REPORT ON THE ACTIVITIES OF THE POLAR ICE CORING OFFICE 1988 - 1995

by

John J. Kelley
Director and Principal Investigator of the
Polar Ice Coring Office

Arctic Center for Applied Research
205 O'Neill Bldg., P.O. Box 757260
University of Alaska Fairbanks
Fairbanks, AK 99775-7260

ACAR
Report 95-01

June 1995

ACAR

Arctic Center for Applied Research
at the University of Alaska Fairbanks

TO: Jack Keating, Provost
University of Alaska Fairbanks

FROM: John Kelley, Principal Investigator
Director, PICO, and Director, ACAR

DATE: June 12, 1995

SUBJECT: Report on the activities of PICO during the contract period - 1988 to 1995

Attached is a report which summarizes the activities carried out under the Polar Ice Coring Office (PICO) contract at the UAF from 1988 to March 31, 1995. For those not familiar with PICO, I have included a brief summary of key events in the history of the contract.

Additionally, I have specifically addressed where PICO has enhanced the University of Alaska's mission through collaborative research with the faculty, publications, and production of graduate degrees.

All PICO reporting obligations to the NSF have been fulfilled, as well as our self-directed research and technical reporting, including theses and dissertations.

My intention is to make arrangements to deposit a complete set of all of our publications with the UAF archives. I have also produced through ACAR an updated version of the catalog of PICO publications. This information and the archive may be useful should the UAF wish to pursue a future bid for the PICO contract.

Please let me know if you desire additional information.

fp
Enclosure
cc: J. Wadlow, Chancellor
M. Rice, Vice Chancellor for Administrative Services

205 O'Neill Building, P.O. Box 757260, Fairbanks, AK 99775-7260 PH (907) 474-5585; FAX (907) 474-5582

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PREFACE

The Vice Chancellor for Research at the University of Alaska Fairbanks (UAF), Dr. Luis Proenza, responded to a Request for Proposal in 1987 for operation of the Polar Ice Coring Office (PICO) for the National Science Foundation (NSF), Division of Polar Programs. A contract was awarded to the university in November 1988. PICO staff at the UAF supported the drilling, coring, and logistics requirements of NSF's glaciology program worldwide.

The single most important effort of PICO was the development of a coring device capable of obtaining a high-quality ice core through the Greenland Ice Sheet to bedrock (called the Greenland Ice Sheet Project, or GISP2). This very high-risk project was successful and utilized innovative technologies and an environmentally safe drilling fluid. A subglacial rock core was also obtained.

Collaboration with visiting scientists, UAF faculty, students, and staff contributed to the success of this project and led to new improved technologies for glaciological research. This collaboration also led to other technologies related to power generation, construction, waste, and water treatment.

Our association with the European ice coring program in Greenland (GRIP) was both pleasant and mutually beneficial.

This report summarizes the accomplishments of the project and will serve as a historical narrative for PICO at the University of Alaska Fairbanks.

CONTENTS

PICO: PAST, PRESENT, AND FUTURE

TRANSITION HISTORY

FEB 1988:	RFP for PICO contract issued
MAR 1988:	Proposal conference
APR 1988:	Proposals for PICO contract due
AUG 1988:	Contract awarded
SEP 1988:	Announcement of GISP2 funding
OCT 1988:	PICO Director announces resignation
NOV 1988:	Contract transfer
	PICO Antarctic projects begin (largest Antarctic season ever)
JAN 1989:	First PICO personnel from University of Nebraska-Lincoln (UNL) arrive at University of Alaska Fairbanks (three PICO/UNL personnel eventually transfer)
	Establishment of PICO office in O'Neill Building
MAY 1989:	Put-in flight for GISP2 Camp
JUN 1989:	End of transition period

POST-TRANSITION HISTORY

AUG 1989:	Phasedown of first season at GISP2 Camp, Greenland (335-meter core recovered)
JAN 1990:	First test of deep ice-coring drill at U.S. Army Cold Regions Research Engineering Laboratory (CRREL), Hanover, New Hampshire
	Shothole Project hot-water drilled, Antarctica, University of Wisconsin (400 holes to 20 meters)
APR 1990:	Put-in for GISP2: second season
AUG 1990:	Phasedown of second field season at GISP2 Camp, Greenland
NOV 1990:	Final move into 205 O'Neill Building
	Construction began on PICO mechanical shop
FEB 1991:	Technical Services Manager hired (new position)
	Mechanical shop completed
APR 1991:	Phaseup for GISP2 third-year field season in Greenland
JUL 1991:	Wind River Glacier, Wyoming, thermally drilled (USGS)
AUG 1991:	GISP2 closure for season
	• 1510 meters drilled • 1175-meter core recovered
OCT 1991:	Assistant Director hired (replacement)
NOV 1991:	Logistics Manager hired (replacement)
	AMANDA Neutrino Detection Project began, South Pole
	Two large-diameter holes hot-water drilled to 850 meters
JAN 1992:	Commencement of the National Scientific Balloon Project, Sondrestrom, Greenland

FEB 1992: Phaseup for fourth-year field season in Greenland

Objectives completed in Antarctica at McMurdo Dome and Amundsen-Scott Base

- Thermally cored ice at Lake Fryxell in the Dry Valleys for the Woods Hole Oceanographic Institution
- Pegasus Runway hot-water drilled to determine ice thickness for CRREL
- Preliminary site selection for 4-inch core drilling at McMurdo Dome for University of Washington

Close of PICO field season in Antarctica

MAR 1992: Test of Ohio State University drill in the PICO test well at UAF preparatory to the drilling program in China

Completion of the National Scientific Balloon Project

APR 1992: GISP2 phaseup for fourth drilling season

JUN 1992: Guliya/China Project (Ohio State University)

Commencement of fourth drilling season at GISP2, Greenland

Development began of Phase I, VALIS (Value-Added Logistics Information System): cargo and personnel tracking

SEP 1992: GISP2 phasedown of fourth season at GISP2 Camp, Greenland

- 2253 meters drilled
- 743-meter core recovered

NOV 1992: Purchasing and soft-ledger tracking system implemented as part of Phase I, VALIS

FEB 1993: Personnel and cargo tracking system implemented as a component of Phase I, VALIS

APR 1993: Frozen sand core drilling at Cape Espenberg, Alaska

New Greenland Field Center opened in Kangerlussuaq, Greenland

MAY 1993: Commencement of fifth drilling season at GISP2, Greenland

Fabrication of rock drill for sub-basal geologic sample recovery at GISP2

Development of new coring equipment for the recovery of 4-inch sea ice cores for Stanford Research International, Pt. Barrow, Alaska

Commencement of two-phase modification of the DYE2 Skiway Training Facility in support of the USAF

- Phase I: Construction of a new ski landing area
- Phase II (1994): Construction of a new C-130 refueling site

JUN 1993: Thermal drilling on Quelccaya Glacier, Peru, for Ohio State University

Approval of preproposal with Geophysical Institute in response to U.S. Army Broad Agency Announcement for drilling and coring in permafrost

JUL 1993: Completion of ice and rock drilling at GISP2 (2793 meters)

NOV 1993: Taylor Dome, Antarctica, drilled

AMANDA Project: first four holes of ten-hole project

FEB 1994: Lunardini/CRREL permafrost coring

MAR 1994: PICO support of ARCSS/LAII began

- Happy Valley
- Barrow
- Prudhoe Bay

APR 1994: Stanford Research Institute drilling on sea ice, Barrow, Alaska

MAY 1994: Major retrograde season at GISP2

AUG 1994: PICO contract awarded to University of Nebraska-Lincoln (implementation by March 31, 1995)

OCT 1994:	Transition conference at UAF to discuss transfer of PICO contract to University of Nebraska-Lincoln
JAN 1995:	AMANDA deep hot-water drilling activity project subcontracted to Institute of Marine Science (UAF - Koci and Kelley)
FEB 1995:	Return of all personnel from Antarctica
MAR 1995:	Completion of transfer of NSF equipment to University of Nebraska-Lincoln
	Completion of reporting obligations to the Office of Polar Programs, National Science Foundation
MARCH 31, 1995:	End of PICO project activities at UAF

1995 PICO PERSONNEL

DIRECTOR
John J. Kelley

ASSISTANT DIRECTOR
Baxter Burton*

BUSINESS OFFICE

Fiscal Officer:	Jennifer Burchfield*
System Administrator:	Shawn Abshear*
Accounts Clerk:	Bob Fath*
Secretary:	Jeanne Wollman
Student Assistant:	Janelle Swan*
Secretarial Support:	Fran Pedersen*

PICO ADVISORY BOARD
Vera Alexander
Carl Benson
Kevin Curtis
William Harrison
Merritt Helfferich
Sathy Naidu
Larry Sweet
Gunter Weller
John Zarling

Visiting Professor: Victor Zagorodnov*
Research Associate: Fucheng Li*

OPERATIONS/LOGISTICS

Logistics Manager:	Scott Jackson
Field Operations Manager:	Sam Lamont
Remote Camp Manager:	Jay Klinck
Logistics Coordinator:	Michelle Johnson
Transportation Specialist:	John Roberts*

ENGINEERING/DRILLING

Technical Services Manager:	Kerry Stanford
Senior Engineer:	Bruce Koci
Field Engineer:	Dave Giles
Acting Field Engineer:	Jesse Collins
Technician:	Terry Gacke
Drafting Technician:	Karl Bergman
Student Engineering Intern:	Jeff Harmon**

SEASONAL/TEMPORARY

GFC

Assistant Field Office Manager:	Tony Perry

SKIWAY

Skiway Operator:	Kevin Killilea
Assistant Skiway Operator:	Earl Ramsey

SUMMIT

Acting Camp Manager:	Don Kahler
Cook:	David Cotter
Electrical Engineer:	Seth Danielson
General Field Assistants:	Bill Barber
	Dennis Ferderer
	Jay Kyne
Mechanic/Equipment Operator:	Paul Kyllonen

LAII

Camp Coordinator/Cook:	Sarah Hackney
Carpenters:	Dave Dausel
	Dave Koester
Student Assistant:	Scott Adams

* Position funded by UAF.
** Position funded by NSF/OCE Alaska Native Student Intern Program (graduated, BSCE, 1994)

PICO ADVISORY BOARD

A University of Alaska Fairbanks Advisory Board advised PICO in the management of its program at the UAF. In order to take advantage of the professional expertise resident at the UAF, advisors were selected from the School of Fisheries and Ocean Sciences, the School of Engineering, and the Geophysical Institute.

The Advisory Board provided advice to PICO management, making possible effective interaction with the faculty and staff of the UAF professional schools. The PICO Advisory Board was disbanded at the close of the university fiscal year, June 1994, in anticipation of the award of a new PICO contract. A new contract award was not made as expected. The PICO contract at the UAF was extended until March 1995 at which time all PICO operations were transferred to the University of Nebraska-Lincoln. PICO/UAF was in transition from November 1, 1994, to March 31, 1995.

PICO/UAF ADVISORY BOARD

John Zarling
Director
Institute of Northern Engineering

Merritt Helfferich
Associate Director of Administration
Geophysical Institute

Gunter Weller
Professor
Geophysical Institute

Kevin Curtis
Professor
Civil Engineering Department

Larry Sweet
Systems Engineer
Geophysical Institute

Carl Benson
Professor Emeritus
Geophysical Institute

Sathy Naidu
Professor
Institute of Marine Science

William Harrison
Professor
Physics Department
Geophysical Institute

Vera Alexander
Director, Institute of Marine Science
Dean, School of Fisheries & Ocean Sciences

PICO: A UNIVERSITY OF ALASKA FAIRBANKS ASSET

PICO AS AN ASSET

- Generated over $4,890,000 overall in overhead for UAF.
- Developed new technology to core the rock beneath the Greenland Ice Cap in July 1993.
- Represented PICO/UAF in national and international conferences, such as:
  - Society of Research Administrators, San Francisco
  - Sovietski Soyuz Consultation Meeting, Murmansk
  - GISP2 Consultative Meeting, University of New Hampshire
  - First International Symposium on Engineering Ecology, Moscow
  - International Design for Extreme Environments Assembly, Houston (PICO Director elected to Board of Advisors)
  - CRREL Symposium (Dr. Fucheng Li presented borehole closure paper)
  - NSF Ice Core Working Group, Miami
  - National Institute of Polar Research, Glaciology Group (PICO Director was invited lecturer)
  - Annual Greenland Consultation, Copenhagen
  - Board of Directors for Canadian Circumpolar Institute, Edmonton, (PICO Director appointed to Board in 1990)
  - American Geophysical Union
- 4th International Workshop on Ice Drilling Technology, Tokyo, Japan.
- 2nd International Symposium on Exploratory Drilling in Complex Conditions, St. Petersburg, Russia.
- NASA MARS Polar Pathfinder Proposal Workshop, San Clemente.
- Supported thermal research and development projects at UAF relative to the development of new opportunities for PICO:

- Thermal mechanical drill for sampling ice and rock (Deben Das)
- Construction of a drill test well (John Zarling, Deben Das)
- Thermal antifreeze drill (Victor Zagorodnov)
- Development of acoustic borehole logging instrument (Victor Zagorodnov)
- Development of whipstock for boreholes in ice (Victor Zagorodnov)
- Development of continuous analytical system for ice cores (Victor Zagorodnov)
- Continuation of collaboration on monograph on thermal drilling (Victor Zagorodnov, Oleg Nogornov, John Kelley)
- Water jet shaping and cutting of ice (Bruce Koci)
- Design of low-power laser system for cutting and shaping ice (Bruce Koci)
- Modeling borehole closure rates (Fucheng Li)
- Design of hand-powered auger for soil and ice till (Terry McFadden, Tay Epperson)
- Development of solar-electric systems for high-altitude, noncontaminating ice coring (Bruce Koci)
- Design for coring moraine and bedrock beneath large ice caps (Zhengwen Wang)
- Design of point-supported structures on ice (Kevin Curtis, Victor Mimken)
- Design for improvement of deep ice-coring/rock drill (Lawrence Kozycki)
- Development of a value-added logistics system (Parviz Koushki, Leroy Hulsey, Lawrence Bennett, John Kelley)
- Management principles for remote site activities (Lawrence Bennett)
- Investigation on the bedrock geology under the Greenland Ice Cap and coordination of the development of a glacio/geology program (Sathy Naidu)
- Investigation of the use and conditions for use of HF packet radios for use in the polar regions (Robert Merritt)

- Consultation on environmental problems (Mark Tumeo)
- Development of methods for sampling subglacial till (William Harrison)
- Investigation of the use of butyl acetate and ethanol as environmentally safe drilling fluids (Thomas Gosink, John Kelley)
- Establishment of a UAF seminar series and a Science and Engineering Research and Development Committee (SERDC) (Kevin Curtis, Mark Tumeo, John Kelley)
- Development of a method for taking parallel sea ice cores both vertically and at 45° (Jesse Collins)
- Analysis of solar heating and electricity system for Amundsen-Scott South Pole Station (Bruce Koci)
- Development of a system for recovering frozen sand cores (Jesse Collins and Kerry Stanford)
- Testing of DC drill motor brushes for use when immersed in n-butyl acetate (Kerry Stanford)
- Research and testing into effects of n-butyl acetate on drill motors and gear reducers (Åsa Hagberg and Torbjörn Henriksson
- Analytical numerical modeling of drill freeze-in rates using finite-element analysis (Fucheng Li)

• Logistics-Supported Research:

- Evaluation of HF communications in the Arctic
- Development of VALIS (Value-Added Logistics Information System)

APPENDICES

A. PICO/UAF: TEAMWORK

B. BUSINESS OFFICE

C. TECHNICAL SERVICES

D. LOGISTICS

E. PUBLICATIONS

F. FACILITIES

G. LONG-RANGE PLAN

APPENDIX A

PICO/UAF: TEAMWORK

INTERACTION WITH UAF PROFESSIONAL SCHOOLS AND ACADEMIC PROGRAMS

PICO recognized that its effectiveness was tied to its strong interaction with faculty and staff of the professional schools and academic programs. We believed that PICO's research and development activities were an essential value-added aspect to carrying out its contractual obligations to the NSF and for developing the tools and techniques to maximize effective ice-coring and related analytical technologies.

The development of this interaction was a continuous endeavor of PICO. Some of its accomplishments include the following:

- Interaction with a local advisory committee composed of faculty and staff of the School of Engineering, the Geophysical Institute, and the Institute of Marine Science.

- Undergraduate and graduate student involvement in research and development and in the operational activities of PICO. This included office and technical student assistants and both Master and Ph.D. candidates engaged in PICO-related research.

- Increased collaboration with other professional schools and academic programs to use campus facilities more effectively.

- Professional interaction with the Institute of Marine Science. Results came early through cooperative research on drilling fluids, including butyl acetate and ethanol. Consultation was made with the engineering staff of the Seward Marine Station. Publication services were provided through the Publications Department of the School of Fisheries and Ocean Sciences.

- Establishment of a memorandum of understanding between PICO and the Geophysical Institute for machine shop, design, and scientific consultative services. The results of this interaction led to major improvements in the deep ice-coring drill, as well as a number of innovations in other drilling systems.

- Interaction with the School of Engineering and School of Mineral Engineering. This led to joint reports and publications in environmental, structural, mechanical, and electrical engineering. The most notable accomplishments were:

  - Development of a more environmentally safe drilling fluid

  - Research into polar structures for the support of NSF's glaciological programs

  - Design and construction of a test well

  - Thermodynamic modeling

- Research into new drill/ice-coring devices
- Development of innovative approaches to operations and logistics

STUDENT INVOLVEMENT WITH PICO

PICO incorporated student involvement with its projects through association with faculty/graduate projects, training programs, and student jobs.

Mr. David Harmon was a Mechanical Engineering undergraduate student who worked with PICO's Technical Services Department. Mr. Harmon was associated with PICO through an NSF-supported internship grant for Alaska Native students.* He received his BSCE in 1994.

Mr. Srikanta Jois was a graduate student in Mechanical Engineering who worked with PICO's Technical Services Department and with Dr. Deben Das, School of Engineering, on modeling new drill concepts. He received his M.S. degree in 1993.

Ms. Laila Fleischer was an undergraduate student in geology who assisted PICO's Technical Services Department in literature searches and provided assistance in PICO's Operations Department. Ms. Fleischer, a citizen of Greenland, is presently a university student in Copenhagen.

Ms. Åsa Hagberg and Mr. Torbjörn Henriksson participated in a cooperative program with the School of Engineering and PICO to study the effect of n-butyl acetate on a motor and gear reducer system for a deep ice-coring drill. Ms. Hagberg and Mr. Henriksson, both Master degree students from Luleå University in Sweden, completed this research at PICO and the UAF School of Engineering. They received their M.S. degrees in 1992.

Mr. Sridar Seetharaman was a graduate student in the School of Engineering and worked with Dr. Larry Bennett on a logistics information support system for PICO. He received his M.S. degree in 1993.

Mr. Sandeep Hazarika was a graduate student in the School of Engineering. He worked with Dr. Deben Das on modeling temperature distribution during ice coring. He received his M.S. degree in 1993.

Mr. Hans Vallgren and Mr. Bengt Wikman participated in a cooperative program with the School of Engineering and PICO that was addressed to a study of turbocharged diesel engine performance for high altitudes and cold climates. Their faculty supervisor was Dr. Terry McFadden. They received their M.S. degrees in Mechanical Engineering in 1994.

Mr. Zhengwen Wang was a graduate student in the School of Mineral Engineering. He worked under Dr. Scott Huang on research associated with diamond coring bits related to PICO's need to core the rock under the ice caps. He received his Ph.D. in 1994.

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* Mr. Karl Bergman occupied this internship in 1990-91 and was employed with the Technical Services Department on its Greenland and Antarctic programs. Mr. Bergman was trained through an NSF internship grant.

Mr. Victor Mimken was a graduate student in the School of Engineering supervised by Dr. Kevin Curtis. He worked on the design and testing of point-supported structures useful for PICO's logistics needs. He received his M.S. degree in Mechanical Engineering in 1994.

Ms. Susan Day is a Mechanical Engineering undergraduate student who worked with PICO's Technical Services Department after the graduation of Mr. Harmon in 1994. Ms. Day was associated with PICO through an NSF-supported internship grant for Alaska Native students.

APPENDIX B

BUSINESS OFFICE

The Business Office served as a central services office of PICO, providing fiscal control and reporting, budget preparation, project coordination, payroll, personnel, and general liaison with the UAF and UA business offices.

OVERHEAD SUPPORT PROVIDED TO PICO

Salaries:	Ancillary Faculty
	Graduate Research Student Support
	Technical Services Manager (25% 1992; 100% 1993)
	Logistics Manager (25% 1992; 100% 1993)
	Accounts Clerk Support
	Student Office Aides
	Associated Fringe Benefits
Travel:	Staff Field Site Visits
	Professional Meetings
	Seminars/Workshops
Services:	Renovation of PICO Office Space
	Renovation of PICO Warehouse Space
	Renovation of PICO Workshop Space
	Publications
	Presentations
	Geophysical Institute Student Shop Fee (MOU)
Supplies:	Renovations Supplies
	General Office Supplies
	Expendable Equipment
	Computer Software
Equipment:	Office Furnishings/Equipment
	Computer Hardware

CONTRACT DELIVERABLES

1.	**Annual Program Plan** (pre-negotiated; ready for approval)	1 November
	Greenland Amendment to	
	Annual Program Plan	15 February
	Monthly Financial Report	15 of month
2.	**Quarterly Technical Report**	
	First Quarter	20 February
	Second Quarter	20 May
	Third Quarter	20 August
	Fourth Quarter	20 November
	a. Status of Tasks: work accomplished during reporting period	
	b. Financial Report: expenses to date, by quarter	
3.	**End-of-Year Technical/Financial Report**	31 December
	Quarterly Subcontracting Report (SF295)	
	First Quarter	25 January
	Second Quarter	25 April
	Third Quarter	25 July
	Fourth Quarter	25 October
	Semi-Annual Subcontracting Report (SF294)	
	First Six Months	25 April
	Second Six Months	25 October
4.	**After-Operations Report**	
	Greenland Field Season	31 December
	Antarctic Field Season	30 June
5.	**Property Reporting**	31 October

Includes all items of capitalized equipment valued at $1500 or more. In addition, some sensitive items under $1000 with life expectancy of two (2) years or more.

EXPENDITURE HISTORY

	Total Budgeted	Total Expended	Balance Reserve
Initial Start-up October 1988	$25,000	$25,000	$0
Year 1 10/1/88 - 9/30/89			
Direct Costs	$2,329,249	$2,072,788	$256,461
Indirect Costs	$ 487,627	$ 307,496	$180,131
Total	$2,816,876	$2,380,284	$436,592
Carry forward to Yr 2			$436,592
Year 2 10/1/89-9/30/90			
Direct Costs	$2,927,897	$2,967,069	$ (39,172)
Indirect Costs	$ 617,871	$ 836,385	$(218,514)
Total	$3,545,768	$3,803454	$(257,686)
Carry forward to Yr 3			$ 178,906
Year 3 10/1/90-9/30/91			
Direct Costs	$4,275,061	$4,207,147	$ 67,914
Indirect Costs	$ 799,311	$ 934,813	$(135,502)
Total	$5,074,732	$5,141,960	$ (67,588)
Prior Yr Residual			$ 178,906
Carry Forward to Yr 4			$ 111,318
Year 4 10/1/91-9/30/92			
Direct Costs	$4,758,378	$4,462,938	$ 294,440
Indirect Costs	$ 853,771	$1,034,303	$(180,532)
Total	$5,612,149	$5,497,241	$ 113,908
Prior Yr Residual			$ 111,318
Carry Forward to Yr 5			$ 225,226

	Total Budgeted	Total Expended	Balance Reserve
Year 5 10/1/92 - 9/30/93			
Direct Costs	$4,371,962	$2,266,651	$2,085,311
Indirect Costs	$ 844,456	$ 632,642	$ 211,814
Total	$5,216,418	$2,919,293	$2,297,125
Prior Yr Residual			$ 225,226
Carry forward to Yr 6			$2,522,351
Year 6 10/1/93 - 9/30/94			
Direct Costs	$5,857,857	$3,517,907	$2,339,950
Indirect Costs	$ 938,158	$ 877,279	$ 60,879
Total	$6,796,015	$4,395,186	$2,400,829
Carry forward to Yr 7			$2,400,829
Year 7 10/1/94 thru 3/31/95			
Direct Costs	$2,016,696	$1,024,366	$ 992,330
Indirect Costs	$ 384,133	$ 170,131	$ 214,002
Total	$2,400,829	$1,194,497	$1,206,332

Total Expenditures through 3/31/95

Direct	$20,543,666
Indirect	$ 4,793,049
Total	$25,336,715

INDIRECT CHARGES TO NSF CONTRACT

(Excludes Other PICO Projects)

Year 1	$ 307,496
Year 2	$ 836,385
Year 3	$ 934,813
Year 4	$1,034,303
Year 5	$ 632,642
Year 6	$ 877,279
Year 7 (Thru 3/31/95)	$ 170,131
Total	$4,793,049

OVERHEAD SUPPORT RETURNED TO UAF

(Includes Overhead From All Sources)

	UAF ADMINISTRATION	PICO SUPPORT
FY 89	$ 0	$ 166,672
FY 90	$ 158,538	$ 383,450
FY 91	$ 467,326	$ 531,142
FY 92	$ 489,153	$ 629,861
FY 93	$ 309,663	$ 394,117
FY 94	$ 388,568	$ 494,541
FY 95 (Thru 3/31/95)	$ 209,969	$ 267,119
TOTALS	$2,023,217	$ 2,866,992

APPENDIX C

TECHNICAL SERVICES

The PICO Technical Services Department provided specialized engineering design, fabrication, test, and documentation capabilities as needed to the Office of Polar Programs, NSF. The department also provided field personnel, expertise, and specialized equipment for specific drilling and coring and other technical projects in remote areas. Technical assistance was available to projects other than NSF-sponsored ones (state and federal agencies, private industry) on a noninterference and cost-reimbursable basis.

Collaboration on a variety of subjects with international ice-coring researchers was maintained on a formal and an informal basis.

The Technical Services Department also recommended research and development projects for consideration by UAF faculty. Whenever possible, the Technical Services group participated in research and development activities with UAF professional schools.

1991 ACCOMPLISHMENTS

- Drilled to 1510-meter depth at GISP2.
- Completed thermal coring project in Wind River Range of Wyoming-Fremont Glacier (USGS).
- Completed seismic project in Antarctica (400 hot-water holes).
- Continued research into n-butyl acetate and ethanol as environmentally safe drilling fluids. Published research papers on n-butyl acetate and submitted one on alcohol.
- Built, assembled, and shipped a new 5.2-inch drill tower, carousel system, and supplies to Antarctica for the austral summer 1993 drilling season.
- Recovered 4-inch cores at GISP2 site (Cores of Opportunity).
- Completed numerous reports and publications (see Appendix E).
- Cored ice on Lake Fryxell dry valleys, Antarctica (Woods Hole).
- Drilled two large-diameter holes 820 and 850 meters deep with a hot-water drill for a neutrino experiment in Antarctica (University of Wisconsin).
- Drilled a 200-meter, 4-inch core at McMurdo Dome, Antarctica (University of Washington).
- Drilled runway in Antarctica for new airfield to determine ice depth (Pegasus Project).
- Researched rock coring relevant to coring the subglacial rock at GISP2.
- Developed laser ice core cutting and shaping instrument (University of Kansas).
- Designed and built ice-coring test well facility in a permafrost area at a Fort Wainwright U.S. Army CRREL field facility.
- Established a fully functioning mechanical shop in the O'Neill Building which greatly facilitated PICO's response time to project needs.
- Invited Dr. Victor Zagorodnov (Institute of Geography, Russian Academy of Sciences, Moscow), Dr. V. Morev (Arctic and Antarctic Institute, St. Petersburg), and Dr. O. Nagornov (Institute of Physics, Moscow) to PICO. Dr. Zagorodnov is on a long-term appointment through a U.S.-Russia Bilateral Agreement. Appointment

includes development of new drilling-coring and analytical systems technologies, and production of a monograph on thermal drilling theory and practice.

- Initiated analytical research into borehole closure rates and drill freeze-in rates for purposes of recovering trapped drills (Fucheng Li).

1992 ACCOMPLISHMENTS

- Expanded research and development activities with Drs. Zagorodnov and Nagornov.
  - Tested thermal antifreeze drill (ATED) in ice well.
  - Tested directional drilling whipstock in ice well.
  - Developed thermal dynamic analytical analysis of ATED system.
- Continued GISP2 Project in Greenland; drilled to 2253 meters; straightened borehole.
- Recovered a 310-meter core from Guliya Glacier in China (Ohio State University); successfully field tested Dr. Zagorodnov's thermal-antifreeze drill.
- Tested a 4-inch drill in PICO ice well (Ohio State University/UAF/PICO).
- Recovered 4-inch Cores of Opportunity at GISP2 (University of Kansas, University of Washington, University of New Hampshire, Penn State).
- Continued hot-water drill/neutrino experiment at Antarctica (University of Wisconsin).
- Evaluated subglacier sampler conceptualization and initial design (UAF).
- Upgraded 4-inch drill systems (winches, core barrels, cutters).
- Upgraded hand auger systems.
- Tested point-supported structures data-gathering system at GISP2 (Kevin Curtis, Victor Mimken).
- Initiated diamond drill tests for use at low power with the 13.2-centimeter drill (to be used at GISP2 and McMurdo Dome).
- Initiated development of brushless drill motors for 13.2-centimeter drill.
- Overhauled and redesigned winch for 13.2-centimeter drill system.
- Designed and fabricated tools for straightening borehole at GISP2.
- Designed new high-pressure, dry-motor canister for use with the 13.2-centimeter deep-drill system in a fluid-filled hole.

1993 ACCOMPLISHMENTS

- Deployed personnel and redesigned equipment to GISP2 in Greenland for final drilling season.
- Continued point-supported structures data-gathering experiment at GISP2 site.
- Designed and fabricated a rock drill addition to the 13.2-centimeter drill system for recovery of geologic samples beneath the Greenland Ice Cap at GISP2.
- Designed and fabricated specialized drilling rig for coring frozen sand sample at Cape Espenberg, Alaska (UAF Museum Quaternary Center).
- Designed and fabricated specialized drilling rig for recovery of numerous parallel, angled sea ice cores at Pt. Barrow, Alaska (Stanford Research Institute).
- Assisted in recovery of permafrost soil samples (UAF exchange student, Japan).
- Prepared a drilling proposal for CRREL to establish permafrost temperature observations.
- Continued preparation (design and equipment fabrication) for massive increase in support of the AMANDA neutrino detection project at South Pole (University of Wisconsin).
- Continued equipment preparation for coring an 800-meter borehole at McMurdo Dome, Antarctica (University of Washington).
- Attended the Fourth International Workshop on Ice Drilling Technology, Tokyo, Japan. Presented or submitted 14 papers for publication. Dr. Kelley, Director, was an invited member of the organizing committee and section chairman. This conference is convened approximately every five years.

1994-95 ACCOMPLISHMENTS

- Acquired U.S. Army CRREL contract to drill in permafrost to establish well-logging sites to monitor effects of climate change. This was a collaborative project with the Geophysical Institute (Tom Osterkamp). Completed project in April 1994.

- Initiated a project to design a drill for making parallel holes in sea ice to study optical properties.

- PICO/UAF contract extended to complete drilling activities in Antarctica.

APPENDIX D

LOGISTICS

The Logistics Department provided a wide range of services: early planning and consultation, logistics information, turn-key logistics support, satellite communications, various types of equipment for field and lab work, a proven shipping and tracking system, field camp operation and construction, reporting, and documentation.

The goal of the Logistics Department was to provide efficient and cost-effective logistical support for small and large research projects. Its services provided researchers with the tools they needed to stay focused on research.

Services were provided to a variety of users, including universities, private researchers, government agencies, the military, NSF program managers, and the European Science Foundation.

1991 ACCOMPLISHMENTS

- Obtained proper clearances (MAC authorization, air base clearance, foreign national clearances, etc.) for 126 scientists and support staff transported via MAC.
- Transported 18 scientists and support staff by 109th TAG.
- Provided packaging labels and transportation for 267,546 pounds of scientific and support staff cargo to Greenland as follows:
  - 41,018 pounds via MAC.
  - 55,590 pounds via 109th TAG.
  - 170,938 pounds via Greenwave.
- Transported a total of 450,503 pounds of cargo from Sondrestrom to remote field camps within Greenland.
- Obtained authorization for, provided packaging instruction for, and transported 118,788 pounds of scientific and support staff retro cargo to the CONUS.
- Coordinated the transportation of retrograde ice cores totaling approximately 20,000 pounds.
- Supported 20 principal investigators and their staff for research with GISP2.
- Supported eight projects outside of GISP2 within Greenland including one NSF DV visit.
- Established and maintained the GISP2 remote camp consisting of 4861 man-days.
- Established and operated the DYE2 Skiway Training Facility, consisting of 220 man-days, and the DYE3 site, consisting of 40 man-days. The DYE2 site was maintained for the 109th Air National Guard. This saved positioning costs of approximately $440,000.
- Supported 170 scientists and field personnel transiting through Sondrestrom Air Base. This consisted of 1716 man-days at the Sondrestrom office.

1992 OPERATIONS

- Expanded the science weatherport from 15' x 20' to 15' x 40'. This provided an additional 300-square-foot area for the scientific personnel. Additionally, the Science Jamesway was upgraded to provide optimal use of working area and extended trench entrances as required.

- Maintained and provided support for all scientific research at the GISP2 site.

- Provided transportation for approximately 178,000 pounds of scientific equipment and supported staff cargo via land, sea, and air to Greenland.

- Provided transportation for approximately 432,000 pounds of cargo from Sondrestrom to remote field camps within Greenland.

- Provided retro transportation for approximately 1300 meters of ice cores from the GISP2 site to CONUS.

- Ensured that scientific and staff support personnel had appropriate documents for military aircraft travel and entrance into Sondrestrom.

- Supported the atmospheric testing site throughout the Greenland season.

- Operated the DYE2 Skiway Training Facility which provided PICO an overall cost savings of $400,000 in positioning costs.

- Provided administrative and Sondrestrom field support for the National Scientific Balloon Facility and Harvard University which were measuring atmospheric trace constituents associated with the polar vortex.

- Assisted the Technical Services Department with worldwide logistics needs.

- Anticipated and responded to new opportunities for programs on the Alaska arctic tundra (LAII Project).

- Continued international cooperation with European Greenland Ice Core Project.

- Supported the Solar Flare Signals Project (Gisela Dreschhoff and E.J. Zeller).

- Supported the MAGIC Project (Robert Clauer).

- Supported Automatic Weather Stations (Charles Stearns).

- Assisted the Peregrine Falcon Survey with transportation and ground support in Greenland.

- Supported several other institutions with logistical support in the Arctic.

1993 OPERATIONS

- Opened the new Greenland Field Center at Kangerlussuaq, Greenland.
- Maintained and provided support for all scientific research at the GISP2 site.
- Provided transportation for approximately 95,000 pounds of scientific and support staff cargo via land, sea, and air to Greenland.
- Provided transportation for approximately 232,000 pounds of cargo from the Greenland Field Center to remote field camps within Greenland.
- Provided retrograde transportation for approximately 1000 meters of ice cores from the GISP2 site to CONUS.
- Provided transport of approximately 70 passengers to Greenland.
- Ensured that scientific and support staff personnel had appropriate clearance and military aircraft travel authorizations for transport to Greenland.
- Provided military clearance and AMC transport and coordinated base support at Keflavik, Iceland, for Lamont-Doherty Geological Observatory (Gerald Bond).
- Provided logistics support for the MAGIC Project (Robert Clauer).
- Supported the atmospheric testing site throughout the Greenland season.
- Provided logistics support for the Atmospheric Noise Project (Jerry A. Ferguson).
- Provided logistics support for permafrost drilling in Prudhoe Bay, Old Man, and Fairbanks, Alaska (Virgil Lunardini).
- Provided military clearance, AMC transport, and field support at the Greenland Field Center for the Greenland Peregrine Falcon Survey (William Mattox).
- Provided logistics support for drilling in Barrow, Alaska (SRI International, Ralph Maffione).
- Provided support to numerous institutions for logistical support in the Arctic.
- Operated and began Phase I of the DYE2 Skiway Training Facility modification.
- Turned over Sondrestrom Air Force Base to Greenland Home Rule Government. The former U.S. Air Force base was renamed Kangerlussuaq, Greenland.

- Moved PICO into Building 506--the former USAF base fire station located on the flight line.

- Established new computer gateway for information transfer.

- Utilized civilian aircraft charters to replace Air Force support.

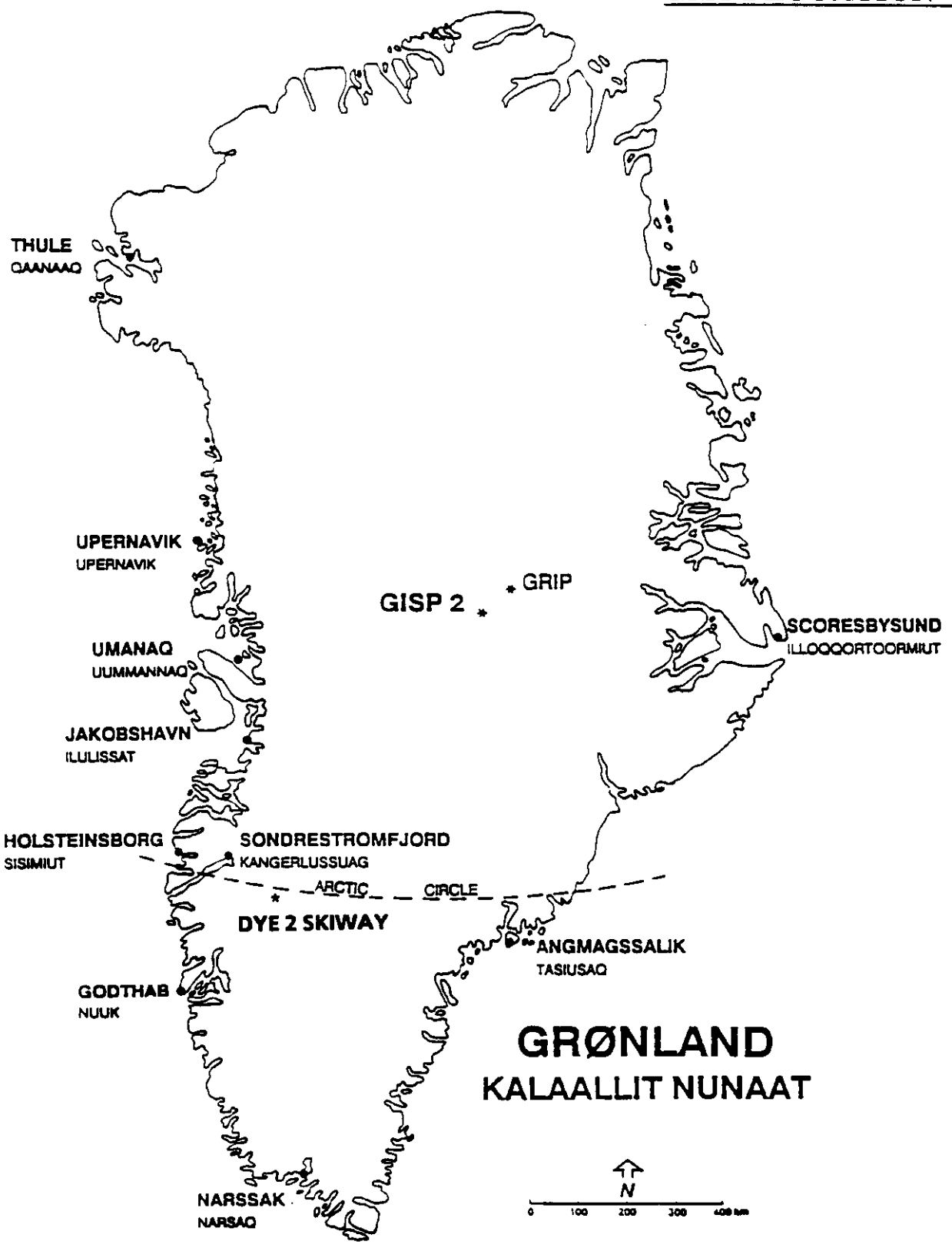
- Returned Greenland deep ice core and rock core to U.S. (Denver, Colorado) by DC-8.

- Moved over 600,000 pounds of cargo.

1994-95 OPERATIONS

- Downsized Summit Camp in Greenland to 20 persons.
- Established new ATM site.
- Designed, constructed, and delivered new generator module for Summit Camp.
- Moved 84 people and 450,000 pounds of cargo.
- Set up Summit Camp for self-sufficiency for next two years.
- Established Happy Valley Camp in April 1994 to support the NSF/LAII long-term tundra research project.
    - Acquired expertise for permitting activities.
    - Provided comprehensive support for investigators working on the North Slope of Alaska.
- "Packaged" camp for ease of reestablishment in 1995.
    - Completed Phase I of the VALIS logistics system.

GISP2 LOCATION



APPENDIX E

PUBLICATIONS

A publication and report policy was established early in the contract. Technical Reports, Conference Proceedings, and Technical Notes were established as a publications series, in addition to reports specified in the PICO contract. The Publications Department of the School of Fisheries and Ocean Sciences (SFOS) and PICO staff implemented all PICO publications activities.

Listings of publications are in numerical order, according to type of publication. Missing numbers in a sequence indicate that a number was assigned to a manuscript that was incomplete, duplicated elsewhere, or not published at the time of publication of this catalog.

PUBLICATIONS CLASSIFICATIONS

CP - Conference Proceedings

OPM - Office Policy Manuals

OR - Operations Reports

TJC - Technical Journal Contributions

TN - Technical Notes

TR - Technical Reports

TM - Technical Manuals

TSU - Technical Services Updates

PICO Bulletin

CONFERENCE PROCEEDINGS

CP-90-01	Logistical Support for Construction on the Greenland Ice Sheet
CP-90-02	Shallow and Deep Ice-Coring Devices Developed by the Polar Ice Coring Office
CP-90-03	Facilities Plan and Protocol for the Support of the National Science Foundation-Sponsored Greenland Ice Sheet Project Two: Deep Ice Core-Drilling Effort
CP-90-04	New Technological Developments in Support of Arctic Research: Proceedings of a Workshop at the 40th Annual Arctic Science Conference
CP-90-05	Butyl Acetate: An Alternative Drilling Fluid for Deep Ice-Coring Projects
CP-90-06	Development of Shallow and Deep Ice-Coring Devices
CP-91-01	Analytical Models for Determining Ice Core Temperatures
CP-92-01	The Polar Ice Coring Office: Shallow and Deep Ice Coring and Drilling
CP-92-02	An Engineering, Environmental, and Logistical Analysis of the Polar Ice Coring Office 13.2-cm Ice-Coring System
CP-92-03	Progress on Thermo-Mechanical Drills at the Polar Ice Coring Office
CP-92-04	Study of Ice Borehole Closure by Finite-Element Method
CP-92-05	Spring Sea Ice Conditions from SAR Images Near the Alaska Coast of the Chukchi Sea
CP-92-06	Perspectives on Logistics Support in the Arctic: Arctic Research Commission Testimony
CP-92-07	The Arctic Environment: Air-Sea-Land Exchange of Trace Gases
CP-93-01	Interaction of Hydrophilic Liquid with Ice
CP-93-02	Directional Drilling
CP-93-03	Drilling of Glacier Boreholes with a Hydrophilic Liquid

CP-93-04	Ice Coring and Drilling Technologies Developed by the Polar Ice Coring Office
CP-93-05	Effect of a Heated Drilling Bit and Borehole Liquid on Thermoelastic Stresses in an Ice Core
CP-93-06	Fluids for use in Deep Ice Core Drilling
CP-93-07	Continuous Study of an Ice Core: ECM, Fine Stratigraphy, Air Bubbles, and Crystals
CP-93-08	The Amanda Project: Drilling Precise, Large-Diameter Holes
CP-93-09	The Guliya Ice Cap, China: Retrieval and Return of a 308-Meter Ice Core from 6200 Meters
CP-93-10	An Analysis of the Use of Solar Concentrators in Hot-Water Drilling
CP-93-11	Thermal Modeling of Ice Cores and Boreholes via the Finite-Element Technique
CP-93-13	The Naval Arctic Research Laboratory: Transition to the Local Community
CP-93-14	Development of the U.S. Deep-Coring Ice Drill
CP-93-15	Future Technical Developments for the Polar Ice Coring Office 13.2-cm Ice-Coring Drill
CP-93-16	Instrumentation for the PICO Deep Ice-Coring Drill
CP-93-17	Low-Power Diamond Rock-Coring Parameters
CP-93-18	Operational Considerations of the U.S. Deep-Coring Ice Drill
CP-93-19	Rapid Deployment of Camp Facilities Utilizing Point-Supported Structures
CP-94-01	Status of Logistics Systems Development (VALIS)
CP-94-02	NSF/PICO Transition Conference

OFFICE POLICY MANUALS

OPM-90-01	1991 Remote-Area Personnel Manual
OPM-91-01	PICO/UAF 1991 Remote- Area Personnel Policy: Definitions of Employee Status
OPM-92-01	Remote-Area Personnel Policy

OPERATIONS REPORTS

OR-89-01	The 1989 Greenland Field Season After-Operations Report for NSF-Sponsored Projects
OR-90-01	Update on GISP2 Drilling and Operations
OR-90-02	The 1990 Greenland Field Season After-Operations Report for NSF-Sponsored Projects
OR-90-03	PICO Advisory Committee Meeting
OR-91-01	Update on GISP2 Drilling and Operations
OR-91-02	Sondrestrom Field Office Review
OR-91-03	PICO Contract Review (Brief Description of PICO Program Activities)
OR-91-04	Transporting Ice Core: Methods and Cost Analysis
OR-92-01	Facilities and Services Available to NSF-Sponsored Projects in Greenland
OR-92-02	The 1991 Greenland Field Season After-Operations Report for NSF-Sponsored Projects
OR-93-01	Facilities and Services Available to NSF-Sponsored Projects in Greenland
OR-93-02	The 1992 Greenland Field Season After-Operations Report for NSF-Sponsored Projects
OR-93-04	The 1993 Greenland Field Season After-Operations Report for NSF-Sponsored Projects
OR-94-01	1994 Facilities and Services Manual - Flux Study
OR-94-02	Facilities and Services Available to NSF-Sponsored Projects in Greenland
OR-94-03	Antarctic Drilling Report
OR-94-04	Washington USGS Thermal Drilling Project on the South Cascade Glacier 1994, 48°20'52"N, 121°03'01"W

OR-94-05	The 1994 Greenland Field Season After-Operations Report for NSF-Sponsored Projects
OR-94-06	Greenland Inventory 1994
OR-94-07	LAII Flux Field Project Inventory
OR-95-01	Summit Camp Traverse Information for the AWS and MAGIC Sites
OR-95-02	Happy Valley Camp "How To" Manual
OR-95-03	LAII Flux Study After-Operations Report

TECHNICAL JOURNAL CONTRIBUTIONS

TJC-101	Instruments and Methods. Butyl Acetate, an Alternative Drilling Fluid for Deep Ice-Coring Projects
TJC-102	Aqueous Ethanol as an Ice-Drilling Fluid
TJC-103	Analytical Solutions for Determining Ice Core Temperatures
TJC-104	Development of a Thermal Mechanical Drill for Sampling Ice and Rock from Great Depths
TJC-107	Hydrophilic Liquid in Glacier Boreholes
TJC-108	Cold Region Logistics Planning and Management
TJC-109	Computation of Gas Hydrate Dissociations by a Finite-Element Model
TJC-110	Calculations of Gas Hydrate Dissociation With a Finite-Element Model
TJC-112	GISP2 Deep Ice Core Drilling

TECHNICAL NOTES

TN-91-01	Materials Available for Mountain Glacier Research
TN-91-02	Clean Power at Remote Sites
TN-91-03	Methods for Straightening Boreholes
TN-91-04	Modification of the PICO 5.2-inch Ice-Coring Drill to Sample Rock at the Base of Glaciers
TN-91-05	Development of a Solar-Powered 40-m Drill
TN-91-06	Review of Methods for Cutting Ice Cores
TN-92-01	Directional Drilling
TN-92-02	Drilling Large-Diameter Boreholes in Snow and Firn
TN-92-03	Antifreeze Thermal Electrical Drill (ATED)
TN-92-04	Borehole Monitoring with Impulse Acoustic Sensors

TECHNICAL REPORTS

TR-89-01	Evaluation of a Prototype Deep Ice-Coring System
TR-89-02	A Literature Survey of Drilling Fluids and Densifiers
TR-89-03	A Case for n-Butyl Acetate. A Safe, Auto-Dense Ice Core Drilling Fluid
TR-90-01	Evaluation of Deep Ice Core Drilling systems
TR-90-02	Deep Drill Status Report
TR-90-03	Temperature Rise in Ice Coring During a Water Jet-Cutting Process
TR-90-04	A Study of the Effect of n-Butyl Acetate on a Motor and Gear Reducer System for a Deep Ice-Coring Drill
TR-91-01	Butyl Acetate Vapor Detection Methods
TR-91-02	The Use of Aqueous Ethanol for Ice Core Drilling in Glaciers
TR-91-03	Analytical Solutions for Temperature Distribution in Ice Cores
TR-92-01	Computation of Ice Borehole Closure by the Finite-Element Method
TR-92-02	Ice Core Analytical Systems
TR-92-03	Hydrophilic Liquid in Glacier Boreholes
TR-92-04	Causes of the Appearance of Stresses in an Ice Core
TR-92-05	Directional Drilling
TR-92-07	Evaluation of HF Radio Communications in the Arctic
TR-93-02	Analysis of Meltwater Freezing in the Ice Borehole
TR-93-05	Measurements of Viscosity and Density of Ethylene Glycol and Propylene Glycol Solutions
TR-93-06	A Management Control System for Remote-Region Projects
TR-93-07	Study of Turbocharged Diesel Engine Performance for Intermediate Altitudes and Cold-Climate Operations

TR-93-09 Determination of Temperature Distribution During Ice Coring with a Composite Cylinder by Analytical Method and Finite-Element Analysis of Freezing Problems

TECHNICAL MANUALS

TM-95-01	Notes on the Adda Generator Module & Electricity Around Summit Camp

TECHNICAL SERVICES UPDATES

TSU-91-01	July 1991
TSU-91-02	August 1991
TSU-92-01	January 1992

PICO BULLETIN

The Polar Ice Coring Office produced an occasional PICO Bulletin which included news of PICO activities, short technical notes, and announcements of interest. They are listed as follows:

Vol. 1, No. 1, April 1989
Vol. 2, No. 1, January 1990
Vol. 3, No. 1, June 1991
Vol. 4, No. 1, June 1994

APPENDIX F

FACILITIES

FACILITIES

PICO occupied a number of work and shop spaces at the UAF:

Main Office: The PICO main office was located at 205 O'Neill Building. This office housed the Operations, Technical Services, and Business Office. It was in close proximity to the School of Fisheries and Ocean Sciences and the Geophysical Institute, which provided publications and machine shop services respectively.

Warehouse: The PICO warehouse was located on lower campus in close proximity to the UAF Physical Plant. This structure also served as a staging area for the assembly of large items and the packing of equipment. The warehouse was shared with the Mineral Industries Research Laboratory.

Research Workshop: A research workshop, shared with the School of Fisheries and Ocean Sciences, was located directly below the PICO main office. It was used primarily by the Technical Services Department for fabrication and assembly, as well as testing and project staging.

Drill Test Site: A 50-foot-deep test well was constructed on the U.S. Army CRREL facility on Farmers Loop Road, about a 20-minute drive from the UAF. An improved access road, power supply, and storage area were also in place.

Warm Storage: PICO rented warm storage space from the UAF facility on University Way. Electronic equipment was principally stored and maintained there.

APPENDIX G

LONG-RANGE PLAN

LONG-RANGE PLAN

Long-range planning exercises, essential to orderly development, were a luxury at PICO during the past 6.5 years. Realistic planning had to take into account the National Science Foundation's plans and consideration of the possible loss of the contract at the UAF.

Collaboration with UAF faculty, invited guests, and the business community on various projects related to drill development and logistics led to the identification of improvements to current technologies for drilling and coring ice, power systems, and logistics.

Informal discussions led to the initiation of several projects which not only offered improvement to our contract performance, but also offered opportunities for potential new enterprises:

- Modeling associated with conceptual hot-water mechanical drill.
- Effective use of composite materials in drill construction.
- More effective structures for field support of drilling operations.
- Improvements in cutter design.
- Pursuit of improvements in logistics services. Current projects under way include the development of a Value-Added Logistic Information System (VALIS).
- Borehole closure and freeze-in modeling.
- Diamond rock-coring tests at low power.
- Lightweight, portable permafrost drilling systems.
- Alternate drill motors and motor brush research.
- Solar electric and hot-water systems for remote sites.
- Monitoring of ice core temperatures during transport.
- Recovery of unconsolidated till and moraine from beneath glaciers.
- Drilling of large hot-water-system access holes through deep ice caps, and mud-motor-driven bedrock sample recovery.

- Modeling associated with thermal drill systems.

- Directional drilling techniques and multiple ice core recovery techniques.

PICO had become an attractor for new ideas throughout the university and within the Alaska community. There appeared to be a need for an organization which could serve as a bridge between the university, private sector, and agencies, through partnerships and alliances, to transfer and commercialize the technological results of UAF research into products and services. This concept was developed early in the life of the PICO project and was known as "PICO Inc." to delineate the parts of the research and development effort which might have some potential for commercial development. A more formal name was later adopted: The Arctic Center for Applied Research (ACAR). ACAR was thought of as a service center which could act as an incubator to assist any unit of the UAF or university system to transfer appropriate technologies to the private sector for commercial utilization. The campaign approach would be used to bring about transfers of technologies. The following are some examples of ACAR projects:

- A new suite of ice-drilling and coring instruments, including continuous thin sectioning and analytical instrumentation, was developed. All of the instruments have been described in reports and papers, with working prototypes available.

- A Value-Added Logistics System was developed to provide a highly versatile logistics management system. Phase I was used to manage the PICO logistics program and is ready for adaptation to the commercial sector. Phases II and III are still in the development stage and will greatly improve VALIS by the use of expert knowledge-based artificial intelligence systems.

- The Advanced Life Systems for Extreme Environments (ALSEE) project is related to the use of new technologies to improve extreme environment waste treatment systems. This project (campaign) is a collaboration between NASA, the UAF, UAA, and the North Slope Borough.

- The Thermophotovoltaic Co-Generator is a collaborative project (campaign) between the UAF, JX Crystals, Inc., and Pyron, Inc. This small, highly efficient thermophotovoltaic generator was developed to provide both heating and electricity. This campaign seeks to test various sizes of the prototype for manufacture and sale in cold regions. The manufacture and sale would be through a commercial company, with royalties returned to the university.

Approval for establishment of ACAR was given by the Chancellor on January 31, 1995.