PDR-1
DR- Wm-10 (2)
Wm-11 (2)
Wm-16 (2)

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'87 MAY 26 A11:12

NRC CONTRACT NO. 002-85-002

DESIGN REVIEWS OF HIGH-LEVEL NUCLEAR WASTE GEOLOGIC REPOSITORIES

TASK ORDER NO.006

REVIEW DOE AND DOE CONTRACTOR DOCUMENTS RELATED TO DESIGN AND ROCK MECHANICS FOR BWIP, NNWSI AND SRP

TECHNICAL AND COST PROPOSAL

ITASCA CONSULTING GROUP, INC.
Suite 210
1313 5th Street SE
Minneapolis, Minnesota 55414

May 1987

8709290096 870531
PDR WMRES EECITAS
D-1016 PDR

WM Record File Wm-Res D1016 Itasca

WM Project 10, 11, 16
Docket No.
PDR ✓
x LPDR ✓ (B,N,S)

Distribution:
Tiktinsky

87237938
WM Project: WM-10,11,16
PDR w/encl
(Return to WM, 623-SS)

WM Record File: D1016
LPDR w/encl

4049

NRC CONTRACT NO. 02-85-002

DESIGN REVIEWS OF HIGH-LEVEL NUCLEAR WASTE GEOLOGIC REPOSITORIES

TASK ORDER NO. 006

REVIEW DOE AND DOE CONTRACTOR DOCUMENTS RELATED TO DESIGN AND ROCK MECHANICS FOR BWIP, NNWSI, AND SRP

A. BACKGROUND/OBJECTIVES

This task order is formulated to allow Itasca Consulting Group, Inc. to provide technical assistance to the NRC in preparation for the review of the Site Characterization Plans (SCP) for BWIP, NNWSI and SRP. These SCPs are expected to be issued in FY 1987 and 1988. Technical assistance under this contract is to be provided in the fields of rock mechanics, mining engineering, numerical modeling, and related disciplines.

B. PROGRAM PLAN

The work delineated in this proposal consists of two tasks with the second task being further subdivided into three subtasks. The proposed effort is concerned primarily with the review of technical documents and preparation for review of the Site Characterization Plans for the three geologic repository media—basalt, tuff and salt. Accordingly, a principal investigator is assigned to each site (as originally proposed):

Adrian Brown — basalt
Jaak Daemen — tuff
Roger Hart — salt

The principal investigators will be assisted by a senior engineer who will also participate in the document reviews and technical meetings associated with their assigned site. Dr. Loren Lorig, of Itasca, will assist Dr. Hart in the salt project and Dr. Daemen in the tuff project. Mark Board, also of Itasca, will assist Adrian Brown in the basalt project. In this way, Itasca will maintain a representative on all three sites, helping to ensure continuity between the reviews.

TASK 1 — REVIEW OF DOCUMENTS

Under this task, project engineers will review up to 60 documents related to design and rock mechanics of BWIP, NNWSI and SRP. The documents to be reviewed are to be supplied by the NRC, with up to three staff days allocated for review of each document. The principal investigator for each site will review the general nature of each document and then assign the document review to one or more members of the project team, based on technical expertise and availability.

Document review letter reports will be provided for all reviewed documents. These reports will address the following topics:

(1) the significance of the documents to the HLW isolation program;

(2) topics not presented in the document which may be of concern to the HLW program;

(3) evaluation of the questions raised by the document and proposed responses to these questions;

(4) discussion and evaluation of the recommendations presented in the document; and

(5) evaluations of the relative importance of any tests and data presented.

TASK 2 — TECHNICAL MEETINGS

Subtask 1 — NNWSI Meetings

It is proposed that two senior engineers attend two pre-meetings, of three days' duration each, and two technical meetings, of five days' duration each, for the tuff site. For our cost estimate, it is assumed that the principal investigator (Daemen) and his assistant (Lorig) will attend, but it is recognized that certain meetings may require substitution with an individual with a specific expertise required for that meeting. Any individual sent to the meeting will be familiar with the NNWSI program. For the purpose of the cost estimate, it is assumed that all pre-meetings and one technical meeting will be held in Silver Spring and one technical meeting will be held in Albuquerque, New Mexico.

Subtask 2 — BWIP Meetings

Two senior engineers are proposed to attend two pre-meetings, of three days' duration each, and two technical meetings, of five days' duration each, for the basalt site. It is assumed that the principal investigator (Brown) and his assistant (Board) will attend, but it is recognized that certain meetings may require substitution with an individual with a specific expertise required for that meeting. Any individual sent to the meeting will be familiar with the BWIP program. For the purpose of the cost estimate, it is assumed that all pre-meetings and one technical meeting will be held in Silver Spring and one technical meeting will be held in Richland, Washington.

Subtask 3 — Salt Project Meetings

Two senior engineers are proposed to attend two pre-meetings, of three days' duration each, and two technical meetings, of five days' duration each, for the salt sites. It is assumed that the principal investigator (Hart) and his assistant (Lorig) will attend, but it is recognized that certain meetings may require substitution with an individual with a specific expertise required for that meeting. Any individual sent to the meeting will be familiar with the salt project. For the purpose of the cost estimate, it is assumed that all pre-meetings and one technical meeting will be held in Silver Spring and one technical meeting will be held in Columbus, Ohio.

C. REPORTING REQUIREMENTS

As part of this task order, the following reports will be issued:

(1) monthly progress reports (submitted by the 20th of each month);

(2) trip reports (submitted within 15 working days of the meetings); and

(3) document review/letter reports (submitted at the completion of each review. A draft of each letter will be submitted for review and comment by NRC staff).

The schedule for the document reviews is unknown at present. The technical meetings have not been scheduled but are expected to occur between June and December 1987.

D. CONFLICT OF INTEREST

We are not aware of any current or potential conflicts of interest in completing the work outlined in this proposal. If, during the course of this task order, any information is brought to our attention that would suggest a potential conflict of interest, we will notify NRC immediately.

E. ADMINISTRATION

As shown on the attached cost summary sheets, the majority of the administrative and support services for this task order will be provided by Itasca at its Minneapolis office. Minor administrative support will be proved by Nuclear Waste Consultants (NWC). For cost estimate purposes, we have assumed that the same general ratio of administrative and secretarial labor to technical labor from Task Order No. 001 (Task 2, Document Review, and Task 4, Technical Meetings) will apply to Task Order No. 006.

F. QUALITY ASSURANCE

All document reviews produced as a result of this task order will be reviewed by an individual not directly involved in the original review. Standard administrative QA procedures for documentation and retrievability will be continued.

G. COST ESTIMATE

The cost estimate for the total task order is provided on the attached Standard Form 1411. Also included are cost breakdowns for each of the tasks (Tables 1 to 4). Where specific individuals have been identified, their actual 1987 cost rates are used. Table 5 provides a summary of the labor utilization by task.

For Task No. 1, review of documents, a blended rate is used for Senior Engineers. This rate is composed of the following equally-weighted individual cost rates:

M. Board	$23.56/hour
M. Christianson	21.15/hour
R. Hart	24.04/hour
L. Lorig	21.15/hour

The Assistant Engineer cost rate is quoted at $15.25/hour. This rate is an average rate for J. Lemos ($18.00/hour) and M. Mack ($12.50/hour).

There are two rates for Associates: Dr. Barry Brady, who recently has joined Itasca (resumé attached), is quoted at his standard cost rate; and a blended rate is included for possible document reviews by C. Fairhurst, P. Cundall, and A. Starfield, who have a cost rate of $52.50/hour.

For Task 2, Technical Meetings, travel costs are provided for Itasca personnel, consultants and subcontractors. All airfare is based on current standard coach round-trip fares, and per diem charges conform to the Federal Travel Regulations issued July 1, 1986.

Communications charges are quoted as 4% of direct labor. These costs include telephone, telex, and postage charges incurred during the performance of these tasks. Estimated report production charges of 2% of direct labor are also included.

Respectfully submitted,

John J. Markham
Executive Vice President
Itasca Consulting Group, Inc.

19 May 1987

attach.
jjm/ks

CONTRACT PRICING PROPOSAL COVER SHEET	1. SOLICITATION/CONTRACT/MODIFICATION NO. NRC-02-	FORM APPROVED OMB NO. 3090-0116

NOTE: This form is used in contract actions if submission of cost or pricing data is required. *(See FAR 15.804-6(b))*

2. NAME AND ADDRESS OF OFFEROR *(Include ZIP Code)*

Itasca Consulting Group, Inc.
1313 5th Street SE
Suite 210
Minneapolis, Minnesota 55414

3A. NAME AND TITLE OF OFFEROR'S POINT OF CONTACT
John J. Markham
Executive Vice President

3B. TELEPHONE NO.
612-623-9599

4. TYPE OF CONTRACT ACTION *(Check)*

A. NEW CONTRACT	D. LETTER CONTRACT
B. CHANGE ORDER	E. UNPRICED ORDER
C. PRICE REVISION/ REDETERMINATION	F. OTHER *(Specify)*

5. TYPE OF CONTRACT *(Check)*
☐ FFP ☒ CPFF ☐ CPIF ☐ CPAF
☐ FPI ☐ OTHER *(Specify)*

6. PROPOSED COST *(A+B=C)*

A. COST	B. PROFIT/FEE	C. TOTAL
$ 200,452.91	$ 16,036.24	$ 216,489.15

7. PLACE(S) AND PERIOD(S) OF PERFORMANCE

8. List and reference the identification, quantity and total price proposed for each contract line item. A line item cost breakdown supporting this recap is required unless otherwise specified by the Contracting Officer. *(Continue on reverse, and then on plain paper, if necessary. Use same headings.)*

A. LINE ITEM NO.	B. IDENTIFICATION	C. QUANTITY	D. TOTAL PRICE	E. REF.
1.	Direct Labor	2441 hours	48,818.01	
2.	Travel		17,854.00	
3.	Consultants	552 hours	38,327.18	
4.	Subcontractors	528 hours	42,730.27	
5.	Miscellaneous Expenses		2,929.08	
6.	G & A Expenses		49,794.37	

9. PROVIDE NAME, ADDRESS, AND TELEPHONE NUMBER FOR THE FOLLOWING *(If available)*

A. CONTRACT ADMINISTRATION OFFICE
Defense Contract Administrative Services
2305 Ford Parkway
St. Paul, MN 55116
(612) 690-8300

B. AUDIT OFFICE
Defense Contract Audit Agency (612) 349-3290
(Arthur Christofferson)
Mpls. Branch Office, Fed. Bldg. and U.S. Courthse.
110 S. 4th St. (rm 117), Mpls., MN 55401

10. WILL YOU REQUIRE THE USE OF ANY GOVERNMENT PROPERTY IN THE PERFORMANCE OF THIS WORK? *(If "Yes," identify)*
☐ YES ☒ NO

11A. DO YOU REQUIRE GOVERNMENT CONTRACT FINANCING TO PERFORM THIS PROPOSED CONTRACT? *(If "Yes," complete Item 11B)*
☒ YES ☐ NO

11B. TYPE OF FINANCING *(✓ one)*
☐ ADVANCE PAYMENTS ☒ PROGRESS PAYMENTS
☐ GUARANTEED LOANS

12. HAVE YOU BEEN AWARDED ANY CONTRACTS OR SUBCONTRACTS FOR THE SAME OR SIMILAR ITEMS WITHIN THE PAST 3 YEARS? *(If "Yes," identify item(s), customer(s) and contract number(s))*
☐ YES ☒ NO

13. IS THIS PROPOSAL CONSISTENT WITH YOUR ESTABLISHED ESTIMATING AND ACCOUNTING PRACTICES AND PROCEDURES AND FAR PART 31 COST PRINCIPLES? *(If "No," explain)*
☒ YES ☐ NO

14. COST ACCOUNTING STANDARDS BOARD (CASB) DATA *(Public Law 91-379 as amended and FAR PART 30)*

A. WILL THIS CONTRACT ACTION BE SUBJECT TO CASB REGULATIONS? *(If "No," explain in proposal)*
☐ YES ☒ NO Small Business

B. HAVE YOU SUBMITTED A CASB DISCLOSURE STATEMENT *(CASB DS-1 or 2)? (If "Yes," specify in proposal the office to which submitted and if determined to be adequate)*
☒ YES ☐ NO

C. HAVE YOU BEEN NOTIFIED THAT YOU ARE OR MAY BE IN NON-COMPLIANCE WITH YOUR DISCLOSURE STATEMENT OR COST ACCOUNTING STANDARDS? *(If "Yes," explain in proposal)*
☐ YES ☒ NO

D. IS ANY ASPECT OF THIS PROPOSAL INCONSISTENT WITH YOUR DISCLOSED PRACTICES OR APPLICABLE COST ACCOUNTING STANDARDS? *(If "Yes," explain in proposal)*
☐ YES ☒ NO

This proposal is submitted in response to the RFP contract, modification, etc. in Item 1 and reflects our best estimates and/or actual costs as of this date.

15. NAME AND TITLE *(Type)*
John J. Markham
Executive Vice President

16. NAME OF FIRM
Itasca Consulting Group, Inc.

17. SIGNATURE
John J. Markham

18. DATE OF SUBMISSION
20 May 1987

NSN 7540-01-142-9845 1411-101

STANDARD FORM 1411 (10-83)
Prescribed by GSA
FAR (48 CFR) 53.215-2(c)

☆ U.S. GOVERNMENT PRINTING OFFICE : 1984 O - 421-526 (37)

Table 1

COST ESTIMATE
Task Order No. 006
Task No. 1 — Review of Documents
(1 of 2)

1. DIRECT LABOR

ITASCA LABOR	INDIVIDUAL	RATE	HOURS	COST
PROGRAM MANAGER	R. Hart	$24.04	40	$961.60
ADMIN MANAGER	L. Gaarder	$8.89	60	$533.40
	J. Markham	$25.96	60	$1,557.60
SR ENGINEER	Blend	$22.48	648	$14,567.04
ASST ENGINEER	Blend	$15.25	80	$1,220.00
ASSOCIATES	B. Brady	$31.25	96	$3,000.00
	Blend	$52.50	53	$2,756.25
SECRETARIAL	R. Kaplan	$6.50	116	$754.00
	K. Sikora	$10.34	240	$2,481.60
QUALITY ASSURANCE	K. Sikora	$10.34	40	$413.60
			1433	$28,245.09

EXPENSES

3. CONSULTANTS		$22,452.30
4. SUBCONTRACTORS		$19,110.14
5. MISC EXPENSES		
COMMUNICATIONS	4% DIRECT LABOR	$1,129.80
REPORT PRODUCTION	2% DIRECT LABOR	$564.90
	TOTAL MISC EXPENSES	$1,694.71
TOTAL LABOR & EXPENSES		$71,502.24
6. G & A EXPENSES	1.02 x DIRECT LABOR	$28,809.99
TOTAL COST		$100,312.23
7. FEE OR PROFIT	8%	$8,024.98
TOTAL JOB COST		$108,337.21

Table 1 (continued)
(2 of 2)

SUBCONTRACTORS		RATE	HOURS	COST
NUCLEAR WASTE CONSULTANTS				
PRIN. INVESTIGATOR		$63.00	160	$10,080.00
SR. ENGINEER		$24.00	30	$720.00
ENG./GEOLOGIST		$12.60	26	$327.60
CLERICAL		$11.03	88	$970.64
TOTAL SUBCONTRACTED LABOR			304	$12,098.24
LABOR OVERHEAD	21.09% DIRECT LABOR			$2;551.52
G & A EXPENSE	20.52% DIRECT LABOR PLUS OVERHEAD			$3,006.13
MISC. EXPENSES	PHONE, COPIES, ETC	1% DIR LABOR		$120.98
TOTAL SUBCONTRACTOR EXPENSES				$120.98
TOTAL COST				$17,776.87
SUBCONTRACTOR FEE	7.5%			$1,333.27
TOTAL SUBCONTRACTOR COST				$19,110.14

CONSULTANTS	RATE	HOURS	COST
K. WAHI	$67.50	80	$5,400.00
J. DAEMEN	$57.75	200	$11,550.00
V. RAJARAM	$66.00	80	$5,280.00
TOTAL CONSULTANT LABOR		360	$22,230.00

CONSULTANT EXPENSES		
MISC EXPENSES	1% DIRECT LABOR	$222.30
TOTAL CONSULTANT EXPENSES		$222.30
TOTAL CONSULTANT		$22,452.30

Table 2

COST ESTIMATE
Task Order No. 006
Task No. 2 — Technical Meetings
Subtask No. 1 — NNWSI Meetings
(1 of 2)

1. DIRECT LABOR

ITASCA LABOR	INDIVIDUAL	RATE	HOURS	COST
PROGRAM MANAGER	R. Hart	$24.04	12	$288.48
ADMIN MANAGER	L. Gaarder	$8.89	12	$106.68
	J. Markham	$25.96	12	$311.52
SR ENGINEER	L. Lorig	$21.15	192	$4,060.80
SECRETARIAL	K. Sikora	$10.34	25	$258.50
	R. Kaplan	$6.50	15	$97.50
QUALITY ASSURANCE	K. Sikora	$10.34	4	$41.36
			272	$5,164.84

EXPENSES

2. TRAVEL

AIRFARE				
MSP-WDC		$522.00	3	$1,566.00
MSP-ABQ		$239.00	1	$239.00
RENTAL CAR		$56.00	16	$896.00
PER DIEM	WDC	$112.00	11	$1,232.00
	ABQ	$84.00	5	$420.00
TRAVEL EXPENSES		$35.00	4	$140.00
		TOTAL TRAVEL		$4,493.00

3. CONSULTANTS		$15,874.88
5. MISC EXPENSES		
COMMUNICATIONS	4% DIRECT LABOR	$206.59
REPORT PRODUCTION	2% DIRECT LABOR	$103.30
	TOTAL MISC EXPENSES	$309.89
TOTAL LABOR & EXPENSES		$25,842.61
6. G & A EXPENSES	1.02 x DIRECT LABOR	$5,268.14
TOTAL COST		$31,110.75
7. FEE OR PROFIT	8%	$2,488.86
TOTAL JOB COST		$33,599.61

Table 2 (continued)
(2 of 2)

CONSULTANTS		RATE	HOURS	COST
J. DAEMEN		$57.75	192	$11,088.00
	TOTAL CONSULTANT LABOR		192	$11,088.00

CONSULTANT EXPENSES				
AIRFARE				
TUC-WDC		$600.00	3	$1,800.00
TUC-ABQ		$188.00	1	$188.00
RENTAL CAR		$56.00	16	$896.00
PER DIEM	WDC	$112.00	11	$1,232.00
	ABQ	$84.00	5	$420.00
TRAVEL EXPENSES		$35.00	4	$140.00
			TOTAL TRAVEL	$4,676.00
MISC EXPENSES		1% DIRECT LABOR		$110.88
TOTAL CONSULTANT EXPENSES				$4,786.88
TOTAL CONSULTANT				$15,874.88

Table 3

COST ESTIMATE
Task Order No. 6
Task No. 2 — Technical Meetings
Subtask No. 2 — BWIP Meetings
(1 of 2)

1. DIRECT LABOR

ITASCA LABOR	INDIVIDUAL	RATE	HOURS	COST
PROGRAM MANAGER	R. Hart	$24.04	12	$288.48
ADMIN MANAGER	L. Gaarder	$8.89	12	$106.68
	J.Markham	$25.96	12	$311.52
SR ENGINEER	M. Board	$23.56	192	$4,523.52
SECRETARIAL	K. Sikora	$10.34	25	$258.50
	R. Kaplan	$6.50	15	$97.50
QUALITY ASSURANCE	K. Sikora	$10.34	4	$41.36
			272	$5,627.56

EXPENSES

2. TRAVEL

AIRFARE				
MSP-WDC		$522.00	3	$1,566.00
MSP-RLD		$660.00	1	$660.00
RENTAL CAR		$56.00	16	$896.00
PER DIEM	WDC	$112.00	11	$1,232.00
	RLD	$59.00	5	$295.00
TRAVEL EXPENSES		$35.00	4	$140.00
		TOTAL TRAVEL		$4,789.00

4. SUBCONTRACTORS $23,620.13

5. MISC EXPENSES

COMMUNICATIONS	4% DIRECT LABOR	$225.10
REPORT PRODUCTION	2% DIRECT LABOR	$112.55
	TOTAL MISC EXPENSES	$337.65

TOTAL LABOR & EXPENSES $34,374.34

6. G & A EXPENSES 1.02 x DIRECT LABOR $5,740.11

TOTAL COST $40,114.45

7. FEE OR PROFIT 8% $3,209.16

TOTAL JOB COST $43,323.61

Table 3 (continued)
(2 of 2)

SUBCONTRACTORS		RATE	HOURS	COST
NUCLEAR WASTE CONSULTANTS				
PRIN. INVESTIGATOR		$63.00	192	$12,096.00
CLERICAL		$11.03	32	$352.96
TOTAL SUBCONTRACTED LABOR			224	$12,448.96
LABOR OVERHEAD	21.09% DIRECT LABOR			$2,625.49
G & A EXPENSE	20.52% DIRECT LABOR PLUS OVERHEAD			$3,093.28
SUBCONTRACTOR EXPENSES				
AIRFARE				
DEN-WDC		$370.00	3	$1,110.00
DEN-RLD		$620.00	1	$620.00
RENTAL CAR		$56.00	6	$336.00
PERDIEM	WDC	$112.00	10	$1,120.00
	RLD	$59.00	6	$354.00
TRAVEL EXPENSES		$35.00	4	$140.00
				$3,680.00
MISC. EXPENSES	PHONE, COPIES, ETC	1% DIR LABOR		$124.49
TOTAL SUBCONTRACTOR EXPENSES				$3,804.49
TOTAL COST				$21,972.21
SUBCONTRACTOR FEE	7.5%			$1,647.92
TOTAL SUBCONTRACTOR COST				$23,620.13

Table 4

COST ESTIMATE
Task Order No. 006
Task No. 2 — Technical Meetings
Subtask No. 3 — Salt Project Meetings

1. DIRECT LABOR

ITASCA LABOR	INDIVIDUAL	RATE	HOURS	COST
PROGRAM MANAGER	R. Hart	$24.04	12	$288.48
ADMIN MANAGER	L. Gaarder	$8.89	12	$106.68
	J. Markham	$25.96	12	$311.52
SR ENGINEER	R. Hart	$24.04	192	$4,615.68
	L. Lorig	$21.15	192	$4,060.80
SECRETARIAL	K. Sikora	$10.34	25	$258.50
	R. Kaplan	$6.50	15	$97.50
QUALITY ASSURANCE	K. Sikora	$10.34	4	$41.36
			464	$9,780.52

EXPENSES

2. TRAVEL

AIRFARE				
MSP-WDC		$522.00	6	$3,132.00
MSP-COL		$520.00	2	$1,040.00
RENTAL CAR		$56.00	16	$896.00
PER DIEM	WDC	$112.00	22	$2,464.00
	COL	$76.00	10	$760.00
TRAVEL EXPENSES		$35.00	8	$280.00
		TOTAL TRAVEL		$8,572.00

5. MISC EXPENSES

COMMUNICATIONS	4% DIRECT LABOR	$391.22
REPORT PRODUCTION	2% DIRECT LABOR	$195.61
	TOTAL MISC EXPENSES	$586.83

TOTAL LABOR & EXPENSES		$18,939.35
6. G & A EXPENSES	1.02 x DIRECT LABOR	$9,976.13
TOTAL COST		$28,915.48
7. FEE OR PROFIT	8%	$2,313.24
TOTAL JOB COST		$31,228.72

Table 5
Task Order No. 006
LABOR DISTRIBUTION

	TASK 1	Subtask:	TASK 2 1	2	3	TOTAL
ITASCA						
Program Manager	40		12	12	12	76
Admin. Manager	120		24	24	24	192
Senior Engr	648		192	192	384	1,416
Assistant Engr	80		0	0	0	80
Associates	149		0	0	0	149
Secretarial	356		40	40	40	476
QA	40		4	4	4	52
Itasca Total	1,433		272	272	464	2,441
SUBCONTRACTOR						
Prin. Invest.	160		0	192	0	352
Senior Engr.	30		0	0	0	30
Engr./Geol.	26		0	0	0	26
Clerical	88		0	32	0	120
Sub. Total	304		0	224	0	528
CONSULTANT						
J. Daemen	200		192	0	0	392
V. Rajaram	80		0	0	0	80
K. Wahi	80		0	0	0	80
Con. Total	360		192	0	0	552
TOTAL	2,097		464	496	464	3,521

BARRY H. G. BRADY

EDUCATION

B.Sc., 1963
M.Sc., 1967

University of Queensland
Australia

M.Sc.(Eng) (Engineering Rock Mechanics, With Distinction), 1975
Ph.D. (Mining and Geo-Engineering), 1979
Imperial College of Science and Technology
London

EXPERTISE

Rock Mechanics Practice
Computational Methods in Rock Mechanics
Underground Mining
Nuclear Waste Isolation

PROFESSIONAL EXPERIENCE

1987 - Present	Vice President — Technical Itasca Consulting Group, Inc. Minneapolis, Minnesota
1984 (Summer)	Visiting Professor Department of Civil & Mineral Engineering University of Minnesota
1983 - Present	Adjunct Professor Department of Civil and Mineral Engineering University of Minnesota
1983 - 1987	Director Division of Geomechanics CSIRO Mount Waverley, Victoria Australia
1981 - 1983	Director and Associate Itasca Consulting Group, Inc.
1979 - 1983	Associate Professor Mining and Geological Engineering Department of Civil & Mineral Engineering University of Minnesota

PROFESSIONAL EXPERIENCE (continued)

1975 - 1979	Lecturer Engineering Rock Mechanics Royal School of Mines Imperial College of Science and Technology London
1967 - 1975	Staff Officer (Senior Rock Mechanics Engineer) Mount Isa Mines Limited Mount Isa, Australia
1964 - 1965	Research Officer The C.S.R. Company Sydney, Australia

PROJECT EXPERIENCE

Scientific leadership, management and direction of a research institute of 90 persons involved in basic and applied research in geomechanics and its engineering applications in mining, civil construction, and novel areas of geo-engineering (CSIRO)

Research in underground excavation design (CSIRO)

Lecturing in applied rock mechanics (site investigation, surface and underground excavations), underground mining methods, mine plant engineering, advanced rock mechanics (rock dynamics and blasting mechanics, rock foundations, deep mining), and computational methods in rock mechanics (boundary elements, finite elements, etc.) (University of Minnesota); lecturing in stress analysis, mining rock mechanics and mine design, rock dynamics, and blasting mechanics (Imperial College)

Research in numerical methods of stress analysis and their application to design of radioactive waste repositories and mining excavations (University of Minnesota); research in boundary element methods of stress analysis and their application in mine design and underground excavations (Imperial College)

Consulting in mining methods and method development, stope engineering, rock support and reinforcement, and extraction design for mines in Australia, Canada and England; review of documents for the Salt Repository Project Office (Argonne National Laboratory)

PROJECT EXPERIENCE (continued)

Design of major stope blasting, investigations in drilling and blasting, and mine ventilation studies; design of mining layouts, mining sequences, and support systems; development and analysis of new mining techniques (Mount Isa Mines)

Research in mass transfer in turbulent systems (C.S.R. Company)

PROFESSIONAL AFFILIATIONS AND AWARDS

Institution of Mining and Metallurgy, U.K.
Australian Geomechanics Society
Society of Mining Engineers of A.I.M.E.
The Australasian Institute of Mining and Metallurgy
International Society of Rock Mechanics
Chartered Engineer, U.K.

U.S. National Rock Mechanics Committee Basic Research Award, 1980

State of Queensland Open University Scholarship, 1960
Award for Best Paper at ISRM International Symposium, 1984

Adviser of Recipient of Award
for Best M.Sc. in Rock Mechanics, 1984

PROJECT EXPERIENCE (continued)

PROFESSIONAL SERVICE

The following is a partial listing of service to the engineering profession:

Member, International Peer Review Panel for Waste Repositories in Salt, U.S. Department of Energy (Argonne National Laboratory) (1984-1987)

Member, Editorial Board, International Journal for Rock Mechanics, Mining Sciences and Geomechanics Abstracts (1983 - Present)

Member, Research Honors Committee, International Society for Rock Mechanics (1983)

Keynote Speaker on Numerical Models, 23rd U.S. Symposium on Rock Mechanics (Berkeley) (1982)

Member, Research Assistance Task Force to Advise on Research Needs in Radioactive Waste Isolation, U.S. Department of Energy (1981)

Session Co-Developer and Co-Chairman, International Conference on Caving and Sub-Level Stoping, S.M.E.-A.I.M.E (1981)

Organizing Secretary, Symposium on Mine Backfilling, N. W. Queensland Branch, Australasian Institute of Mining and Metallurgy (1973)

SELECTED PUBLICATIONS

The following publications are selected from a list of more than 70 papers and major reports.

Brady, B.H.G., R. Fox, and D.A.W. Williams. "Slurry Explosives Underground at Mount Isa," Proceedings of the Australian Institute of Mines and Metallurgy, No. 247, pp. 33-44. Aus.I.M.M, 1974.

Brady, B.H.G. "An Analysis of Rock Behavior in an Experimental Stoping Block at the Mount Isa Mine," Int. J. Rock Mech. Min. Sci. & Geomech. Abstr., 14, 59-66 (1977).

Brady, B.H.G., L. G. Alexander, and R. G. Friday. "Stress Measurement in a Bored Raise at the Mount Isa Mine," Advances in Stress Measurements (Proceedings of the ISRM Symposium, Sydney, 1976), pp. 12-16.

Brady, B.H.G., and J. W. Bray. "The Boundary Element Method for Determining Stresses and Displacement Around Long Openings in a Triaxial Stress Field," Int. J. Rock Mech. Min. Sci. & Geomech. Abstr., 15, 21-28 (1978).

Brady, B.H.G., and J. W. Bray. "The Boundary Element Method for Elastic Analysis of Tabular Orebody Extraction, Assuming Complete Plane Strain," Int. J. Rock Mech. Min. Sci. & Geomech. Abstr., 15, 29-37 (1978).

Brady, B.H.G. "A Boundary Element Method of Stress Analysis for Non-Homogeneous Media and Complete Plane Strain," Proceedings of the 20th U.S. Symposium on Rock Mechanics (Austin, Texas, June 1979), pp. 243-250. New York: American Society of Civil Engineers, 1979.

Brady, B.H.G., and E. T. Brown. "Energy Changes and Stability in Mine Structures: Design Applications of Boundary Element Methods," Transactions, Section A, The Institute of Mining and Metallurgy, 90, A61-A68 (1981).

Brady, B.H.G. "Chapter 31: Determination of Stability of Underground Mine Structures," Design and Operation of Caving and Sublevel Stoping Mines (D. Stewart, Ed.), pp. 427-435. SME/AIME, 1981.

Publications (continued)

Brady, B.H.G., and A. Wassyng. "A Coupled Finite Element-Boundary Element Method of Stress Analysis," Int. J. Rock Mech. Min. Sci. & Geomech. Abstr., 18, 475-485 (1981).

Brady. B.H.G., and C. M. St. John. "The Role and Credibility of Computational Methods in Engineering Rock Mechanics — Keynote Address," Issues in Rock Mechanics (Proceedings of the 23rd U.S. Symposium on Rock Mechanics, Berkeley, 1982), pp. 571-586. New York: Society of Mining Engineers, 1982.

Lorig, L. J., and B.H.G. Brady. "A Hybrid Computational Scheme for Excavation Support Design in Jointed Rock Media." Design and Performance of Underground Excavations (ISRM Symposium, Cambridge, U.K., 3-6 September 1984), pp. 105-112. Edited by E. T. Brown and J. A. Hudson. London: British Geotechnical Society, 1984.

Brady, B.H.G., and E. T. Brown. Rock Mechanics for Underground Mining, 527 pp. London: George Allen and Unwin, 1985.

Brady, B.H.G., M. L. Cramer, and R. D. Hart. "Preliminary Analysis of a Loading Test on a Large Basalt Block," Int. J. Rock Mech., 22(5), 345-348 (1985).

Hobbs, B. E., and B.H.G. Brady. "Normal Stress Changes and the Constitutive Law for Rock Friction (Abstract)," Eos, 16(18), 382 (1985).

Lorig, L. J., B. E. Hobbs, and B.H.G. Brady. "A Hybrid Computational Scheme for Modelling Earthquakes and Sliding Stability (Abstract)," EOS, 16(18), 382 (1985).

Brady, B.H.G., B. E. Hobbs, L. P. Paterson, and H. P. Schlanger. "A Novel Operating Principle for a Nuclear Waste Repository in Crystalline Rock," Rock Mechanics: Key to Energy Production (Proceedings of the 27th U.S. Symposium on Rock Mechanics, University of Alabama, 1986), pp. 910-916. Littleton, Colorado: Society of Mining Engineers, Inc., 1986.

Brady, B.H.G., J. V. Lemos, and P. A. Cundall. "Stress Measurement Schemes for Jointed and Fractured Rock," Rock Stress and Rock Stress Measurements (Proceedings of the International Symposium on Rock Stress and Rock Stress Measurements, Stockholm, Sept. 1986), pp. 167-176. Lulea, Sweden: Centek Publishers, 1986.

Publications (continued)

Lorig, L. J., B.H.G. Brady, and P. A. Cundall. "A Hybrid Distinct Element - Boundary Element Analysis of Jointed Rock," Int. J. of Rock Mech. Min. Sci. & Geomech. Abstr., 23(4), 303-312 (1986).

Brady, B.H.G. "Chapter 5: Boundary Element and Linked Methods for Underground Excavation Design," in Analytical and Computation Methods in Rock Mechanics. London: George Allen and Unwin, 1987.

Reports

"A Boundary Element Method for Determining Stresses and Displacements Around Long Openings in a Triaxial Stress Field," Imperial College Project Report to the Australian Mineral Industries Research Association Limited (AMIRA), October 1977.

"Boundary Element Methods for Mine Design," Imperial College Final Report to AMIRA, October 1979.

"Basin Electric Raw Water Intake Tunnel, Beulah, North Dakota," Consulting Report to Gorsuch, Campbell, Walker and Grover, Denver, June 1980.

"HEFF — A Boundary Element Code for Two-Dimensional Thermo-Elastic Analysis of a Rock Mass Subject to Constant or Decaying Thermal Loads," University of Minnesota Project Report to BWIP, Rockwell Hanford Operations, July 1980.

"Numerical Modeling of the Accelerated Room Test," University of Minnesota Project Report to BWIP, Rockwell Hanford Operations, September 1980.

"Experimental Testing of Rock Salt Under Varying Stress and Thermal Conditions: Phase 1, Initial Designs and Test Program" (with E. N. Lindner), University of Minnesota Project Report to ONWI/Battelle, October 1980.

"Review of the Design of the Jointed Block Test" (with R. D. Hart), University of Minnesota Report, RHO-BWI-C88, Rockwell Hanford Operations, December 1980.

"Predictive and Retrospective Analysis of Step 2 of the Jointed Block Test," University of Minnesota Project Report to BWIP, Rockwell Hanford Operations, May 1981.

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Reports (continued)

"Pre-test Analysis of Step 2 of the Jointed Block Test" (with R. D. Hart), Subcontract SA-957, Rockwell Hanford Operations, August 1981.

"RSTFEBE — A First Generation Hybrid FE/BE Code" (with A. Wassyng), University of Minnesota Project Report to ONWI/ Battelle, September 1981.

"Site Exploration, Design, and Construction Principles for Radioactive Waste Repositories," Itasca Consulting Group Report to W.P Systems AB, Sweden, June 1982.

"Subsurface Isolation of Hazardous Waste," University of Minnesota Report to Minnesota Waste Management Board, June 1982.

"Analysis of Block Test No. 1, Data and Recommendations for a General Analysis Program," Itasca Consulting Group Report to BWIP, Rockwell Hanford Operations, March 1983.

"A Data Analysis Program for Large-Scale Experiments on Jointed Rock Exhibiting Inelastic and Elastic, Isotropic or Transversely Isotropic Deformational Behavior" (with M. Asgian, M. C. Christianson, and R. D. Hart) , Itasca Consulting Group; Subcontract SA-957, Rockwell Hanford Operations, 1983.

"Fissure Flow in Fractured Rock Masses," Institute of Energy and Earth Resources Workshop on Fluid Flow in Porous Media, July 1984.

Hobbs, B. E., L. P. Paterson, L. J. Lorig, and B.H.G. Brady. "The Stability of Frictional Sliding and Earthquake Mechanisms (Abstract)," Earthquake Symposium, Bureau of Mineral Resources, Canberra, 1986.