PICO ADVISORY COMMITTEE MEETING

Polar Ice Coring Office
University of Alaska Fairbanks
Fairbanks, Alaska 99775-1710

PICO OR-90-3

February 1991

PICO is operated by the University of Alaska Fairbanks under contract to the National Science Foundation, Division of Polar Programs

UNIVERSITY OF ALASKA FAIRBANKS

Polar Ice Coring Office
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MEMORANDUM

TO: Members, PICO Advisory Board

FROM: John J. Kelley, Director, PICO John Kelley

DATE: 26 November 1990

SUBJECT: Annual Meeting

Attached is a copy of a briefing document to serve as a reference for your deliberations at the annual meeting. I would like to take this opportunity to thank the PICO Advisory Board for the numerous meetings which you have attended and services performed in the interest of this project at the UAF.

cc. L. Proenza

Executive Summary

The Setting The PICO program at the University of Alaska has been in operation for nearly 26 months. It was relocated from the University of Nebraska at a time when NSF was already committed to a major field project in Greenland (GISP-2), extensive glaciological field projects elsewhere and the development of a major new ice-coring concept for use in the U. S. program. Also, only three personnel transferred from the University of Nebraska to the UAF and the former director decided not to come.

A director was appointed (J. Kelley) in March 1989, and the task began in earnest to get all PICO personnel under one roof and to consolidate office and shop spaces in accordance with agreements made with NSF (Appendix 2, TASK 5). We are still trying to complete the final phase of space allocation by constructing our workshop in cooperation with the IMS/SFOS in the O'Neill Building. We anticipate completion of the construction by 1 January with relocation of our shop equipment into that space shortly thereafter.

Despite very good cooperation and action from the Vice Chancellor for Research, response from other service sectors of the university was slow, expensive, and at times disruptive.

While in the process of transferring the contract, including the shipment of equipment and records, we had to plan for a full field season in Greenland. The prototype drill was tested at CRREL, Hanover, New Hampshire, and sent to the GISP-2 camp, where it was operated without a shelter and using diesel fuel laced with PBBE (polybromylbiphenylethers) as the drilling fluid. At the same time, a large, previously agreed upon (1987-88) living unit was in the procurement stage. The idea for the operation of this camp was that a large scientific contingent could conduct in-the-field studies of ice cores. We would learn shortly that the operation of such a large camp was going to be very costly (Appendix 1).

The Drill Results of the field tests of the prototype drill added additional concern about its effectiveness. We had acquired a good staff and were very pleased with our association with the Geophysical Institute, especially L. Kozyki, and with the School of Engineering, especially M. Tumeo, K. Curtis, J. Zarling and D. Das.

When all personnel returned from the field, we embarked on an ambitious program to meet all promised schedules, which entailed the development of an almost entirely new drill (L. Kozyki and B. Koci) and a system to support it (M. Wumkes). We were pleased to have the assistance of Henri Rufli, University of Bern, in this endeavor.

During spring and summer 1989, I became very concerned about the use of traditional drilling compounds, which are not only environmentally unsafe-- but hazardous to human health as well. Our research experiences, which included an extensive literature search and laboratory studies on how various fluids acted in the expected temperature ranges, resulted in the publication of several reports (a paper is in press in *J. Glaciological Research*) and acceptance of butyl acetate by the NSF and GISP scientists as the fluid of choice. We published several additional reports on the drill and construction techniques as part of our report series (Appendix 7).

1990 Season The drill and drill handling system were shipped to Greenland in June. However, full operation of the drilling system was delayed until late July.

Many investigators who came to the ice expecting to work on cores were disappointed. Next season we will not encourage any participant to come to the ice until a significant amount of ice core is stockpiled in the relaxation trench. Our target for coring depth was 1000 m. Because of the delays in setting up the site, we achieved 350 m for the shortened season with one shift operating. Next season we are budgeted to have a lengthened season and personnel for two shifts.

During the 1990 drilling season, the drill operated satisfactorily but showed several areas needing improvement. The most critical need was to improve the cutters and make it easier to remove the chips. The butyl acetate worked entirely satisfactorily (Appendix 6.)

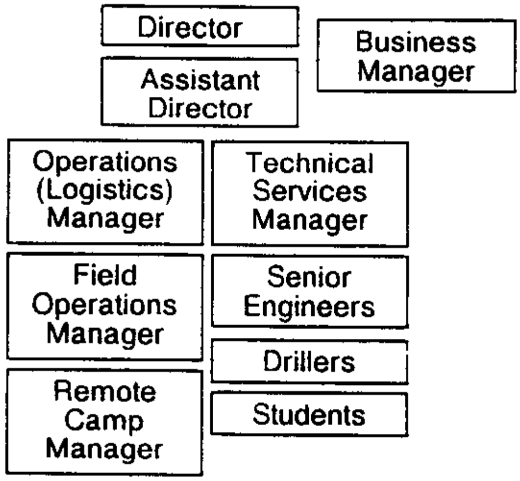
We were concerned about the motor and gear reducer operating in butyl acetate (a solvent). Preliminary tests at the PICO showed that under no load the motor operated for 700 hours with no failure. Under load on the ice, failure occurred at 100 hours. This fall, in cooperation with Dr. Terry McFadden, we have two M.S. students from Lulea University, Sweden, who have taken on the problem of wear associated with operating these motors in butyl acetate. They will finish their report in November 1990. We now know how to protect the motor and gear reducer by sealing them in an oil-filled chamber.

A drill status report is given in Appendix 6.

1991 Season Planning for the 1991 season has been an on-going effort. Appendices 3, 4 and 5 summarize the discussions and schedules. Although we have support commitments elsewhere, GISP-2 clearly occupies the majority of our time. In addition to periodic meetings with the Science Management Office (SMO), we agreed to get together with SMO representatives in Fairbanks on an approximately 6-week basis. Our next meeting is 10-13 December 1990.

Personnel PICO started its contractual life at the UAF with three transfer employees from the University of Nebraska. It was necessary to engage all of the small staff into a unified cooperative body as quickly as possible.

There were, and still are, two main tasks: an effective Operations Group and a Technical Services Group. The management structure remains traditional:



Note that the Business Manager (Fiscal Officer) position reports directly to the Assistant Director and Director. We must do everything that we can to keep all PICO activities organized financially and able to respond to requests on short notice. This will be discussed further in a later section.

The Operations Manager position is traditionally related to Greenland operations. The Greenland operation experienced great growth in the past two years. Also, we wish to develop the operations department to address new opportunities (expressed early in the PICO program by L. Proenza) with respect to the application of new technologies and to explore how the Operations department can assist the Technical Services Group of the GISP.

With the resignation of Kent Swanson we decided not to fill the Operations Manager position until we are able to redefine the duties. The Assistant Director is taking on this function as an additional duty until we fill the position, perhaps as early as next summer.

In order to properly address the five contractual tasks (Appendix 2), especially TASK 3, I revised the organization diagram in April 1989 to show a Technical Services Manager position. This is a senior engineering position which will be responsive not only to NSF's tasks to provide drillers but to continue to develop our R&D program that has already made significant contributions (the modified drill, the handling system, n-butyl acetate, alcohol as a drilling fluid, etc.). I consider this position absolutely essential and, in association with Jay Sonderup, have been managing the department as part of my duties.

The Board members and PICO staff reviewed applicants for this position last year. None were acceptable. We re-advertised and now have five finalists. Our first candidate will visit during mid-December 1990.

We plan to hire an additional Field Engineer (Appendix 1) and additional technical and operations staff to ensure that we can meet our objectives in Greenland, as well as in other geographic areas of interest to NSF. Appendices 3 and 5 discuss manning requirements further.

Interpersonal Communication Since April 1989 we have held weekly staff meetings with an agenda and minutes, in order to maintain information exchange among all employees. We have also held weekly and, more recently, daily engineering meetings to constantly update our status and develop as effective as possible a plan-of-the-day.

Interpersonal communications between GISP-2 and PICO-Sondrestrom, which had eroded early in the summer, improved greatly with the installation of INMARSAT Telex and with the presence of Kent Swanson back in Fairbanks to help with the operations management.

Short Course We also decided to hold a series of short courses on management for all PICO personnel and other interested members of the UAF community. We held our first course on interpersonal communications in October.

Business Management In addition to an Administrative Assistant and Administrative Secretary, we had to hire a full-time purchasing technician to do whatever we could to make procurement as effective as possible. This is the most critical area of concern to us and we spend a considerable amount of time working out problems in this area.

We make the following observations about UAF service departments with respect to PICO operations:

Grants and Contracts: We have had several problems here. It would be useful if G&C would act more as a service organization and help move problems through the system.

Employee Relations: Generally helpful now. We have no major problems, but they are slow in evaluating positions.

Accounts Payable: Reacts without getting information. The system is not set up to pay bills in a timely manner and personnel at times show a poor attitude.

Physical Plant: Slow and expensive.

Purchasing: The purchasing agent is probably doing the best that he can but may be not overly suited for the type of technical procurement that we do. We very much require someone who will be more helpful in expediting orders.

Students I am committed to bringing students into the PICO program whenever possible at both the undergraduate and graduate levels. They are our future.

At present we have an undergraduate student (Karl Bergman) on a Native science enhancement internship. Karl is a first year Mechanical Engineering student. He has four years' Army experience, a technical drafting certificate, and is fluent in Danish.

We also have a Greenlandic student (first year Geology). Laila is working in the office and on a literature search.

We have an M.S. student in Mechanical Engineering who is working with Dr. Das on a new PICO drilling concept (modeling).

We expect to add two additional students.

Student Fellowship I feel very strongly that the PICO should allocate some of its overhead money to fund graduate student fellowships. The suggestion for student fellowships was made in the Research Section of the 1984 UAF accreditation document.

We cannot afford to rest on old technologies, which never were perfected even in their time. If we do not put a portion of our funds (overhead) into R&D, we will stagnate quickly. These fellowships may be thought of as venture capital to try out new ideas prior to submission of proposals to a funding agency.

Relationship to Other UAF Units I have tried to develop strong relationships between PICO and the Geophysical Institute, School of Engineering, and Institute of Marine Science. We have developed a formal relationship with the Geophysical Institute (Memorandum of Understanding) and are developing one with the School of Engineering. Over the past two years we have steadily grown in this relationship, as evidenced by the cooperative drill development program with the Geophysical Institute, cooperation with the IMS/SFOS on various projects and student participation with the School of Engineering. Publications are already forthcoming from these associations. A partial list is given in Appendix 7.

PICO has been asked by Claude Lorius (University of Grenoble) to sponsor the next drilling technology symposium, and I have agreed to do this if it could be convened in 1992 or 1993.

Dr. Viktor Zagorodnov will spend a year with us (September 1990) with his family.

Mr. Henri Rufli (University of Bern) will visit us this January to assist with the testing of the modified drill.

We will send Steve Peterzen to Copenhagen and Mark Wumkes and Larry Kozyki to Bern.

Concluding Remarks PICO has been active on many fronts since it came to the UAF. Its continued strength rests on its strong associations with appropriate academic departments and a responsive administration. PICO's fate will certainly be sealed if it is looked upon simply as a "money cow."

In my opinion, the major assets of PICO are its staff and associates from other units. All else is secondary.

PICO DRILLING PROJECTS
EXCLUDING GISP2

Year 1 88-89
1. Stanford University, 500 shot holes on Ross Ice Shelf.

2. University of Wisconsin, 200 shot holes on the Siple Coast.

3. University of Alaska Fairbanks, hot water holes on the Siple Coast.

4. University of New Hampshire, 2 ice cores in the Ansgaard Range.

Year 2 89-90
1. State University of New York at Buffalo, 200 meter ice core at Byrd Station

2. Ohio State University, 4 ice cores on the Antarctica Peninsula.

Year 3 90-91
1. Stanford University, 750 shot holes on the Ross Ice Shelf.

2. CRREL, ice core and hot water drilling on the Ross Ice Shelf.

Year 4 91-92
1. Ohio State University, ice core drilling in China.

2. Ohio State University, ice core drilling in USSR.

3. University of Washington, 500-800 meter ice core on McMurdo Dome. **POSTPONED**

4. USGS, ice core drilling in Alaska. **TENTATIVE**

Appendix 1

Summary of PICO Business Office Operations for FY89 and FY90

University of Alaska Fairbanks

PICO BUSINESS OFFICE

FISCAL YEAR 1989:

BUDGET:		
	Salaries & Benefits	$ 585,750
	Travel	91,853
	Services	1,275,643
	Supplies	164,295
	Equipment	211,708
	Overhead	510,173
	TOTAL	$2,839,422

General Administration/ Research Design & Support	$1,482,256
GISP II	1,104,881
Contract Transition	252,285

(OVER)/UNDER BUDGET: $436,592

PERSONNEL:		
	Director	John J. Kelley
	Asst. Director	Jay Sonderup
	Sr. Logistics Mgr.	Kent Swanson
	Field Ops. Mgr.	Cathleen Cavin
	Sr. Engineer	Bruce Koci
	Fiscal Officer	Bonnie Hughes
	Admin. Asst.	Dorothy Dahl
	Temp/Seasonal	12 employees

PICO BUSINESS OFFICE

FISCAL YEAR 1990:

BUDGET:

Salaries & Benefits	$ 751,776
Travel	163,436
Services	1,162,427
Supplies	343,805
Equipment	523,271
Overhead	578,507
TOTAL	$3,523,222

General Adminstration/ Research Design & Support	$1,074,447
GISP II	2,448,775

(OVER)/UNDER BUDGET: ($418,611)

PERSONNEL:

Director	John J. Kelley
Asst. Director	Jay Sonderup
Sr. Logistics Mgr.	Kent Swanson
Field Ops. Mgr.	Steven Peterzen
Remote Camp Mgr.	Jay Klinck
Sr. Engineer	Bruce Koci
Field Engineer	Mark Wumkes
Engr. Technician	Terry Gacke
Fiscal Officer	Bonnie Hughes
Admin. Asst.	Michelle Johnson
Secretary	Dorothy Keith
Temp/Seasonal	29 employees

PICO BUSINESS OFFICE

OVERHEAD SUPPORT RETURNED TO PICO:
(Combined FY89 & FY90)

SALARIES:	$ 75,600
Faculty Match ($15,600)	
Full-time Accounts Clerk ($41,600)	
Student Support ($9,000)	
Staff/Fringe Benefits ($9,400)	
TRAVEL:	20,000
Staff Relocations/3 ($11,800)	
Visiting Professionals ($1,300)	
Staff Field Site Visits ($4,800)	
Staff Professional Meetings ($2,100)	
SERVICES:	48,000
Renovation/Office & Warehouse ($30,000)	
GI Student Shop ($2,000)	
INE Technical Services Shop ($2,500)	
IMS Publications Services ($3,500)	
Vehicle Rental ($2,000)	
Miscellaneous ($8,000)	
SUPPLIES:	43,000
Renovation/Office & Warehouse ($9,000)	
Supplies/Expendable Equipment ($28,000)	
Computer Software ($6,000)	
EQUIPMENT:	60,000
Computer Hardware ($28,400)	
Office Furnishings/Equipment ($31,600)	
TOTAL UAF MATCH	**$246,600**

SPACE ALLOCATION

C.T. Elvey Building:

Use	*Area*	*Rooms*
Shared raw material storage	2,400 sq. ft.	102H
Field equipment storage	468 sq. ft.	102F
Shared mahcine shop space	2,084 sq. ft.	102
Shared staging and assembly area	2,069 sq. ft.	107
Office space adjacent machine shop	1,164 sq. ft.	109
		108
		108A & B

O'Neill Building:

Use	*Area*	*Rooms*
Main PICO Offices	2,785 sq. ft.	206
		206A-D
		203
		203A-C
		204
		205A-B
		208
		209B

New butler building:

Use	*Area*	*Rooms*
Assembly, fabrication and storage	5,000 sq. ft.	Unnumbered

Cold Room Facilities:

Three coldrooms capable of -30 degrees Celsius exist in the C.T. Elvey Building and others exist within the engineering building on lower campus.

Machine Shop Facilities:

Attached is a list of the equipment presently installed in our machine shop and we propose to purchase and install at UAF's expense that equipment necessary to carry out the functions.

Summary:

The office space in the O'Neill Building has been identified for PICO's main office and will be assigned as required. The University of Alaska is prepared to provide 17,397 feet of space for PICO initally, other space can be arranged as required.

SPACE ALLOCATION - ACTUAL

C.T. Elvey Building

Shared raw material storage
Shared machine shop space
Shared staging and assembly area

O'Neill Building

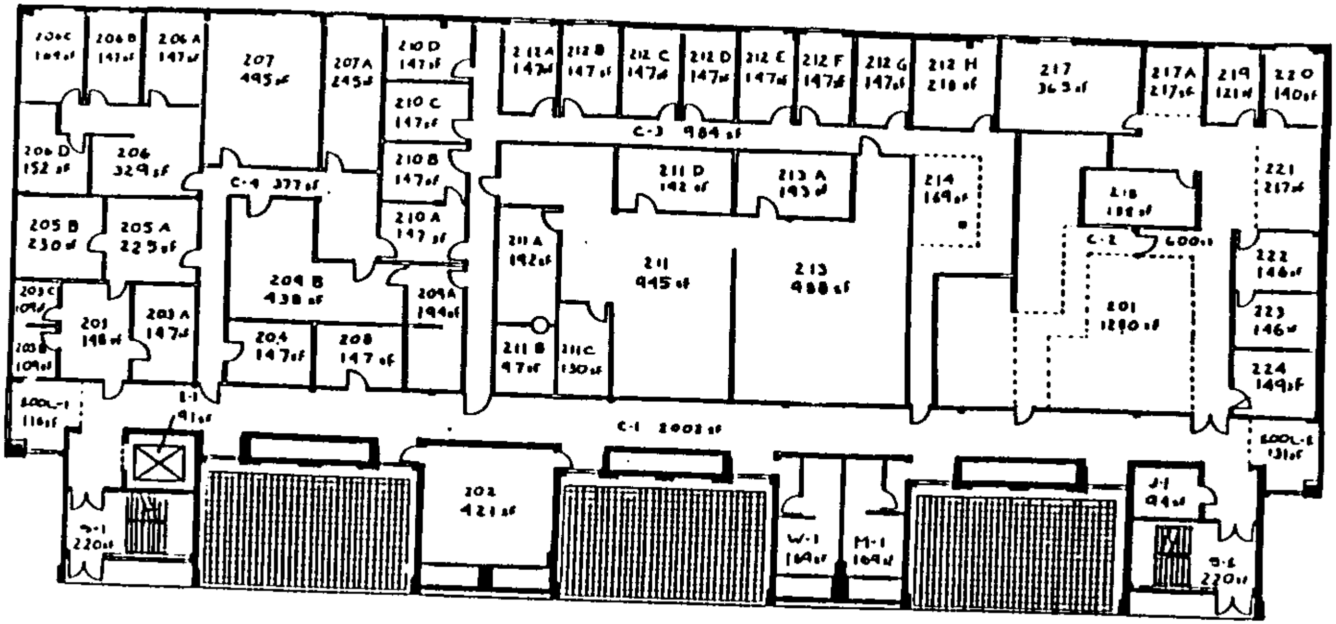
Main PICO Offices:	Rooms #203 #205 #206 #207
Total Area =	2,883 s.f.
Machine Shop Area:	Room #106

Currently under renovation.
Construction costs to be shared by IMS/SFOS

New Butler Building

Use of 1/2 of warehouse space in the new MIRL Building for cold storage.

Use of 600 s.f. warm storage in the old University Park School Facility.



SECOND FLOOR

O'NEILL BUILDING UAF

Appendix 2

The Pico Contract

University of Alaska Fairbanks

THE CONTRACT

(Summary)

PERIOD:

September 1, 1988, through October 31, 1991
with two-year option to renew
Note: NSF Contract Review Team will visit PICO in March 1991

COST:

Estimated Cost = $ 5,482,889

Estimated Cost-Sharing = $ 755,545

INDIRECT COST:

1988-1991 40% (on-campus)
30% (off-campus)

1991- 43% (on-campus)
negotiable
30% (off-campus)

SPACE:

1. Office suite in 205 O'Neill
2. Shop space shared with the Institute of Marine Science, first floor of O'Neill (under construction)
3. Cold storage, MIRL Building
4. Warm storage, Old University Park School
5. Shop and office space at Sondrestrom AFB, Greenland
6. GISP-2 camp, Greenland
7. Storage yard space, McMurdo, Antarctica

KEY PERSONNEL:

Principal Investigator, 8%
Director, 50% (specified in contract)

TASKS:

"Under scientific policy direction of the Foundation, the Contractor will carry out five (5) main tasks."

1. Assist the NSF and the US scientific community in the development of a comprehensive, integrated approach to ice-core drilling and drill development.

   Director's Comment: Transfer of PICO to the UAF was brought about concurrent with the development and implementation of the largest multi-institutional glaciological project ever undertaken by DPP. It should be kept in mind that only three PICO personnel transferred to the UAF. In addition, PICO was also tasked to conduct an Antarctic program as well.

Although not tasked to produce any specific products to the NSF related to TASK 1, PICO actively participated in national and international conferences and consultative meetings with NSF.

2. Maintain liaison with US principal investigators of ice coring projects, developers of ice coring instrumentation and users of ice coring data. As directed by the NSF, coordinate or integrate US program execution with programs of other countries.

   Director's Comment: PICO personnel are tasked by NSF to participate in the Ice Core Working Group and other national/international consultative meetings. PICO briefs the Danish and Greenlandic government once a year regarding its activities in Greenland and has frequent communication with the University of Copenhagen and University of Bern. Reciprocal visits have also been carried out since the establishment of PICO at the UAF.

   Future consultative meetings are scheduled for

   - H. Ruffli (Bern) to PICO, January, 3 weeks
   - V. Zagorodnov (Moscow) to PICO, February (3 weeks)
   - J. Kelley (PICO) to Copenhagen, March, briefing
   - L. Kozyki (G.I.) and M. Wumkes (PICO) to Bern (10 days), visit to shop facilities
   - Y. Motoyama (NIPR, Japan) to PICO and GISP-2 camp (3 months, summer)
   - V. Zagorodnov (Moscow) to PICO, 1 year, September 1991

   Our primary coordination function is through our Sondrestrom office for Greenland and in Fairbanks for projects elsewhere.

3. Design and construct new ice-core drilling equipment and update existing designs as new technologies and materials become available and specific drill requirements are needed. A special requirement is the development of a drill for operation in a fluid-filled hole for ice penetration of more than 3,000 m.

   Director's Comment: PICO's major activity to the exclusion of just about everything else in the technical service area has been the development of the deep drill and its support system. PICO inherited a prototype drill from Lincoln which required considerable modification, which is still under way. The first season (summer 1989) of UAF operation in

Greenland tested only the Lincoln prototype. Design and construction of the drill/drill handling system occurred during the fall, winter and spring 1989-90.

Actual drilling was to commence in late June 1990, but did not get underway until a month later due to delays in putting in the GISP-2 camp and setting up the drill site. The season ended in late August with about 350 m of core extracted. The 1990 season was in effect a field test of the modified drill. The record of the technical evaluation was sent back to Fairbanks periodically so that additional modifications could be started early. The second version of the modified drill will be field tested in Fairbanks in January. PICO will have a 15 m deep test well located at the CRREL site on Farmer's Loop Road. The CRREL test site at Hanover, NH, is no longer operable.

PICO initiated studies on drilling fluids with the acceptance of butyl acetate as an environmentally safe fluid. PICO also holds frequent engineering meetings with UAF participation. This has lead to the implementation of a modeling project (D. Das) for a new hot fluid-mechanical drill.

4. Provide logistic coordination and operational support of NSF field projects in the Arctic and Antarctic and elsewhere in an efficient and cost-effective manner, including establishment of remote field camps and conduct of drilling operations.

   Director's Comment: PICO field projects in Greenland are carried out through the Operations Department and implemented through the Sondrestrom field office. PICO also coordinates with the military services and Danish (GRIP) office.
   Activities in Antarctica are coordinated through NSF contractor (ASA, Inc.) or British Antarctica Survey (BAS).

   The most significant PICO task has been the GISP-2 program. Because of the existence of a large number of investigators conducting on-site core preparation, the camp has grown substantially. Camp needs are dictated by the GISP-2 Science Management Office and, if approved by NSF, are implemented by PICO. During the summer 1990 season, PICO experienced a large budget overrun (about $419,000) to meet the needs of GISP-2. A post-season meeting was held in October to assess the past summer's activities and to delineate as close as possible future requirements and costs. The results of this meeting were transmitted to NSF. There are certain obvious costs which must be met to maintain a safe operation at GISP-2. For example, a new CAT tractor is required for the summer 1990 operation (about $80K). Failure to provide the CAT in lieu of providing constant "first-aid" for the 17-year-old worn out one can seriously jeopardize the program. As a result of the mid-east problem, we are also informed that the cost of all military air transportation will more than double. Commercial rates are rising significantly as well. In summary, GISP-2, which is already a very expensive project, will cost significantly more.

5. Maintain an adequate inventory of field equipment, including ice coring and drilling equipment for the needs of the US scientific community. Provide storage and workshop space for drill fabrication and sufficient office space for the administrative requirements of this contract.

   Director's Comment: A severe handicap on the PICO project was the lack of adequate space during the transition months of this contract. Operations between Lincoln and Fairbanks, especially with the UAF personnel dispersed over the campus, put preparations for the 1989 season in jeopardy.

   By June 1989, a PICO office was partially established in the O'Neill Building and, with considerable energy expended on Facilities and Planning and the Physical Plant, we had about two-thirds of the office space ready within a couple of hours of the site visit.

   Three phases of space provision were identified:

   Phase 1: Warehouse (cold): Able to accept all cargo from Lincoln by summer 1989. This space also had to serve as our shop for the construction of the 1990 drill handling system. (This is not a designated shop space.) We recently rented warm storage space to dry out returned field equipment.

   Phase 2: Office Space

   2.1 September 1988-May 1989 – scattered

   2.2 May 1989-August 1989 – 203 O'Neill (2/3 complete)

   2.3 October 1989 – acquired one of the engineering rooms

   2.4 November 1990 – acquired the final engineering room

   (Note: We lost two rooms to the Climate and ARCUS program as we did not have immediate need for them.)

Phase 3: Workshop

PICO has had no adequate workshop space since its inception at the UAF. All major items for fabrication are assigned to the Geophysical Institute, School of Engineering, or outside contractors. However, considerable development work does go on and has been carried out in the MIRL warehouse, which has only a 110 VAC outlet for all of our power equipment. The whole drill handling system, which is heavy duty construction, was built out of the MIRL warehouse.

An agreement was made with the School of Fisheries and Ocean Sciences/Institute of Marine Science to share the space (and cost) of making a combined shop out of the first floor IMS shop, storage space and space assigned to PICO. This phase is still incomplete due to complications in moving other users (Forest Soils, MIRL) and getting the attention of the Physical Plant. We anticipate completion of this phase by January 1, 1991.

PICO has made an inventory of all accountable items and instituted a bar code similar to that used by the School of Fisheries and Ocean Sciences/Institute of Marine Sciences.

PICO (Technical Services Department) began recently a program of relocating and refurbishing all field gear, including standardization of parts.

We have also begun a systematic program to document all PICO designed drilling equipment on a time-available priority and we will seek student assistance.

Appendix 3

Planning for the 1990-1991 Field Season in Greenland and Input to the SMO-PICO Conference, Lake Tahoe, 3 Oct 1990

University of Alaska Fairbanks

PICO DEBRIEFING (GISP)
October 2, 1990
AHRB Building

1330 Introduction John Kelley

1400 Overview of Operations

* Jay Klinck - Camp
* Steven Peterzen - Sondrestrom
* Mark Wumkes - Drilling
* Terry Gacke - Drilling

1530 **Results**

1. What have we learned from the summer season experience?

2. What changes can we suggest as a result of this experience?

3. What staffing changes/numbers can we suggest to guarantee a successful season next year?

4. How can we improve our operations through more effective interpersonal communications and interactions?

5. What can we do at PICO to further improve our relationship with UAF purchasing personnel?

cc: L. Proenza

Prompts

- International Communication
- Authority
  - Sonde & Camp
  - Personnel while in Sonde
  - UAF liability
- Responsibility / liability
- Organization
  - Phase-up
- PERCEPTIONS

Colin K

POLAR ICE CORING OFFICE
Staff Meeting
October 2, 1990

PRESENT:

John Kelley, Jay Sonderup, Terry Gacke, Kent Swanson, Jay Klinck, Mark Wumkes, Lori Smith, Bonnie Hughes, Michelle Johnson, Dotti Keith, Steven Peterzen.

TASKING ASSIGNMENTS:

John Kelley gave a brief memo to all staff outlining the tasking requirements needed by Thursday for the Reno meeting. Each task will require a brief one page typed presentation and a view graph. View graphs need to be titled with the subject, person presenting, and status.

TASK	STAFF MEMBER(S)
1. CRREL TEST PLAN Testing dates have been requested and purchasing completed. Coordinate with Lori's information on status.	**John, Jay S., Mark**
2. SNOW MACHINES One page recommendations (new vs. repairing old).	**Steven, Jay K.**
3. CAT One page recommendations (new vs. repairing old). Most of this work has been done by Bonnie & Jay S.	**Steve, Jay K.**
4. DEEP WINCH Specifications available; already on order. Sole source has been given to (Lebuss).	**Jay S., Bonnie**
5. HOUSING FOR WINCH Include costs and scheduling proposal.	**Mark, Jay K., Terry**
6. INTERCOMS	**Jay K.**
7. FLIGHT ~~PERIODS~~ COSTS (C-130 - Twin Otter) Coordinate with the needs of operations and drilling.	**Kent S.**, Steven P.
8. MEDICAL HUT Develop a "point-paper" to bring up discussion. List pros, cons, and alternatives.	**Jay K., Jay S.**

PICO
STAFF MTG
OCT 2, 1990

9. MEDIC — Jay K., Jay S.
   Job description and costs.

X 10. ESTIMATED STAFFING - SONDE — **Steven**

11. ESTIMATED STAFFING - GISP — **Jay K.**

12. ESTIMATED STAFFING - DRILLING — **Mark**
    Include shift crews/supervisory and overtime.

13. REPLACEMENT OF ENTRY WEATHERPORT — **Jay K.**

14. STORAGE WEATHERPORT — **Jay K.**
    Address needs of cat regard storage and maintenance.

15. EXPANSION OF REEFER SYSTEM — **Jay K.**
    How big,needs, and costs.

16. SHORING UP SCIENCE TRENCH — **Jay K.**
    Supporting alcoves; Mark has some suggestions.

17. PHASE-UP PLAN — **Steven, Jay K., Mark**
    Brief outline to include; scheduling, personnel, equipment, and supplies.

18. DRILL COMPONENTS — **Mark, Larry K., John**
    Address problems faced this past year and how to correct for future drilling seasons.

19. BUTYL ACETATE '91 — **Mark**
    Target dates for put-in and coordinate with flights.

20. SAFETY PLAN — **Mark, Jay K.**
    Include Butyl Acetate handling, etc.

21. Construction Projects — Jay K.

PHASE UP FOR GISP2 1991

THE SCIENCE PERSONNEL FOR PHASE UP IS T.B.A.

PUT IN FLIGHT (10K)	12 PICO
CAMP MANAGER	1
EQUIPMENT OPERATOR	1
MEDIC/SAFETY OFFICER	1
MECHANIC	1
CARPENTER	3
GFA'S	4
COOK	1

CARGO:
Replacement Skidoos
Radio Gear
Food

SECOND FLIGHT	3 PICO
PLUMBER	1
ELECTRICIAN	1
COOK	1

CARGO:
Replacement cat if skiway conditions acceptable to USAF

TASK	**MAN-HOURS**
1. Open Big House; activate radios and weather equipment	8
2. Document, survey, and photograph the drifting	24
3. Dig out door, preheat the generator, charge the batteries, and activate the generator	16
4. Dig out, preheat, and activate the Tucker and old 931 CAT	16
5. Remove the window covers on the big house	6
6. Excavate and groom accumulated snow around big house, bath house, generator modules, and food trench	48
7. Re-connect sewer and water supply piping on big house	8
8. Activate the melter and water system to the big house	8
9. Dig out the groomer and replace damaged hydraulics	12
10. After the 931 is started, begin grooming skiway	48*
11. Groom and level the weatherport, berthing, and tent areas	8

*The phase up time depends on the amount of drifting and the conditions to work under at time of put in.

Subject: Phase Up GISP2 1991
Presenter: Jay Klinck
Status: Estimate

TASK	MAN-HOURS
12. Erect berthing weatherports: includes heaters and electrical (4 people/per X 8 structures = 32 ea)	256
13. Dig out lab van and core processing trench weatherport	48
14. Excavate rear entrance of core processing trench	8
15. Stabilize core processing trench roof	T.B.A.
16. Dismantle and relocate C.P. entrance weatherport to berthing	75
17. Construct new enclosure for winch and core barrel	T.B.A.
18. Remove cap from dome center	8
19. Dig out side labs in C.P. trench	150
20. Install ventilation and wiring	48
21. Enlarge freezer unit	36
22. Relocate compressor unit off the side of the dome.	56
23. Driller requirements	T.B.A
Sub Total	887

- 25% added to man-hour estimate for unforeseen problems and weather

- Any materials required for repairs should be on one of the first two flights. This is assuming that there would be additional aircraft available for put-in

Subject: Phase Up GISP2 1991
Presenter: Jay Klinck
Status: Estimate
Page: 2

BERTHING

STRUCTURES ON SITE:

BUILDING	TYPE	SIZE	ACCOMMODATES
LIBRARY/SCIENCE	WEATHERPORT	15 x 30	NONE
BERTHING	WEATHERPORT	15 x 40	10
BERTHING	WEATHERPORT	15 x 40	10
BERTHING	WEATHERPORT	15 x 20	4
C.P. ENTRY	WEATHERPORT	15 x 20 30	4
BERTHING	JAMESWAY	16 x 16	3
BERTHING	DRILLERS LOUNGE	20 x 20	3
GENERATOR SHACK	SINGLE WALL WEATHERPORT	15 x 20	NONE

WE SHOULD CONSIDER HAVING ABOUT 60 SQ/FT PER PERSON FOR THOSE WHO ARE STAYING FOR THE SEASON. THIS INCLUDES WALKING AREAS AND REQUIRED SPACE FOR THE HEATER. THE DRILLERS SHOULD HAVE THERE OWN SPACE WITH NO MORE THAN 4 PEOPLE TO A 15 x 20 WEATHERPORT.

THE CAMP STAFF SHOULD HAVE THEIR OWN SLEEPING QUARTERS AND NOT MIXED IN WITH THE TRANSITING SCIENCE FOLKS.

NOTE:

A. THE GARAGE WEATHERPORT, IF PURCHASED, SHOULD BE A HIGH ROOF STRUCTURE ABLE TO ACCEPT THE 931 CAT AND THE TUCKER SNOW-CAT. THIS DOES NOT REQUIRE A FLOOR. THIS STRUCTURE WOULD PROVIDE COVERED WORK AREA TO REFURBISH THE 931 CAT.

B. THE ENTRY WAY 15 x 20 WEATHERPORT IS STILL IN PLACE BETWEEN THE LAB VAN AND THE DRILL DOME. THIS IS CONNECTED TO THE C.P. TRENCH ENTRANCE AND COULD BE USED AS AN ADDITIONAL BERTHING UNIT FOR ONE OF THE DRILLING CREWS WHEN RELOCATED.

COSTS:

WEATHERPORT:	15 x 40 WITH FLOOR & 2 DOORS	=	$16,000
	15 x 30 WITH FLOOR & 2 DOORS	=	$13,000
VESTIBULES:			$ 1,300

SUBJECT: BERTHING
PRESENTER: JAY KLINCK
STATUS: DISCUSSION

GISP2 1991 CONSTRUCTION PROJECTS

WINCH ENCL.	THE WINCH WILL REQUIRE TO HAVE A STRUCTURE BUILT AROUND IT. THIS WOULD BE APPROX. 8 X 8 X 24 FEET. MATERIAL COSTS FOR THIS WOULD BE $3,500 DOLLARS IN LABOR.
CORE RACK	THE 6 METER CORE RACK ENCLOSURE. THIS WILL EXTEND OUTSIDE THE DOME.
C.P. ENTRANCE STRUCTURE	THE ENTRANCE TO THE CORE PROCESSING TRENCH WILL HAVE TO BE REPLACED AND THE WEATHERPORT RELOCATED. THE SIZE OF THE NEW STRUCTURE WOULD BE 16 X 30 FEET. QUOTE OF $12,600 WITH TWO DOORS. IF THE SAME ROOF MATERIAL ON THE BIG HOUSE IS FELT NECESSARY, IT WOULD ADD $1,800 TO THE COST.
STABILIZE C.P. TRENCH ROOF	THE CEILING IN THE CORE PROCESSING TRENCH SHOULD BE STABILIZED PRIOR TO RE-EXCAVATING THE SIDE LABS AND DOORWAYS.
FREEZER	THE FREEZER SHOULD BE EXTENDED BY ONE SECTION. AVAILABLE WITH FLOOR AND ROOF PANELS: 24" = $2,150 36" = $2,975 48" = $3,700 COST INCLUDES DELIVERY TO SCOTIA, N.Y. THESE PRICES ARE PARTS ONLY AND NOT INSTALLATION.
COMPRESSOR RELOCATION	RELOCATE THE COMPRESSOR ASSEMBLY FOR THE FREEZER TO THE SIDE OF THE DOME. PIPING DESIGN WILL BE COMING FROM VENDOR.
METAL STAIRS	INSTALL METAL STAIR THREADS THAT LEAD TO THE TRENCH OF FELT NECESSARY.
CHANGING ROOM	ESTABLISH CHANGING AND SHOWER ROOM FOR THE DRILLERS, POSSIBLY USING ONE OF THE WEATHERPORTS ON SITE.

NOTE: IF THE MEZZANINE IS TO BE CONSTRUCTED IN THE DRILL DOME, THERE ARE AMPLE BUILDING MATERIALS ON SITE AT THIS TIME TO COMPLETE ALL OF THE ABOVE PROJECTS.

SUBJECT: GISP2 1991 CONSTRUCTION
PRESENTER: JAY KLINCK
STATUS: DISCUSSION

CORE PROCESSING TRENCH ENTRANCE STRUCTURE REPLACEMENT

THE STRUCTURE THAT COULD REPLACE THE CORE PROCESSING TRENCH ENTRANCE COULD EITHER BE A WINTER HOMES STRUCTURE OR STICK BUILT STRUCTURE.

<u>WINTER HOMES STRUCTURE</u>:

SIZE: 16'9" x 30' WITH INSULATED FLOOR

DELIVERED TO SCHENECTADY, N.Y.	$12,343
LABOR ESTIMATE	$ 2,500

LABOR FOR ONE OF THE WINTER HOMES PEOPLE TO COME UP WOULD BE $150/DAY FOR TIME SPENT OUTSIDE THE U.S.A.

<u>STICK BUILT STRUCTURE</u>:

CONVENTIONAL STICK BUILT STRUCTURE OF THE SAME SIZE

MATERIALS: SONDE COST	$11,040
LABOR ESTIMATE	$ 5,000

<u>EITHER STRUCTURE WOULD REQUIRE</u>:

* SILL TIMBERS: IN SONDE - REQUIRE MIN. 8 EA. 16'-18'
* ELECTRICAL: TO WHAT EXTENT?
* HEATING METHOD: ELECTRIC?
* EXTERIOR DOORS: METAL AT $300 EACH
* SARNAFIL ROOF: $ 1,800

SUBJECT: CORE PROCESSING TRENCH ENTRANCE
PRESENTER: JAY KLINCK
STATUS: DISCUSSION

GISP2 CARGO DELIVERY COSTS
AIRFRAME VS COST/LBS

Check — Share with BAS available — need T.O. for season — maintenance difficulties — need to fly once a week

LC-130 (109TH TAG)

FLIGHT TIME:	3.4 HOURS
FLIGHT COST:	$ 16,792
PAYLOAD:	21,500 LB

COST PER POUND DELIVERED TO SITE = .78/LB

DC-3 (TRI-TURBO)

COST PER POUND DELIVERED TO SITE = $ 2.91/LB

GLACE TWIN OTTER

FLIGHT TIME:	6.5 HOURS
FLIGHT COST:	$ 10,725
PAYLOAD:	1,200 LBS

COST PER POUND DELIVERABLE TO SITE = $ 8.93/LB

BAS TWIN OTTER

FLIGHT TIME:	6.5 HOURS
FLIGHT COST:	$ 6,000
PAYLOAD:	2,200 LBS

COST PER LB DELIVERABLE TO SITE = $ 2.72/LB

ASSUMPTIONS: AIRFRAME ACL BASED ON AVERAGE PAYLOADS OPERATING FROM PREPARED SKIWAY.

SNOWMOBILE REPLACEMENT

SCANDIC MODEL IS NO LONGER MANUFACTURED

CHEYENNE IS CLOSEST COMPARABLE CURRENT MODEL PRODUCED

THE CHEYENNE:

- 1991 COST: $4,100
- MANUAL START STANDARD
- TRACK/ENGINE LARGER THAN OLD SCANDIC
- OIL INJECTION; NEGATES USE OF MIXED FUEL
- ADVANCED CLUTCH "TRA": ALLOWS MANUAL ADJUSTMENT OF BELT.
- LONG TRACK FOR CARRYING HEAVIER LOADS
- ELECTRIC START OPTIONAL
- GEARS: FORWARD, REVERSE, PARK
- HIGH WINDSHIELD, ARTICULATED SUSPENSION
- ACCOMMODATES 2 - LUGGAGE RACK ON BACK
- 42 ITEM SPARE PARTS PACKAGE RECOMMENDED: COST UNDER $500

NORDIC 50:

- COST: $5989
- USES PER MIX FUEL
- AMPLE STORAGE UNDER SEAT
- OLDER DESIGN & STYLE CLUTCH
- ABILITY TO HAUL MORE
- MANUFACTURED IN FINLAND; FIT AND FINISH IS NOT AS GOOD AS THAT OF THE CHEYENNE
- 2 FORWARD/1 REVERSE: EXTRA PULL POWER
- PARTS AVAIL. NOT AS GOOD AS CHEYENNE

ALPINE II:

- COST: $8,955
- SLOW FOR LONG TRAVERSE
- ONLY ONE PERSON CAPACITY
- 2 FORWARD/1 REVERSE GEAR
- DOUBLE THE COST OF CHEYENNE
- GREAT PULLING POWER W/DUEL TRACKS
- NOT EASY TO MANEUVER
- FUEL MUST BE MIXED

MEDICAL FACILITY

GISP2

October 4, 1990

Is it necessary to have a separate structure dedicated for emergency and routine medical care?

» Patient care - For most situations, proper recovery begins and ends with patient care.

» Privacy - This also goes along with patient care and for a "work" area for the medic.

» Disruption - Without a separate facility it is often necessary to interrupt a structure being used such as berthing or the "Big House". This can also cause a time delay.

» Construction - This could be a simple as a room divider for the library (weatheport divider), or as elaborate as a plywood sheeted 2 x 4 structure built in Sondy or at the site.

Cost can run from :

Weatherport divider - $310.00

Weatherport addition - $4,500.00 per 10' section with floor.

Constructed facility - $2,600 ea.

JUSTIFICATIONS / COMPARISONS
PROCUREMENT OR REPAIR OF 931 CAT

Plagued with problems throughout the 1990 field season, it will be necessary to replace or overhaul the CAT prior to the 1991 startup of GISP2.

The equipment currently being used is 17 years old and is in need of the following replacement parts and repair.

- » New turbo unit
- » New clutches and brakes
- » Overhaul of fuel system
- » Overhaul of electrical system
- » Replacement of hydraulic cylinders for lifting arms
- » Overhaul winch assembly
- » Track and roller guides need to be replaced or rebuilt

The entire piece of equipment needs a complete inspection by a certified CAT mechanic to prepare a thorough checklist of areas that need the most attention and to justify the work needed. The above list are only those items that were obvious to the individuals operating the CAT and the camp manager.

It is unfair and unreasonable to place a cost on the CAT rejuvenation without the needed checklist. However, with the above list, an estimated cost of parts and repair are as follows:

» Mechanic — (certified) $68.00 per hour based on a 7 day week 10 hrs. per day equals $4,760 a week. It is estimated for the parts requested it would take 4 weeks to repair the CAT.

$4,760 x 4 weeks = $19,040.00

» Parts — This also is an estimation from the CAT dealer as it is uncertain what is totally needed. Working with the known parts the cost is as follows:

Parts as listed above = $28,850.00

This total of $47,890.00 the CAT dealer feels is conservative given the age and history of this piece of equipment. According to the dealer and mechanic a estimate of $60 - 70K would probably be closer.

REPAIR CONCERNS

Other concerns with repair of the current 931 are:

» Down time at the beginning of the season could be a month.

» Place to perform the necessary repairs on site (weather).

» The unknown of what else may be needed once the work has begun. This could be parts or tools and related equipment to perform the repairs.

» Available flights for the mechanic and tools in and out of camp.

SPECIFICATIONS OF A NEW 931 LGP

Research of a replacement 931 from a Caterpillar dealer runs as follows:

» Base cost	$ 55 - 60K
» Turbo package (a must at that elevation)	3,000.00
» Winch	7,000.00
» LGP	5,000.00
» Cab and bucket	14,000.00
» Oil cooled clutches (wet clutches)	5,000.00
» Preparation for cold weather use	7,000.00
	total cost - $101,000.00

Advantages:

» *Fuel cost* - 30% savings with the new 931

This would save approximately 1,600 gallons per season, close to one airframe.

» *Reliability* - new vs. old rebuilt

» *Phase-up* - season starts with a known entity without the risk of a major failure of the rolling stock

» *LGP* - 8 PSI compared to 4.5 on the current equipment at GISP.

» *Parts* - ability to correctly identify specific parts/parts #'s for necessary maintenance.

ESTIMATED STAFFING FOR DRILLING

* 10 DRILLERS & 2 GENERAL FIELD ASSISTANTS

* 1 SHIFT = 3 PERSONS ON DRILL
  1 DRILL OPERATOR
  1 BUTYL FARMER

* 10 HOUR SHIFTS WITH 4 HOURS/DAY ALLOTTED TO MAINTENANCE AND REPAIR.

* 2 EXTRA DRILLERS SO THAT "DAYS OFF/SICK DAYS" CAN BE ROTATED.

* AT PUT-IN LEG WE WILL HAVE TECHNICIANS TO HELP WITH THE INSTALLATION PROCEDURES.

PHASE UP PLAN FOR DRILLING OPERATIONS
1991 SEASON

DIG OUT - OPEN UP DOME	1 DAY
CLEAN OUT & REORGANIZE DOME CONTENTS	4 DAYS
BUILD DOGHOUSE FOR 4000 METER WINCH	7 DAYS
BUILD DOGHOUSE FOR TILT TABLE	2 DAYS
INSTALL 4000 METER WINCH	7 DAYS
INSTALL NEW TILT TABLE	4 DAYS
INSTALL CORE TABLE	2 DAYS
SET UP BUTYL FARM	3 DAYS
DRILL ASSEMBLY & TEST	2 DAYS

3 WEEKS FROM ARRIVAL TO COMMENCEMENT OF DRILLING

4000 METER WINCH HOUSING ADDITION TO DRILL DOME

IMMEDIATELY UPON ARRIVAL WINCH WILL BE INSTALLED

SIZE - 8 X 8 X 24' WITH FRAMED FLOOR

LIST OF MATERIALS:	WT IN LBS	1990 DOLLARS APPROX. COST
45 - 2 X 6 STUDS X 8'	750	220
25 - 2 X 8 RAFTERS X 8'	550	170
30 - 2 X 10 JOISTS X 8'	780	300
48 - 4 X 8 X 1/2 PLYWOOD	2400	528
25 - 4 X 8 X 3/4 PLYWOOD	2000	500
1 - 6" DOUBLE DOOR	125	300
1 - 36" DOOR	50	150

LABOR:

2 CARPENTERS	8 HRS X 6 DAYS
1 GFA	8 HRS X 6 DAYS
1 OPERATOR	4 HRS X 1 DAY

BUTYL ACETATE - 1991 SEASON

<u>BUTYL ON HAND AT GISP2 SITE</u>:

11 PALLETS @ 12 DRUMS/PALLET = 132 DRUMS

6600 GALLON @ 2 GAL/FT = 3300' = 1000M

FOR 2000 METER SEASON WE WOULD NEED A MINIMUM OF 175 DRUMS.

THIS BUTYL ACETATE SHOULD COME IN ON 1ST AVAILABLE FLIGHTS AFTER PUT-IN.

MARK – RENO

MODIFICATIONS TO 5.2 INCH WET DRILL

HEAD DESIGN

1. MODIFY CUTTER/HEAD TO CUT RELIEF ANNULUS TO PREVENT IMPARTING CUTTING STRESSES ON CORE. THIS WILL ALSO INCORPORATE PENETRATION SHOES INTO THE CUTTER DESIGN. THIS WILL THEN BE COMPARED TO DATA GENERATED BY ANTI-TORQUE TESTS TO DETERMINE OPTIMUM PENETRATION.

2. SLIGHT MODIFICATION TO CORE DOGS AND SPRINGS. SOME SLIGHT PROBLEMS WITH BREAKAGE SO WE ARE SWITCHING TO DIFFERENT MATERIAL.

3. TIGHTEN UP CLEARANCES BETWEEN INNER/OUTER CORE BARRELS. HMW BUTTONS FOR CLEARANCE AND LOCATION.

4. MODIFY LEAD INLET TO STREAMLINE CHIP PATH. ALSO WILL TAKE A LOOK AT SURFACE FINISH AND TRACKING CHARACTERISTICS.

5. TAKE A LOOK AT FEASIBILITY OF MOUNTING CUTTING RING ON INNER CORE BARREL IN EFFORT TO SIMPLIFY HEAD CONFIGURATION.

6. MAKE AN ACCURATE SHARPENING FIXTURE AND NOTE THE EFFECTS OF SHARPENING ON PENETRATION RATE.

ANTI-TORQUE DESIGN

TEST VARIOUS STYLES OF ANTI-TORQUE SPRINTS. THREE (3) DESIGNS HAVE BEEN IDENTIFIED AND ALL WILL BE BUILT AND TESTED. SEVERAL OPTIONS AVAILABLE TO GIVE MOST FLEXIBILITY IN FIELD.

COUPLING

COUPLING HAS BEEN REDESIGNED TO ALLOW FOR UNOBSTRUCTED CHIP PATH. PROTOTYPE IS DONE AND READY FOR TESTING. MINOR CHIP PROBLEMS IN COUPLING CONNECTION HAVE BEEN ADDRESSED AND CHANGES INCORPORATED.

Carousel needs to be strengthened currently it relys on the tower for support which is bad.

SUBJECT: DRILL STATUS
PRESENTER: MARK WUMKES
STATUS: ON ORDER

CORE BARRELS

1. SLIGHT CHANGES TO BOTTOM OF INNER/OUTER CORE BARREL TO MINIMIZE CLEARANCE BETWEEN FLIGHTING ON INNER CORE BARREL AND OUTER CORE BARREL. ALSO INCORPORATED IN THIS MODIFICATION WILL BE A CENTERING DEVICE TO KEEP OUTER CORE BARREL CENTERED IN BOREHOLE.

2. LOOK AT POSSIBILITY OF USING A SIMPLE CUTTER RING ON INNER CORE BARREL TO SIMPLIFY HEAD DESIGN.

3. LOOK AT EFFECT OF SURFACE FINISH/COATINGS.

4. LARGER INVENTORY - 3m and 6m BARRELS.

VIBRATOR

UTILIZE A VARIABLE FREQUENCY, VARIABLE AMPLITUDE VIBRATOR PLUS MORE AMPLE SPARES. ALSO INCORPORATE SWIVEL AND LOAD CELL, AS WELL AS A CABLE REEL TO SIMPLIFY HANDLING.

UTILITY WINCH

WILL INSTALL DUAL CONTROLS FOR OPERATION AT TOP AND BOTTOM OF CAROUSEL.

TILT TABLE

DESIGN WILL BE CHANGED TO ENABLE EASIER HANDLING OF 6m CORE BARREL. AN INTEGRAL PART OF THIS WILL BE A CORE HANDLING TABLE TO STREAMLINE EXTRACTION OF CORE AND HANDLING CORE BARRELS AFTER THEY ARE LAID FLAT.

TV MONITOR

TV CAMERA ADDED TO CAROUSEL FOR IMPROVED OPERATOR VISIBILITY AND SAFETY.

INSTRUMENT PACKAGE

CHARGE POWER PACKAGE FROM CURRENT 560V AC TO 1120V AC MAXIMUM OUTPUT TO MINIMIZE POWER LOSSES IN LONGER CABLE. VARIAC OUTPUT (0-280V AC) WILL BE STEPPED UP 4X AND STEPPED DOWN 8X AT THE DRILL BEFORE BEING CHARGED TO 0-115V DC.

COMPLETION OF 2 IDENTICAL INSTRUMENT PACKAGE WITH TRIPLE REDUNDANCY IN CRITICAL AREAS (TRANSFORMERS, SWITCHES CPUS---).

ADDITION OF INERTIAL AZIMUTH READING DEVICE TO READ "NORTH" WHEN DRILL IS UPHOLE NEAR MAGNETIC SOURCES. THIS IS FOR ORIENTED CORE RECOVERY.

ALSO TO BE INCLUDED WILL BE AN HOURMETER TO TRACK DRILL COMPONENT LONGEVITY. ALSO COMPUTER PRINTOUT OF DRILL PARAMETERS.

RETRIEVAL TOOLS

DRILL ATTACHMENTS AND INDIVIDUAL RETRIEVAL TOOLS OF VARIOUS TYPES.

CABLE CLEANER

TO REMOVE RIME AND BUTYL ACETATE

CABLE CENTERING COVER

UHMV CAROUSEL GUIDES

TO PREVENT CUTTER TOOTH DAMAGE

CURVED TOWER CROSSMEMBERS WITH CIBA WINDSCREEN

DEPTH SOUNDING DEVICE

SUBJECT: DRILL STATUS
PRESENTER: MARK WUMKES
STATUS: ON ORDER

PERSONNEL 'NVOLVED: MARK +

CRREL DRILL TEST

HANOVER, N.H. JAN 15 - FEB 15, 1990

TEST PLAN:

1) DRILL HEAD

A) TEST PRE-CUTTER ARRANGEMENT
B) TEST EXISTING HEAD WITH VARIOUS CUTTER GEOMETRIES
C) TEST PENETRATION SHOE CHANGES & COMPARE TORQUE LOADS OF HEAD TO TORQUE LOADS WITHSTOOD BY ANTI-TORQUES
D) CHECK CORE DOGS & NEW SPRING MATERIAL
E) SHARPENING FIXTURE & ITS EFFECT ON CUTTER PERFORMANCE
F) STUDY EFFECT OF MORE ACCURATELY LOCATED INNER/OUTER CORE BARREL CLEARANCES
G) CHIP PATH & SURFACE FINISH

STATUS	*TARGET COMPLETION DATE*
DRAWINGS & DESIGN NEARING COMPLETION TARGET DATE FOR COMPLETION ON UAF SHOP	*JANUARY 1991*

2) ANTI-TORQUES

A) TEST FOR FREE MOVEMENT UP & DOWN BOREHOLE
B) TEST TORQUE LOADS THAT EACH STYLE WILL TOLERATE BEFORE SLIPPING.

STATUS	*TARGET COMPLETION DATE*
DRAWINGS UNDERWAY EST. COMPLETION DATE UAF SHOP	*DECEMBER 1990*

3) COUPLING

A) TEST FOR ABILITY TO READILY UNLOAD CHIPS
B) TEST HANDLING FEATURES, RIGIDITY, ALIGNMENT, ETC.

STATUS	TARGET *COMPLETION DATE*
PROTOTYPE DONE - MODIFY EXISTING COUPLINGS AND FABRICATE NEW ONES NEEDED	*DECEMBER 1990*

4) DRILL STABILIZERS

TEST EFFECT OF REMOVING STRESSES THAT GET TRANSFERRED TO THE CORE

STATUS	TARGET *COMPLETION DATE*
SIMPLE MOD - VENDOR LOCATED	*DECEMBER 1990*

5) PUMP SECTION

TEST 2 LOBE TEFLON PUMP TO PREVENT DRAINAGE OF FLUID ON THE OPERATORS

STATUS	TARGET *COMPLETION DATE*
	JANUARY 1990

6) GEAR REDUCER - DRILL MOTOR

LONGEVITY TEST

STATUS	*TARGET COMPLETION DATE*
UNDERWAY - MINIMAL EFFECT ON CRREL TEST	

7) <u>INSTRUMENTATION</u>

A) CHARGE POWER PACKAGE FROM CURRENT 560V AC TO 1120V AC MAXIMUM OUT PUT TO MINIMIZE POWER LOSSES IN LONGER CABLE. VARIAC OUTPUT (0-280V AC) WILL BE STEPPED UP 4x AND STEPPED DOWN 8x AT THE DRILL BEFORE BEING CHARGED TO 0-115V DC.

B) COMPLETION OF 2 IDENTICAL INSTRUMENT PACKAGES WITH TRIPLE REDUNDANCY IN CRITICAL AREAS (TRANSFORMERS, SWITCHES, ETC.)

C) ADDITION OF INTERNAL AZIMUTH READING DEVICE TO READ "NORTH" WHEN DRILL IS UPHOLE NEAR MAGNETIC SOURCES. THIS IS FOR ORIENTED CORE RECOVERY.

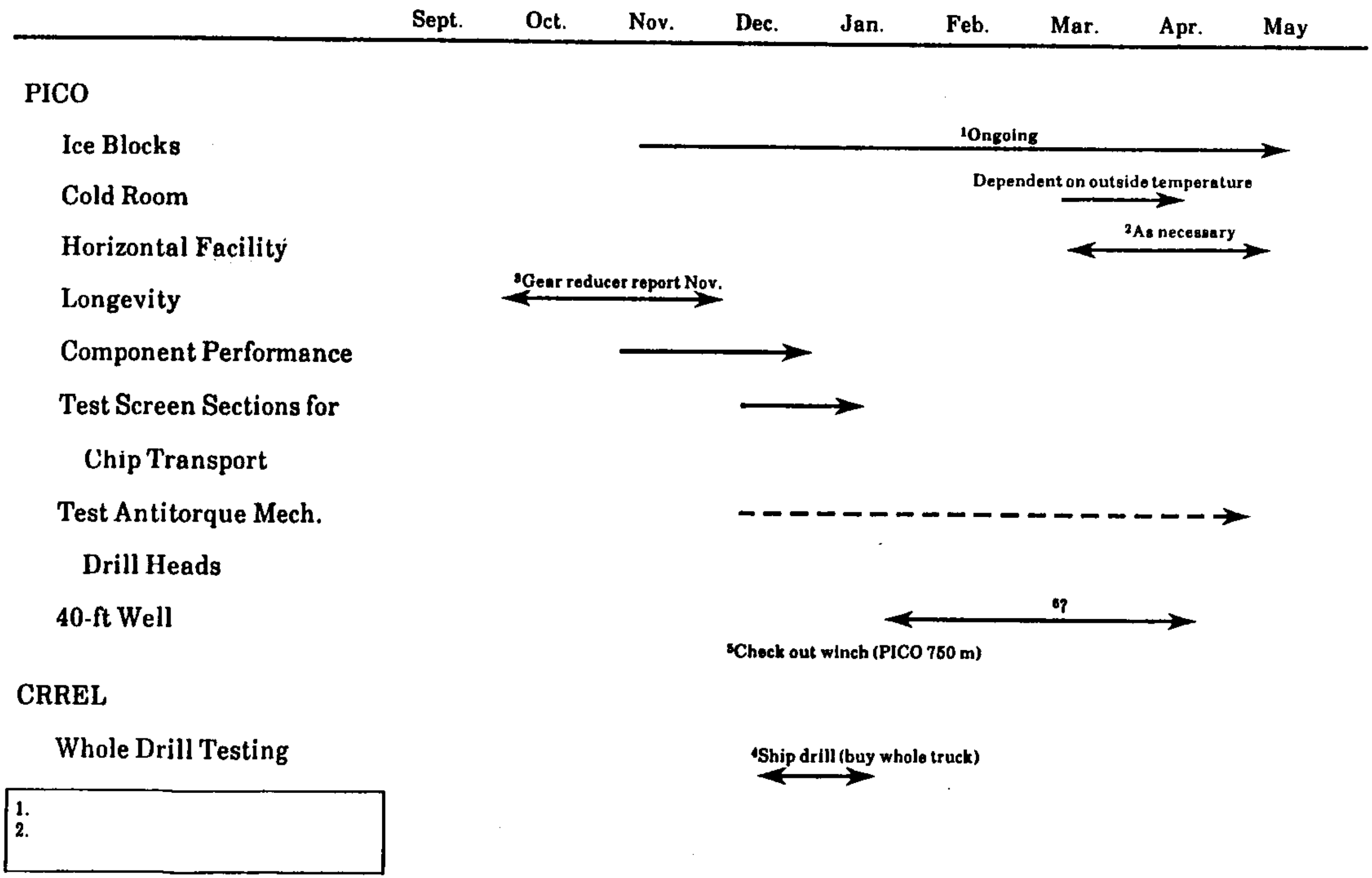
D) PRESSURE TEST OF SYSTEM TO CONFIRM DESIGN.

STATUS	*TARGET COMPLETION DATE*
UNDERWAY - WALT HANCOCK UNL	*MAY 1991*

TEST AT CRREL

TASKS		DEADLINE
1.	OBTAIN ALL ESTIMATED COSTS	OCT 15
2.	OBTAIN ALL CLEARANCES/CONDITIONS SECURE ACCESS TO CRREL MACHINE SHOP	NOV 01
3.	SHIP ALL MATERIALS TO CRREL	DEC 15
4.	ACCESS TO CRREL MACHINE SHOP AS NEEDED	JAN 15 - FEB 15
5.	SET UP CREW GOES TO CRREL * SET UP TOWER, WINCHES AND DRILL * PILOT HOLE. PERSONNEL NEEDED: * CRANE OPERATOR + 3 PICO TECHS	JAN 15 - 25
6.	SET UP WET DRILL/CHECK OUT 3 PICO TECHS, MARK WUMKES, BRUCE KOCI	JAN 28 - 30
7.	PRELIMINARY TESTS	FEB 1 - 7
8.	TEST OF ALL COMPONENTS WITH ALL TECHNICIANS, PERSONNEL AND VISITORS	FEB 7 - 15

TEST FACILITIES AND TESTS



Appendix 4

GISP 2
Recommendations and Course of Action 1990-1991

Prepared by:

Paul Mayewski
Michael Morrison

Lake Tahoe Conference
October 3, 1990

University of Alaska Fairbanks

Greenland Ice Sheet Project Two

GISP2

GISP2 Recommendations and Course of Action
1990 - 1991

Prepared By:
Paul Mayewski and Michael Morrison
GISP2 Science Management Office
Institute for the Study of Earth, Oceans, and Space
University of New Hampshire

Oct. 3, 1990 *70 Copies*

TABLE OF CONTENTS

PREFACE

There were many successes during the 1990 field season and it is not the purpose of this document to understate these achievements. Unfortunately, however, the season turned out to be more of a construction and shake down season than originally projected. The general level of support provided by PICO in the field was excellent. A comfortable camp was established (jointly by PICO and the science team), a core processing line was constructed by SMO and GISP2 scientists, and the basis for a very innovative PICO deep drilling system is in place. However, the final expected product (core) exceeded by only 135 meters the depth attained during the 1989 season. While we are hopeful that the 1991 season will be a productive one, during which we can catch up and meet our goal of a 2000 m depth by season's end, there are many concerns.

This document is intended to serve as a working document geared toward preparations for the 1991 GISP2 field season. It reflects all of the recommendations gathered by the SMO from members of the GISP2 field season. Any additions, changes, etc. are welcome and will be added to this document on a routine basis. As recommendation and/or tasks are completed, the results will be included in this document *in italics*. At any time during the year, copies of the most current version of the document can be requested from the SMO. An updated version will also be distributed at the GISP2 Spring Workshop.

— Paul Mayewski
October 1, 1990

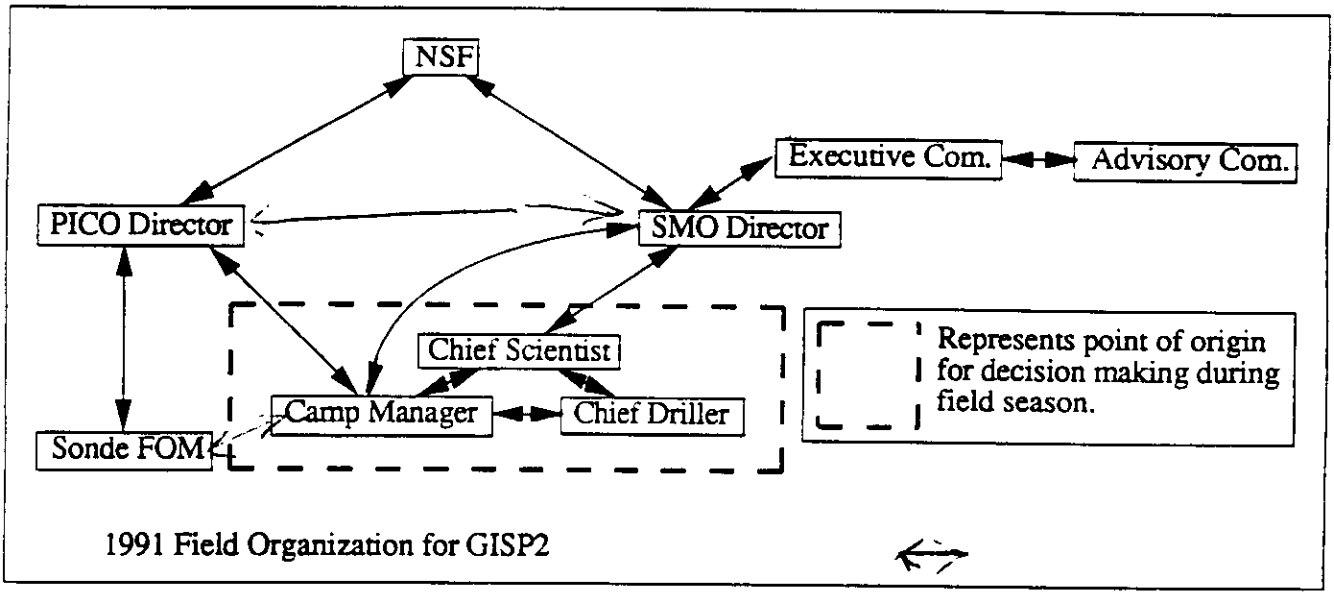
(1500-1900) usually accepted
Little Ice Age. Start ~1200 in Greenland ~200 m depth
It must be longer in higher latitudes

GISP2 - PICO ORGANIZATIONAL PLAN

FIELD SEASON ORGANIZATION

A revised organizational plan for the field season has been developed and is depicted below. Of principle importance is the fact that the field is the primary focus for prioritization and decision-making. Field operations will be directed by a triumvirate of the Chief Scientist, Camp Manager, and Chief Driller. Since this is a scientific project, final authority lies with the Chief Scientist. Decisions of major impact will also be considered and approved by PICO-UAF and the SMO.

Weekly reports ("Sitreps") will be filed on each Monday. The Camp Manager and Chief Driller will send their reports to PICO-UAF and copy the SMO; the Chief Scientist's report will be sent to the SMO with copies to PICO-UAF. PICO-UAF and the SMO will forward copies to NSF.



1991 Field Organization for GISP2

All communications screened by Camp Manager.

NON-FIELD SEASON ORGANIZATION

During the rest of the year, a SMO representative will visit PICO-UAF every 4 - 6 weeks for ~3 days in order to assure that there is a clear dialogue with PICO. These visits will coincide with PICO planning and design meetings. In between these visits, it is the responsibility of the PICO Director to report any major changes, difficulties, or delays related to GISP2 operations and/or drilling directly to the SMO Director and vice-versa.

DRILLING

There were many successes, pertinent to core retrieval, during the 1990 field season. One of the most significant success of the season was butyl acetate. Butyl acetate proved to evaporate extremely rapidly, to pose no significant fire or explosion hazard, to be well received by drillers and core processors alike, and, so far, to have left the core almost totally uncontaminated. Protective clothing and equipment were regularly worn and effective.

While drilling production was well below expectations, the carousel concept proved to be very workable, and an effective drilling and drill development team has been established. There are, however, several significant difficulties remaining. The major difficulties we are aware of are listed below.

A test during the 90/91 development season is essential. This is scheduled for late January at CRREL. A January test will allow time for modifications to be made before deployment for the field season. Such a test in 89/90 might have avoided the serious problems encountered with chip removal and anti-torque slippage. It is recommended that all promising and reasonable alternative solutions be tested, modified as required and brought to the field.

ANTI-TORQUE SYSTEM

Drilling was often slowed or stopped due to spinning of the drill in the hole. Penetration rates were slowed to a crawl to prevent spinning on several occasions. Several alternative anti-torque systems have been discussed and all promising systems should be brought to the field in 1991, as well as tested at CRREL.

Development of adequate anti-torques is essential to attaining expected core production rates. This issue is of paramount importance.

The ability to "steer" the drill has not been developed to date. This capability could be critical at greater depths. Extensible anti-torques have been discussed as a possible solution, utilizing the signal from the inclinometers in the drill's instrument package to orient the drill as necessary. This capability might also provide an ability to increase the anti-torques' pressure on the bore-hole wall to reduce slippage by extending all the anti-torques at the same time. The feasibility and value of this type of system should be evaluated and developed for the CRREL drill test.

CUTTERS

Preliminary experimentation with the geometry of the cutters during 1990 indicates that cutter geometry changes may lead to significant improvement in drill performance. Evidence to support this idea was provided when a 2.26 m intact section of core was retrieved after simple modifications to the cutters were made. This occurred near the end of the season so more testing could not be done. It is not inconceivable that significant improvements in core quality and cutter performance could be realized from improvements in cutter geometry.

Pre-cutters have been discussed as a promising improvement to make, in particular to relieve stresses in the brittle ice zone, and they should be investigated and tested at CRREL.

It has been suggested that the pre-cutters, and indeed the cutters themselves could take on the geometry of a curved band-saw blade possibly resulting in smoother cutting.

Bedrock penetration capability should be worked on after the 1991 drill is finalized.

Borehole Camera and "Fishing" Tools

Drilling was plagued until the very end of the 1990 season by foreign objects in the hole. Numerous unsuccessful attempts were made to remove the objects with the drill, and lacking a borehole camera (capable of working in a fluid filled hole) and fishing tools, the object(s) could neither be identified nor removed. It is possible that one of the first jobs drillers will have after drilling has begun in 1991 will be to identify and remove an object from the hole.

These capabilities must be developed for 1991 if we are to avoid losing considerable time at the onset of the 1991 season.

Pump Section

The rubber boot in the drill's pump section failed on the last day of drilling (it was the *scheduled* last day; the pump failure did *not* precipitate the last day...). Investigation of the lifetime of the pump in butyl acetate, and development of alternative materials or a plan for replacing the pump on a schedule must be carried out more thoroughly.

Alternative materials which do not degrade in butyl acetate are the preferred option since degradation products from the rubber will build up in the drill fluid. No problem has been detected as a result of this to date but the cleaner the fluid is, the less likely the chance of a problem.

Chip Removal and Drill Handling

1. Removal of ice chips proved more difficult than anticipated. Constrictions in the screen section (at the joints) prevented chips from exiting the screen section. Some improvements were made in the field and this was not a major contributor to the slow drilling progress by the end of the drilling season. It was, however, an added headache for the drillers who had to make and break a screw coupling for every run and knock the chips out of the screen section amidst showers of butyl soaked ice chips. New designs should also be tested at CRREL.
2. The drill's couplings proved to be a difficulty at times, and must addressed.

Padding, "Shock Absorbing", and Core Handling

1. The carousel and core arm require increased padding and shock absorbing. Jolts to the carousel occasionally lead to core fragments falling from the barrel. Anything that can be done in the whole core handling process to provide a gentler ride for the core should be done. This will become especially important during the 1991 season when it is anticipated that the majority of the brittle ice will be retrieved.
2. In order to maintain the required -15° C temperatures, core should not hang in the barrel in the drill dome, but either be down hole or in the dome being processed and sent below.
3. During the 1990 season, the core barrel had to be lifted twice on its way to the drill trays. Slides or rollers should be developed to eliminate this necessity and a more efficient handling system developed to integrate with the core processing line.
4. A longer core out-loading area is suggested, especially for 6 m core sections.
5. The ends on drill trays need to be tapered so as not to scrap the core as it slides into and out of trays.

3.114

6. The drill trays must be longer than 2-meters in order to allow space between breaks for butyl acetate to evaporate. These should probably be ~2.5 meters. They will require a plastic liner of some sort to prevent the core from freezing to the trays. Handles on the trays, or some better way to hold them are also required. Development of these trays should be done in close coordination with SMO, or by the SMO, as their design will have to mesh with the CPL trays and the core transfer system.

WINCH SPEED

152 m/min

The ability to raise and lower the winch will become ever more important as drilling progresses. The 4000 meter winch will need to have, and is expected to have, a significantly faster transport rate than the drill in use this year.

BORE HOLE DEPTH MEASUREMENT AND INSTRUMENTATION

1. acoustic
2. Plumb bob

1. We need accurate hole depth measurements. Can the stretch on the drill cable be known well enough to use the drill as depth plumb? Do we need another type of measuring cable? Is there an electronic distance meter that can be used to do the job?
2. What instrumentation is necessary to adjust drill fluid levels in the bore hole? Hole diameter meters? Pressure meters?

PICO

Science Trench

1. The roof of the science trench is settling, mostly on the alcove side. This appears to be a major problem. There are several specific concerns which must be addressed.
   - A. How can the alcove entrances be kept open without continually removing more snow from the roof, an obviously limited solution?
   - B. How can the alcoves be kept open?
   - C. What must be done to insure the integrity of the roof?
   - D. Could the alcove floors be deepened, safely without danger of butyl acetate collection, rather than removing material from the roof of the entries and rooms?
2. The frequency controller for the ventilation fans in the science trench must be installed. We understand that the controller is on site.
3. Do we have sufficient butyl acetate monitoring capability? What more/different do we need to do and who should do it?
4. Wiring plan for the science trench must be reviewed and updated.
5. The science trench entry weatherport will be replaced next season with a stick-built shelter of the same size which will be for the Data Manager's computer, other computers that need to be in close proximity to the science trench, use as a warming area, use in supporting sampling or other experiments in the science trench area (e.g. vapor sampling, rime studies, etc.). The electrical outlets for this new building need to be improved over last years, with clearly marked UPS, clean, and dirty power outlets. Do we need more UPS's? A 16' x 30' structure has been discussed.

Freezer and Pre-CPL Core Storage

1. In order to accommodate the core build up before the full CPL crew arrives, a new core storage trench must be built off of the existing "cooling trench". It should be deep and distant from the slime trench wall so that it will be cold and will not weaken the slime trench wall. It should have capacity for 500 - 700 meters of core (see: *Padding and Core Handling* item #6).
2. The core freezer will need to be made longer to accommodate longer drill trays. The addition of 3 - 4 feet will be sufficient.
3. The core freezer was not installed with air recirculation as planned. According to Northeastern, the parts (dampers, 12" round pipe) are on site. This must be installed. The recirculating portion of the 12" round pipe must also be insulated. This should overcome much of the icing problem on the evaporator.
4. A full width diffuser for supply and exhaust air is required for the freezer.
5. A new core rack will be built for the freezer and the new storage trench by the SMO.

Lab Van

1. An addition for a second milli-Q rinse station needs to be constructed. Perhaps the MIT group can use space in the science trench entry weatherport and the middle room in the lab van can be used for the second rinse station thus avoiding an awkward addition to the lab van.

2. The temperature control in the lab van caused trouble with the IC's. A better heating system is required. Specifically, problems occurred when the heat went on and the temperature of the lab would change several degrees. The temperature throughout the lab van must be constant to less than 2° F throughout the heating cycle.

3. The water pumping, filtering, and distribution system needs to be redesigned.

Vehicles and Facilities

1. The Cat 931 and Tucker both need repair. The requirements for the Cat have been assessed on site this year. All potentially necessary parts must be procured and sent on site at put in with a skilled (certified) Cat mechanic, tools, and a shelter. On site repair facilities and tools will provide a less expensive means of repairing the Cat plus a facility which can be used for all vehicles on site.

2. A Cat dealer on the East coast must be contacted and arrangements for shipment of parts to either Scotia or McGuire from this dealer must be made. There should be discussions with the dealer about the 931 on site so that they are familiar with the vehicle and can respond directly and intelligently. The dealer should have a telex on their premises so direct communications with camp are possible.

3. A weatherport designated as "Science Workspace" is required and should contain desks, UPS outlets for computers, chairs and lights. Size? need good heat system

4. A set of shelves for books (a "library") is required in the Big House. There should be approximately 20' of shelves.

5. A better communications system in camp and Science Trench are required. Either cheap radios that can be given to many people or an intercom system. Perhaps the radio system used by the drillers could be extended? [illegible]

6. The bath house was very poorly built and even had to be shut down near the end of the season. Plans for repairs must be made. replacement

7. Planning for camp construction was extremely poor this year. Significant improvements on this straight forward task are mandatory and expected.

8. PICO must plan for office supplies. Heavy dependence was made on SMO supplies in 1990.

11. Snow machines — 4 Cheyennes + Spares

Ice Transport to CONUS

Maintaining temperatures below -15° C on the LC-130's proved difficult this year. Outside air temperatures at the 20,000+ feet cruising altitudes simply were not low enough. A few options have been discussed.

1. Hold all the ice in freezers in Sonde or in camp until the very end of the season, and take it all back to the states on a C-141 charter. This compares favorably in terms of price, and likely temperature since the 141's fly higher, but 141 availability can be questionable, and we will either need to build excess storage for ice at camp or obtain more freezer space in Sonde. Can we load pallets directly into the large freezers in Sonde?

2. Design a freezer container (number of units? core tubes/unit?) that could hold core tubes without boxes and which could be unplugged and loaded onto the 130's for transport to the states. These have the advantage of being able to be plugged in any time they are on the ground (Goose Bay, Scotia, etc.) but present concerns about handling and protecting the core from damage, and require significant design effort and procurement costs. SMO is willing to undertake this task. On the plus side, more core could be fit into these units than by using core boxes. The savings in flight hours could offset the cost of the units.

3. A dumbwaiter to move core boxes to the surface has been discussed. Is this necessary? What should it look like?

PICO Staff

1. A medic must be on site at GISP2 for the whole season in 1991. This person must have significant emergency response, medical, and remote camp experience.

2. The field camp staff for 1990 was superb and efforts should be made to have these people return for 1991.

3. As requested last year, and now again this year, while there is the opportunity (Twin Otter, 109th, etc.) we should provide a few days leave in Sonde for personnel who spend the whole field season on site.

4. PICO should consider having a purchasing agent/expediter in McGuire to cut costs and increase efficiency.

5. The cook should be given an amount of money to spend at vendors of his/her choice in the states before going to the field.

6. The CPL Data Manager should serve as an administrative assistant to the Camp Manager and the Chief Driller as a secondary responsibility to this person's primary role of assiting the Chief Scientist. The cost for this position should be shared between PICO and SMO.

General

1. There will be SMO visits to PICO every 4-6 weeks for meetings and progress evaluation. While this creates some burden on the SMO staff, it appears to be essential for maintenance of clear lines of communication and proper oversight of GISP2 activities at PICO

2. Purchasing at UAF has often been cited as a significant obstacle in achieving PICO goals. A "PICO Purchasing Tracker" is needed. The costs of this person should not come from NSF funds since this an internal UAF problem. This person should monitor the progress of all purchases, and inform each person originating purchases of the status of all their purchases on a weekly basis as well as on demand as necessary. Any difficulties arising from UAF purchasing policy should be brought to the immediate attention of the PICO Director for resolution.

3. The Sondy/camp briefings must be significantly improved for 1991. They *must* include: fire extinguisher use, use of all items in the survival bags, collection of medical forms, aircraft safety and procedures briefing, camp policies, ...

4. Camp policies which are determined to be necessary must also be followed, and an example *always* set by camp leadership.

5. We should investigate having an air drop of fuel, the winch, and any other items which are possible to air drop. POINT — Paper Butters

6. A map product from the surveyors work of the past two years is required. The surveyor position should be terminated since it has not proved to be useful. — This is being updated by Terry Put on Autocad

7. Medical forms must be prepared and distributed early this year. Distribution before december 1990 is highly recommended.

SCIENCE

CORE PROCESSING LINE

It is realistic to expect that the CPL can process 30 - 40 meters of core per 8 - 10 working hours. The concept of sending samples home for most properties (decided on a PI by PI basis), with each PI remains an efficient and appropriate approach and should be developed further.

The principal modifications that need to be made to accomplish the goal of 30 - 40 meters per day are:

1. Refinements in core and information flow and handling efficiency.
2. Modulariztion of CPL saws and critical parts. Parts that can fail or require maintaining should be easily replaceable, and adequate spare parts should be on site. This is most important for the horizontal and vertical bandsaws (discussed below) but should be a common design principle for all equipment and instruments.
3. Re-assessment of on-site analysis expectations. Laser particulates analyses will not be able to keep up with this rate without significant modifications. The effort that should be expended to provide this valuable information in "real time" should be discussed.
4. Improved in-trench and trench-to-elsewhere communications systems.
5. To address the communication of CPL objectives and protocols to all who work on the line, and to insure the effective transfer of those concepts a *CPL Handbook* will be published and distributed to all CPL personnel. A draft of this handbook will be at the Tahoe meeting for comment.
6. Measurement of the core's surface temperature is an effective way, and perhaps the only accurate way, to know the core's temperature and assure that the temperature remains below -15° C. How should this be incorporated and implemented? What changes or improvements should be made to science trench temperature monitoring? SMC Cut 6-10 digital thermometer
7. The clear table station needs to be redesigned to reduce the chance of dropping the core, to make transfers to trays easier, and to provide more space for core cards, brushes, tray parts, etc.
8. Information learned at the ECM is very important to sampling. The core pieces which are cut at the clear table and wing slabbing station should be held in the plexiglass trays until ECM has been done before other sampling (ISO01, etc) begins. Communication between ECM and the rest of the CPL should be encouraged and supported.
9. The ECM microtome appeared to prepare a better surface than the router in 1990. The router lead to extensive chipping and core damage. Randy Borys made some modifications to the microtome which improved its performance even further. The stratigraphy station personnel much preferred the microtome surface to the routered one as well.
10. It was found during the 1990 season that marker and pencil made clear marks on the core. These were easier to see and make than the drill holes, and likely cause less damage to the core or risk of contamination.
11. There should be plenty of brushes for cleaning core, benches, etc.
12. Pre-print labels for the core tubes, core boxes, and chip bags.

SAW MODIFICATIONS

The horizontal saw is a critical link in the CPL. Parts for this saw, and all other saws, should be rapidly replaceable (bolt in, bolt out), and plenty of spares should be on hand. When the horizontal saw breaks down, a new saw can be put in in a matter of minutes. This should go for the vertical saws also, the instrument packages to go with them, and any other parts which could potentially break down. This should be a general principle for all CPL equipment.

1. **Horizontal Saw.** Difficulties were with snow and ice build up in the cover, snow clogging the transport screw, and cut deflection from horizontal as a result of being supported on only one side. When the horizontal saw goes down, the whole CPL stops - it is truly the heart of the CPL. It is recommended that the horizontal saw be supported from above by a triangular truss, that the transport screw be replaced by a overhead motor driven winch, that the horizontal saw itself be custom made to accommodate ice dust, and that all parts that have the ability to fail be bolt-out/bolt-in. This would include the saw, the winch motor and gear-box, the electronics package, and the motor for the vertical control screws. Two to three replacement modules for each of the above should be on site so that when a problem occurs, the part may be replaced in a matter of minutes in the trench and the failed part may be worked on later in a warm area.

2. **Cross Cutting the Core.** Even though we did not reach the 400 meter depth where brittle ice was to start, the ice was increasingly "brittle" often popping and spalling. Cross cutting the core with hand saws, while not an excessive amount of work, resulted in the loss of core around the cut due to popping. As much as 5 to 10 cm's could be lost at the packaging table cross cut, and rarely less than 1 or 2 cm's was lost. Similar problems existed in the drill dome and at the clear table. We began to make these cuts on band saws (carrying the piece of ice to the nearest available band saw) as the quality of cut on the band saws was nearly perfect. As a result of this experience, developing vertical bandsaws for all three of these positions is recommended.

   The saws in the drill dome and at the clear table should be supported from above by a large "C" frame placed on the opposite side of the core piece from the operator. These should use the same vertical control screws that the horizontal saw uses so that parts are interchangeable. The vertical saw at the Packaging station can be more simply surface mounted since there is no need to work on the core in the area of the saw. A triangular truss supporting the saw from above (as in the horizontal saw) with the same vertical control screws could be used. All vertical saws should be of the bolt-out/bolt-in style, and interchangeable at all vertical saw locations. The same interchangeability concept used at the horizontal saw should apply to the vertical saws. Any parts that can possibly fail should be bolt-out/bolt-in, and there should be plenty of spares on hand.

To summarize the recommended requirements for vertical saws: we will need 2 "C" frames, one for the drill dome and one for the clear table, plus a surface mounted frame for the Packaging table. Three vertical saws will be in operation at any time, and so at least five and preferably six vertical saws should be made. This same number goes for all breakable parts; vertical screw motors, electronics packages, etc.

CORE HANDLING

1. Refinement of core transfer, transport, and packaging to minimize damage.
2. A core tray liner has been discussed. Is there a liner which could go with each core from drill shelter to core tube to help protect it?
3. Core trays bounce on the rail rollers. Is there a better design or way to cushion the core?

LAB VAN

1. The UNH and U Miami IC's can and should be combined to make lab van operations more efficient and minimize material and personnel required on site.
2. The temperature control in the lab van did not meet specifications causing instrument problems during the 1990 season. The total temperature variation in the lab van during the heating cycle must be less than 2° F.

SAMPLE ALLOCATION

Sampling for 1991 must be justified prior to receipt of the sample allocation forms for 1991.

CORE STORAGE FACILITY

The core storage facility (wherever it is) must work in close coordination with the SMO, have evening and weekend capability, and have a clean, adequate processing area.

BUTYL ACETATE

1. Butyl acetate evaporated very quickly from exposed surfaces. In most cases it was completely gone within a matter of 8 hours. However, the fluid would persist in cracks and core breaks for substantial periods of time. It was possible to satisfactorily address the fluid in the core breaks by separating sections of core as much as possible in the freezer (hence the need for longer core trays). However, butyl acetate also penetrated larger cracks in the core. These cracks could not be separated (without breaking the core) and butyl acetate could be detected in these cracks after waits of several days. This issue did not present major concerns during the 1990 season, but did cause analytical difficulties for the ion analyses on a few occasions and caused concern due to the presence of butyl acetate and the potential for contamination.

   Certainly longer waiting periods (which are a part of the 1991 season plan) will improve the situation, but may not resolve it. The issue of butyl acetate in cracks of the core still requires thought.
2. What is the C-14 content of the butyl acetate on site - Alex Wilson? Is it OK?

ATM

1. What changes, if any, need to be made to ATM for 1991? More power? Personnel requirements? Camp setup?
2. A shipping container on skis with top and side access is suggested as a base camp for ATM.

FLIGHT PLAN AND FIELD SCHEDULE

While there is every expectation that the current drill development team will meet core quality and production expectations for 1991, the drill in 1991 will still be experimental.

A flexible and efficient science personnel schedule must be developed for the 1991 field season.

Following is a first cut at the 1991 field schedule. It is based on LC-130 support at the beginning, middle, and end of the field season, and NSF funded Twin Otter support during the season.

The drilling goal for the 1991 field season is to reach 2000 meters depth.

X 1. Mid-April - Put-in Flight
   - A. PICO staff to open camp.
   - B. SMO staff to open CPL.
   - C. Driller(s) to open drill dome.
   - D. New core storage trench is built.
   - E. Install Rodriquez well if still economically feasible.
   - F. CPL entry shelter constructed.
   - G. Cat and Tucker mechanic to arrive with parts, tools, and shelter and to begin work on Cat and Tucker.
   - H. Two new Skandics and two new Alpines will arrive on site, repairs to old snow machines will take place.

2. Late-April
   - A. Main body of drillers arrive to finalize drill dome, drill, and begin drilling.
   - B. Drilling on two 8-hour shifts for 16 hours per day of drilling.
   - C. Skeleton CPL crew arrives: Data manager, Slimers, and Physical Properties.
   - D. Core is logged, minimally processed, and stored in new core storage trench.

3. After 300 m of Core are Drilled (Late May?)
   - A. Full CPL crew arrives. One shift, 8 to 10 hours, plus a small night crew. Science personnel deployment will depend on drilling progress and expected progress at the time of deployment. Deployment of personnel by Twin Otter.
   - B. If there are significant drilling delays, the full CPL crew will only be deployed at such a time as the amount of core in storage merits the deployment.

* 4. Mid Season (mid to late July?)
   - A. Mid-season ice retrograde and materiel resupply.
   - B. Change of some science personnel. Graduate students and technicians requested to stay entire season.

* 5. Early September
   - A. Ice retrograde and camp close out.

*C130 ; possibly 3 as training flight.

Appendix 5

Recommendations for Operations in Greenland based on discussions between PICO and the GISP-2 Science Management Office Lake Tahoe Conference October 3, 1990

Steven Peterzen
Field Operations Manager

University of Alaska Fairbanks

TAHOE BRIEF OUTLINE

1. Shipping and Transportation-
2. 931CLGP-
3. Ice transport-
4. Sondy personnel-
5. Briefing-
6. Medical records-

Also included are the outline of the <u>Greenland Operations Management Schedule</u>

SUGGESTIONS/RECOMMENDATIONS AND COURSE OF ACTION
TAHOE IN BRIEF
FROM SONDRESTROM FIELD OFFICE

1. Shipping and transportation: After the site visit to Dover AFB, it was felt by both the FOM and Admin. Asst., that the cargo movement protocol at Dover was efficient and well organized.

It may still be prudent to utilize a east coast staging location for a few of the items that will be purchased on the east coast.

Most shipments will go either by charter out of Alaska, Mac flights from Dover at 40.7¢ per lb over 3600 lbs. or with the 109th given permission per mission from the commander.

Passenger travel is through commercial charter out of Philadelphia.

Flight schedules were proposed at the Arctic Planning Conference and are enclosed.

2. 931 CAT: Procurement of a 931CLGP is progressing with the purchase through the Defense Developement Department at CAT.

This mode of purchase will realise a substantial savings. Comparatively a dealer invoice = $102,000.00 while the defense quote from CAT is $77,000.00 given the current specifications requested.

This order should be complete and into our purchasing department before the first of Dec.

3. Ice containers: Ice transport to the US from Sondy is being investigated with contact to several airlines for info on cold cargo movements. This is still being investigated but interest is in the solid, reusable frozen food containers are the most logical. At this time a price quote has not been recieved.

4. Sondy staff: PICO personnel in Sondrestrom will remain as it was at the close of this past season as it was found it to be the most efficient staffing formula.

The staff will be three full time employees with a FOM (Field Operations Manager) and two assistants.

5. Briefings: The PICO Sondy staff will be responsible for the intro briefings in Sondrestrom during the arrival of science and camp staff. An update as to what the briefing contained is being reviewed by the SMO while the Sondy staff is continuing developing a written text to be distributed to all arriving personnel. Completion of this text will be in Jan. of 1991.

6. Distribution of Medical Forms: Medical forms have been recieved at the PICO UAF office and are currently being layed out for printing with a 4 page carbon-less paper to expidite the mailing of records to the NSF and back to the PICO UAF office. A travel medical card is also being included in this package for a convenient medical record for each individual traveling to and from Greenland.

GREENLAND OPERATIONS MANAGEMENT SCHEDULE, 1990-1991

5-8 Oct.	Reno, 1990 GISP2 Workshop
23 Oct.	Arctic Planning Conference-109th
25 Oct.	Dover AFB to visit with P.O.C. for cargo movement
1 Nov.	NSF-DPP issues PICO contract and/or Notice to Proceed.
15 Nov.	PICO distributes Facilities and services brochure and project support forms to PI's proposing Greenland Fieldwork in 1990. 1990 Greenland project cost summary completion deadline.
15 Nov.-1 Jan	PICO proposal reviews and preliminary support projections and cost estimates provided to NSF.
20 Nov.	PICO submits to NSF the completed "Project proposal/Data Sheet for the US Scientific Research in Greenland" for 1990 PICO field work.
1 Dec.	Deadline for distribution of 1990 After Operations Report.
7 Dec.	PI deadline for return of Project Support Forms to PICO. Copies sent to NSF Program Managers.
12 Dec.	UNH/SMO visit to UAF/PICO
15 Dec.	1990 Greenland project cost summary completion deadline. NSF provides PICO with list of all NSF-sponsered programs in Greenland complete with their "Project Proposal Data sheets". GISP2 planning deadlines for: Camp Plan Load Plan Staffing Plan Operations Budget Dates of Operation
9 Jan.-15 Jan.	PICO contact with PI's for preliminary operations plan and field schedule.
9 Jan.	Request annual USAF clearance package for all PICO employees.

15 Jan.	All operations procurements turned in to PICO purchasing.
? Feb.	Washington trip for budget and project review.
9 Feb.	NSF notification to PICO of projects funded for 1990 Greenland field work.
15 Feb.	PICO submits first round of NSF/PICO personnel names to the USAF for clearence packets.
1 Mar.	PICO deadline for submission of budget amendment for 1991 Greenland Operations/Logistics.
	PICO distributes Operations Plan For NSF - Sponsered Projects in Greenland.
1 Apr.	Open operations in Sondrestrom with Sondy crew and Dye2 personnel. Greenland field operations begin for 1991.
7 Apr.	GISP2 put-in crew arrive Sondrestrom.
14 Apr.	DYE2 opens.
15 Apr.	GISP2 opens.
	NSF presentaion of projects before the Danish Commission for Scientific Research in Greenland.
	GISP-GRIP Science and Operations Planning Meeting, Dansk Polar Center, CPH.
20 Sep.	Close Sondrestrom field office (season).
1 Oct.	Greenland 1991 Inventory and equipment resupply completed.
1 Dec.	Greenland 1991 Cost Summary completion deadline.
	Deadline for distribution of 1990 After Operations Report.

109th TAG - Greenland

1991 Flight Calender

	DYE2	GISP	GRIP
APRIL Arrive 14th	open 14th ↓	open 15th-18th	
Leave 18th		2-4 flights ↓	
MAY Arrive 6th	training ↓	as needed ↓	open 14th
Leave 10th			2 flights ↓
Arrive 13th		begin drilling ↓	
Leave 17th			
Arrive 20th			
Leave 24th			
JUNE Arrive 3rd	training	4 flights ↓	2-3 flights ↓
Leave 8th	out to Sondy ↓		
JULY Arrive 15th	training	4 flights ↓	2 flights ↓
Leave 20th	back into DYE2 ↓		
AUGUST Arrive 12th	close 17th ↓	3 flights ↓	close ↓
Leave 18th			15th/17th 2 flights ↓
SEPTEMBER Arrive 9th		4 - 5 flights close ↓	
Leave 15th			

Dates and flight activity arrived at during the 109th Arctic Planing Conference and may change as season freight requirements and PAX movements are confirmed.

Total flights:	DYE2: TBA	GISP: 20	GRIP: 9

ATTACHMENT 2

Appendix 6

Deep Drill Status Report

University of Alaska Fairbanks

DEEP DRILL STATUS REPORT

Mark A. Wumkes

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Polar Ice Coring Office

University of Alaska

Fairbanks, Alaska

PREFACE

The purpose of this report is to review the progress of the development of the PICO Deep Drill, as designed for the GISP2 project. It examines the concepts and procedures that were implemented in the 1990 GISP2 field season in central Greenland.

This report presents an evaluation of the drill's performance as well as providing a number of solutions to the problems that were identified. It describes the steps necessary to refine the design so that it will perform as expected in the 1991 drill season, as well as the test schedule that will be necessary to prove the effectiveness of these modifications.

INTRODUCTION

The 1990 GISP2 drilling season began June 11, 1990 and ran until September 7, 1990. During this time the entire drill and drill handling system was constructed. This consisted of, among other things, a 33 meter high twin tower assembly, the carousel drill handling system, the drill fluids handling and recovery systems, the ventilation system as well as the core handling line where the core was extracted and initially logged. Also installed was 77 meters of 25 cm diameter drill casing. All of these components are housed inside a 17 meter diameter geodesic dome.

These construction tasks were completed in two stages. Stage 1 was primarily aimed at achieving the tasks necessary to put the drill into the position of producing dry core. Stage 2 was primarily for the purpose of preparing the drill for wet drilling.

Dry drilling began July 6 and ended July 13, and produced core to a depth of 131.6 meters. Wet drilling began August 2 and ended August 25 and produced core to a depth of 335.2 meters. The period of wet drilling also acted as a testing ground for the actual performance of butyl acetate as a drilling fluid. Butyl acetate was found to be a safe, workable drill fluid. It's levels in the dome and science trench were kept well below the threshold limit values as defined by OSHA. This is quite important in the light that it replaces the types of drilling fluids used in the past which have characteristically contained dilute solutions of PBBE, (polybrominated biphenyl ether) a known carcinogen.

Although the depth reached in the 1990 drill season was not that which was expected, it can still be safely stated that the drill was a success. A number of minor problems plagued the drilling procedure. The problems themselves were not serious, but were not curable in the field. These will be discussed further as well as the solutions that will be implemented.

PROBLEMS ENCOUNTERED DURING 1990 GISP2 SEASON

There were three areas of the drill that caused the problems that were encountered in the 1990 drilling season. These are the anti-torque springs, the couplings and the drill head itself. The solutions to these problems were evident while still in the field but due to their nature, could not be dealt with in the field.

Probably the most important improvement that will be made to the drill string will be a re-designed anti-torque assembly. This keeps the drill from spinning in the borehole while core is being taken. This year it was the major limiting factor in core production. The drilling process was slowed down considerably in an effort to keep the anti-torques from spinning. Once the anti-torques had spun, the drill process was slowed even further due to the great care needed to drill past the section where the anti-torques had spun and enlarged the borehole.

The anti-torque springs added another factor that made drilling rates difficult to control. They did not travel down the borehole in a smooth steady manner, rather, they slid down in jerks. This resulted in a feedback mechanism that caused the drill to dig in when the anti-torques slid down unevenly. The drill would cut until it took enough core to weight the cable and overcome the vertical friction of the anti-torques. The drill string would then slip down the borehole and the cutters would grab, spinning the drill. This uneven downward travel was working in conjunction with another problem that made itself evident during the drilling season. The drill head itself was not tuned to match the penetration rates of drilling that the anti-torques were capable of holding.

The drill head penetration shoes, which control the rate of cutting, were not matched to the anti-torques. The penetration shoes that we had were too aggressive and as a result the anti-torques could not hold the drill from spinning. In a normal drill operation the penetration rate is controlled by the penetration shoes on the head which limits the depth of cut that the drill makes. As a result, we had to control the penetration rate by the winch cable alone.

Only one type of cutter shoe was available this season. It had a penetration angle of 1.2 degrees. This allowed too heavy a cut which the anti-torques could not hold. With only one penetration shoe angle to chose from, the head could only be tuned by using shims to alter the clearances between the cutter and the penetration shoe. This proved to be awkward at best and did not seem to offer a permanent solution. Different combinations were tried which pointed out the best angles to use, but were not effective in solving the problem.

Another factor that contributed to the overly aggressive nature of the cutter geometry was the sharpening process of the cutters themselves. As material is removed from the cutter during sharpening, it increases the clearance between the cutter and the penetration shoe, thus increasing the penetration angle thereby taking a heavier cut. This is an inherent design limitation that cannot be altered without changing the design of the head itself.

The third problem area discovered during the drill season was the restrictive chip path at the bottom of the screen sections. This caused problems with the removal of the chips after every run. The chips were removed with a vibrator and a wash system. The wash system, using a series of nozzles spraying butyl acetate, proved ineffective. The vibrator proved to be effective when used by itself but due to the slightly restrictive chip path, tended to clog up at the bottom of the screen. This was solved in the field by removing the coupling from the screen section after every run and turning on the vibrator. With a free chip path, the vibrator was very effective at removing all the chips from the screen.

MODIFICATIONS TO THE 5.2 INCH WET DRILL

Although the problems that surfaced during the GISP2 field season were frustrating, they were not serious. Simple solutions were developed while still in the field but could not be incorporated until our return.

ANTI-TORQUE SYSTEM

The most important modification to the drill for the 1991 field season will be an improved anti-torque system. Several designs have been developed and approved for testing at the CRREL test facility in January - February 1991. All of the anti-torque designs will be interchangeable with the existing hardware. See figure 2. This will allow several configurations to be available in the field to adapt the drill to varying ice conditions.

The new anti-torque designs will incorporate wheels and skates. This will allow the drill to travel more smoothly down the borehole as well as offering greater resistance to rotation. All designs will be tested at the UAF coldroom facility to determine their relative effectiveness before being tested at CRREL. All design and fabrication will be done at UAF so that PICO engineering can monitor the progress and development.

DRILL HEAD DESIGN

Although the current drill head design produced good quality core, a number of limitations became evident as the season progressed. The current head design needs a greater latitude of tunability. We were limited to penetration shoes with a 1.2 degree lead angle. This proved to be too aggressive for the anti-torques to hold. For the 1991 season we plan on having a number of different angled penetration shoes that will allow the penetration rates to be changed without resorting to shims. This will allow the head to be tuned to the conditions encountered.

Some slight problems with core dog springs were encountered but will be solved with making the springs out of a different material.

Along with the refinements of the existing head, we are also developing another design that will incorporate several features that are not part of the present head. See figure 3. The idea of a pre-cutter arrangement that will cut a relief annulus to prevent imparting stresses on the core has been examined. A prototype incorporating this pre-cutter design will be built for testing at PICO and will be given a trial run at the CRREL test.

A feature incorporated into this new head design will be a combined cutter and penetration shoe assembly. These will have replaceable cutter inserts. This will reduce the cost of the cutters and lend itself to easy replacement in the field. Another benefit will be a cleaner surface on the penetration limiting portion of the cutter assembly. This will eliminate the problems with accretion that occurred on the penetration shoes used in the field in 1990.

Another feature of the combined cutter - penetration shoe arrangement that will be approached is the self tracking ability of the head. Along with the pre-cutter feature, profiles of the cutters will be tried in an effort to determine the effects of cutting a pilot hole that the drill will follow thus allowing a straighter more vertical hole to be drilled.

Other areas that will be examined will be a cleaner chip path after the cutter assembly. Surface finish will also be examined to define it's effect on chip transport. An accurate sharpening fixture will also be examined in an effort to produce more consistent results in the sharpening process.

The feasibility of incorporating a cutter ring that bolts directly to the inner core barrel is also being examined.

COUPLINGS

The restrictive chip path that caused difficulty in the screen cleaning process has been corrected. A prototype was fabricated by the time we returned from the field and was displayed at the GISP2 meeting in Reno. It will be tested in Fairbanks as well as at the drill test at the CRREL facility. The splined coupling shaft running through the screen has been modified as well as the indexing pin configuration. This has provided a clear chip path that will enhance the couplings ability to allow the chips to empty out the bottom of the coupling.

The vibrator used to shake the screens was effective in getting the chips to move in the screen section. It was only tuneable in amplitude. This year's vibrator will be both amplitude and frequency tuneable. This will allow us to find the most effective combination for chip removal.

Core barrels used in the 1990 season represented a success in the use of carbon graphite / epoxy composites. Clearances between the inner and outer core barrels will be reduced slightly in an effort to keep the drill tracking as straight as possible. Centering buttons located on the outer perimeter of the outer core barrels will also be incorporated for the same reason.

INSTRUMENT PACKAGE

The instrument package proved to be effective and serviceable. It performed well the entire season with only minor technical problems that were solved in the field. A number of modifications will be incorporated to provide more data to be used for hole logging and maintenance. The power package will be changed from a 560 volt supply voltage to 1120 volt AC supply. This will minimize power losses in the longer 4000 meter cable. An hourmeter will be added to the control panel so that accurate records of component life can be noted and integrated into a service schedule. This time record as well as drilling parameters will be recorded on computer so a further study of the effect of modifications on drill performance can be done.

RETRIEVAL TOOLS

Due to the very real possibility of dropping a foreign object downhole, a broader selection of retrieval tools will be on hand. A borehole television camera is being investigated so that the object can be identified and the proper method of retrieval can be used. Most fasteners used in the drill are currently made of stainless steel. These will all be replaced with grade 8 steel fasteners which are steel which will allow a magnet to be used for their removal. A number of other retrieval tools from the oil industry are currently being examined.

TELEVISION MONITOR

A television monitor mounted on the carousel will be used to provide the drill operator with a better view of the coupling procedure. This will remove the blind spot and offer a much safer coupling and de-coupling process which has the most potential for bodily injury.

TILT TABLI AND CORE HANDLING TABLE

A new tilt table for lying the core barrel in a horizontal position will be designed and built. This will speed up the core handling process in the dome. It will also streamline the core extraction process as well as offer a more gentle handling of the core. This is particularly important this coming season because of the problems with the brittle ice zone. This tilt table will also consist of a matching core removal table which will reduce the amount of handling of the core.

FIELD PLAN FOR 1991 DRILL SEASON

With the benefit of the experience gained during the 1990 field season, it was felt that a goal of 100 days of drilling would be needed. As a result, the flight periods and put-in flights have been arranged to accommodate this as much as possible. An overall season goal for 1991 was discussed at the GISP2 planning meeting in Reno and a figure of 2000 meters was chosen. This goal seems reasonable in light of the 100 day drilling season. A number of factors will work in our favor, such as the increased winch speed when bringing the drill to the surface. The 1000 meter winch used in 1990 had a speed of 30 meters per minute. The new 4000 meter winch has a retrieval speed of 150 meters per minute.

Drilling personnel will be increased for 1991. Additional drillers will be hired and trained so that two 10 hour shifts can be implemented. This will allow 20 hours of drilling per day and allow a 4 hour maintenance and repair period. This 4 hour period will allow for scheduled repairs and maintenance to take place without interfering with core production.

A revised organizational plan for the field season has been developed. The field is the primary focus for prioritization and decision making. Field operations will be directed by a triumvirate consisting of the Chief Scientist, Camp Manager and Chief Driller. Weekly reports will be filed and distributed to the SMO, and PICO-UAF.

CONCLUSION

The 1990 GISP2 field season offered a true test of the potential of the PICO deep drill. Although the total depth achieved was not as expected, PICO believes that it was a successful season all in all.

A number a major theories have been proven in field conditions. The use of butyl acetate as a drilling fluid has proven to be a success. PICO has led the way in finding safe, workable solutions to the health risks that have plagued drilling programs in the past. PICO has proven that carcinogen containing drill fluids are no longer necessary or acceptable.

No other country or institution has ever fielded a drill system of this magnitude and produced as much core in their first year as PICO did in the 1990 GISP2 season. Total depth achieved was not as great as expected but this must not cloud our view of the overall project. We feel confident that the goals of the GISP2 program will be realised and that a continuous high quality core will be produced.

A very important, but often unacknowledged, issue is that of safety. No core is worth the loss of life or limb. One of the problems with the deployment of the drill this season was the underestimation of construction time. This season represented a large undertaking in constructing a drill of this complexity. PICO is proud of the fact that the entire drill and all support systems were constructed in the field without a single injury.

GISP2 1990 DRILLING REPORT

The 1990 GISP2 drilling season began on 11 June 1990 and ended 7 September 1990. This includes two construction periods as well as two modes of drilling, one period of dry drilling from 6 July to 13 July and a wet drilling period of 2 August to 25 August. Initial field deployment was delayed from the initial put in of 25 May due to a number of factors including last minute problems with vendor deliverables.

The first task of the field drill crew was to construct the drill tower and associated drill handling components. This initial construction period began 14 June and lasted until dry drilling commenced on 6 July. This proved to be more time and labor consuming than planned. Among the tasks completed during this time were construction of the drill base, erection of the twin 100 foot towers, anchors and guys, installation of the 1000 meter winch and controls, construction of the carousel handling system, catwalk working platform, as well as the reaming of the existing hole and installation of 77 meters of 25 cm diameter casing. All materials and parts necessary were on hand and did not interfere significantly with the commencement of dry drilling.

Dry drilling began in earnest on 6 July with the drilling out of the casing seal which consisted of an ice plug at the bottom of the casing. The hole was first reamed to a diameter of 33 cm and a depth of 85.4 meters. 77 meters of 25 cm diameter casing was then assembled and suspended in the reamed hole. Approximately one cubic meter of snow was then shoveled down the inside of the casing followed by 1000 liters of water. This was to form an ice plug at the bottom of the casing to act as a seal to prevent the loss of butyl acetate from the borehole. After shoveling in the snow the depth measured 73.3 meters and after the water was added and had frozen the depth measured 68.1 meters. It was discovered that after the casing was frozen in it was no longer perfectly straight. This caused some minor problems when drilling began. After several runs it was noticed that we were drilling into the casing wall and rapidly ruining cutters. A TV camera was lowered down the borehole and we could see that the drill was indeed hitting the side of the casing. This was caused by the casing buckling during the freezing-in process. 120 liters of water was put down the hole to fill up the void where the core had been removed. A centering device was fabricated and installed on the end of the outer core barrel in order for the drill to track down the center of the casing without hitting the side.

This proved successful and we drilled through the ice plug and into the ice sheet without any further problems. Dry drilling was continued to a depth of 131.6 meters which was reached on 19 July.

A second construction period began after the July flight period. At this time the various systems for handling the wet drilling using butyl acetate were built. Among the construction tasks completed at this time were the auger system for handling the butyl/chip slurry, the ventilation system, the butyl recovery system, the screen washing system and all the pumps, valving and handling system for butyl acetate. This construction period lasted until the commencement of wet drilling on August 2. Other minor construction and modifications continued while wet drilling was being done.

The use of butyl acetate as a drilling fluid was one of the successes that came from the 1990 drill season. There were many questions surrounding the use of butyl acetate. It's flammability and health risks were of concern. In the field these concerns proved easy to deal with. The safety gear proved to be very workable and effective even in the cold conditions. The ventilation system was effective in keeping the butyl levels at an acceptable level. The drilling equipment withstood the effects of being immersed in butyl acetate without any major effects except for that of the DC drill motor. A report describing the effects of butyl acetate on the motor is attatched.

The deep coring wet drill used for the 1990 field season was a departure from systems used in the past in that the drill components were handled with a revolving carousel system. See figure 1. Due to the length of the core barrels (3 and 6 meters long) and the screen sections (6 and 12 meters long) the drill was quite long (15 meters using a 3 meter core barrel and 24 meters using a 6 meter core barrel). As a result, the tower from which the drill was suspended was 100 feet in height. To handle these long sections a revolving carousel was designed to handle the components in a vertical mode. Extra stations were used to enable the carousel to hold the replaceable sections of the drill so that as the drill was taken apart at the surface to release the core barrel and screen sections, fresh core barrels and screens would be ready to reconfigure the drill and start down for the next run. This kept to a minimum the time that the drill was at the surface.

After the drill was reconfigured and sent down for another run the core barrel and screen could be dealt with at the surface without affecting the drilling process. This system proved to be very effective and workable. Only a few minor changes of the carousel are in order for the 1991 drill season. No mechanical problems arose with the carousel during the drill season and it proved to be both durable and easy to handle. One drawback was the time taken for it's construction.

Design changes for a more streamlined light- weight portable carousel system have been noted for future field seasons. A television camera will also be installed to allow the drill operator a better view of the coupling proceedure making this proceedure much safer.

To handle the core barrel after it was removed from the drill a tilting table was used to lower the core barrel from a vertical position to the horizontal. This was a simple table made of aluminum H-beam that was raised and lowered with a winch. It was designed to be able to handle either a 3 meter or a 6 meter core barrel. It proved to be simple and effective although a little slow. Because of floor space restraints it had to be relocated so that it tilted up into the throat of the carousel core barrel station. This caused an awkward situation in placing the core barrel into the tilt table with-out introducing shock to the core. This will be solved by a new tilt table design that will allow a more streamlined proceedure for laying the core barrel down and extracting the inner core barrel as well as the core. The new tilt table will line up with a core handling table that will make core extraction and cutting the core to length a less labor intensive job as well as being gentler on the core, something that is very important in the brittle ice zone.

The chip slurry that was produced by emptying the screen sections was caught in a drip pan that was located under the carousel. A 6" U-trough auger then transported this slurry outside the dome where the butyl acetate was separated from the chips by draining and by centrifuge. This proved to be a workable arrangement. With a few minor refinements this system will work even better for the 1991 season. 22 drums of butyl acetate were recovered this season using this system. At a cost of $1000 per drum this is a significant savings. It was found that it requires a person dedicated to operating the butyl farm for most of a drill shift. This has been taken into consideration for projected staffing for 1991.

For the most part the carousel and related system was a success. With only a few minor changes we will be able to efficiently handle the drill components as designed.

The drill string performed relatively well during the season. Although plagued with a few problems that were for all practical purposes minor, they could not be easily solved in the field. One of the most visible and frustrating problems was the couplings between drill component sections. Due to a restricted chip path, the chip slurry mixture did not readily empty from the screens. We had in the field both a washing system and a vibration system to clean the chips from the screen. Washing was to be done with a spray ring and 12 wash nozzles spraying butyl acetate onto the screen section. This proved to be ineffective. The vibration system worked well for transporting the chips out the bottom of the screen but due to the restricted chip path the chips piled up at this restriction. The only other field option availeable to us was to remove the coupling from the screen section each time the screen needed cleaning. This was both time consuming and frustrating, but did not seriously affect the trip time. This situation was aggravated by the minimal nummber of screens that we had on hand. A visit by Larry Kozycki was very helpful in that we designed a solution to the chip path problem in the coupling. By the time I had returned from the field he had already incorporated these changes into the new coupling and had constructed a proto-type. Although this coupling has yet to be tested, I am very confident that the problem has been solved. As far as the performance of the coupling in making and breaking the connections between drill components, it proved to be both simple and strong. It lent itself to ease of handling which was an important consideration in that it was easy to deal with while wearing all of the protective gear.

Another area of improvement lies with the anti-torques. The main limiting factor for drilling this year was that the anti-torques could not hold the drill from spinning at the penetration rates defined by the penetration shoes on the head. The anti-torques did not slide down the borehole smoothly, rather they moved down in cycles. This is a result of a number of factors. Hysteresis of the cable and the frictional charactoristics of the anti-torque design as well as an over aggressive penetration shoe led to a feedback mechanism that would cause the drill to cut until the weight of the drill would overcome the friction of the anti-torques.

The drill would slip down until sitting on the penetration shoes which would allow too big a cut to be taken and the drill to grab thus spinning the anti-torques. A number of options must be exercised in order to address this problem. The cutter penetration rate must be more closely matched with the cable feed rate while using an anti-torque system that moves freely up and down the borehole while also having greater rotational resistance. A number of designs have been examined and will be fabricated and tested before the up coming field season.

The drill head performed relatively well for the field season both for wet and dry drilling. There are a number of modifications that need to be incorporated in future head designs. One problem was that we had only a limited number of cutters for the field season. This did not become a problem because of the abbreviated drilling season but must be addressed before deployment for the 1991 field season. Because of the problems encountered when drilling through the casing as well as the presence of foreign objects in the borehole, we found ourselves with an inadequate cutter supply.

The design of the cutter and shoe configuration also leads to a problem when the cutters are sharpened. The material removed during the sharpening process changes the clearances between the cutter and the penetration shoe thus changing the penetration angle allowing a more aggressive cut. Shimming the penetration shoes became necessary as the cutters were sharpened and ice conditions changed. Also the open tapped holes in the shoes lead to ice build up which reduced the penetration rate. The self tracking charactoristics of the cutter profile also need to be examined. There is evidence that the self tracking of the drill head might be inadequate and contribute to the fracturing of the core during the drilling process.

The core dogs in the drill head performed well. A minor change in geometry might lead to easier core breaks. It was found that the core broke easier if only 2 core dogs were used. Some core dog spring breakage occured also and would be solved by making them out of spring steel rather than beryllium copper.

Chip paths of the head needed some slight field modification. These chip paths will be streamlined and smoothed in the 1991 version.

The carbon graphite / epoxy inner core barrels worked very well both in dry and wet drilling. THey proved to be very effective in transporting the chips when dry drilling.

The graphite inner barrels performed well all season without any major repairs being needed.

The outer core barrels also performed well. Two outer core barrels were used for the entire duration of the 1990 season without any major repairs or modifications. The shear strips welded to the inside of the outer core barrel became loose and detatched causing minor damage to one of the inner core barrels. This was easily repaired with an epoxy repair kit. The first 15 cm of the strips were removed which prevented any further problems. An effort was made to re-attatch the strips in one of the outer core barrels which caused the end of the core barrel to be slightly out of round.

A more extensive inventory of core barrels would have been beneficial as well. Only 3 meter core barrels were availeable in the field.

A variable amplitude vibrator suspended by the utility winch was coupled to the screen section during the cleaning process. This was effective in getting the chips to move down the screen section but an improvement for 1991 would be a tuneable amplitude and tuneable frequency vibrator. Other improvements would include a swivel attatchment to the utility winch cable as well as a load cell so that it could be determined when the screen was completely clean by noting the weight of the empty screen instead of decoupling the vibrator each time.

The utility winch used for handling the vibrator worked without fail the entire season. It would be helpful to mount another control panel at the bottom of the carousel so that the winch could be operated from either work station. This would steamline the screen cleaning and handling process.

The instrument package designed and built by Walt Hancock of the University of Nebraska- Lincoln worked very well. It provided all the parameters necessary for efficient drill conrol. Early in the wet drilling process one of the transformers failed. It was easily repaired and didn't result in excessive down time. On several occasions the instrument section locked out and refused to communicate with the control panel at the surface. On one occasion the microprocessor in the instrument package failed. The microprocessor was replaced and a minor design change incorporated to prevent further problems. The instrument section worked flawlessly the remainder of the season.

During windy periods it became difficult to make the connection between drill components because the drill was being displaced off center nearly 30 cm. A wind shield of CIBA pipe may be necessary next season to prevent high winds from affecting drill operations. This could be incorporated into a modified tower bracing system.

During the course of the drilling season it appeared that there might be foreign debris downhole. Various methods were used in an effort to remove this debris. A more developed compliment of retrieval tools will be required to deal with this problem. Particularly useful would be a borehole television camera to inspect the borehole for the presence and type of debris so the proper tool could be utilized for it's removal.

Drilling personnel for the 1990 field season were very hard working and capable. Not enough praise can be said on their behalf. They performed their tasks without fail despite the conditions they were forced to deal with. They accomplished a major construction project in the field with limited resources.

The drilling process, because of it's use of butyl acetate as a drilling fluid was particularly awkward because of the need to be fully clothed in butyl rubber suits, boots, respirators, goggles, gloves and hardhats. All while working in cold temperatures. Their attitude was cheerful despite all the pressures and frustrations. Without them the 1990 field season would have been much less productive.

Core quality through out the wet drilling portion was generally very good. A number of operating parameters had to be continually adjusted to match the charactoristics of the cutters and penetration shoes. The drill log describes the modifications and adjustments to these parameters in order to produce the quality that we recovered.

At the onset of wet drilling the fluid levels were kept to a minimum in an effort to keep the slip ring assembly and instrument package from being immersed too deeply in the butyl acetate. This was to test the systems operation before introducing the drill to higher pressures of immersing it deeply in butyl acetate. On one occasion this caused a problem in that a poor quality core was produced due to running out of fluid in the hole. After this incident the fluid level was brought up considerably to prevent this problem from recurring.

Tuning of the drill head had the most profound effect on core quality. Core runs were typically 2.6 - 2.9 meters in length with 70 - 80 cm pieces. After various efforts at tuning the head core segments became longer and a 2.26 meter continuous piece of core was produced. Elsewhere in this report the details of head parameters will be discussed.

DC DRILL MOTOR SERVIC:; EVALUATION

A DC motor was used in the motor section of the 1990 GISP2 wet drill. After an estimated running time of between 80 and 100 hours, sudden and violent current surges indicated problems with the motor and it was replaced with one of the three spares on hand. Upon return from the field it was dismantled and inspected with the following observations.

Corrosion of the external case was evident but attributed to the shipping conditions encountered when retrograded from the field.

BEARINGS- The bearing seals were all intact with no obvious breakdown of seal material. All lubrication had been washed out of the bearings and as a result had failed. The bearings were not frozen but felt rough when turned by hand.

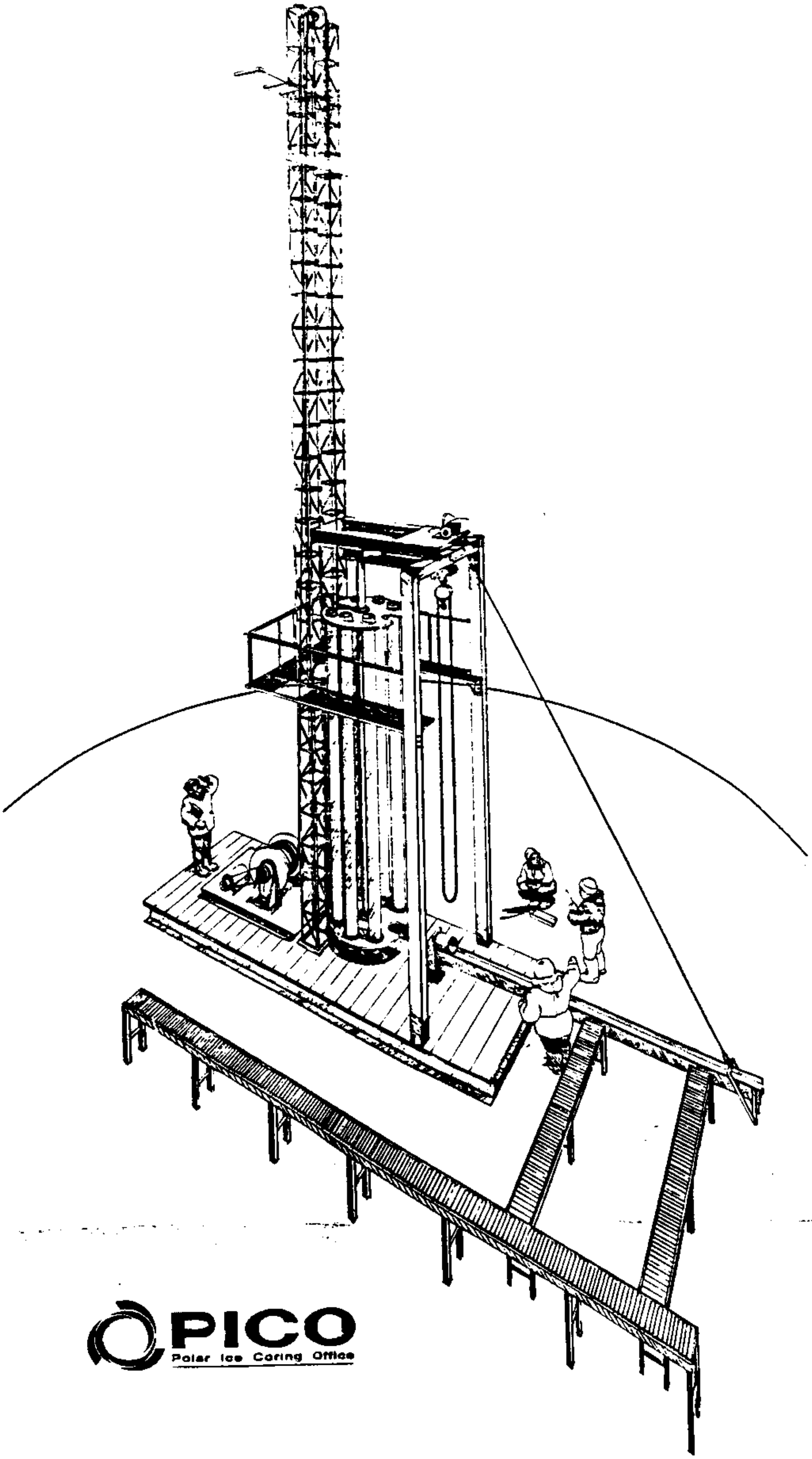
ARMATURE- The varnish insulation on the armature was inspected closely and found to have broken down in the area where two wires were in close approximity to each other. Bare spots on the wire and bubbling of the varnish were also observed. Also visible were several wear spots on the armature laminations where it had struck the magnets. This was attributed to the bearing failure allowing misalignment of the armature in the magnet housing.

BRUSHES- The brushes were well worn and had little useful life left. An inspection of these brushes took place a short time before the motor failed and were found to have very little wear at that time.

COMMUTATOR- Inspection of the commutator revealed arcing and over-current conditions. The commutator was well worn where the brushes made contact. Some carbon dust was present imbedded between commutator segments.

MAGNETS- The adhesive used to secure the magnets to the motor housing had deteriorated and several magnets were loose.

SOLUTION- To solve the problems associated with the motor running submerged in butyl acetate, we will seal the motor section of the drill so that it can be filled with a light oil. This will exclude the butyl acetate and the service life of both the motor and the gear reducer will be increased.



PICO
Polar Ice Coring Office

FIG. 1

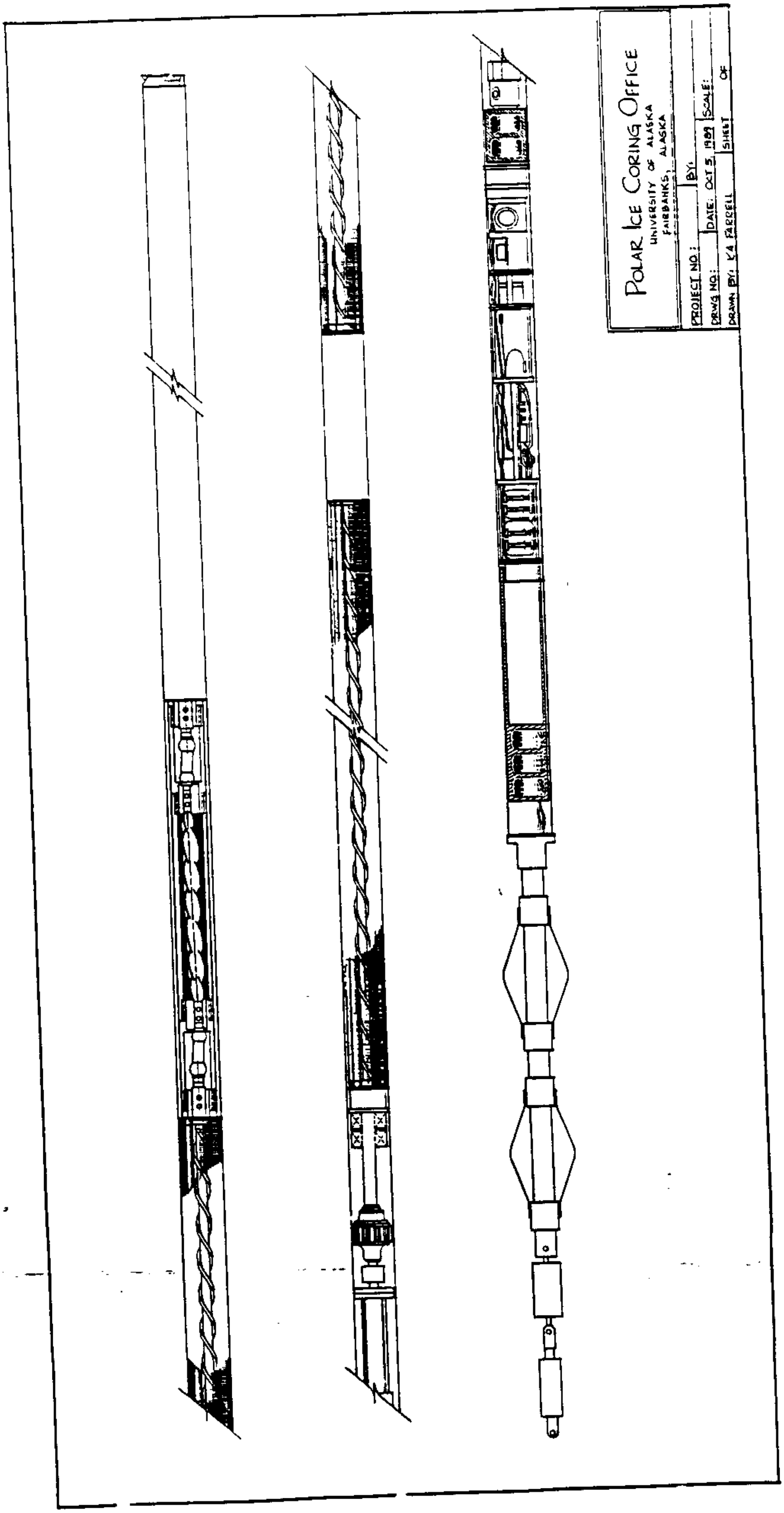

POLAR ICE CORING OFFICE
UNIVERSITY OF ALASKA
FAIRBANKS, ALASKA
PROJECT NO:
BY:
DRWG NO:
DATE: OCT 5 1989
SCALE:
DRAWN BY: KA FARRELL
SHEET
OF

FIG. 2

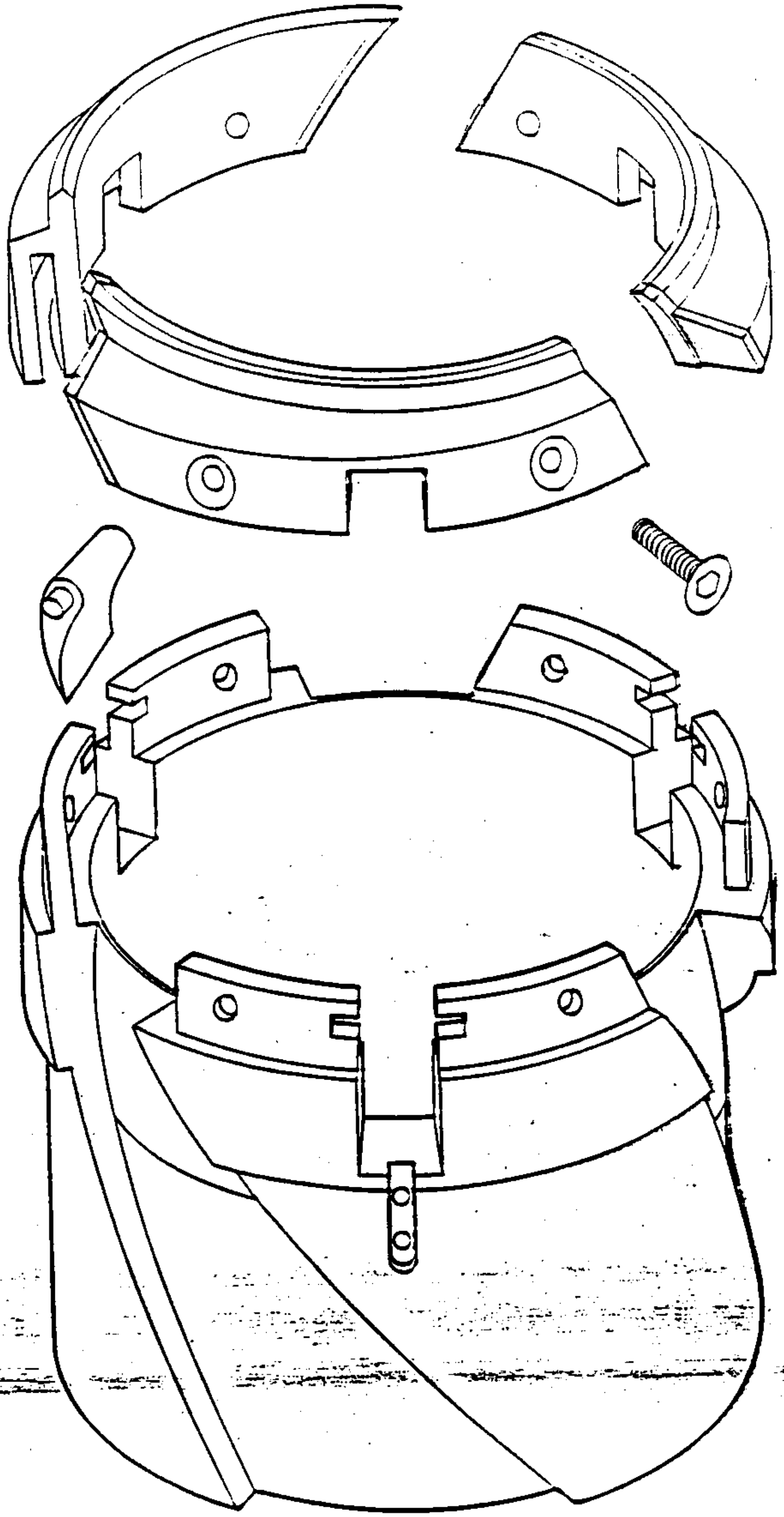


FIG. 3

Appendix 7

PICO has several types of publications:

1 The ***PICO BULLETIN*** is an informal newsletter which is used in part to maintain liaison with U. S. and international investigators of ice coring projects, inform its subscribers of the PICO's activities and to present semi-technical contributed articles on research activities of projects logistically or technically supported by PICO. We have had two issues to date with a third due in early 1991.

2 ***TECHNICAL REPORTS.*** Technical reports are given a classification as to whether they are the result of a conference presentation or research report. Publications resulting from PICO activities are attached.

3 We will institute a ***TECHNICAL NOTE*** series soon. These notes will be short disclosures of new products or techniques. (Our first note, soon to be published, will disclose our experiments on the use of high-pressure water jets to cut ice.)

PICO PUBLICATIONS

The 1989 Greenland Field Season After Operations Report
For NSF - Sponsored Projects
OR 89-1 Dec. 1989
Thomas A. Gosink, Mark A. Tumeo, Bruce R. Koci,
and Tyler W. Burton

Evaluation of a Prototype Deep Ice Coring System
TR 89-1 April 1989
Bruce Koci

A Literature Survey of Drilling Fluids and Densifiers
TR 89-2 July 89
Thomas A. Gosink

A Case of N-Butyl Acetate A Safe, Auto Dense Ice Core
Drilling Fluid and Densifiers
TR 89-3
Thomas A. Gosink, Mark A. Tumeo, Bruce R. Koci,
and Tyler W. Burton

Logistical Support for Construction on the Greenland Ice Sheet
CP 90-1 May 1990
K. Curtis, J. Sonderup, D. Dahl

Shallow and Deep Ice Coring Devices Developed by the
Polar Ice Coring Office
CP 90-2 May 1990
L. M. Proenza, J. J. Kelley, B. Koci, J. Sonderup and
Mark Wumkes

Facilities Plan and Protocol for the Support of the National
Science Foundation-Sponsored Greenland Ice Sheet Project Two:
Deep Ice Core Drilling Effort
CP 90-3 May 1990
L. M. Proenza, J. J. Kelley, K. Swanson, J. Klinck, S. Peterzen
and T. Gacke

Deep Drill Status Report (Draft Status)
TR 90-1 Nov 1990
Mark Wumkes

New Technological Developments in Support of Arctic Research
Proceedings of a Workshop at the 40th Annual Alaska Science Conference
CP-90-4 Nov 1990
John J. Kelley, Editor, Helen Stockholm, Technical Editor
Dorothy Dahl, Technical Editor

Butyl Acetate: A Drilling Fluid for the Extraction of Deep Ice Cores
from Glaciers
CP-90-5
T. A. Gosink, J. J. Kelley, B. R. Koci, T. W. Burton
M. A. Tumeo Civil and Environmental Quality Engineering

Development of Shallow and Deep Ice Coring Devices
CP-90-6
J. J. Kelley and B. Koci

Coding|
CP - Conference Proceedings
OR - Operations Report
TR - Technical Report

Appendix 8

Correspondence from European Observers of the PICO Program

University of Alaska Fairbanks

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Bern, Oct. 2. 1990

Dear John,
Report from GISP 2 1990 Visit at Summit Greenland.
From July 8. to 15. I took the offer and spent the time at GISP 2.
Since I already got involved in the planing stage of the PICO Drillsystem, the few days at Summit gave me an opportunity to see the success PICO made to realise the project.
I have not been involved in any machining or building any of the components for this drill. The amount of work requested to build the drill and arrange the set up for the field was almost an abnormal load of work for PICO's new situation after the move to Alaska.
Moving the office from Lincoln to Fairbanks, the integration at the new home and the Antarctic summer season in addition made me feeling uncomfortable for the situation PICO moved into.

One of my concern in Oct. 1989 was not whether the choosen drillconcept will work, my concern was, if PICO ever would be able to get it ready in time.
As always a projekt like this dimension is a question of optimizing and lining up the whole peripherie with the center as there is:
Infrastructure, time, money and personal on the peripherie and the object well designed and clearly lined up in the center.
The only help I could offer was part of this center, the type of drillsystem we have choosen to fullfill the order in the limit of possible support.

For my conception this first GISP 2 drilling season 1990 should have been used for :
1. Camp set up, drillrig and coreprocessing.
2. Function tests of all that components.
3. track all possible and as many unknown, invalid and unsatisfactory functions of both drill and coreprocessing.

Use the winter season 90/91 for tuning in all that components, and there should be no real problems any more to full fill the order of the 3000 meter core in 2 seasons.
The 2 drillsystems GISP 2 and GRIP cannot be compared in capacity related to time.

As far as I could observe the US campactivity of this summer during my time I was there, (I got only very few information about the time afterwards), I would say we have to be very satisfied with all that progress was made untill that time.

Involving all sciencepersonal in camp and other construction, was from my point of view the best thing ever done in field work. This way everyone learns paying attention to the others and sciencepersonal learn to appreciate the effort necessary to remove a useable core as well as the drillers have to be involved in the request of the sciencework.

PICO under all that additional circumstances of:
Moving from Lincoln to Fairbanks,
Tune in there to the new peripherie and infrastructure,
Antarctic support 89/90
Find a proper solution for a new deepdrilling system,
Realise all hardware for camp and drillsystem,
Line up personal for fieldcampactivity, etc.
did from my point of view a great effort.

Certainly I have a list of necessary modifications for 91.
I expected some components of drill and rig in a different outfit, but there is right now nothing, which can nomore be tuned in for next season, there is no real deadend situation.
The comphents I realy would like to see in the way they have to be, still can be made for next summer.
I hope very much that enough experiences with the liquid was made after I left this summer.
I am willing to support as much as feasible.

Some more aspects for all impatient supporters:

There is not much continuity left from the last US deepdrilling at Byrdstation and GISP 2
A deepdrilling requests some technical and other effort, and can not be done like digging a pit.
Technologie has to grow with the personal using it, as long as it is not that kind of equipment every day used like a car.
Even the Danish deepdrill already used once, today would not run proper with just some skilled personal, the one are running it are grown into it.
That does not mean, drilling is a mysterious or metaphysic thing.
It is just some kind of technologie, which requests some special experiences, either you grow into it, have it, or make it.
Otherwise everyone is wellcome to make the experiences with the experience.

With my kindest regards

Henry Rufli

Department of Glaciology | Building T-246

Copenhagen, August 30, 1990

To: Polar Ice Coring Office
Director John Kelley

Dear John,

Thank you very much for your note left at my office. I am very sorry, that we were not able to meet in Copenhagen, especially as I consider the cooperation between PICO and GOC as a cornerstone for our field work. In fact, we have been cooperating with PICO since before PICO was born: The cooperation goes back to the early Dye 3 drilling in 1971. And in the years, we have developed an understanding of each others position and problems. As PICO and UCPH have a quite different background and financial status, it may from time to time be difficult to understand each others position. Never the less, we have up until now been able to solve the problems.

Few people understand how close we cooperate: How many of your people knows, that the fork lift in Sonde is in fact owned by GOC? And few people that has not participated in field work will understand, the way the two field teams help each other in spite on the natural competition. Any problem for one group is considered a common problem. This is how a cooperation should work.

PICO have had a very high exchange rate of personnel. In order to show your personnel our background, why and how we operate, it may be an idea, that PICO personnel visit us in Copenhagen. Right now, this could be done in the way, that Steven could pass Copenhagen on his way back to Fairbanks after the field season, and spend a little week in Copenhagen. We can pay for his hotel and approx 20 $ per day per diem in Copenhagen. If there is any problems, we can also pay for either his ticket from Sonde to Copenhagen, or from Copenhagen to Fairbanks. Please let me know your response.

Yours Sincerely

Niels Gundestrup
Director, GOC

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