private sectors were invited by the USNC/TT, and DOE invited other participants primarily from the SSC project and federal agencies.

The symposium began with introductory remarks by DOE, the Texas National Research Laboratory Commission (TNRLC, the agency charged with administering participation by the State of Texas in the SSC project), and the SSC Laboratory. Edited transcripts of comments made by invited speakers are obtainable in the public domain through DOE offices at the SSC project. A summary of key points raised in the discussions is given below.

The keynote address was given by Normal Nadel, NAE member, former Chairman of USNC/TT, and Subcommittee Chairman for the study which led to the National Research Council publication "Contracting Practices for the Underground Construction of the Superconducting Super Collider". Nadel reviewed safety-related statistics released by the National Safety Council (NSC). Between 1981 and 1990, death rates in construction were reduced 21 percent, but lost work days remained stable. In 1990, there were 6.4 million workers, 2100 work-related deaths, and 210,000 disabling injuries. The NSC estimates each disabling injury to have a cost of about \$23,000, and each fatality to have an associated cost of \$730,000. These statistics imply that construction-related injuries cost the U.S. about \$6.4 billion in 1990, or about \$1,000 per worker. Safety must be managed, both from concern for worker health and from concern for real project costs. Nadel made some points particularly about safety regulation:

 Past work experience clearly indicates that regulations and cooperative safety management programs are required, and both workers and contractors should be actively involved in these programs.

- Occupational and Safety and Health Administration (OSHA) regulations often address non-problems and suffer from internal inconsistency. Adversarial attitudes in regulation implementation are counterproductive, and qualified inspectors are needed who understand construction. Inspectors do not always need to find violations to do their job.
- The effects of regulations has already resulted in most contractors instituting training programs and supplying safety equipment. However, the object of the regulations is now the contractor and not the worker. Nadel believes we need a system where workers are held responsible for their malfeasance, and where "accident-prone" workers can be terminated from jobs with appropriate documentation.

Safety Management

James Peay (U. S. Bureau of Mines) summarized experience from USBM research on safety management. Peay noted that, while increased mechanization has resulted in increased production rates and decreased injuries per production volumes, increased mechanization has not insured reduction in lost time injuries. Injury rates in the coal mining industry vary widely across all producers, a variation which can be directly related to management practices. However, safe mines do correlate with high production which is achieved by high commitment organizations which have the following characteristics:

- Employees participate in decision making and problem solving.
- Performance and safety incentive systems are in place open systems with criteria and awards known in the public domain and with the rewards paid out quickly.
- The management demonstrates a commitment to safety, goes underground often, and avoids status symbols to make miner-management distinctions invisible.
- The organizational structure is flat, with few levels of management and supervision. Greater control and responsibility is given to the individual, and decision making is decentralized.

Don Pittinger (U.S. Army Corps of Engineers, USACE) discussed the long involvement of the Corps in safety management issues. In 1941, the first USACE Construction Safety Manual was produced, and in 1967 a tunneling section was added. This manual is the basis for the Corps program, and it is a contractual document that can be enforced easily. Contractors are paid to follow it. OSHA does not visit Corps sites. USACE believes that accident prevention programs should have definite economic value. Accident rates on Corps jobs are about 25% of the industry average so that, if accident rates on Corps' projects were the same as for the construction industry

as a whole, then the total cost of the project would be 1.0 to 1.5 percent more. Additional comments from Corps experience include:

- Safety programs should be integrated with, rather than superimposed upon, operations.
- A safe job is not one without risks. Rather, safety is doing each task right the first and every time. An acceptable level of risk must be established.
- On Corps jobs, employees are considered to have responsibilities for their own safety and the safety of their co-workers, for attending training sessions, for identifying hazards.
- Worksite surveys and accident analysis by the contractor are important. Corps people have quality assurance responsibilities.
- To err is human the answer is design. Accidents occur, and the best defense is good design of any procedure, facility, or piece of equipment. If design assures good constructability, safety is enhanced.

Lance de Stwolinski (Kiewit Construction Co.) discussed safety management from a contractor's perspective. For successful contractors, a commitment to safety is made up front, and an organized safety program includes indoctrination (including safety handbooks in the language of the work force), training, and awards. The program must involve all levels within the organization from the very top down. The responsibility for safety should stand with the line managers, safety supervisors, and the construction managers. The project manager has the ultimate responsibility for safety on the project.

- Contractors with good safety records secure the confidence of employees, and one of the major assets of a contractor is the quality of people.
- It is important to establish a system for early detection of unsafe practices. Pre-start up planning and hazard analysis are keys. Accident analysis is important.
- Kiewit jobs are controlled with a "zero tolerance program" which means that each employee is responsible for working safe. If a worker violates safety rules, the first time they receive a written reprimand. For a second violation, the penalty is a week off with no pay. The third time means termination. Drug testing is increasingly common. Kiewit tests prior to hiring. For accidents where drug or alcohol involvement is suspected, workers will be retested for cause.
- Recently, there has been a trend of owners or engineers taking away a lot of schedule float. Contractors are forced into working multiple shifts, 6 or 7 days a week, and with such overwork safety is compromised.

John Ramage (Vice President, CH2M Hill) spoke about experiences on the Milwaukee Water Pollution and Abatement Program, to be completed in late 1995 at a cost of \$ 2.29 billion (close to

the 1982 estimate of \$ 2.1 billion). CH2M Hill is the resident engineer/construction manager on this program. CH2M Hill has full-time safety coordinators and is responsible for staff training and verifying that contractors have met contractual requirement for specific safety procedures.

Ramage focused many of his comments in the aftermath of a November 1988 methane explosion which killed the three most experienced people on one underground construction contract. The contractor was convicted of negligent homicide. A federal grand jury was convened, but the jury chose not to hand down an indictment against the engineer for criminal violations of OSHA. The accident occurred in spite of the CH2M Hill commitment to develop a whole concept of safety from a management point of view, from a control point of view, from a redundancy point of view, and from an equipment and training point of view. Ramage is convinced that the only way to further improve on safety is to technically pre-qualify contractors. Top down commitment concerning safety, as indicated by a contractor's experience record, has to be the absolute single most important factor in pre-qualification.

The extensive discussion of safety for gassy ground operations cannot be detailed here, but routine defense strategies can be defined. In addition to training, the first defense for construction in gassy ground is a ventilation system of sufficient capacity to keep concentrations well below the lower explosive limit. The second order of defense is redundant detection systems, and the third order of defense is evacuation. The final line of defense is an upgrade (per National Electric Code, NEC) of equipment. Additional points raised by Ramage included:

- The OSHA code is ambiguous, and major code changes are needed in order for all parties to the construction process to truly understand unequivocally what are the responsibilities and what procedures should be taken to provide a safe working operation.
- For projects in gassy ground, application of the restrictive OSHA code makes underground work in hazardous conditions difficult if not impossible. The NEC recognizes that there are some conditions where you must have the authority to work in a hazardous environment. The relevant parts of the NEC should apply in underground construction.

Byron Ishkanian, Safety Engineer for the Division of Occupational Safety and Health (DOSH), State of California supported many of Ramage's observations. California operates under the 1972 Tom Carrell Tunnel and Mine Safety Act and the Tunnel Safety Orders, which are anticipatory

regulations. Under State law, every horizontal or vertical excavation 30 in. in diameter and larger is classed as a tunnel or shaft. The State reviews plans and borings for projects, visits the site, and makes classifications according to whether the excavation is to be considered Non-Gassy, Potentially Gassy, Gassy, or Extrahazardous. For each classification, different procedures are required by the contractor.

Engineers for the State analyze excavation equipment and ask for sensors to be installed at specific locations to monitor air flow. For Gassy or Extrahazardous classifications, the State requires contractors to use exhaust ventilation. If there is a chance of hitting gasoline-contaminated ground, the contractor is recommended to put their main crew through a 40-hour training program so that they will be prepared and work can continue safely without shutdown.

Pre-bid and pre-job conferences are required, including the fire department, personnel, labor unions, owners, subcontractors, consultants - all who are involved in a project. An emergency plan is developed for each specific project. The contractor must have his own rescue team which responds first because they know where to get into the tunnel, the Sheriff's Rescue team responds second, and the Fire Department team stands ready to respond as a third line of defense.

Wrap-up Insurance Issues

Several of the speakers on safety management indicated the importance of a viable incentive program. Incentives keyed to safety programs and wrap-up insurance are very effective, and the incentives should include the workers, as they are most able to effect the desired results.

Earl Adams, Jr. (Vice President, Johnson and Higgins) offered comments from his experience with wrap-up insurance policies (or CIPs - coordinated insurance policies). A wrap-up program is an owner-provided insurance program. The owner secures and pays for those coverages that a contractor normally would purchase on its behalf: general liability, worker's compensation, and property insurance. Wrap-up covers the owner and most contractors, usually with the same limit. Losses are paid and costs are controlled through effective claims management and administration that is supported by safety and loss control measures that help avoid injuries to workers and the public and damage to property. Contractors are required to deduct insurance costs from bids.

Wrap-up programs are designed to insure large projects with construction values of \$100 million or more. The primary incentive for a wrap-up is to decrease the owner's vulnerability and to save money. The best way to save money is to cut losses, which brings attention back to safety. With losses controlled, the savings generated frequently allow the underwriter to return a portion of the premiums in the form of dividends.

The advantages of wrap-up include owner control of the program, enhancement of public relations, adequate limits provided to all parties, broad coverage terms dictated by the particular project hazards, a coordinated safety program, and cost savings which are the result of volume discounts, good loss experience, and elimination of contractor mark-ups. One additional advantage is that, by reviewing all contractors of most insurance requirements, a wrap-up increases the number of small and disadvantaged business enterprises that can participate.

There can also be a disincentive to safety. Under some wrap-up packages, the business incentive for a contractor to spend money on a safety program beyond the legal requirements is removed if savings go only to the owner. Contractors (and subcontractors) need to be beneficiaries of any reward for good loss experience. It is important to require contractors to contribute to claim payments via a deductible.

Experience modification rates (EMRs) compare a contractor's experience with the industry average. For the construction industry, the average EMR reflects the industry's overall loss experience and currently is about 1.07, meaning that for every dollar collected in premiums, underwriters pay out about \$1.07 in claims. The EMRs used by underwriters have a significant effect on premiums, so that an experienced contractor with a better safety record will be more competitive in bidding a job. However, new companies (including new joint ventures), which have not yet established their own experience modification rates, may pay premiums based on standard rates even if the loss history of the joint venture individual entities reflects horrible losses. Underwriters are starting to modify their practices with regard to assigning EMRs to more closely reflect the loss experience of the entities forming the joint venture.

Larry Parberry (Vice President, SAE Civil Construction, Inc.) acknowledged the prevalent view of contractors in that they do not always trust wrap-up insurance programs. Safety and construction should be a partnering relationship between the owner and the contractors, subcontractors and suppliers. It may be possible to sell wrap-up to an owner on the basis of saving millions of dollars, but the mutual insurance needs of the contractors cannot be ignored.

In fact, contractors are not adamantly against wrap-up programs. Rather, they are opposed to owners who don't understand that the overall objective of the wrap-up is to have a safe place for all parties involved. In addition, a main issue for contractors is that there has to be a relationship between the owner's broker and the contractor.

It is important to have a wrap-up management director with knowledge of construction and what the overall risks are. If the wrap-up program is really set up to only save money, not necessarily to pay claims, the contractor becomes concerned. Administration is very important - if claims can be prevented on the front end and effectively administered at the back end, not only will the owner's money be saved but it also will improve the contractor's EMR.

Walter Mergelsberg (Director of Construction, Washington Metropolitan Area Transit Authority, WMATA) discussed the WMATA wrap up insurance and construction safety awareness program (SAP). The safety program, established in 1978, represented a positive action to coordinate all available means of eliminating or controlling hazards and risks associated with Metro system construction. Prior to 1978, WMATA's record was average at best, and it was clear that contractor's were not giving adequate emphasis to safety. Costs associated with construction accidents were rising, and the immediate objective was to reduce worker's compensation claims.

WMATA also provides a monetary incentive tied to a safety performance goal. The contractor earns a payment at the end of the contract if his incidence rate for lost-time accidents is below the target rate specified in the contract. Conversely, higher incidence rates result in a penalty.

WMATA awards plaques in public assembly to the resident engineer, contractor safety engineer, and project management jointly on projects which have achieved safety goals. WMATA estimates that its program has resulted in a 55 percent injury incidence rate decrease, and has saved the

construction program about \$93 million. Contractors have been awarded a total of \$9.0 million for providing an environment with fewer accidents.

Keith Wilkinson, Group Director of Health and Safety, Transmanche-Link (TML), in a delightful presentation, described how safety management on the Channel Tunnel project has progressed through a conversion from a reactive, compliance-led culture to a proactive positive safety management style. With a negative press attitude towards the tunnel, the general public resentment, and the general condition of society seeking retribution, there was a strong motivation for TML management to develop a safe, self-regulated environment for underground construction.

In order to develop a positive safety culture, TML adopted a safety management structure similar to that developed by DuPont. TML's organization is a hierarchical system of management safety committees. Line management must investigate accidents and make decisions. The Health and Safety Group has oversight responsibility and performs management safety audits with a numerical safety audit system. Worker training is acknowledged as essential. There are three days of induction training for every newcomer, and people who misbehave are reinducted with a severe financial penalty in loss of salary and bonuses.

Recent disasters have triggered a review of legislation in many countries. In the various reports by commissions of inquiry into U. K. legislation were a number of recommendations, including the need for self-regulation, and greater employee responsibility and participation. The report from the investigation of the King's Cross fire in the U.K. included the following comment which serves as a fitting conclusion to this article:

A safe environment is not one in which there is an absence of serious injury accidents, but it is the result of active participation by management and staff in identifying hazards and then doing something about them. In other words, the absence of accidents is a negative measure largely dependent on luck, while the identification and then prompt elimination or control of hazards is a positive step and is essential to the discharge of our duties under current legislation.

written by: Dr. Priscilla P. Nelson, Associate Professor in the Department of Civil Engineering at The University of Texas at Austin, and chairperson of the First North American Rock Mechanics Symposium (NARMS) to be held in Austin June 1-3, 1994.

U.S. National Committee for Rock Mechanics

The U.S. National Committee for Rock Mechanics (USNC/RM) provides advisory studies and reports on problem areas in rock mechanics; provides for U.S. participation in international activities in rock mechanics, principally through adherence to the International Society for Rock Mechanics; and keeps the U.S. rock mechanics community informed about new programs directed toward major areas of national concern in which rock mechanics problems represent critical, or even limiting factors—for example, energy resources, tunneling and other forms of excavation, underground storage and waste disposal, and reactor siting. The USNC/RM sponsors the U.S. Rock Mechanics Symposium and is the U.S. partner in the new North American Rock Mechanics Symposium series. Current 1993 membership comprises the following individuals:

Barry H.G. Brady, CHAIRMAN Dowell Schlumberger, Inc.

Bernard Amadei University of Colorado, Boulder

Herbert Einstein Massachusetts Institute of Technology

Bezalel C. Haimson University of Wisconsin

Jane C.S. Long
Lawrence Berkeley Laboratory

James E. Monsees PR/MK Team

Ronald P. Nordgren Rice University

Miklos Salamon Colorado School of Mines

Lawrence W. Teufel Sandia National Laboratories

Donald L. Turcotte Cornell University

Lewis V. Wade U.S. Bureau of Mines

National Research Council Geotechnical Board

Meeting of the U.S. NATIONAL COMMITTEE FOR ROCK MECHANICS

Room 250
The National Academy of Sciences
2101 Constitution Avenue, N.W.
Washington, DC 20418
(202) 334-2250

January 28-29, 1993

AGENDA

Thursday, January 28th

Executive Session/Committee Members Only

9:00 am Chairman's Statement

- Barry Brady, Chairman, USNC/RM

Introduction of New Committee Members

- Bezalel Haimson
- Lawrence Teufel
- Donald Turcotte

Bias Discussion

- Peter Smeallie

National Academy of Sciences/National Research Council committees consist of volunteers, such as yourselves, that are formed to achieve intellectual balance and capabilities. In order to assure this balance, each committee is required to discuss bias and composition, usually once a year. During this discussion you will be asked to describe your current job responsibilities, consultancies you hold, sources of research support, organizational affiliations, relevant financial holdings, and public positions taken relevant to the committee's charge (such as in published papers). A discussion of scientific misconduct will also be held. A confidential record will be made of the discussion.

Other Matters Appropriate for Executive Session

- Ethics in Rock Mechanics
 - Bezalel Haimson
- Discussion of INTRAVAL Project and the Possible Role of the USNC/RM
 - Peter Smeallie

USNC/Rock Mechanics Meeting Agenda January 28-29, 1993 Page two

Session open for guests

10:30 Special Studies of the USNC/RM

- Committee on Fracture Characterization and Fluid Flow
 - Jane Long
 - Discussion on Chapter 7 may be delayed until H. Einstein arrives at 2:00 pm
- Report on Stability, Failure, and Measurements of Boreholes and Other Circular Openings
 - Peter Smeallie
- Proposed Study on U.S. Funding of Rock Mechanics Research
 - Lew Wade
- Proposed Study on Rock Anisotrophy
 - Bernard Amadei

12:00 noon Lunch in Meeting Room

12:45 pm Policies for Organization of the U.S. Rock Mechanics Symposium

- Section on Financial Guidelines
 - Lew Wade, Ron Nordgren, Barry Brady
- Overall Discussion and Disposition

1:30 U.S. Rock Mechanics Symposia

- Final Report on the 33rd Rock Mechanics Symposium in June 1992 in Sante Fe Including Special Symposium Fund
 - Larry Teufel, Peter Smeallie
- Status Report on the 34th Rock Mechanics Symposium in June 1993 in Madison, Wisconsin
 - Bezalel Haimson
- Discussion on Sites for the 35th (1995) and 36th (1997) Symposia
 - Barry Brady, Peter Smeallie

3:00 1993 Rock Mechanics Awards

- Miklos Salamon, Bernard Amadei

3:30 ISRM

- Report from ISRM Council Meeting, September 1992, Chester, England
 - Barry Brady

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ISRM, continued

- Agenda Items for the ISRM Council Meeting, June 1993, Lisbon, Portugal
 - Barry Brady
- Application to Host 1994 ISRM International Symposium in June in Austin, Texas, as Part of the First North American Rock Mechanics Symposium
 - Jim Monsees
- Discussion of Greater U.S. Participation in ISRM Working Commissions
 - Herbert Einstein
- Discussion of News Journal and U.S. Correspondence
 - Miklos Salamon, Peter Smeallie
- ISRM U.S. Membership
 - Peter Smeallie
- 5:30 Adjourn for the Day
- 5:45 Reception, NAS Executive Dining Room
- 6:30 Dinner, NAS Executive Dining Room
 - Remarks by Arch Wood, Executive Director, Commission on Engineering and Technical Systems, National Research Council

Friday, January 29th

8:30 am Yucca Mountain Site Characterization Project: Issues of Rock

Mechanics

- Max Blanchard, Deputy Project Manager, YMP, DOE
- Michael Voegele, SAIC

General Discussion with Committee

10:30 Dynamic Tunnel Closure in Jointed Rock

- Paul Senseny, Defense Nuclear Agency

General Discussion with Committee

12:30 pm Lunch in Meeting Room

USNC/Rock Mechanics Meeting Agenda January 28-29, 1993 Page four

1:00	Related	Studies	and	Activities

- Geotechnical Board/U.S. National Committee on Tunneling Technology
 - Peter Smeallie, Priscilla Nelson
- Symposium on Practical Lessons from the Loma Prieta Earthquake
 - Peter Smeallie
- Advanced Drilling Technology
 - Peter Smeallie, Jim Monsees
- 1:30 First North American Rock Mechanics Symposium (NARMS) in June 1994 in Austin, Texas
 - Background, Trilateral Agreement
 - Peter Smeallie
 - Terms of the Agreement and Working Understandings
 - Barry Brady
 - First NARMS and Role of the USNC/RM
 - Priscilla Nelson
- 2:55 Next Meeting
- 3:00 Adjourn

National Research Council Geotechnical Board

Meeting of the U.S. National Committee for Rock Mechanics

Wisconsin Center, Room 315 North Lake and Langdon Streets Madison, Wisconsin (608) 262-5514

AGENDA

Sunday, June 27th

EXECUTIVE SESSION FOR COMMITTEE MEMBERS ONLY

8:00 a.m. Chairman's Statement

- Barry Brady

The New Division of Infrastructure, Environment, and

Energy Engineering

- Dev Mani

Director's Report

- Peter Smeallie

8:30 Committee Composition

- Peter Smeallie

SESSION OPEN FOR GUESTS

9:00 Special Studies of the USNC/RM

- Report on Stability, Failure, and Measurements of Boreholes and Other Circular Openings
 - Jean-Claude Roegiers
- Report on Committee on Advanced Drilling Technologies
 - Neville Cook
- Committee on Fracture Characterization and Fluid Flow
 - Jane Long
- Proposed Study on U.S. Rock Mechanics Research for the 21st Century
 - Lew Wade
- Proposed Study on Rock Anisotropy
 - Bernard Amadei
- Discussion of Potential Policy-Oriented Studies
 - -All
- Discussion of Potential Activities with the Yucca Mountain Project
 - All

10:00 U.S. Rock Mechanics Awards Selection Process

Barry Brady and Bernard Amadei

How is it working?

How can it be improved?

10:30 a.m. U.S. Symposia on Rock Mechanics/North American Rock Mechanics Symposium

- 1993 34th U.S. Symposium on Rock Mechanics, Madison, Wisconsin
 - Bezalel Haimson
- 1994 First North American Rock Mechanics Symposium, Austin, Texas
 - Priscilla Nelson
- 1995 35th U.S. Symposium on Rock Mechanics, Reno, Nevada
 - Jaak Daemen
- 1996 Second North American Rock Mechanics Symposium, Canada
 - Peter Kaiser
- 1997 36th U.S. Symposium on Rock Mechanics
 - Scott Huang

12:00 noon Lunch at Husnus, 547 State Street (256-0900)

2:00 p.m. General Discussion on Policies and Guidelines for the Rock Mechanics Symposia

- How are they working?
- How can they be improved, if needed?
- 2:30 International Society for Rock Mechanics
 - Report from the President
 - Charles Fairhurst
 - Report from the Vice President, North America
 - Peter Kaiser
 - Report from U.S. Delegation to the 1993 ISRM Meeting in Lisbon
 - Barry Brady
 - Peter Smeallie
 - Report from ISRM News Journal
 - Jennifer Bartholomew
 - Report from Working Commissions
 - Herbert Einstein, Chairman, Commission on Swelling Rocks
 - Barry Brady, Member, Commission on Petroleum Rock Mechanics
 - Peter Smeallie, Member (former), Commission on Education
 - Others, as Appropriate
 - Discussion on Increasing the U.S. Involvement in International Rock Mechanics
 - The ITA Example
 - Peter Smeallie
 - Priscilla Nelson
 - U.S. ISRM Membership
 - Peter Smeallie

USNC/Rock Mechanics Meeting Agenda Page 3

4:00	Intraval Project — Charles Fairhurst — Charles Voss — Peter Smeallie
4:20	Next Meeting
4:25	Other Business
4:40	General Discussion: What is happening to geomechanics in the national labs? In the Bureau of Mines? — Jane Long, Lawrence Berkeley Laboratory — Larry Teufel, Sandia National Laboratories — Lew Wade, U.S. Bureau of Mines
5:15	Adjourn



Announcement and Program

34th U.S.
Symposium
on Rock
Mechanics

June 27-30, 1993

University of Wisconsin-Madison



A Regional
Conference of the
International Society
for Rock Mechanics
Sponsored by the
United States
National Committee
for Rock Mechanics

Hosted by the Department of Materials Science and Engineering, and the Geological Engineering Program College of Engineering

College of Engineering University of Wisconsin Madison

Symposium Technical Program

Monday, June 28:

Dean of the College of Engineering, UW-Madison
J. Hudson, Imperial College, London
P. Kaiser, Laurentian Univ., Canada
Golder & Assoc. and D. Young, Michigan Tech.)
S. Ezzerdine, G. de Marsıly P. LaPointe, P. Wallmann, W. Dershowitz S. Blair, N. Cook, S. Daveler D. Young
S. Müller. R. Luark
. 13

➤ Geophysical Properties of Rocks—(Chairs: N.	Christensen.	Purdue Univ	. and M.	Batzle.	ARCO)
1:40-5:10 p.m., Auditorium					

Compressional to Shear Velocity Ratios in Sedimentary Rocks	J. Johnston, N. Christensen
Shear Wave Attenuation in Dry and Saturated Sandstone at Seismic to Ultrasonic Freque	ncies D. Green. H. Wang, B. Bonner
Acoustic Velocity Changes During Shear Enhanced Compaction of Sandstone	T. Scott. Q. Ma. J-C. Roegiers
Moduli/Permeability Variations During Air/Water Flow in Shaley Sandstone	J. Holder. S. Thallak. M. Younus. K. Gray
Variation of Shear-Wave Amplitude During Frictional Sliding	W-Y. Chen . C. Lowell, G. Haley, L. Pyrak-Nolte
Effects of Stress Anisotropy on the Static and Dynamic Properties of Berea Sandstone	S. Ita. N. Cook. L. Myer. K. Nihei
Induced Seismicity and Fault Zone Characterization	F. Cornet. O. Scotti
Induced Seismicity Investigations in the Site Characterization of Nuclear Waste	R.P. Young, C.D. Martin
Critical Porosity-A Physical Boundary in Poroelasticity	H. Yin, A. Nur, G. Mavko
Citical Follosity-A Physical Doubleary In Polociasucity	······································
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➤ Borehole Instability and Breakouts I—(Chairs: M. Zoback, Stanford Univ. and R. Steiger, Exxon) 9:30 a.m.-12:10 p.m., Lakeshore Room

➤ Borehole Instability and Breakouts II—(Chairs: J-C. Roegiers, Univ. of Oklahoma and S. Bell, Geol. Survey of Canada) 1:40-5:10 p.m., Lakeshore Room

Crustal Stresses in the North Sea from Breakouts and Other Borehole Data S. Cowgill P. Meredith, S. Shale-Fluid Interaction and Its Effect on Creep and Borehole Stability How Accurately Can Breakouts Record In Situ Stress Orientations? S. Bell M.	F. Remvik P. Skalle
➤ Modeling in Underground Mining—(Chairs: S. Crouch, Univ. of Minnesota and R.P. Young, Queen's Univ., Canad 9:30 a.m12:10 p.m., Room 313	a)
Constraining Models with Geomechanical Data and Fault-Plane Solutions	L. Spinnler. J. Fine Siebrits . S. Crouch Y. Jung. K. Holberg R. Pine. R. Trueman
➤ Rock Mechanics in Tunneling—(Chairs: H. Einstein, MIT and J. Monsees, PB/MK Team) 1:40-5:10 p.m., Room 313	
Performance of Tunnel Portal in Weathered Rock	. Picard, G. Rousset . Green, W. Wallace F. Kendorski Hagedorn, G. Sattel
Design and Construction of a Wide Tunnel Under Shallow Cover-The Lafayette Bluff Tunnel	cott . J. Kottenstette
Tunneling Under the Apache Trail	cott . J. Kottenstette M. Simmons
Tunneling Under the Apache Trail	cott . J. Kottenstette M. Simmons L. C. Felice. S. Green M. Bruno. C. Bovberg R. Steiger Youglas. C Dintaman G. Greaves. J. Martin Durham. B. Bonner ert. V. Dwarakanath
Tunneling Under the Apache Trail	cott . J. Kottenstette M. Simmons L.C. Felice. S. Green M. Bruno. C. Bovberg R. Steiger Youglas. C Dintaman G. Greaves. J. Martin Durham. B. Bonner ert. V. Dwarakanath J. Inyang. J. Pitt

Tuesday, June 29:

PLENARY SESSION (Memorial Union Theater)

> Keynote Lecture 8:00-2:00 ~ m.	
"Rock Eng deering Systems: Theory & Practice"	J. Hudson, Imperial College, London
CONCURRENT SESSIONS and WORKSHOP (Wisconsin Center)	
➤ Block Theory—WOKKSHOP—(Chairs: R. Goodman, Univ. of California-Berkeley and M 9:30 a.m12:10 p.m., Auditorium	I. Mauldon. Univ. of Tennessee)
The Influence of Water on the Behavior of a Key Block Stability Analysis of Multiple-Block Sliding Surfaces Rock Slope Instabilities: A Comparison with Block Theory Forecast Variation of Joint Orientation in Block Theory Analysis The Plock Failure Likelihood: A Contribution to Rock Engineering in Blocky Rock Masses Computing 3-D Key Blocks Delimited by Joint Traces on Tunnel Surfaces	
➤ Rock Mechanics of Building Stones and Guarries—(Chairs: G. Simmons, Hager-Richt 1:40-5:10 p.m Auditorium	ter Geosciences and J. Logan, Texas A & M Univ
Variations of Rock Properties within a Quarry	J. Logan. M. Hastedt. J. Lehnert. M. Dentoi O. Del Grecii, A. Ferrero. C. Ogger C. Tanimoto, S. Yoshimura. J. Kondo
	17
ccelerated Weathering of Building Stonese of Physical Property Data and Testing in the Design of Curtain Walltructural Analysis of Stone Clad Precast Concrete Building Panels	J. Bayer, C. Clift
Hydraulic Fracturing for Enhanced Recovery—(Chairs: N. Warpinski, Sandia and I. Sa	•
9:30 a.m12:10 p.m. Lakeshore Room Indeling the Propagation and Closure of Micro-Hydraulic Fractures Inalysis of Crack Reopening Behavior for Hydrofrac Stress Measurement Influence of Inelastic Rock Behavior in Hydraulic Fracturing Inproving the Performance of Open Hole Stress Tools Iffects of Chemical Solutions on Rock Fracturing Inock Dilatancy Near the Tip of a Propagating Hydraulic Fracture Indicate Propagating Newtonian and Power-Law Fluids Incremental Growth of a Shallow Hydraulic Fracture at a Waste Remediation Site	J. Desroches. M. Thiercelin T. Ito. K. Hayashi P. Papanastasiou. M. Thiercelin M. Thiercelin. J. Desroches M. Karfakis den Hoek, J. van den Berg, J. Shlyapobersky J. Sousa, B. Carter, A. Ingraffea
Rock Mechanics in Reservoir Engineering—(Chairs: L. Teufel, Sandia and J. Russel, Te 1:40-4:50 p.m., Lakeshore Room	ŭ
lodeling Fractured Reservoirs Using Deformation-Dependent Flow Mechanisms	M Bai D Clausanh I.C Passions

Permeability Reduction Due to Grain Crushing around a Perforation E. Papmichos. I. Vardoulakis. H. Ouadfel

Acoustic Emission and Rock Fracture	
Acoustic Emission and Ultrasonic Velocity Study of Excavation-Induced Microcrack Damage S. Carlson R.P. Studying Hydraulic Fracturing Mechanism by AE Monitoring I. Matsunaga, H. Kobayashi, S. Sasaki, T. I. Precursory Pressure Anomalies Prior to Coal Mine Failures B. Brady, K. F. Pattern of Microseismic Activity Prior to a Mountain Bump J. Coughlin G. F. Variation of AE Hypocenter Distribution in Coal During Triaxial Compression M. Seto, O. Nishizawa, K. Katsu The Development of Rock Fracture: From Microfracturing to Main Fracture Formation J. Huang, Z. Wang, Y.	Young Ishida Ianna Rowel iyama
➤ Acoustic Emission and Failure Prediction II—(Chairs: D. Holcomb, Sandia and R. Kranz, USBM) 1:40-3:00 p.m Room 313	
General Theory of the Kaiser Effect D. Ho Anisotropic Crack Damage and Stress-Memory Effects in Rocks under Triaxial Loading C. Stuart. P. Meredith. S. M. Assessment of Damage in Rock by the Kaiser Effect of Acoustic Emission C. Li. E. Nor The Effect of Attenuation on B-Values in AE Measurements - A Theoretical Investigation T. Un	lwreil dlund
➤ Yucca Mountain Project—SPECIAL SESSION—(Chairs: L. Shephard, Sandia and M. Voegele, SAIC) 3:30-5:10 p.m Room 313	
Yucca Mountain Site Characterization Project Issues in Rock Mechanics	echte Elkins Rydei
	19
Numerical Methods in Book Machanias (Ob. 1 and B.	
Numerical Methods in Rock Mechanics—(Chairs: M. Plesha, Univ. of Wisconsin and J. Long, Lawrence Berkeley Lab.) 9:30-11:50 a.m., Room 316	
A. Selvadiracture Process Zone Development during Hydraulic Fracturing J. Huang, K. Gumerical Simulation of the Effects of Heterogeneities	lurai aran Kim giers
Alicromechanics of Granular Materials-Numerical Simulation of the Effects of Heterogeneities	lurai aran Kim giers

Wednesday, June 30:

PLENARY SESSION (Memorial Union Theater)

> Keynote Lecture 8:00-9:00 a.m.

"Role of Pore Pressure in Some Rock Mechanical Processes Pertaining to the Oil Industry" E. Detournay, Univ. of Minnesota

CONCURRENT SESSIONS and WORKSHOP (Wisconsin Center)

➤ Coupled Fluid/Solid Mechanisms—WORKSHOP—(Chairs: T. Boone. Imperial Oil-Ca 9:30 a.m12:10 p.m Auditorium	
Concept of Effective Stress in Rocks Review of Some Examples of Poroelastic Effects in Rock Mechanics Hydrofracturing Models and Their Applications Modeling of Near Tip Process :s in Hydraulic Fractures Couplings in Thermoporomechanics: How to Distinguish the Important from the Unnece	
➤ Coupled Mechanical and Hydrologic Processes—(Chairs: H. Wang, Univ. of Wiscons 1:40-5:10 p.m., Auditorium	sin and T. Doe. Golder & Assoc.)
1:40-5:10 p.m., Auditorium	
1:40-5:10 p.m Auditorium Pore Pressure Buildup Coefficient in Synthetic and Natural Sandstones	P. Berge, H. Wang, B. Bonne P. Vinard, P. Blumling, J. McCord, G. Aristorena:
1:40-5:10 p.m Auditorium Pore Pressure Buildup Coefficient in Synthetic and Natural Sandstones Evaluation of Hydraulic Underpressures at Weilenberg, Switzerland	P. Berge, H. Wang, B. Bonne P. Vinard, P. Blumling, J. McCord, G. Aristorena: W. Parisea
1:40-5:10 p.m., Auditorium	P. Berge, H. Wang, B. Bonne P. Vinard, P. Blumling, J. McCord, G. Aristorena. W. Pariseai R. Beauheim, W. Wawersik, R. Robert

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A Micromechanically Consistent Poroviscoelasticity Theory for Rock Mechanics
➤ In Situ Stress Measurements I—(Chairs: C.D. Martin, AECL Research, Canada and W. El Rabaa, Mobil Research) 9:30 a.m12:10 p.m., Lakeshore Room
In Situ Stress Measurement by Hydraulic Fracturing at the Kamaishi Mine K. Hayashi, T. Ito Estimating the State of Stress from Subhorizontal Hydraulic Fractures at URL B. Haimson, M. Lee. N. Chandler, D. Martin In Situ Stress Measurements in a Borehole for the Design of a Transalpine Railway Tunnel D. Burlet Near-Surface "Thin Skin" Reverse Faulting Stresses in the Southeastern United States D. Moos, M. Zoback Hydrofrac Stress Data for the European HDR Research Project Test Site Soultz-Sous-Forets G. Klee. F. Rummel In Situ Stress Measurements for the Design of the Gjovik Olympic Mountain Hall L. Tunbridge, S. Hansen, J. Kristiansen Hydraulic Fracturing Stress Measurement Assisted by Water Jet Borehole Slotting Y. Mizuta, S. Kikuchi, K. Tokunaga Stress Field in the Coal Mines of the Ruhr Coal District F. Rummel, U. Weber
➤ In Situ Stress Measurements II—(Chairs: D. Schmitt, Univ. of Alberta, Canada and D. Moos, Stanford Univ.) 1:40-5:10 p.m., Lakeshore Room
Bored Raise Overcoring for In Situ Stress Determination at the Underground Research Laboratory

➤ Rock Fractures and Joints I—{Chairs: J. Kemeny, Univ. of Arizona and L. Myer, Lawrence Berkeley 9:30 a.m12:10 p.m., Room 313	Lab.)
Numerical Modeling of Borehole Breakout by Mixed-Mode Crack Growth. Interaction. and Coalescence Model of Crack Growth in Microcracked Rock	A. Dyskin. L. Germanovich
Cracked Chevron Notched Brazilian Disc Test-Geometrical Consideration for Practical Rock Fracture Assessment of Conventional Methodologies for Joint Roughness Coefficient Determination	
The Pressure Dependence of Apparent Hydrofracture Toughness	S. Thallak, J. Holder, K. Grau
Determination of In Situ Fracture Toughness	X. Zhao, J-C. Roegiers
A Study of Squeezing Flow in Fracture Channels	D. Lin. J-C. Roegiers

➤ Rock Fractures and Joints II—(Chairs: J. Labuz. Univ. of Minnesota and L. Costin. Sandia) 1:40-4:50 p.m., Room 313

Effects of Finite Size Joints on Deformability of Jointed Rock at the Three-Dimensional Level	P. Kularilake. S. Wana
Hydromechanical Response of a Fracture Undergoing Shear	
Laboratory Study of Water Flow Through Multiple Fractures	M Shimo S lihoshi
Stability of the Jointed Roof in Stratified Rock	.E. Passaris, J. Ran. P. Mottahed
Numerical Analysis of Mode I and Mode II Propagation of Rock Fractures	B. Shen, O. Stephansson
Effect of Strain Rate on a Set of Fractures	H. Wu. D. Pollard
A Finite-Width Elliptical Crack Model	Y. Yuan, E. Laitai, M. Auari
Fractal Characteristics of Mesofracture in Compressed Rock Specimens-SEM Investigation	Y. Zhao. J. Huang. R. Wang

> Coal and Metal Mining and Ground Control—(Chairs: W. Khair, West Virginia Univ. and L. Wade, USBM) 9:30 a.m.-12:10 p.m.. Room 316

Factors Affecting Strength of Coal Pillar
Field Evaluation of Cable Bolt Supports

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Seismic Imaging of Blast Damage Failure Mechanisms Under Waterjet Impact Design Charts for Groundwater Flow into Mined Panels A Study of Ground Behavior in Longwall Mining Through Field Instrumentation Numerical Modeling of Ground Subsidence Due to Mining Comprehensive Classification of Rock Stability. Blastability and Drillability Based on Neur	D. Summers, D. Wright, G. Galecki Z. Ouyang, D. Elsworth Z. Yu, Y. Chugh, P. Miller, G. Yang	
➤ Large Underground Facilities—(Chairs: K. Kim, Columbia Univ. and J. Ratigan, RE/S 1:40-5:10 p.m Room 316		
Design Methodology for Rock Excavations at the Viscos Mountain Project		

Effects of the Number of Caverns on the Performance of Underground Oil Storage Facilities E. Hoffman. B. Ehgartner

1993 U.S. Rock Mechanics Award Recipients

Helen E. Farrell, Phillips Petroleum Co., "Effect of reservoir depletion and pore pressure drawdown on *in situ* stress and deformation in the Ekofisk Field, North Sea," Case Histories Award

Steven Glaser, National Institute of Standards and Technology, "Acoustic emissions produced by discrete fracture in rock, Part 1 - Source location and orientation effects" and "Acoustic emissions produced by discrete fracture in rock, Part 2 - Kinematics of crack growth during controlled Mode I and Mode II loading of rock," Basic Research Award

Chengho Lee, ITASCA Consulting Group, Inc., "Identifying probable failure modes for underground openings using a neural network," Applied Research Award

Priscilla P. Nelson, University of Texas at Austin, "Acoustic emissions produced by discrete fracture in rock, Part 1 - Source location and orientation effects" and "Acoustic emissions produced by discrete fracture in rock, Part 2 - Kinematics of crack growth during controlled Mode I and Mode II loading of rock," Basic Research Award

Kurt T. Nihei, University of California, Berkeley, "Micromechanics of seismic wave propagation in granular rocks," Ph.D. Thesis Award Award

Douglas W. Rhett, Phillips Petroleum Company, "Effect of reservoir depletion and pore pressure drawdown on *in situ* stress and deformation in the Ekofisk Field, North Sea," Case Histories Award

Raymond L. Sterling, University of Minnesota, "Identifying probable failure modes for underground openings using a neural network," Applied Research Award

Lawrence W. Teufel, Sandia National Laboratories, "Effect of reservoir depletion and pore pressure drawdown on *in situ* stress and deformation in the Ekofisk Field, North Sea," Case Histories Award

Maria A. Vieira, "Numerical Model for the Study of Deformable, Naturally Fractured Reservoirs," M.S. Thesis Award in Rock Mechanics

Geotechnical Board
Article for the December 1992
Issue of Geotechnical News

A LETTER FROM THE CHAIRMAN OF THE U.S. NATIONAL COMMITTEE FOR ROCK MECHANICS By Barry H.G. Brady

Dear Friends:

The purpose of this letter is to provide news of the current business and activities of the U.S. National Committee for Rock Mechanics (USNC/RM) and the International Society for Rock Mechanics (ISRM).

USNC/RM MEETING: JUNE 6, 1992

The USNC/RM met on June 6th, prior to the 33rd U.S. Rock Mechanics Symposium held in Santa Fe, New Mexico. In addition to the USNC/RM members (Bernard Amadei, Herbert Einstein, Jane Long, James Monsees, Ronald Nordgren, Miklos Salamon, Lewis Wade, Wolfgang Wawersik, Barry Brady), Priscilla Nelson, Peter Kaiser, Charles Fairhurst, Ronald Steiger, Jean-Claude Roegiers and Jaak Daemen attended the meeting. Among the matters discussed were interactions with the ISRM, a proposal for North American rock mechanics symposia, venues for future U.S. rock mechanics symposia, arrangements for U.S. symposia currently in planning, reports on special studies in progress or planned, annual awards for distinguished publications, the SSC project, and the NSF Center of Excellence award to the University of Oklahoma. Several of these matters are considered below.

INTERACTIONS WITH THE ISRM

At the Santa Fe meeting and symposium, Charles Fairhurst outlined some of his initiatives to invigorate the ISRM, particularly in terms of the services it provides its members. The new ISRM News Journal is one such initiative. In addition to its role in publicizing events of general interest, the brief technical articles and advertising by international agencies and corporations will provide us with more informed contact with colleagues and opportunities overseas. On a technical level, it is important for U.S. members to participate in the business of the ISRM, especially through the various commissions. A listing of active commissions is set out in the ISRM Directory. The products of the commissions' deliberations (such as "Recommended Procedures") can have substantial effects on professional geo-engineering practice in the global market. For that reason alone, it is important that they reflect the state of contemporary rock mechanics science and engineering practice in North America, as well as in the other economically advanced areas. While it is a matter of individual initiative to participate in the commissions, Peter Kaiser (telephone: 705/673-6517) could advise on how to become actively engaged in their business.

U.S. ROCK MECHANICS SYMPOSIA

The 33rd Symposium

The importance of U.S. Rock Mechanics Symposia in the technical activities of the national, North American, and overseas rock mechanics communities was reaffirmed by the attendance at and technical contributions to the 33rd Symposium, held at Santa Fe, New Mexico, in early June. Organization of the symposium was carried through by the Inter-Laboratory Organizing Committee (IOC), consisting of members of the geomechanics groups of the Sandia, Lawrence Berkeley, Lawrence Livermore and Los Alamos National Laboratories, and chaired by Wolfgang Wawersik of Sandia. The attendance exceeded four hundred; more than one hundred technical papers were presented, and there were several workshops and short courses. Those who were fortunate enough to attend enjoyed technical and social programs which reflected the thorough efforts of the IOC in ensuring presentation of an outstanding event. In many ways, the 33rd symposium will serve as a model for future U.S. symposia, and we add our compliments and commendations to the entire IOC.

The 34th Symposium

The next U.S. Rock Mechanics Symposium is scheduled for June 27-30, 1993, at the University of Madison-Wisconsin. Associated workshops are planned on in-situ state of stress and poroelasticity. Abstracts for papers have already been called for, with a closing date for submission of September 30th. Bezalel Haimson, the chairman of the Local Organizing Committee, reports that arrangements are well in hand. The lakeside venue is very attractive, with scenery and charm typical of the upper midwest. In the technical arrangements, the organizers intend to depart from the publishing format for proceedings followed in the recent past. While the symposium will fulfill the objective of providing for prompt review of work in progress, papers recognized as being ready for publication in the refereed literature will be published in a special issue of the *International Journal for Rock Mechanics*. That initiative is consistent with the recent emphasis of the Geotechnical Board and the National Research Council, under whose auspices we operate, to encourage improvement in the technical quality of published proceedings of meetings.

Symposia Beyond 1993

The USNC/RM is anxious to ensure that a venue is provided annually for members of the U.S. geomechanics community to present their work for review and to obtain the other benefits of a well-organized technical meeting. For that reason, we are looking well beyond 1993 in seeking symposium organizers. Several universities have expressed interest in conducting future symposia, and we will continue to explore possible arrangements with the interested parties. The 1994 symposium to be held at the University of Texas at Austin, previously noted as the 35th U.S. Symposium, may be organized on a different basis, as discussed below.

PROPOSAL FOR NORTH AMERICAN ROCK MECHANICS (NARM) SYMPOSIA

Several years ago it was proposed that, in relation to the amount of work in progress and the number of members of the rock mechanics community, there were too many rock mechanics symposia on general topics and that some rationalization of the annual calendar of symposia may benefit our client community. On the other hand, it is recognized that the U.S. rock mechanics community and its supporting agencies have been well served by the U.S. symposium series for many years. In an effort to meet the requirements of continuity of the U.S. symposium series and its other scientific and professional objectives, and to extend the pool from which technical contributions are drawn, the U.S. National Committee for Rock Mechanics, the Canadian Rock Mechanics Association (CARMA), and Mexico's Sociedad Mexicana de Mechanica de Rocas (SMMR), are pleased to announce a cooperative effort to hold the first North American Rock Mechanics Symposium. The USNC/RM, CARMA, and SMMR have agreed on an arrangement under which, every second year, a NARM symposium would take the place of a U.S. symposium. The venue for a NARM symposium would rotate between host universities in the U.S., Canada, and Mexico. The first NARM symposium is planned for 1994 at the University of Texas at Austin, with a local organizing committee chaired by Priscilla Nelson.

SPECIAL STUDIES

Two special studies, conducted by appointed voluntary committees of the National Research Council under the auspices of the USNC/RM, are currently in progress. The first, on the subject of Borehole Stability, was performed by a team led by Jean-Claude Roegiers. Its report is currently nearing publication. The second, on Fracture Characterization and Fluid Flow, was reviewed in detail by the committee chairman, Jane Long, at the Santa Fe symposium. Its report will be published in book form by the National Academy Press in 1993. The interest expressed in the study following the review in Santa Fe and the effort invested in the preparation of the report by a distinguished group of specialists on rock fractures and fracture flow suggest the book will be a benchmark contribution to the literature on this topic.

AWARDS

The annual awards, recognizing distinguished contributions by U.S. researchers and engineers to the rock mechanics literature, is an important function of the USNC/RM. For several years, the awards subcommittee has been chaired by Jean-Claude Roegiers of the University of Oklahoma. At the Santa Fe committee meeting, Jean-Claude recorded the view that, after several years, his sub committee considered it was time for a change and tendered its resignation. In accepting the resignation, the USNC/RM noted the effort required to review the papers nominated for awards, and complimented the awards subcommittee on their dedicated contributions over its tenure period. Miklos Salamon of the Colorado School of Mines accepted the position of chairman of the subcommittee and noted his intention to recruit members from throughout the United States. It was agreed

USNC/RM Chairman's Letter Page four

that, in the future, the membership of the awards committee would be matter of public knowledge.

ISRM COUNCIL MEETING, CHESTER, U.K., SEPTEMBER 13, 1992

The meeting of the ISRM Council was the first held under the chairmanship of the current President, Charles Fairhurst. Among the items considered were: the effect of currency fluctuations on ISRM finances and the shortcomings of the fee structure; the News Journal and the need to support it with advertising; status of arrangements for the 8th ISRM Congress (September 23-29, 1995, in Japan); the announcement of the 1993 Rocha Medal award to Dr. Olivia Maria Reyes, a former student of Herbert Einstein, to both of whom go our congratulations; preliminary proposals for the 1999 Congress, submitted by Scandinavia and France; proposals to recognize either the 1994 University of Texas North American Rock Mechanics Symposium or a symposium in Chile as the ISRM international symposium for 1994 (the vote on the selection of the venue was deferred pending clarification of the possible NARM symposium noted above).

Several of the active technical commissions also held meetings. However, it was clear that much of the business of these groups needs to be conducted by mail, and that permits U.S. members to contribute without necessarily incurring the expense of attending the meetings.

If you have any comments on matters raised in this letter, or any other items you wish to discuss, I would be pleased to hear from you. My telephone number is 918/250-4204 and fax number is 918/250-9323.

Best wishes,

Barry Brady Chairman, U.S. National Committee for Rock Mechanics

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A LETTER FROM THE CHAIRMAN OF THE U.S. NATIONAL COMMITTEE ON TUNNELING TECHNOLOGY By Raymond L. Sterling

Dear Friends:

This letter is to inform those involved in tunneling and underground excavation about the activities of the U.S. National Committee on Tunneling Technology (USNC/TT), a part of the U.S. National Research Council's Geotechnical Board. Since the cessation of the USNC/TT newsletter, <u>Tunneling Technology</u>, and because the committee meets infrequently, I think it is important to have a vehicle of communication on committee activities. In this letter, I will attempt to provide a general view of the scope and direction of our current activities.

Committee Outreach

A number of people have mourned the passing of the USNC/TT newsletter and wondered why it was stopped. The decision was taken by the committee for several reasons:

- 1. When the newsletter was being published originally, the USNC/TT had a separate staff. Now, the same size of staff handles the Geotechnical Board, the U.S. National Committee for Rock Mechanics (USNC/RM) and the USNC/TT. A newsletter is a time-consuming activity and takes away from other important committee and staff activities.
- 2. The American Underground Space Association (AUA) newsletter now fulfills a similar communication role for the tunneling and underground construction industry with a lively and interesting newsletter. The committee felt it would rather use this vehicle for much of its news (as it has been encouraged to do by the AUA) than to maintain a duplicative role.
- 3. The committee felt that an annual report of USNC/TT activities would provide a better formal vehicle to let the U.S. community know what the committee has accomplished and is planning to undertake, with a lesser demand on staff time and resources.

The liaison members to the USNC/TT from allied societies and organizations also provide an important communication role. They bring issues of broad national concern to the committee and present the viewpoints of their respective societies. They also pass information back from the committee to their constituencies. We are currently in the process of adding committee liaisons from the American Public Works Association (APWA) and the North American Society of Trenchless Technology (NASTT) as mentioned in the discussion of infrastructure issues below.

Special task committees of the USNC/TT are another means of involving a broader range of participants in USNC/TT activities. These often include many participants outside the immediate group of committee members and liaisons and outside the specific underground construction community.

International Activities

We are fortunate to have at present Dick Robbins as Vice President of the International Tunnelling Association (ITA). Dick Robbins, well known to all in the tunneling community, was our national representative to the ITA until his election to the Executive Council last year and his election as Vice President this year. His place as U.S. Representative has now been taken by Harvey Parker, the former Chairman of our committee. It is intended that Dr. Parker, with input from Dick Robbins and other participants and attenders at ITA activities will provide regular reports of ITA affairs to our USNC/IT sponsoring agencies and the community at large.

The committee has been concerned for some time with the erosion of the U.S. competitive technological position in underground construction over the past decades and is undertaking several activities to address this question. One approach to this problem is to encourage more U.S. participation in the activities of the ITA and following the USNC/TT committee meeting in February 1992, a parallel U.S. committee has been linked to each of the ITA working groups (ten in total—see list) picking a chairperson to create one if necessary. The USNC/TT recognizes the existing interests or activities of other underground construction organizations in the U.S. and has used existing committee structures where available. Exactly how the new committees among these U.S. counterparts will function is not exactly determined yet. In most cases, it will depend on the directions of the ITA working groups and the energy and enthusiasm of the nominated U.S. representative to the committee. It is important to stress that the ITA working groups welcome any participants and that many people besides the official representatives play important roles in the working groups.

We were especially pleased to see a U.S. representatives on every working group at the May 1992 ITA Congress in Acapulco, Mexico. Representatives participated vigorously in their working groups and will continue to provide good communication in keeping the U.S. community abreast of ITA activities. We anticipate that the U.S. representatives will rotate on a fairly regular basis to provide incentives to participate and to keep activity levels high.

Questions are sometimes raised as to why the USNC/TT is the official representative of the U.S. to the ITA. In partial answer to this question, I can offer a few observations. The National Research Council currently has 25 U.S. national committees which fulfill this role in many different international bodies. Originally done as a way of allowing continuity in participation in international scientific and engineering activities for government, industry and academia through the National Academy of Sciences complex, it still offers important benefits as a vehicle for U.S. participation:

- 1. The USNC/TT as a National Research Council committee is in an excellent position to advise the federal government and its agencies of important developments and activities in the international community.
- 2. Sending a delegation to the ITA meetings is a costly activity. The precedent of NRC's role in such international committees allows the selection of U.S. participants without regard to whether their personal circumstances would allow them financially to participate.

The USNC/TT role as an official representative to the ITA should not be seen as a bar to international activities by people outside the immediate committee. The ITA meetings are open to anyone and the USNC/TT is anxious to assist any U.S. groups in increasing their participation in the activities of the ITA.

Global Competitiveness/Procurement Issues

In reviews and discussions of the U.S. technological position in underground construction relative to Europe and Japan, the same issues continually resurface—those of the institutional impediments to private R&D and innovation that appear to exist to a greater extent in the U.S. than in Europe or Japan. Such issues include the litigious nature of our society which directly inhibits innovation and the procurement methods for our design and construction of public works which provide little or no incentive and/or reward for innovative solutions. Issues such as these are often controversial and difficult and impact on some of the cherished notions of the historical ways of doing business in the U.S. Nevertheless, they need to be examined as to whether there are some adjustments that could be made in some types of projects to encourage innovation.

Mindful of the long-term success of the USNC/TT effort in the contracting practices area carried on through most of the 1970s, we have convened a subcommittee this year to examine what changes might be possible in the area of procurement practices for underground construction to encourage innovation and private R&D efforts. As this subcommittee examines the possibilities, a decision will be made as to whether to make this a major committee effort. It is certainly a national problem of critical significance.

Infrastructure-Related Efforts

The committee is concerned about the growing importance of underground infrastructure in the future (especially in our urban areas) and the lack of a coordinated approach to dealing with the issues raised. Since the National Research Council has a special committee on infrastructure under the joint auspices of the Building Research Board and the Geotechnical Board, the USNC/TT will coordinate its efforts through this committee to address specific infrastructure issues related to underground construction. I am privileged to also serve on this committee and provide the link to our efforts within USNC/TT. As mentioned above, we are also in the process of adding new committee liaisons to the APWA and the NASTT to strengthen communication in this area.

SSC Underground Construction Safety Symposium

The construction of the Superconducting Super Collider (SSC) will be one of the major underground construction projects ever undertaken. Following the special study of recommended contracting practices for the SSC completed in 1989, the committee will convene a special meeting in July 1992 which will provide a forum to discuss how safety can be enhanced during the construction of the SSC. The committee is in a unique role to facilitate this kind of dialogue and will continue to try to offer its services in such projects of special national importance and scale.

Yucca Mountain Contracting Practices

Discussions are currently being held about the possibility of the committee carrying out a contracting practices study for the High-Level Radioactive Waste Repository being considered for Yucca Mountain. This would be another massive underground project of critical national importance and involving many miles of underground tunnels in its eventual configuration. The study would recommend contracting and management practices for the underground works tailored to the special site and functional requirements of the waste repository and the special quality control requirements of a nuclear-related facility.

Future Meetings of the Committee

In addition to the meeting connected with the safety issues for the SSC, a general meeting of the committee will be held in Boston just prior to the AUA conference on North American Tunneling (October 3-8, 1992). The committee generally tries to attach its meetings to a tunneling or underground construction conference where possible to avoid diluting U.S. activities. During the AUA conference there will be the first USNC/TT Sponsored Lecture given by Jack Lemley, chief executive of Transmanche-Link, builders of the English Channel tunnels. It is intended that such a lecture will be a regular event at U.S. underground construction meetings in the coming years with leading U.S. academics and practitioners in the field asked to prepare a special lecture to review a particular aspect of tunneling and underground construction.

I hope this letter has given you an idea of the scope of activities underway at the USNC/TT. Other activities related to the underground are also occurring in the U.S. National Committee for Rock Mechanics and the Geotechnical Board.

Sincerely.

Raymond L. Sterling Chairman

Editor's Note: Dr. Raymond L. Sterling is the current chairman of the USNC/TT. When not attending to USNC/TT business, Dr. Sterling is the Director of the Underground Space Center at the University of Minnesota in Minneapolis. He is also on the faculty in the civil and mineral engineering department and currently serves on the National Research Council's Committee on Infrastructure.

--Peter Smeallie

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