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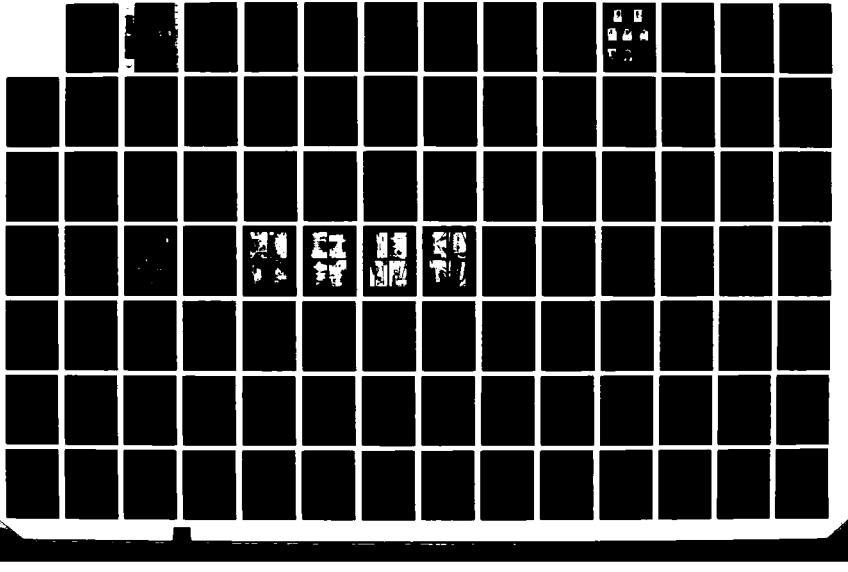

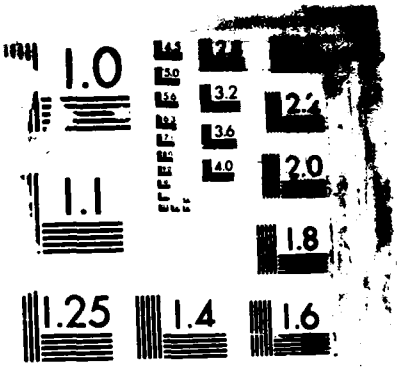
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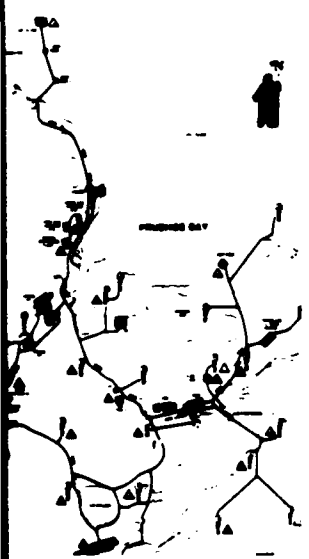

PROCEEDINGS OF THE 45TH MEETING OF THE COASTAL ENGINEERING RESEARCH BOARD

14-16 May 1986

FAIRBANKS AND HOMER, ALASKA

Hosted by
US Army Engineer District
Alaska

December 1986
Final Report

Approved For Public Release; Distribution Unlimited

Prepared for DEPARTMENT OF THE ARMY
US Army Corps of Engineers
Washington, DC 20314-1000

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PO Box 631, Vicksburg, Mississippi 39180-0631

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PREFACE

The Proceedings of the 45th meeting of the Coastal Engineering Research Board ~~(CERB) were prepared for the Office, Chief of Engineers (OCE), by the Coastal Engineering Research Center (CERC), US Army Engineer Waterways Experiment Station (WES). They~~ provide a record of the papers presented, the questions and comments in response to the papers, the interaction in response to the papers, the interaction among program participants and the CERB, ~~and the tour~~.

(cont on page 5)

The meeting was hosted by the US Army Engineer District, Alaska (NPA), under the direction of COL Wilbur T. Gregory, Jr., Commander. NPA is in the US Army Engineer Division, North Pacific (NPD), under the direction of BG(P) George R. Robertson, Commander. Acknowledgements are extended to the following: Mr. Carl Stormer (NPA) who coordinated the meeting; Mr. James Bales (NPA) who executed the planning details including the field trips to Prudhoe Bay and Valdez; Ms. Trillis Rubison who coordinated the details of the activities in Homer, Alaska; and Ms. Elizabeth J. Brady, Court Reporter, for taking verbatim dictation of the meeting. Worthy of commendation also is Mrs. Sharon L. Hanks (CERC/WES) whose assistance in setting up the meeting and assembling information for this publication proved invaluable. Mrs. Jamie W. Leach (Information Products Division/WES) edited these proceedings. Acknowledgement is also extended to Mr. Andre Szuwalski (CERC/WES) for providing summaries of discussions following the papers, editing, and compiling these proceedings. Special thanks are extended to Ms. Brenda J. White who typed the original manuscript.

The proceedings were reviewed for technical accuracy by Mr. Charles C. Calhoun, Jr., Assistant Chief, CERC, and Dr. James R. Houston, Chief, CERC. COL Allen F. Grum, USA, Executive Secretary of the Board and Director of WES provided additional review.

Approved for publication in accordance with Public Law 166, 79th Congress, approved 31 July 1945, as supplemented by Public Law 172, 88th Congress, approved 7 November 1963.

Patrick J. Kelly
Brigadier General, Corps of Engineers
President, Coastal Engineering Research Board

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DIVISION RESEARCH NEEDS

INTRODUCTION

The 45th Meeting of the Coastal Engineering Research Board (CERB) was held in Fairbanks and Homer, Alaska, on 14-16 May 1986. It was hosted by the US Army Engineer District, Alaksa (NPA), under the direction of COL William T. Gregory, Jr., Commander. NPA is in the US Army Engineer Division, North Pacific, under the direction of MG (then BG) George R. Robertson, Commander. The program format was designed to promote information exchange among members of the Board and attendees from various US Army Corps of Engineers (Corps) Districts and Divisions and the Office of the Chief of Engineers.

The Beach Erosion Board (BEB), forerunner of the CERB, was formed by the Corps in 1930 to study beach erosion problems. In 1963, Public Law 88-172 dissolved the BEB by establishing the CERB as an advisory board to the Corps and designating a new organization, the Coastal Engineering Research Center, as the research arm of the CERB. The CERB functions to review programs relating to coastal engineering research and development and to recommend areas for particular emphasis or suggest new topics for study. The Board's four military and three civilian members meet ~~twice a year at a particular coastal Corps District or Division~~ to do the following:

- Disseminate information of general interest to Corps coastal Districts and Divisions;
- Obtain reports on coastal engineering projects in the host (local) District or Division; receive requests for research needs;
- Provide an opportunity for State and private institutions and organizations to report on local coastal research needs, coastal studies, and new coastal engineering techniques;
- Provide a general forum for public inquiry;
- Provide recommendations for coastal engineering research and development.

Presentations during the 45th CERB meeting dealt with local and national concerns. Topics included the regulatory program in Alaska coastal areas, North Slope hydraulic modeling activites, deep-draft navigation aspects of Prince William Sound, Homer Spit Beach Erosion Project, Anchorage Harbor Deep-Draft Navigation Feasibility Study, and the Alaska Coastal Data Collection Program. During this meeting discussions also continued related to the challenges that were presented to the Board by LTG E. R. Heiberg III at the previous CERB meeting in Sausalito, California (4-6 November 1985).

Documented in these proceedings are summaries of presentations made at the meeting, discussions which followed these presentations, as well as recommendations by the Board for coastal engineering research and development. Verbatim transcripts of the proceedings are on file at WES.

Appendix A to this proceedings contains the dredging operations research and development program needs and priorities. Appendix B summarizes the CERB task force meetings. Appendix C contains recommendation letters from nonmilitary CERB members.

THE COASTAL ENGINEERING RESEARCH BOARD
MAY 1986

BG Patrick J. Kelly, President
Deputy Director of Civil Works
US Army Corps of Engineers
20 Massachusetts Avenue, N.W.
Washington, DC 20314-1000

COL Allen F. Grum, Exec Sec
Director
US Army Engineer
Waterways Experiment Station
PO Box 631
Vicksburg, MS 39180-1000

BG (P) George R. Robertson
Commander
US Army Engineer Division,
North Pacific
PO Box 2870
Portland, Oregon 97208-2870

BG Donald J. Palladino
Commander
US Army Engineer Division,
South Pacific
630 Sansome Street, Room 720
San Francisco, California 94111-2206

BG Paul F. Kavanaugh
Commander
US Army Engineer Division,
North Atlantic
90 Church Street
New York, New York 10007-9998

Dr. Bernard J. Le Méhauté
Ocean Engineering Division
Rosenstiel School of Marine
and Atmospheric Science
4600 Rickenbacker Causeway
Virginia Keys
Miami, Florida 33149

Dr. Chiang Chung Mei
Professor of Civil Engineering
Massachusetts Institute
of Technology
Bldg. 48, Room 413
Cambridge, Massachusetts 02139

Dr. Dag Nummedal
Department of Geology
Louisiana State University
Baton Rouge, Louisiana 70803-4101

45TH COASTAL ENGINEERING RESEARCH BOARD MEETING

14-16 May 1986
Fairbanks and Homer, Alaska

ATTENDEES

BOARD MEMBERS (CERB)

BG Patrick J. Kelly, President
BG(P) George R. Robertson
Dr. Bernard J. Le Méhauté
Dr. Chiang Chung Mei
Dr. Dag Nummedal

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Mr. David Barrows (DAEN-CWO-N)
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Mr. Leonard Ratushewitz (NADPL)

NORTH PACIFIC DIVISION (NPD)

Mr. Herbert H. Kennan (NPDEN)
Mr. Terence McKiernan (NPDCO)
Mr. John G. Oliver (NPDEN-TE)
Ms. Rebecca B. Ransom (NPDOC)
COL Wilbur T. Gregory, Jr. (NPADE)
Mr. J. Ted Bales (NPAEN-H-HD)
LTC Roy S. Carlson, Jr. (NPADE)
Mr. Carlton A. Davenport, Jr. (NPAEN-H-HD)
Mr. Kenneth J. Eisses (NPAEN-H-HD)
Mr. David G. Hendrickson (NPAEN-H)
Ms. Lynn M. Hornecker (NPAEN-H-HD)
Mr. Harlan E. Moore (NPAEN)
Mr. Larry L. Reeder (NPACO-R-S)
Mr. Carl D. Stormer (NPAEN-H-HD)
Mr. James W. Stuhler (NPAEN-SY-D)
COL Gary R. Lord (NPDDE)
Mr. Robert P. Flanagan (NPPEN)
Mr. A. David Schuldt (NPSEN-PL-CP)

SOUTH ATLANTIC DIVISION (SAD)

Mr. Theodore A. Abeln (SADEN-TH)

SOUTH PACIFIC DIVISION (SPD)

Mr. A. E. Wanket (SPDED)

SOUTHWESTERN DIVISION

Mr. Ronald R. DeBruin (SWDPL-P)

WATER RESOURCES SUPPORT CENTER

Mr. William R. Murden, Jr. (WRSC-D)

WATERWAYS EXPERIMENT STATION (WES)

COL Allen F. Grum (WESZA)
Dr. James R. Houston (WESCV-Z)
Mr. Charles C. Calhoun, Jr. (WESCV-A)
Mr. H. Lee Butler (WESCR)
Mrs. Sharon L. Hanks (WESCV-I)
Mr. Thomas W. Richardson (WESCD)
Mr. Orson P. Smith (WESCW-D)
Mr. Andre Z. Szuwalski (WESCV-I)

COLD REGION RESEARCH AND ENGINEERING LABORATORY, ALASKA

Mr. John Bouzoun

COURT REPORTER

Ms. Elizabeth J. Brady

VISITORS

Mr. Brent Drage
Mr. W. D. Howitt
Mr. Victor Manikian
Dr. John B. Olson
Captain Andy D. Santos
Mr. Harvey Smith
Mr. Richard Spears
Dr. Tsair-jyh Tzong

45TH MEETING OF THE COASTAL ENGINEERING RESEARCH BOARD

14-16 May 1986
Fairbanks and Homer, Alaska

AGENDA

14 May 1986		
0630 - 0730	Fort Wainwright Breakfast Briefing at Captain Bartlett Inn - Military only required	
0730 - 0815	Registration	
0815 - 0820	Opening Remarks	BG Patrick J. Kelly (DAEN-CWZ)
0820 - 0830	Welcome	BG(P) George R. Robertson (NPDDE)
0830 - 0835	Welcome to Alaska District	COL Wilbur T. Gregory, Jr. (NPADE)
	Announcements	Mr. Carl D. Stormer (NPAEN-H-HD)
0835 - 0850	Regulatory Program in Alaska Coastal Areas	Mr. Larry L. Reeder (NPACO-R-S)
0850 - 0905	North Slope Hydraulic Modeling Activities	Mr. H. Lee Butler (WES/CERC)
0905 - 0930	Design Evaluations in Support of North Slope Activities Oil Production Major Projects in Prudhoe Bay Region, Alaska	Mr. Victor Manikian, Prudhoe Planning Facilities
0930 - 0945	COFFEE BREAK	
0945 - 1015	Deep-Draft Navigation Aspects of Prince William Sound	Captain Andy D. Santos, Port Captain Sohio
1015 - 1045	Transport to Airport	
1045 - 1245	Flight to Prudhoe Bay with Box Lunches on Aircraft (Convair 580 Turbo Prop)	
1245 - 1600	Tour Prudhoe Bay	
1600 - 1745	Flight - Prudhoe Bay to Fairbanks	
1745 - 1815	Transport to Lodging	
1900 - 2100	DINNER (Captain Bartlett Inn)	
15 May 1986		
0730 - 0830	Transport to Airport	
0830 - 0945	Flight to Valdez	
0945 - 1000	Transport to Valdez Terminal	
1000 - 1030	Valdez Terminal	Mr. W. D. Howitt, Terminal Superintendent, Alyeska Pipeline Service Company
1030 - 1200	Tour Valdez Terminal Facilities	
1200 - 1300	LUNCH (Sheffield Valdez)	
1300 - 1315	Transport to Airport	
1315 - 1430	Flight to Homer	
1430 - 1500	Airport to Lodging (Lakewood Inn and Bidarka)	
1500 - 1600	Discuss Field Trip	

AGENDA (Concluded)

16 May 1986

0800 - 0805	Open Meeting	BG Patrick J. Kelly (DAEN-CWZ)
0805 - 0820	Review of CERB Business	COL Allen F. Grum (WES)
0820 - 0930	Initiatives to Meet Chief's Charges a. Work for/with Private Industry, Education Program, Facility Requirements, and Supporting Organizations b. National Dredging Program	BG Patrick J. Kelly (DAEN-CWZ) Mr. Jesse A. Pfeiffer, Jr. (DAEN-RDC) Mr. William R. Murden (WRSC-D)
0930 - 0945	COFFEE BREAK	
0945 - 1030	Continuation of Chief's Initiatives	BG Patrick J. Kelly (DAEN-CWZ)
1030 - 1100	The Coastal Community in the State of Alaska	Dr. John Olson, Department of Transportation & Public Facilities
1100 - 1130	St. George Harbor	Mr. Brent Drage, Peratrovich, Nottingham & Drage, Inc.
1130 - 1200	Homer Spit Beach Erosion Project	Mr. Carlton A. Davenport (NPAEN-H-HD)
1200 - 1310	LUNCH	
1310 - 1340	Update on DUCK '86 and Crescent City Dolos Monitoring	Mr. Thomas W. Richardson (WES/CERC)
1340 - 1410	Recommendations by Members of the Board	
1410 - 1430	Selection of Date and Place for Next Meeting	BG Patrick J. Kelly (DAEN-CWZ)
1430 - 1445	COFFEE BREAK	
1445 - 1515	Computer Aided Coastal Engineering	Mr. Charles C. Calhoun, Jr. (WES/CERC) Mr. Orson P. Smith (WES/CERC)
1515 - 1530	Alaskan Floating Breakwater Experience	Mr. Kenneth J. Eisses (NPAEN-H-HD)
1530 - 1545	Anchorage Harbor Deep-Draft Navigation Feasibility Study	Ms. Lynn M. Hornecker (NPAEN-H-HD)
1545 - 1600	Wave Engineering Tests in the Directional Spectral Basin	Dr. James R. Houston (WES/CERC)
1600 - 1630	Public Comment	
1630 - 1650	The Alaska Coastal Data Collection Program	Mr. Carl D. Stormer (NPAEN-H-HD)
1650 - 1715	South Atlantic Division Coastal Research Needs	Mr. Theodore A. Abeln (SADEN-TH)
1715 - 1740	North Pacific Division Research Needs	Mr. John G. Oliver (NPDEN-TE)
1740 - 1750	North Pacific Division Remarks	Mr. John G. Oliver (NPDEN-TE)
1750 - 1800	Closing Remarks	BG(P) George R. Robertson (NPDDE)
1800	ADJOURN	

OPENING REMARKS

BG Patrick J. Kelly, President
Coastal Engineering Research Board
Deputy Director of Civil Works
Washington, DC

Welcome to the 45th meeting of the Coastal Engineering Research Board (CERB). I'd like to thank first of all our host, Brigadier General George Robertson, whose idea it was to come up to Alaska at the last CERB meeting we had in San Francisco in November.

I'd also like to thank Colonel Woody Gregory and the Alaska staff for all of their hosting here so far. It's just been tremendous. Yesterday we were treated to a special program by the District and by the Cold Regions Research and Engineering Laboratory (CRREL); I'd like to thank all those people. We had the opportunity yesterday morning to go out and visit the permafrost tunnel, which is really quite an object. And then yesterday afternoon Colonel Gregory arranged, along with his area engineer, Carl Smith, to tour the Chena River Flood Control Project. We had a good day yesterday. It was very informative. I think it set the tone for this meeting.

I would like to take a minute, if I could, to introduce the official members of the board to all of the participants here today. Besides myself on the military side, we have, as our host, Brigadier General George Robertson from North Pacific Division. We have Colonel Al Grum who is the Director of the Waterways Experiment Station (WES) and is our Executive Secretary and official member. Then we have our three civilian members: Dr. Bernie Le Méhauté who is the chairman of Ocean Engineering at the University of Miami; Dr. C. C. Mei who is Professor of Civil Engineering, Massachusetts Institute of Technology; and Dr. Dag Nummedal, Professor, Department of Geology at Louisiana State University. Our other two military members were not able to make it today. Brigadier General Paul Kavanaugh, the NAD Commander, is in the midst of moving. He is being reassigned from the North Alantic Division out to the Defense Nuclear Agency at Kirtland AFB, New Mexico. So, he has other things to do right now; he has to get himself and his family moved. Brigadier General Don Palladino is Commander of the South Pacific Division. One of his sons is graduating from college, and he had to go back

east to attend that graduation, so he was unable to make it to this meeting.

I'd like to thank the participants from ARCO and Standard Oil. I appreciate you coming here today. If you'll look to the agenda you'll find that we have a fantastic time ahead of us. I'm going to let General Robertson and Colonel Gregory go into that in a little detail, but, if you look at the agenda, we have some basic material to cover early this morning and then we're going up to the North Slope for the rest of the day and come back here tonight. We'll spend most of tomorrow looking at the projects in the southern part of the Alaska District and Friday will be a business day. We'll continue on Friday morning with the Chief's initiatives, and we've got some interesting things to tell you about that. Then we'll discuss where and what we want to do for our meetings next year. Then we have some very interesting presentations that members of WES and others will make to conclude that day. I'm going to turn the meeting over right now to our hosts, General Robertson and Colonel Gregory.

WELCOME

BG(P) George R. Robertson, Commander
US Army Engineer Division, North Pacific
Portland, Oregon

I always take every opportunity to find every excuse I can get to come home to Alaska. As most of you know, I spent three years here from 1976 to 1979 probably on the best tour I ever had, which now Woody Gregory is enjoying as I did. Some of the same problems still exist. In fact, some of them I left still exist for Woody. If you look at the United States and at Alaska, you look at more coastline in the State of Alaska than the entire lower 48 combined. I think it's very appropriate that we bring the Board up here and take a look at some of the unique problems and unique solutions that have been found by the technical staffs and government agencies as well as private industry.

I'm particulary delighted that Jim Posey from ARCO and the other folks from Standard were able to join us. I've been bugging the oil industry quite a bit to share some of the tremendous information they have. I thought that was another great advantage in having this meeting here--to give us the opportunity, as the guiders of coastal engineering and coastal research for the Federal government, to share some ideas and learn what the oil industry is doing in this tremendous quest for knowledge that we must have in order to advance our capabilities to protect our coast and find ways to use the coastal areas to the better benefit of both developmental and environmental groups. So, I'm delighted that we can have this meeting here. The big question is, how are we going to pay for it? Well, I think we've taken care of that. We found it's not too much more expensive in coming to Alaska than it might be going to Las Vegas.

I'd like to add my thanks to those of General Kelly, particularly for the folks here in Alaska. You know, I volunteered to host something and then I appointed the Portland District, Alaska District, somebody else to do all the work. In the Alaska District, Woody, Carl, Ted, you guys have done a fantastic job. I got my guidance from and legwork done down at the Division

from John Oliver and Herb Kennon. I really appreciate all the work you have done.

I'd like to make a couple of announcements. Many of you are probably aware that the South Pacific Division and North Pacific Division cosponsored a coastal design conference in Oakland, California, 7 and 8 November 1985. All the Board Members have a copy of the proceedings of that conference, and the proceedings are being mailed out to all the Districts and Divisions. So, everybody will get a copy if you were there, or you can get a copy through your nearest Division, District, or laboratory. That was an excellent initiative. South Pacific Division did a fantastic job on doing most of the legwork. Again, John Oliver assisted in my office on that. It was an outstanding conference.

The Assistant Secretary of the Army for Civil Works, Mr. Bob Dawson, has recently approved the Corps of Engineers, specifically the North Pacific Division and South Pacific Division, to cohost the Coastal Zone 1987 conference. That conference is primarily being hosted by the American Shore and Beach Preservation Association. That is going to be held in May of 1987 in Seattle. The call for papers went out about 2 months ago. It did have a due date of 15 May but because of the lateness of the call, it's been extended to 15 June. So, I encourage you and your own folks to submit papers for that, and let's make another tremendous advance in our mutual concern about shore protection and beach activities at that conference.

Well, again, I want to thank the Alaska District for developing an outstanding agenda and to express my appreciation to all of those presenters who have worked hard to put together something worthwhile for our mutual interest. I think we'll have a very productive meeting and, again, welcome to the North Pacific Division. Now I'll ask Woody Gregory to come up to give you a specific welcome to one of the greatest Districts in the Corps of Engineers.

WELCOME TO ALASKA DISTRICT

COL Wilbur T. Gregory, Jr.
US Army Engineer District, Alaska
Anchorage, Alaska

I just wanted to say welcome to Alaska. It is our pleasure at the Alaska District to have you all here. We've had lots of folks who have worked very hard on this. They're the ones that take the credit for the District, not the fellow you see standing in front of you right here. You're going to be hearing from one of them in just a moment. Carl Stormer, Ted Bales, and a whole host of other folks from the Alaska District have really worked hard to make this a success.

To give you a feeling for how big this place is--now, there have been some tall stories told up here already, bear stories and bear camping stories and some other things--but just to give you an idea of how big this place is, if you were to take Metlakatla which is down in southeast Alaska, place it on Jacksonville, Florida, and take Barrow and put it up around St. Paul, Minnesota, in otherwords overlay a map of Alaska over that of the lower 48 states, you'd find that Attu, out on the Aleutian chain, lies at San Diego. This state is one fifth the size of the land mass of the lower 48.

Welcome to Alaska. I think we've got an exciting time for you all. We want to make it productive. We want to make it fun. There are a lot of logistical things to be dealt with; perhaps we've overlooked something. If we have, I hope that during your stay here, you'll get in touch with me, Carl Stormer, Roy Carlson, Ted Bales, or other folks here from the District. We'll try to make amends for any oversight.

I do want everybody to enjoy themselves. It's a great state. I want your visit to be productive, and I want it to be fun.

Again, on that same note, the best we've ever done at WES as far as the total year's program is $110 million, and we've either obligated or expended $77 million in the first six months. We can't keep that pace up because we only have $150 million on the program and 2 times 77 is 154 which means that Jim, Charles, and Dwayne Lee all go to jail at the end of this time because there's a law about overexpending.

The other thing that we've looked at is what's called a "Task Order Contract." What a Task Order Contract does is to ask people to come in and make proposals on a specific area, and they're indefinite kind of proposals. It merely says, "I'm interested in doing work, and here's my expertise." If we pick up on that proposal we say, "Okay. Fine. You're one of our contractors." We can exercise options anywhere from no work to that contractor up to some very large number.

Now, the task we asked for in the coastal arena was for the numerical modeling of coastal and oceanographic processes. We received 13 proposals, again, from a variety of academic institutions and private companies.We see seven of those as viable. In other words, we may award up to seven contracts for people to assist in numerical modeling this year. It may be that of those seven, some of them get several hundred thousands of dollars worth of work and others get no work, depending on what our needs are over the year.

Martin Luther King once said he had a dream. We at WES have a dream that we've worked on since January. Many of you may know that we've had a graduate program at WES for a long time. We've had about 50 people who have actually achieved a Master's Degree from Mississippi State University over the last 20 years by studying at WES.

Partly at the urging of the Board and partly for a number of other reasons, we'd like to expand that considerably. What we would like to have is a graduate institute at WES. We went over to the first school (Texas A&M) to talk about this, and I've made a little analogy about the story. It's like me at my age seeing this beautiful girl on the street and going up and saying, "Would you like to go out with me tonight?" And she says, "Yes." And I'm so surprised I can't remember what to do anymore. We went to A&M and said, "You know, we've got this dream of this little graduate institute down in Vicksburg"... and I supposed I thought their reaction was going to be, "Well, that's fine, but go away and don't bother us anymore, come back and tell us

more details," but when we went to A&M the reaction was, "Well, that's really wonderful. When do you want us to start?" And about a week after we were there, the president of A&M came over and spent a day with us. It was so astounding that we didn't know quite what the next step was. We went down to LSU, and I must admit that Dag had sort of poured molasses in the well down there to make us look a lot sweeter. We got the same kind of very positive reaction. We thought maybe Mississippi State might have some bad feeling about bringing in these other two schools, but they're very excited about the prospect of being able to enhance their own program by the cooperation of two other fine schools. Perhaps even more amazing, we went to OCE which is full of--as most of you field people know--the biggest "nay sayers" in the world, and even they thought it was a great scheme. We kept looking at this. There had to be something wrong if everybody said it was good. We haven't been able to find anything wrong so far.

Our great scheme is merely this, that you would come down to Vicksburg and there would be a lot of people working down there, some teaching, some doing research, and it would be very difficult to tell whether they were government employees or academic people. You would also go to academic institutions and find people from WES who are teaching and doing research in those institutions.

Let me tell you a little bit about the kind of degrees we're hoping to offer. Master of Science degrees of civil engineering: geotechnical; water resources; structural, hydraulic, and environmental engineering; engineering mechanics; engineering science; ocean engineering; and oceanography. And then geology, geophysics, marine science, computer information science, and electrical engineering. A great spectrum of Master's Programs.

The enrollee would get a degree from the school that he signs up with. So far it looks like the schools are very agreeable to accepting any course that we teach there using their faculty or with adjunct faculty. We're also looking at the possibility of long-term training for other Corps of Engineers agencies. In other words, perhaps if someone in, for example, Portland District was really interested in coastal engineering, it may make as much sense to come to Vicksburg and spend your year there getting your Master's Degree as going off to some other school.

We're still trying to put it together. We've never done it before, and

we're really working hard at it. We're at the point where we are ready to get the lawyers in and we've got some agreements that are pretty well roughed out. I'm very optimistic. I think as early as next fall we'll be teaching courses under the aegis of a graduate institute.

The other thing that I need to mention is that on the 15th of July of this year, General Heiberg is going to come down and dedicate the J. V. Hall Building. There was a J. V. Hall Building at Belvoir and we've moved it down to Vicksburg. J. V. Hall was the first civilian engineer hired by the Beach Erosion Board and he worked from 1931 till he died in 1956. He was chief of the Engineering Development Division. The building has a movable bed modeling facility, spectral wave generators, and a number of wave flumes. We'll also have a ribbon cutting ceremony for the CERC headquarters building and a ceremony to honor Thorndike Seville and George Watts who will be inducted into our CERC gallery of distinguished employees.

Saville was the Technical Director of CERC from 1971 until 1981, and Watts retired in 1977 as the chief of the Engineering Development Division.

One final thing which is not old business, but new business. The Environmental Protection Agency has asked for a numerical model of Chesapeake Bay, a three-dimensional water quality model, and it looks like that we're going to be the lead on that with people from our Environmental Laboratory at WES and also from Hydraulics Laboratory and Dr. Peter Chang from the University of Florida. Dr. Chen, who is one of Dr. Chung Mei's proteges, is going to be the principal investigator for the hydrodynamics part of the study and Don Robey from the Environmental Laboratory will be the overall study manager. This is going to be a major effort to improve the quality of Chesapeake Bay.

DISCUSSION

MR. DeBRUIN: Mr. DeBruin asked whether there were any plans to have the Corps sponsor or Corps employees participate in the WES graduate program.

COL GRUM: When you say plans, that's probably beyond where we are. Certainly that would be our hope that people would be down there on both short- and long-term training.

INITIATIVES TO MEET THE CHIEF'S CHARGES

BG Patrick J. Kelly, President
Coastal Engineering Research Board
Deputy Director of Civil Works
Washington, DC

When we met in San Francisco last fall we decided to concentrate in 1985 and 1986 on some of the initiatives that had been laid out to us by our Chief, General Heiberg. We then subsequently met in January. We organized ourselves into two groups. Each one of the groups had about five or six areas to look at. The two groups met separately in the morning session, and then in the afternoon we combined both groups. The task groups felt that dredging had the biggest payoff in areas that we need to concentrate and research.

Other research and development areas were discussed. I'm going to ask Jesse Pfeiffer to come up and discuss some of those areas. Following that, Bill Murden will discuss an ambitious program in dredging research.

FOLLOW-UP ON CHIEF OF ENGINEERS' CHARGE TO THE CERB

Mr. Jesse A. Pfeiffer, Jr., General Manager
Civil Works Research and Development
Directorate of Research and Development
Office, Chief of Engineers
Washington, DC

We are going to be very innovative in following the Chief's charge and not be small thinkers. There are five areas identified for discussion. I will discuss four of those; Bill Murden will give you a very thorough rundown on the fifth, the Dredging Research Program.

First, I'd like to address education and training. Colonel Grum has provided you an update on the significant strides that have been taken to expand what we're calling the WES Graduate Center. The program will be used as a base to further education and CERC's role in coastal engineering education, including development of an international course.

Representatives from CERC met with representatives from the Board of Engineers for Rivers and Harbors to discuss the formulation of a coastal engineering course administratively modeled after the Planning Associates course. The Planning Associates approach looks very promising, and we will pursue that further. Such a course would take advantage of the facilities at Vicksburg and at Duck, and the expertise of the CERC staff and visiting experts from within and outside the Corps and the Graduate Center.

Next I would like to address enhanced facilities. Here we got some very innovative and big thinking. I might note that the task force concluded, "major progress in the dredging program and in many other areas of coastal research requires large-scale facilities in which the processes and procedures can be modified at scales where scale effects can largely be eliminated." Now, that's an important distinction to note, the scale effects. The task force further concluded that planning or facilities devoted entirely to dredging research should take place after the dredging research program has been developed because there was a lot of discussion whether it should lead our way in or after the program. But I think we decided that we needed CERC to define the need for facilities to study coastal processes. These facilities should support the dredging mission of the Corps in that dredging and coastal

processes are interrelated and inseparable. So, we're going to move ahead on those coastal-type facilities, that additional facilities devoted entirely to dredging would be recommended after the dredging program has been established and its direction firmly established. There are four basic needs for enhanced facilities: improved prediction of sediment transport and interaction of waves, winds, tides, and currents; improved methods for evaluating effectiveness of structures or dredging projects; improved capability to model designs with more realistic force loading and minimal scale effects; and improved capability to measure processes and monitor design performance in the field. To meet these needs requires: (a) a very large basin with a directional spectral wave generator and tide and current generators, (b) an enlarged field research facility and enhanced portable field measurement facilities, and (c) an ultra long wave flume with current generator and wide wind wave flume with wind and current generators. The large wave basin will be 1,000 ft long, 300 ft wide, and 10 ft deep. The idea here is minimal scale effects.

We think that a facility of this type could be used for project studies. It can also be used for fundamental R&D, basic R&D, and lab extension of field prototype studies.

There is no kidding ourselves that a facility of this type will cost a lot of money. It's going to require some innovative financing. We started thinking about that. We'd have to go a variety of ways. Our best thinking right now is we'd have a heck of a time simply getting that out of Corps budgets. We might have to turn to the National Science Foundation (NSF), joint funding with industry, or a special bill out of Congress.

The enlarged field research facility and enhanced portable field measurement facilities could be used for fundamental R&D, basic R&D, and also to test data collection devices. An example of that kind of thing is what has happened with CODAR. We started that out at DUCK and are now moving it right out to the field.

The ideas behind the ultra long wave flume are fundamental R&D, basic research, and project studies. We think it would be a useful facility for all three.

Finally, the wide wind wave flume is probably most directed toward fundamental R&D and basic R&D and to a lesser degree toward project studies. There are certain constraints on performing work for the private sector. Some

of the constraints were identified at the task force meeting, and since the meeting other constraints have surfaced. It is recognized that some of the constraints cannot be eliminated in the short term, and perhaps not at all. However, any plan developed by the CERB or CERC must recognize the constraints. First, the percent surcharge. There is an engineer regulation, ER 70-1-8, that requires CERC to place a 15-percent surcharge on work for private companies and foreign governments. That constraint has been with us a long time, at least 15 or 20 years. This surcharge is intended to prevent Corps labs from competing against private sector laboratories who, unlike the government, must add profit to their proposals.

CERC is the only coastal laboratory in the country with a full range of coastal engineering expertise. Expertise at that scale is not available anywhere else in the United States. The surcharge provision is largely unnecessary for that reason and has the net effect of only making CERC noncompetitive with foreign coastal laboratories. The ER does provide, however, for exceptions to the surcharge. I'm going to quote a couple of things: "When the final product will directly contribute to activities in which Federal funds are involved and when there is direct benefit to the government." So, those two exceptions are written into the ER. However, it is unfortunate that many private companies and foreign government requirements result in intangible benefits which do not fall under the umbrella of these two exceptions. The simplest means for eliminating the situation would be a revision to the ER, removing the surcharge entirely. At a minimum, the revision could allow for a waiver of the surcharge in all instances where private or foreign companies state that the desired services are not available from the private sector in the United States. So, we'd be looking at an amendment to ER 70-1-8. The Directorate of Research and Development (DRD) would have to get involved in that since we are the proponent for that. There are some legal and other aspects to it we have to dig into.

Manpower

Certainly manpower is a constraint. Manpower practices are a constraint to doing work for anyone outside the government. We'll just have to be innovative. We do have some flexibility with the manpower we do have aboard. There is quite a bit of flexibility at WES in that the size of the organization really gives us an advantage there. Also, our new graduate program now

including LSU and Texas A&M will offer an opportunity. Better use of the Interpersonnel Agreement (IPA) program will also help, as will more contracting.

Cost of Facilities

If CERC is to be a national laboratory, then facilities must be upgraded. CERC's staff is unexcelled worldwide, and our facilities are slowly being upgraded through the Plant Replacement and Improvement Program (PRIP). However, the payback nature of PRIP increases the cost of doing business and discourages potential customers. Consideration should be given to funding the new and improved facilities needed to support both government and nongovernment customers outside the PRIP system.

The 10-Percent Contingency Fee

There is a WES supplement to ER 70-1-8 which requires a 10-percent contingency fee to be assessed on the total estimated cost of work to be performed for private companies and for foreign governments. This is to cover a potential cost overrun. This contingency, when added to the 15-percent surcharge, has resulted in CERC estimates being approximately 25 percent greater than the actual cost of work. However, current WES management has recognized the detrimental effect of this contingency and has abolished the requirements.

Approval Authority

ER 70-1-8 established a $20,000 limit on approval authority by the WES Commander and Director for work for private companies and foreign governments. Amounts above this must be approved by OCE. This is restrictive for R&D labs, and the limit should be raised to somewhere in the vicinity of $200,000.

Foreign Travel Restrictions

Performing work for foreign governments or US companies in foreign countries requires travel to those countries with rapid response capability in some instances. Current OCONUS travel authorization procedures take a lot of time, and foreign governments might feel we're nonresponsive sometimes. We understand Secretary Dawson's concern about foreign travel, but perhaps working with the Director of Civil Works we might look at a possible modification of policies with certain guidelines.

Organization

At the task force meeting it was suggested that potential customers be invited to CERB meetings. This suggestion was expanded to include development of a constituency to support coastal engineering in its broadest sense. Such

a constituency is needed if coastal engineering is to receive the R&D funds needed, both within and outside the Corps.

NATIONAL DREDGING RESEARCH PROGRAM

Mr. William R. Murden, Chief
Dredging Division
US Army Corps of Engineers
Water Resources Support Center
Fort Belvoir, Virginia

At the last meeting of the CERB, General Heiberg identified dredging as a potential area that could produce significant payoffs. We, on the dredging side, support that wholeheartedly, and I'm sure you do in the coastal engineering community.

I will outline for you the major steps we have taken since that meeting. We believe these steps will result in the program and address both the immediate Corps needs and the longer term needs that will develop as the Corps' dredging program continues to respond to a changing economic, environmental, and political climate.

Before I address this very important initiative, however, I would like to take a few minutes to tell you where we stand on another topic of interest to all of us. At the 43rd meeting of the CERB in May 1985, I described our plans and status for the use of dredged material to create underwater berms in the nearshore zone area. Prior to that meeting, we had conducted a study and a demonstration project in conjunction with CERC in the Norfolk District. This project demonstrated the feasibility of constructing underwater berms using conventional dredging equipment and methods. Many of you will recall that significant mounding was created at the offshore disposal site using maintenance materials and included large quantities of fine-grained sand and silts.

Prior to this operation it was generally believed that mounding would not result using these types of materials. Another very important part of this operation is that, during the past two years or so, several severe storms have occurred and very little of the mound material has been displaced. So, now we know that the mounds have stablized.

Since the May 1985 CERB meeting, with considerable assistance from CERC and the WES Environmental Laboratory staff, we have actively sought a suitable situation for demonstrating the nearshore berm concept on a larger scale. Our

activities were increased by General Hatch's approval of our request to conduct such a demonstration project in the Norfolk District area. This approval was provided in November 1985.

For some time our efforts were directed toward establishing this demonstration, using material from the maintenance dredging of Thimble Shoal Channel which is just inside the mouth of Chesapeake Bay. The information obtained from this documentation project would have been utilized in assessing the use of the berm concept for the disposal of the material in the Norfolk Harbor deepening project. From an economics viewpoint, this would have been a very attractive site for the evaluation of the berm concept. However, it has recently become apparent that the use of new disposal method in the environmentally and politically sensitive lower Chesapeake Bay area might cause a delay of the deepening project. Therefore, at the request of the North Atlantic Division staff, we have deferred our activities in this region for the time being.

At the same time that the Norfolk Harbor demonstration project was becoming less promising, the Mobile District staff was expressing an interest in an underwater berm demonstration project in the Gulf of Mexico near Dauphin Island. I met with members of the Mobile staff a few days ago. During the discussions I outlined the objectives of the berm concept, and the District staff described their plans for the Mobile Harbor deepening project. Based on these recent discussions, I believe there is a real potential for developing a solution that will meet both the deepening project objectives and the berm concept. The potential for large-scale economic savings and dredging costs that exists in the Norfolk Harbor deepening project does not appear to be available for the most part in the Mobile Harbor project. However, it seems to me that the most important task before us is to conduct a test which will demonstrate the viability of the berm concept and its objectives, that is the dissipation of storm wave energy which will reduce beach erosion and, if constructed properly, serve to improve the habitat for fish and other marine life. We should know in a few weeks whether or not we can proceed with detailed plans for a berm concept demonstration in conjunction with the Mobile Harbor deepening project. After we display the feasibility of the berm concept, we should be able to utilize it on other deepening projects around the country.

I have often expressed the belief that dredging and coastal engineering are two disciplines that are very closely related. At the last CERB meeting it was suggested that a tie-in with the upcoming SUPER DUCK experiment at Duck, North Carolina, might provide data that would be useful in the evaluation of the berm concept. Through close coordination with the CERC staff, we have developed such a tie-in by supplementing and modifying some of the experiments already planned for the area seaward of the surf zone.

We believe that this approach will demonstrate the feasibility of various monitoring techniques so that we can gather specific types of data that will be useful, not only to the nearshore underwater berm concept, but also to other types of open water disposal activities as well.

Now, I will return to my initial topic, the National Dredging Research Program, related to operational and maintenance activities. The representatives of the January 14 task force meeting of the CERB reached the following conclusions regarding the topic:

a. Dredging operations research appears to be the biggest single payoff area for the Corps and perhaps the Nation.

b. This research should include a wide variety of topics such as dredging technology in an overall sense, improvements in equipment and machinery, improvements in operational and maintenance systems and procedures, as well as inlet and channel processes evaluation techniques.

c. The program should incorporate both laboratory and field research.

d. The staffs of DRD, Water Resources Support Center (WRSC), CERC, and WES as a whole should all work jointly to accelerate the development of this program.

On February 11 we hosted a workshop at the Kingman Building at Fort Belvoir to develop an initial list of operations-oriented research needs and priorities in response to the above conclusions of the CERB. The workshop was attended by 26 people representing 13 Districts and Divisions, the Operations and Readiness Division of Civil Works, DRD, WRSC, CERC, and WES. We felt that such a workshop was absolutely necessary to ensure that the proposed research program would include the field suggestions and thoughts. The workshop was very successful. The participants identified 43 topical areas in five different functional categories where research activities would benefit dredging operations. The five functional categories are as follows:

a. Material. What are we dredging and what properties of the material affect dredging operations? This is an important area for maintenance dredging and an essential area in the evaluation of deepening projects.

b. Mechanics. Types of equipment and systems that can be used to carry out dredging operations more efficiently.

c. Monitoring. Measuring, reporting, and recording production and retention rates, material effects on the marine biota, and the potential for the movement or displacement of dredged material placed in open water disposal areas.

d. Management. The evaluation of improved methods for directing and controlling the dredging operation or the program of operations.

e. Technology transfer. How to place existing and new technology in the hands of those who need it in the most readily usable form. This, of course, is the bottom line of the research program.

In addition to the functional and topical areas, this workshop also helped establish some overall guidance for the research program. We believe the program should have the following major purpose: reduction of the cost of dredging to a minimal level consistent with mission performance and environmental considerations. This can be accomplished in a variety of ways including: increasing the efficiency of a process, operation, or equipment; reducing the impact of contract claims; comprehensibly defining operational requirements; and sharing District and Division successes in cost avoidances and if necessary modifying them for Corps-wide applications.

We anticipate a program structure similar to that of the Repair, Evaluation, Maintenance, and Rehabilitation (REMR) Research Program with strong emphasis on field input through program reviews and a field review group. We believe this program should be funded under the operation and maintenance appropriation, such as was the case for the Dredged Material Research Program, the Environmental and Water Quality Operational Studies Program, as well as the REMR Research Program.

We are proposing a six-year interval for the dredging research activity. Program technical monitors representing several organizational elements such as Civil Works, Engineering and Construction, and Water Resources Support Center would be responsible for the overall integrity, direction, and progress of the program. I believe the program should include demonstration and implementation components to ensure that the research results are tested under

field conditions and that the research products are available in readily usable forms.

We have summarized the work accomplished to date on this program in a package of several documents that was recently distributed by General Kelly to all the Corps field elements involved in dredging activities. I'm very pleased to report that we have received many favorable responses and constructive recommendations from the field on the needs and priorities presented in the package. When we have all of the field input, we will incorporate that input into a final draft which will serve as a basis for making the recommendation to proceed with the program. I expect we should be able to send the package to General Kelly by the middle of August, and the package will suggest a full program start beginning in fiscal year 1988.

The idea of cost-sharing is not new to coastal engineering because it has been applicable to coastal engineering projects such as beach fills for some time. However, it is a mode of operation that is entirely new to navigation and dredging projects. When cost-sharing becomes a reality, and I am convinced that it will, we will be faced with many new challenges. One of these challenges will be a high degree of motivation for the ports and the states to evaluate the way we manage our dredging program and to investigate new and improved dredging procedures. With this very real prospect on the horizon, now is the time for us to develop innovative approaches to dredging to make sure that we are conducting dredging in as cost-effective a manner as possible.

Some of the things we can and should look at in our research program are pretty basic. For example, many of the open water and ocean disposal sites that we use today were selected many years ago. As a result, they may not have included proper consideration of the environmental effects. Some of the disposal sites may even be located on the wrong side of the channel prism. We need to determine if the existing sites and the sites for the deepening projects are located such that the material placed in the disposal areas will not be transported back into the channel by littoral processes. This is a case where the expertise of CERC could be put to very good use. It seems to me this is a matter that deserves our attention now.

Most of the ocean disposal sites are still designated on an interim basis by the Environmental Protection Agency (EPA), so I will appreciate your

giving the suggestion some immediate thought. It would be very embarassing if we should find that some of the disposal areas are on the wrong side of the channels. However, it will be far better to find that out now rather than have a cost-sharing partner make the determination for us.

I'm very encouraged by our progress and the many favorable reactions we have received to date on the proposed program. I believe we are developing a comprehensive program which addresses the major Corps and national interests in dredging. In my view, this program will serve as an indication of the continuation of the Corps' leadership in the dredging field and as a basis for projecting that leadership into the future. All of the cards seem to be falling into place at one time, and it appears that we will soon be able to proceed with some of the actions in the dredging field that are long overdue. The CERB has endorsed the underwater berm concept. In addition, the concept is supported by the Chief's Environmental Advisory Board and the headquarters staff of the National Marine Fisheries.

Our revisions to the National Dredging Regulations are about to pass muster in the Office of Management and Budget. It's about time because the regulation has not been revised since it was initially published in 1974. Members of the EPA headquarters staff have indicated they're willing to transfer some of the ocean site designation regulation authorities to the Corps. Based on recent discussions with the EPA staff, it appears that EPA may be willing to make some significant concessions in this area. Again, it is about time, since 114 of the originally specified 130 ocean disposal sites that we use do not have final designation status. General Hatch has approved a workshop on beneficial uses of dredged material that will be cosponsored by the EPA and the National Marine Fisheries. In addition, I hope to get the Marine Board of the National Research Council to accept the responsibility of sponsoring the workshop and to publish the proceedings under their logo. With this arrangement, the contents and findings of the proceedings should be acceptable to a wider audience. This workshop will be held at Fort Walton Beach or Pensacola, Florida, in the fall of this year. The themes which we hope will be addressed by a wide variety of Federal, state, and local authors will be, "What have you done in the beneficial uses area and what were the results, good or bad; what are you planning to do in this area and what do you hope to achieve?" From this workshop we hope to be able to compile a compendium on

the beneficial uses of dredged material from a wide variety of sources.

Also, it appears that we may soon get the long-awaited approval to proceed with some of the port deepening projects. Lastly, our relationship with the national representatives of the dredging industry has never been better. T · long and bloody struggle over the size and makeup of the minimum fleet is over. For the past two years or so we've been working with the industry toward objectives that are mutually beneficial to dredging technology. For example, the industry has invested almost $300 million in the construction of new dredging equipment since Public Law 95-269 was passed in 1978. In addition, the industry representatives have applauded our work, including periodic updates on our research program during our semiannual national dredging meetings.

For the first time in many years, the industry representatives seem to be aware of the fact that the findings of our research program on dredging are essential to the well-being of the Nation and to the industry at large.

DISCUSSION

DR. MEI: Dr. Mei said that the combination of the educational program that's now in progress and the planned addition, the four large facilities, makes CERC comparable to the Woods Hole Oceangraphic Institution. But he said this brought some questions to mind. Who pays for these facilities? Who will use these facilities? Who operates these facilities?

He stated further that the planned large wave basin is comparable in size to the one in Trondheim, Norway; the long wave flume is comparable to the one at Hanover, Germany; and the wind wave flume is comparable to the one in Delft. He crudely estimated that each item will cost $10 million and said that there must be some clear source for this kind of funding. With regards to the question of who uses the facilities, he felt that the expense for these things would not be easily justified unless there is a great deal of usage by other organizations such as universities, the National Oceanic and Atmospheric Administration (NOAA), and other industrial concerns.

On the question of who operates it, Dr. Mei felt that to operate big facilities like this, the current CERC structure and personnel might not be sufficient. It may require expansion of CERC personnel and elevation of military status of this thing.

MR. PFEIFFER: Mr. Pfeiffer said that no conclusions have been reached and that we will have to seek beyond our own budgets and traditional sources of funding to get such facilities built and operated. He stated the facilities would be available to universities, and naturally to CERC itself. The idea would be to run those facilities, if at all possible, 24 hours a day to keep them busy.

DR. NUMMEDAL: Dr. Nummedal stated that what CERC might be able to do with these large facilities is to establish a national type of research facility. The way to start is to build a national constituency in terms of operations and funding. The first step would be an organization of a workshop of representatives from professional organizations to give input into the needs and designs of these kinds of facilities.

BG KELLY: BG Kelly asked if the facilities have to be at WES. He suggested locating one of those facilities at a university. That way it would answer the question of who operates it, and solve some of the manpower problems.

MR. PFEIFFER: Mr. Pfeiffer responded by saying this is certainly an approach and will be studied.

BG KELLY: BG Kelly now wanted to run down the results of the task force item by item and hopefully within the Board get agreement on certain aspects, and then get some comments from the rest of the audience. The first item was inrovative funding for research.

DR. NUMMEDAL: Dr. Nummedal said that NSF is a funding source for research facilities. A $30 million facility certainly is within the realm of what NSF is funding and has been funding. He thought the most important thing to keep in mind is to make sure that the facilities that will be developed are national facilities developed for the benefit of a national coastal engineering program, not specifically Army Corps facilities. NSF would not be interested unless it is a truly national institute open to participation by all concerned agencies and individuals.

DR. LE MÉHAUTÉ : Dr. Le Méhauté didn't expect much from NSF in this regard. He made a comment about what he perceived as being the main handicap of CERC. It's a matter of "mass versus acceleration and the Corps of Engineers has a lot of mass and little acceleration." He suggested that the Corps review the process by which tasks are being done or authorized and examine where the time schedule can be shortened. The reason for this is that each time a company or an organization of any kind wants something done, in most of the cases they want to have it done fast. He said that last week he got a phone call from a firm that wanted to build a movable bed scale model outside because they didn't have the facility to build it inside. His reaction was "Why don't you do it at WES?" "Oh, they don't have the time." He asked Dr. Houston, "Do you know about this?" And Dr. Houston said, "No." Dr. Le Mehaute said that they have not even asked CERC whether they have the time or not. It is this type of reputation CERC has to overcome.

BG(P) ROBERTSON: BG(P) Robertson stated that if we get the universities tied in to the advancement of coastal research and education, we could, through the universities and some of their backers, tie in to philanthropic organizations and foundations. But in order to do that, he said we have to develop a tremendous marketing capability and have folks who have the persuasiveness to convince people who are potential sources of funds that what we are doing is extremely good for the Nation.

DR. MEI: Dr. Mei was not very optimistic about much support from NSF under the current situation. He felt that unless there is a new Act of Congress, perhaps justified by some big hazard, it will not be possible for the current programs to absorb a significant amount of support for coastal engineering. He felt that innovative funding approaches must be tied up through private industries.

BG KELLY: BG Kelly stated that CERC right now is a laboratory primarily oriented towards Corps of Engineers' activities. That's why it exists. He sees a need to look to the future organization and future trends of CERC. He perceives a laboratory evolving nationally, that's doing a lot of things in the whole coastal area with a second priority for Corps of Engineers' support to the Districts and Divisions because CERC is involved in doing work for private industry or getting involved in other areas.

DR. LE MÉHAUTÉ: Dr. Le Méhauté said he called a number of his friends in industry to see what the response would be if CERC was opening their door and willing to work in cooperation with private industry. The response was mixed. Some said, "Yes, they would do it. That would be great, but,"--it was always this "but." And one of these "but's" was the time response. The others said, "Wait a minute. That's going to compete with us." Dr. Le Mehaute said that it was not CERC's intent that this facility compete with them but to help them. Nevertheless, there was suspicion, and CERC would have to overcome this suspicion.

DR. HOUSTON: Dr. Houston addressed Dr. Le Méhauté's comment about trying to get some trust between the Corps and private industry because they're not sure whether or not CERC would be competing with them or working with them. Dr. Houston stated that one of the mechanisms that's going to help is task order contracting. He anticipates task order contracts where private industry would come to CERC and actually operate some of the facilities and some of the model studies.

DR. LE MÉHAUTÉ: Dr. Le Méhauté stated that CERC needs to create an environment in which it would be possible and worthwhile for the private sector to open branches at Vicksburg--to create a center like Delft which would work with the private sector or universities.

BG KELLY: BG Kelly asked whether CERC had looked into contracting out to a firm to run the physical plant.

DR. HOUSTON: Dr. Houston answered that WES, to some degree, uses that mechanism. He gave as an example, the Automation Technology Division, which is run by contractors. The contractor provides the manpower.

MR. PFEIFFER: Mr. Pfeiffer stated that the Chesapeake Bay Model was run that way.

MR. WANKET: Mr. Wanket said that the San Francisco Bay Model was run by contract. Tetra Tech was the contractor, and it was highly successful. However, there was a problem finding enough work on the model to keep that particular contractor busy.

MR. KENNON: Mr. Kennon made two observations. One had to do with the issue of the Corps of Engineers as being in control or as a facilitator. And in that role, the Corps could possibly make land available to whoever would wish to develop a research project on that land.

The other observation has to do with private industry. The AE community is a very important part of a market group that would use this facility; they would bring the money, the problems, and the opportunities into that facility.

BG KELLY: BG Kelly said that there is an effort within the current Reagan Administration to privatize different things. For instance, the Maritime Administration operates a computer simulation facility at Kings Point, New York, and they are now looking at not just operating it through a contractor but in fact turning the whole thing over to a contractor who then will lease it and make money on that facility.

BG Kelly then asked to discuss the next task area, the big payoff research areas: dredging research, field data collection program, and the operation and maintenance program.

MR. LOCKHART: Mr. Lockhart said he is doing some things in the field data collection area that may lead to some cost savings; but as has been pointed out during this meeting, the Corps is not collecting near the amount of data that it needs to be collecting. He said we need to be looking at ways to collect more accurate data, and ways of collecting it more economically. We need to start gathering up our sources of data and making it easy for the users to obtain.

DR. MEI: Dr. Mei stated that the collection of more wave data at more locations is important to all future and present coastal engineering projects. He felt there should be some bigger effort in analyzing wave data statistics and converting these wave data from computer tapes to usable forms for the designers. He asked whether there is any mechanism by which Districts can contribute to the funding of data collection activities.

MR. KENNON: Mr. Kennon stated that the Alaska District supports wave data collection and cooperates in a program with the State and CERC. A third of the budget was supported by the District's general investigations to help develop design data for small boat harbors in Alaska related to bottom fishery. The other two thirds came from the State of Alaska.

MR. PFEIFFER: Mr. Pfeiffer stated that the money Districts put up is project related and short term. He said they're quite willing to do it, but once the project design or that certain phase is completed, they have no more money for implementation.

MR. LOCKHART: Mr. Lockhart stated that this year there is $7.8 million in the data collection program divided up primarily among the wave information studies, wave gaging effort, and data management system. He stated it would be a great benefit if we had wave gages at every major harbor in the United States. It would be of benefit to navigation to know the wave climate going into or out of the harbor. Another benefit would be if a jetty was knocked down, we would know what knocked it down and be better prepared to repair it.

BG KELLY: BG Kelly now shifted the discussion to the dredging research program.

DR. NUMMEDAL: Dr. Nummedal stated an extremely important component of the Dredging Research Program is the documentation of geotechnical properties of the sediments that we're dealing with. He said Districts do not as yet routinely investigate in advance of project development such as seismic surveys to identify the different kinds of sediments that they would be dredging through. Seismic reflection is an excellent survey tool for identifying the geometry, the types of sediments, the depth of burial, and the cohesive nature. He wanted to throw that question out to find out whether or not this will become a routine part of future field investigations and to what extent plans exist to incorporate this as a component of the dredged material research program.

MR. LOCKHART: Mr. Lockhart stated that when the Corps proposes new dredging, we don't know what that dredger is going to be dredging out there. The Corps is laying itself open for some substantial claims. As far as he was aware of, the Corps goes out and takes quite a number of core samples. In the offshore areas, the Corps uses the seismic reflection studies because it's much cheaper than going out there and putting down hundreds or thousands of cores.

MR. MURDEN: Mr. Murden said we haven't had a new work dredging program in a very long time, but when we did have a new work dredging program of some volume, we did extensive geotechnical background investigations. When you dredge a harbor for 20 years or so, you know exactly what's there in the nature of silts. He felt the Corps has become lackadaisical in the sense of getting a thorough analysis of the geotechnical conditions. He said unless you extract a core in a very precise, given way and unless you treat that core in such a way to preserve it in its in situ status, the results you get are totally misleading. He felt the need to emphasize the importance of a full analysis of what we are doing in our general design memorandums against what we might do better and more thoroughly.

DR. MEI: Dr. Mei said he read over the written portion on the dredging research proposal (Appendix A) and it seemed to him that this proposal puts a great deal of emphasis on research having to do with the design and manufacturing of hardware dredging technology and also on the management of dredging operations. Little has been said, at least in the written documents, about the root of the dredging problems, namely, the coastal processes of sediment transport and the mechanics of estuaries and coastlines. It seemed to him that these more fundamental processes which have always been the domain of CERC research should be tied in with the dredging research.

MR. MURDEN: Mr. Murden said that there's no research that is being performed in the United States in dredging operational and maintenance activities by either the Federal Government, State governments, universities, or the dredging industry of any magnitude whatsoever.

He does not expect the dredging industry to participate in dredging research. He said we will do like we've done in the Dredged Material Research Program, go to universities and private firms with some effort by CERC. He said we have to start from ground zero because nothing has been done in well

over 20 years, and that applies to management procedures, equipment, and analyses of littoral processes in the offshore regime.

DR. LE MÉHAUTÉ: Dr. Le Méhauté agreed with Mr. Murden that the research community doesn't exist and has to be created. He felt CERC should be a very significant participant in that creation.

MR. MURDEN: Mr. Murden said the only university in the United States that has any research facility at all is Texas A&M. And under this program, he invisioned that where facilities exist such as dredge loops, even though they're limited, the Corps could utilize them as was done in the Dredged Material Research Program. He said the major effort would have to come from the Corps, from the Federal Government with contributions being made by firms and universities and others.

MR. CALHOUN: Mr. Calhoun cited the Dredged Material Research Program which was at the time the largest program ever undertaken by the Civil Works Directorate at $33 million. He said that approximately 65 to 70 percent of that study was contracted out, and that which wasn't contracted out was generally in the first and the last years where planning was going on in the first year and synthesis reports were being prepared in the final year. He said there would certainly be a very massive amount of contracting in the new program.

DR. NUMMEDAL: Dr. Nummedal said one of the next steps in the program is to pull together a community of people that understands the dynamics of sediment transport in estuaries and have them formulate some of the key questions. Draw on the people that have studied estuaries and marine harbor circulation regardless of what their objectives were in the past, bring them to a workshop and identify the key scientific problems. He said there are a lot of answers out there already that we clearly need to know about rather than duplicating that effort.

BG KELLY: BG Kelly stated that CERB's theme for 1985-1986 was to look into some of the Chief's initiatives including innovative funding, big payoffs, dredging, and field collection data. He said he would like to add another area--education and training of Corps coastal engineers.

He said this whole effort has taken on an additional importance because the Chief has received a number of suggestions from Dean O'Brien over an extended period of time. O'Brien feels that the Corps is losing their expertise in coastal engineering, that because of the Corps' limited coastal opportunities, coastal expertise ought to be consolidated at Division level as opposed to District level. Other concepts would be to have district centers of expertise. Perhaps a planning associates program can be adapted to the coastal engineering area.

DR. HOUSTON: Dr. Houston said that in a lot of the District Offices there are no coastal branches, and no real path for promotion; therefore, there are a lot of people who get experience and then leave that particular area.

DR. MEI: Dr. Mei stated that from the point of view of the Massachusetts Institute of Technology (MIT), the number of American students going into the coastal engineering specialization is decreasing. Most of the graduate

students at MIT are foreign. He finds that many responsible engineers presently in the coastal engineering area very often get their formal training in coastal engineering by on-the-job training. He feels that the WES initiative of getting into the education area is a very positive approach but welcomes this approach with mixed feelings. It is making use of the facilities, manpower, and experience at CERC, but it is putting itself at a competitive level with existing university programs.

MR. MURDEN: Mr. Murden stated that coastal engineering and dredging are interrelated and should be treated in that fashion. There is no university in the United States and only one in the world that offers degrees with major emphasis on hydraulics/dredging, which is Delft. Mr. Murden suggested that the Board include dredging as a part of the institute planning.

DR. NUMMEDAL: Dr. Nummedal said that the most important aspect of postgraduate education is for people to continuously interact with other people involved in the process of generating new knowledge. Professional people interact by attending professional meetings, by publishing papers, and by reviewing each other's papers. He said CERC is doing an excellent job at this, but engineers in the Districts should be encouraged to get more involved in that level of professional interaction so that they continuously renew their own understanding of coastal engineering as new concepts are developed.

MR. KENNON: Mr. Kennon said that as a technical engineering specialty, coastal engineering is a key and vital feature of Corps specialties in the engineering discipline. He felt that the emphasis at the command level should be to support classification and a classification structure that would recognize coastal expertise.

MR. WANKET: Mr. Wanket stated that workload challenge is a key to maintaining any expertise in any function, including coastal. He believes the coastal workload in the Corps of Engineers has been declining for the past 5 or 10 years. The South Pacific Division recognized this about 3 years ago and took coastal engineering away from the San Francisco District and created a center of competence at the Los Angeles District. The Los Angeles District is now responsible for all coastal engineering for the South Pacific Division and essentially along the coast of California. That has had its problems. The problem of one District doing work for another District is always difficult to sort out. There's always a problem of functional relationship between the engineering, the planning, and the operations arena. But he feels it is a solvable problem.

COL LORD: COL Lord stated that some of the suggestions with regards to furthering the coastal engineering community in the Corps of Engineers are perhaps overly optimistic with regards to what might be expected in the way of fruition in a time of real fund and manpower constraints. Clearly, centralization is not always welcome. From a District point of view, the major source of funds that could be available to support the coastal engineering community, short of having new projects, is dredging. The Portland District doesn't anticipate very many new projects on the coast in the cost-sharing environment because the big projects have already been completed. All three Districts in the North Pacific Division that are on the coast have fairly good dredging programs. He stated that perhaps if the Corps finds a better way to

cut the costs of doing business in the dredging arena and becomes more competitive, a spinoff from that might be to bank some of that money in the furthering of the coastal engineering community.

MR. WANKET: Mr. Wanket said the O&M people in the Chief's Office have been extremely cooperative in financing research-and-development-related activities if they can see a payoff at the end. He gave three examples in SPD. The first is the dolos project. Secondly, the Oceanside sand bypassing system that is currently under construction in California. And lastly, the remote sensing activity that Jesse Pfeiffer spoke about eariler. All three are highly successful O&M-related activities that have great potential for a payback.

BG KELLY: BG Kelly suggested forming a committee composed of members from the field, WES, and the Chief's Office to review the Corps' workload, look at the education, look at the interchange between CERC and the field, and lay out something that perhaps the Board might consider at the next meeting.

BG(P) ROBERTSON: BG(P) Robertson said that the first thing that the group has to look at is requirements--not just in coastal engineering but also in dredging.

MR. SMITH: Mr. Smith indicated that in July CERC will conduct six workshops in coastal regions around the Nation to brainstorm software and hardware needs related to the coastal engineering workload around the Nation. He said it would be quite easy to adapt the workshops and discuss Corps requirements in coastal engineering and dredging.

BG KELLY: BG Kelly said that was an excellent idea, and added an additional subject matter--education and training of coastal engineers. He wanted John Housley, Jay Lockhart, Jesse Pfeiffer, Herb Kennon, and Charles Calhoun to report at the next Board meeting on the outcome of the workshops.

CERB FIELD TRIP

INTRODUCTION

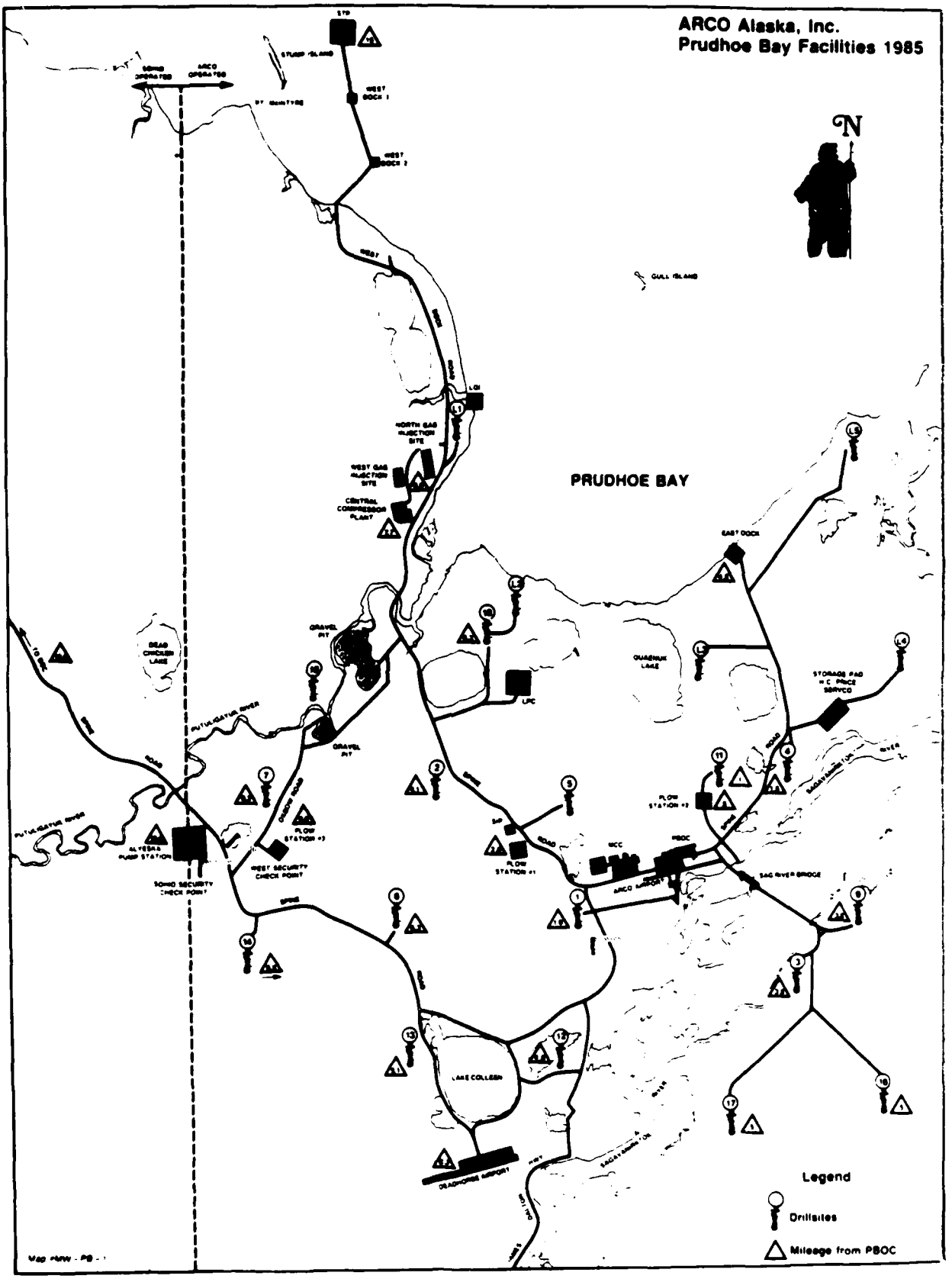
The Alaska District planned an exciting and informative field trip. The first place visited was the North Slope of Alaska, 400 miles north of Fairbanks, 250 miles north of the Arctic Circle, and 1,500 miles south of the North Pole. On 14 May a chartered plane flew the CERB meeting participants from Fairbanks to Prudhoe Bay on the North Slope, the largest oil field yet discovered in the United States. While in the Pruhdoe Bay area the meeting participants visited Pump Station No. 1 on the Trans-Alaska Pipeline, a well drill site, and the seawater treatment plant. The seawater treatment plant treats water from the Beaufort Sea for pressurization of the Prudhoe Bay oil field through water flooding.

On 15 May the chartered plane took the meeting participants to Valdez, Alaska. Valdez is the terminal point for the 800-mile Trans-Alaska Pipeline. The facilities that were visited at the terminal site were the ballast water treatment system, tank farms, and tanker berths. This section includes location maps and photographs of sites visited.

PRUDHOE BAY ITINERARY

14 May 1986

12:45	Arrive ARCO Airstrip
12:45 - 16:00	Sagavanirktok River Bridge via Spine Road
	Alyeska Pump Station No. 1 (Pipeline Milepost 0.0)
	Flow Station No. 3
	Putuligayuk (Put) River Bridge
	Put No. 23 Gravel Pit
	Put River pipeline crossing via Spine Road/ West Dock Road
	Dockhead No. 3
	Central Compressor Plant
	Seawater Treatment Plant (Tour of Fish Bypass)
	Return via Spine Road
	Prudhoe Bay Operations Center (PBOC) (visit living quarters/refreshments)
17:45	Arrive Fairbanks International Airport


ARCO Alaska, Inc.
Prudhoe Bay Facilities 1985
N
PRUDHOE BAY
GULL ISLAND
STUMP ISLAND
WEST DOCK
EAST DOCK
LPC
GRAVEL PIT
GRAVEL PIT
PUTULIGAYUK RIVER
ALYESKA PUMP STATION
SOHIO SECURITY CHECK POINT
WEST SECURITY CHECK POINT
FLOW STATION #3
FLOW STATION #2
FLOW STATION #1
WCC
PBOC
SAG RIVER BRIDGE
LAKE COLLEEN
OLIKTOK AIRPORT
Legend
Drillsites
Mileage from PBOC

MARINE TERMINAL ITINERARY

15 May 1986

Ballast Treatment Facility

Vapor Recovery Facility

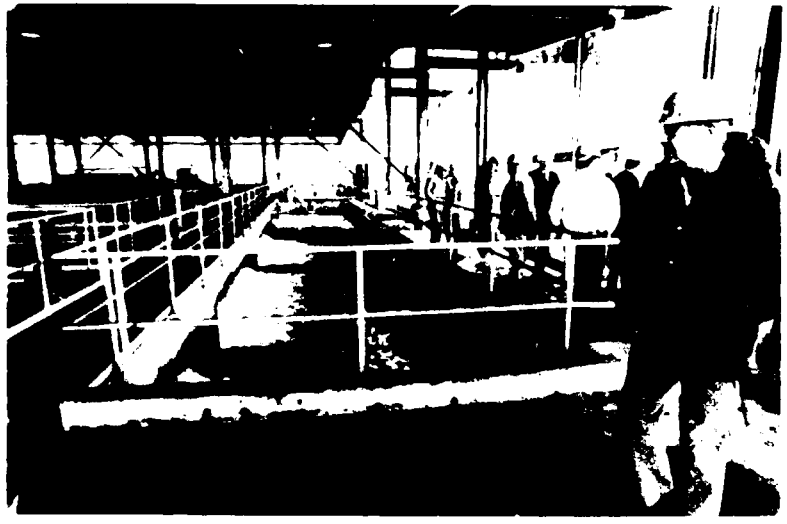
Fire Protection System

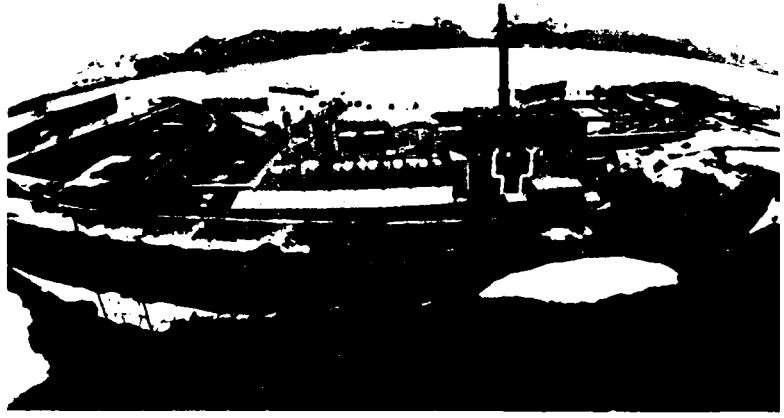
East Tank Farm

Floating Tanker Berth

PRUDHOE BAY, ALASKA (Continued)

PRUDHOE BAY, ALASKA (Concluded)





MARINE TERMINAL, VALDEZ, ALASKA (Continued)

MARINE TERMINAL, VALDEZ, ALASKA (Concluded)

DISCUSSION OF FIELD TRIP

DR. MEI: Dr. Mei said he was fascinated by a lot of interesting and challenging problems peculiar to the cold coastal regions, for example, the movement of ice, the permafrost problem, and the transport of fragile ice. It's clear that nearly all the research is now being done at the Cold Regions Research and Engineering Laboratory (CRREL). He wondered whether this would also be a useful area for CERC to take some part in in order to contribute their expertise in hydrodynamics. His understanding is that CRREL has a lot of expertise on the physical properties of ice, snow, and so forth, but they are not strong in hydrodynamics. This seems to be a very fruitful area in which CERC can contribute, so that the cold regions need not be entirely the domain of CRREL.

DR. NUMMEDAL: Dr. Nummedal extended thanks to the Anchorage District Office for having arranged this field trip. He was particularly impressed with the Valdez terminal and some of their treatment facilities. He said "what we see here in Alaska is a result of a very conscious and well-planned effort at establishing an industrial activity without any detriment to the environment. I'm particularly impressed since, as you all know, I live in Louisiana where it unfortunately appears that the state has ignored its responsibilities with the environment. The kind of concern that is displayed at the Valdez terminal today, in terms of the quality of the water that they released, is not even an issue, apparently, in many of the gulf coast states. I think that should be pointed out as being credit to the State of Alaska and to the Corps of Engineers and the other agencies that are involved in controlling and permitting the activities that go with the oil industry in this state." He went on to say that in addition to seeing CERC get involved in coastal issues, he would also like to see that the Corps make an effort to get the University of Alaska more involved in research and development related to Alaska's coastal zone. It would be very useful to the academic community, to the industrial community, and to the State of Alaska if the Corps could encourage the development of coastal engineering expertise within the university structure in this state.

BG(P) ROBERTSON: BG Robertson expressed his appreciation to the Alaska District for the outstanding arrangements they made and also for the courtesy extended by the aircraft crew.

One reason he wanted to get the Board to Alaska was to involve it with the oil industry. BG Robertson was pleased at the openness of Vic Manikian and Jim Posey and the offer of the bibliography of studies and papers that have been done. He encourages CERC to take a close look at that. He said the Corps needs to establish a very close relationship with the industry and their research capability. During the field trip a question came up on the wave data collection that the Corps has in the Prudhoe Bay area, the Beaufort area, and other areas around Alaska. Until about a year or so ago, the Corps had a joint program going with the State. It was joint-funded to collect wave data. The State is not participating in that any longer. The Corps needs somehow to impress the State, perhaps a letter from the Board to the governor commenting about what the CERB learned here and praising his state and saying, "By the way, we would like to get a little more wave data collection, but jointly with the State."

BG Robertson went on to say several years ago the Corps conducted some Section 32 stream bank erosion tests. "We tried everything from controlled ice revetment protection to old tires and trees and everything else to try to control erosin of this tremendously braided river system here. We currently have about 10 groins built out to protect those levees, millions of dollars worth of investment. We have to come up with some better ways to do that, not only to protect large structures like our Federal structures but ways to give to local interests." He said the Alaska District provides a tremendous technical service to private concerns, principally to protect the shores along these rivers to keep homes and private roads from washing away.

BG KELLY: BG Kelly said he did not realize before he came to Alaska the extent of the regulatory effort required in this state. Forty to sixty percent of the state is, in one way or another, wetlands. It all has to be regulated. He said "I don't know whether you picked up a comment that George Robertson said yesterday about isolated wetlands, but there was a recent ruling that the EPA counsel made last fall and has been subscribed to by the Corps of Engineers. It basically says that small isolated wetlands that either are in use or could be used by migratory waterfowl are now subject to 404. And, in this state, that has very serious implications."

MR. PFEIFFER: Mr. Pfeiffer said that in looking over the program of both laboratories, CERC and CRREL, in the past couple of years, "we have made some starts toward strengthening ties between CERC and CRREL. The strong hydraulic knowledge, working together with the ice knowledge, will produce good benefits. And we will follow up on that."

BG KELLY: BG Kelly suggested getting the two labs together in a joint one- or two-day session and just go over where the interfaces could be made.

MR. STORMER: Mr. Stormer said that for the last two years the state has not been able to participate financially with the Alaska coastal data collection program. The program itself is still active and viable. There are a number of project-oriented possibilities that will be potentially coming up this summer.

MR. RICHARDSON: Mr. Richardson said the state was traditionally supposed to be the biggest contributor of the three, the State, Alaska District, and CERC, to the field wave gaging program. Without State support, he thinks it's fair to say that the program will probably be in a maintenance problem mode with what already exists.

BG(P) ROBERTSON: BG(P) Robertson asked if the problem is that the Corps has been unable to persuade the State of the tremendous payoff that they can get. He suggested maybe a letter to the governor might help.

COL GREGORY: COL Gregory said his discussion with Commissioner Dick Knapp on this subject was basically that the Department of Transportation is supportive of our efforts. But in the last two years nothing has happened in terms of appropriation.

MR. STORMER: Mr. Stormer said that at the moment the District has wave gages out at Homer, two Waverider buoys out in the bay, and staff gages at Wittier.

There is a site at Akutan, but it's not working right now because the shore power is down. There are a lot of other wage gages around.

BG KELLY: BG Kelly asked if the Alaska District integrates with them, "Do you get information from all of them?"

MR. STORMER: Mr. Stormer answered no but said it's desired. He said much of the information comes from the oil companies, and sometimes that's proprietary type of information.

BG(P) ROBERTSON: BG(P) Robertson said we're finding the oil companies a lot more open now. He discussed that specifically with Jim Posey, Vice President from ARCO. Mr. Posey stated he saw no objection whatsoever in sharing that type of data.

MR. PFEIFFER: Mr. Pfeiffer made an additional comment on wave gaging and that was for North Pacific Division and Alaska District to keep an eye on the on-going CODAR field demonstration. This may offer a new opportunity to have a gage that can move around and be more cost-effective than the ones that are presently available.

BG KELLY: BG Kelly asked someone to comment about the University of Alaska, and integrating some of their work with the District.

MR. BOUZON: Mr. Bouzon responded by saying that right now CRREL is working up a memorandum of agreement with the University of Alaska to exchange people, data, etc. The University is taking some really big cuts in their budgeting because of the general decline in fund levels throughout the state. As a result, they are interested in setting up a much better relationship with CRREL. In the past they have had a very good informal one-on-one relationship with CRREL's principal investigators. But it's strictly been very informal, and that is being formalized right now.

MR. LOCKHART: Mr. Lockhart suggested that CRREL might want to consider bringing the oil companies into these memorandums and maybe some of the fishing industries, too, and get as much interaction and exchange as possible.

MR. WANKET: Mr. Wanket said that the integration of the CERC folks with the bank protection business is sorely needed. He urged that CERC folks take advantage of the knowledge of the committee on channel stabilization, an existing organization heavily involved in this sort of activity and in the Section 32 demonstration program for low-cost, bank-protection methods. This program was completed a year or two ago, and there are a lot of data available.

MR. OLIVER: Mr. Oliver said that NPD has some real coastal erosion problems, and the hydrodynamics of coastal erosion are somewhat different than that of river erosion. He thinks this is one field that maybe CERC could get into much deeper than they are now, developing practical designs for coastal erosion problems. NPD had a lot of erosion on the Oregon coast last year, with a lot of rock dumped down there and a lot of rock lost. He said there isn't any real efficient method of taking care of those kinds of erosion problems.

MR. WANKET: Mr. Wanket said he thinks CERC's involvement in all sorts of coastal erosion, whether it be from river systems or from coastal processes, is important.

MR. OLIVER: Mr. Oliver said that one of the things he has seen on this trip is the oil companies' involvement in concrete mattresses. That seems to be an approach that could be very productive. He thinks it would be a big payoff item to find the limits of that revetment. He feels concrete mattresses might be a solution to many erosion problems.

DR. MEI: Dr. Mei seconded the opinion expressed by Jay Lockhart and a lot of other people that the oil companies really should be brought in as much as possible. The activities of CERC in coastal problems should be expanded with the help and collaboration of the oil industry. It seemed to Dr. Mei that in many aspects (for example, wave data and engineering solutions to coastal problems) the oil companies may have knowledge or access to data superior to that of CERC or other Federal agencies. He feels that their experience could be made use of much more productively if CERC would take an active role in going into the area of coastal problems in cold regions.

DR. NUMMEDAL: Dr. Nummedal felt that there is a reluctance on the part of many engineers and scientists to inquire into oil company research results and data because of the belief that everything is proprietary. But he gave an example that the companies are willing to release the upper 2 sec of the seismic reflection profiles to map out subsea permafrost in the Beaufort Sea. He said the primary thing the oil companies want to keep secret is data as to where the oil is in the subsurface, essentially before they have bought the leases.

MR. REEDER: Mr. Reeder said that, dealing with the regulatory program, the District has some experience in this area of proprietary information with the oil companies. He said in most of the cases they consider a lot of that information proprietary because they are in competition with other oil companies. They are very restrictive with their information because in some cases they spend a lot of money to get that data. It's not that they don't want anybody else to use it, but they want whoever is going to use it to pay for it.

MR. PFEIFFER: Mr. Pfeiffer stated that the Canadians take a very different approach. They work hand in hand with their companies in joint funding and therefore the data are much more open. US companies seem to go at it by reinventing the wheel and holding it close to their vest. Mr. Pfeiffer suggested a meeting with them to explore some joint problems.

MR. RICHARDSON: Mr. Richardson said that CERC has had success in the past in working with the oil companies in areas where CERC has been able to show that it was to everybody's benefit to share the information. An example of this is the hurricane surge data collection in the Gulf of Mexico where CERC gets data periodically that the oil companies take on the offshore rigs and where they allow CERC to install gages on some of their rigs. He said we have to be able to show them there's a benefit to them giving us access to the information.

REGULATORY PROGRAM IN ALASKA COASTAL AREA

Mr. Larry L. Reeder, Chief
US Army Engineer District, Alaska
Special Actions Section
Regulatory Branch
Anchorage, Alaska

INTRODUCTION

The Alaskan coastline totals more than 34,000 miles, encompassing a wide variety of coastal ecosystems of immense natural resource value. The main portion of our regulatory workload is in coastal areas.

BACKGROUND LAWS AND REGULATIONS

The Rivers and Harbors Act of 1980

This Act requires a permit for all work affecting the navigable capacity of navigable waters of the United States. Permits are required for all work in, under, or over a navigable water of the United States.

Section 103 of the Marine Sanctuaries Act

This Act only has relevance in the coastal area and requires a Department of the Army permit for the transportation of dredged material for the purposes of disposal in a designed open ocean disposal site.

Clean Water Act

This Act requires a permit for the discharge of any pollutant into a water of the United States under various sections of the Act including Section 404.

Section 404

This Section covers permit requirements for dischargers of dredged and/or fill material into a water of the United States including wetlands as defined by our regulations.

REGULATORY PROCESS

The regulatory process for permitting discharges of dredged and/or fill

material formally begins with the receipt of applications for a permit. After receipt of the application, a public notice is published giving the public an opportunity to make comments on the proposal and to request that a public hearing be held. After the public notice comment period, the Corps completes its evaluation of the permit.

The National Environmental Policy Act (NEPA) requires that all major Federal actions, including all permitting activities, be assessed as to their expected impacts on the environment before making the decision or taking the action.

INFORMATION NEEDS

Hydrology Considerations

Routine requests for assistance are made in-house on currents, flow, velocity, erosion potential, deposition, bed-load transport, longshore transport, and other concerns.

Hydrodynamic Modeling

On larger projects where baseline information is limiting, impact projections may be provided through the use of water quality modeling. These models for the most part must be developed to meet the specific site conditions encountered in the arctic.

Fishery Impacts

Just determining what "habitat" or physical impacts may result is not enough--we must also try to show what it means as a practical matter. For most developments in coastal areas this means the impacts to fish and other marine resources that are important to man.

Agency Review and Public Coordination

Each action is coordinated with the resource agencies and the public. This helps us to keep a balanced program.

TYPES OF PROJECTS

Seacoast Communities

Water access is one of the major transportation links with the outside world and almost all communities have associated docking facilities.

Docks, Piers, Etc.

Docks, piers, and related facilities run the full range from simple to complex. Some are marinas and boat harbors; others are simple floats for occasional private use.

Gold and Gravel Mining

Many gold- and gravel-mining operations have been proposed and operated in marine waters. Some are small private use operations, and others involve more than a million cubic yards.

Causeways

The use of causeways for various purposes has been one of the most difficult issues to deal with. This is due primarily to the potential for significant impacts and to our limited knowledge of most areas from a natural resource standpoint.

FUTURE NEEDS

Baseline Data

These needs range from basic field reconnaissance to full-fledged maping and database informational programs.

Research Needed

More basic research is needed before we will truely know causeway impacts and if there are viable alternatives to using a causeway, such as a subsea pipeline. Basic research into life histories and habitat preferences of marine fishes is another area that needs attention.

Regional Modeling

Regional modeling for the North Slope of Alaska is an area of needed investigation. We expect this to have a big payoff in saved time and money for future decisions and in more acceptable results of future modeling that may be required. Our efforts are aimed at serving our customers, the general public, and protecting the public interest as it relates to Alaskan coastal areas.

DISCUSSION

BG(P) ROBERTSON: BG(P) Robertson asked whether the District has officially designated the alpine tundra as wetland or was it a case-by-case basis.

MR REEDER: Mr. Reeder answered that it is still a case-by-case basis. "We know from our investigations that the alpine are montane type of tundra and that roughly about 15 to 20 percent of that would be purely classified as wetlands. Now, there are lots of tundra that are unvegetated, for example, in the high alpine areas that we would not consider wetlands."

BG(P) ROBERTSON: BG(P) Robertson then asked, "the impact of the recent policy clarification on any area that is or could be used for migratory bird use, would almost lock that in, wouldn't it?"

MR. REEDER: Mr. Reeder answered, yes, that those mountains and alpine tundra areas, particularly those that have ponds or open water areas associated with them, are used consistently by waterfowl. Recent policy guidance, particularly with EPA's indication of what they would like to see is, "not that we would have to prove or take a picture or document it if one was there, but is it acceptable to being used? So, it makes it kind of difficult for us sometimes to eliminate."

BG(P) ROBERTSON: BG(P) Robertson stated that a lot of these areas are smaller than a 10-acre limitation; therefore, there is a large application of general or national permits on these areas.

MR. REEDER: Mr. Reeder agreed and said that the projects less than 10 acres would not require an individual permit in most of those areas, particularly if they're above the headwaters up in the high mountain areas.

NORTH SLOPE HYDRAULIC MODELING ACTIVITIES

Mr. H. Lee Butler
Supervisory Oceanographer
Coastal Engineering Research Center
US Army Engineer Waterways Experiment Station
Vicksburg, Mississipppi

ABSTRACT

CERC has been assisting the US Army Engineer District, Alaska (NPA), by providing technical review of studies performed in support of proposed coastal projects in the Beaufort Sea. The Prudhoe Bay area has been the focus of drilling activities since the discovery of vast oil deposits on Alaska's North Slope in 1968. To facilitate drilling and production operations at offshore locations, various oil companies have proposed offshore fill islands and gravel fill causeways. These projects can be expected to alter current and circulation patterns and water quality in the vicinity of the project. To support an environmental assessment or impact statement, oceanographic and modeling studies have used results from numerical models of Prudhoe Bay and adjacent lagoonal waters as a primary basis for determining levels of impact. This paper briefly describes the oceanographic processes that characterize the North Slope, reviews the previous model studies of the Prudhoe Bay area, and presents the concept of a North Slope regional model technology.

INTRODUCTION

The US Army Engineer Waterways Experiment Station (WES) was requested by NPA in 1984 to provide expert technical advice and comment relating to projects in the vicinity of Prudhoe Bay, Alaska. The projects included existing and proposed gravel fill causeways extending from the shoreline to fill islands over 2 miles offshore. The primary purpose of WES's review effort was to address the adequacy of numerical hydrodynamic and transport modeling studies used to support conclusions regarding impact of existing or proposed causeway projects on the circulation and water quality (temperature and salinity) of water bodies adjacent to the projects. Reviews have included examining model studies associated with the extension of the existing West Dock Causeway (Waterflood Project), the newly constructed Endicott Causeway, and the proposed Lisburne Causeway to be constructed within Prudhoe Bay.

AREA PROCESS

The oceanographic and coastal processes that characterize the North Slope area near Prudhoe Bay are very complex and difficult to model precisely. The environment also can impede collection of field data to support model application. Circulation in Prudhoe Bay and nearby water bodies is dominated by wind forcing. Tide range in the study area varies between 15 and 30 cm. Offshore tidal currents are usually less than 7 cm/sec but can reach substantially higher speeds in inlet entrances to lagoon areas adjacent to Prudhoe Bay. Wind-driven currents have been shown to be about 3 to 5 percent of the wind speed. Ice-free nearshore waters exist between the period from mid-July to late September. River discharge rates, particularly from the Sagavanirktok (SAG) on the east side of Prudhoe Bay and from the Kuparuk on the west side, are highest in June and diminish substantially during the summer months. Area hydrodynamics are complicated by a two-layer system of colder marine water in the lower depths (usually held to a depth of 4 m below the surface) and warmer, brackish water in the upper layer. All of these processes have a substantial effect on the salinity and temperature of the neighboring water bodies, in particular Prudhoe Bay and adjacent lagoons west of the West Dock Causeway.

HISTORICAL MODELING EFFORTS

Figure 1 displays existing and/or proposed oil-industry-related projects in the Prudhoe Bay area. To date, four modeling studies have been conducted to provide data in support of area oil production projects. Three of the studies involved the application of two-dimensional hydrodynamic numerical models including applications in support of an extension of the West Dock Causeway (Waterflood Project), construction of the Endicott Causeway, and the proposed Lisburne Causeway. In all of these studies, a major criticism dealt with applying uncalibrated, unverified models. Recently, owners of the Lisburne Project funded a new effort to overcome limitations and deficiencies of previous studies. This investigation called for the application of a three-dimensional model to the Prudhoe Bay area. The model used was applied in a rigid-lid mode and the calibration/verification results were not convincing.

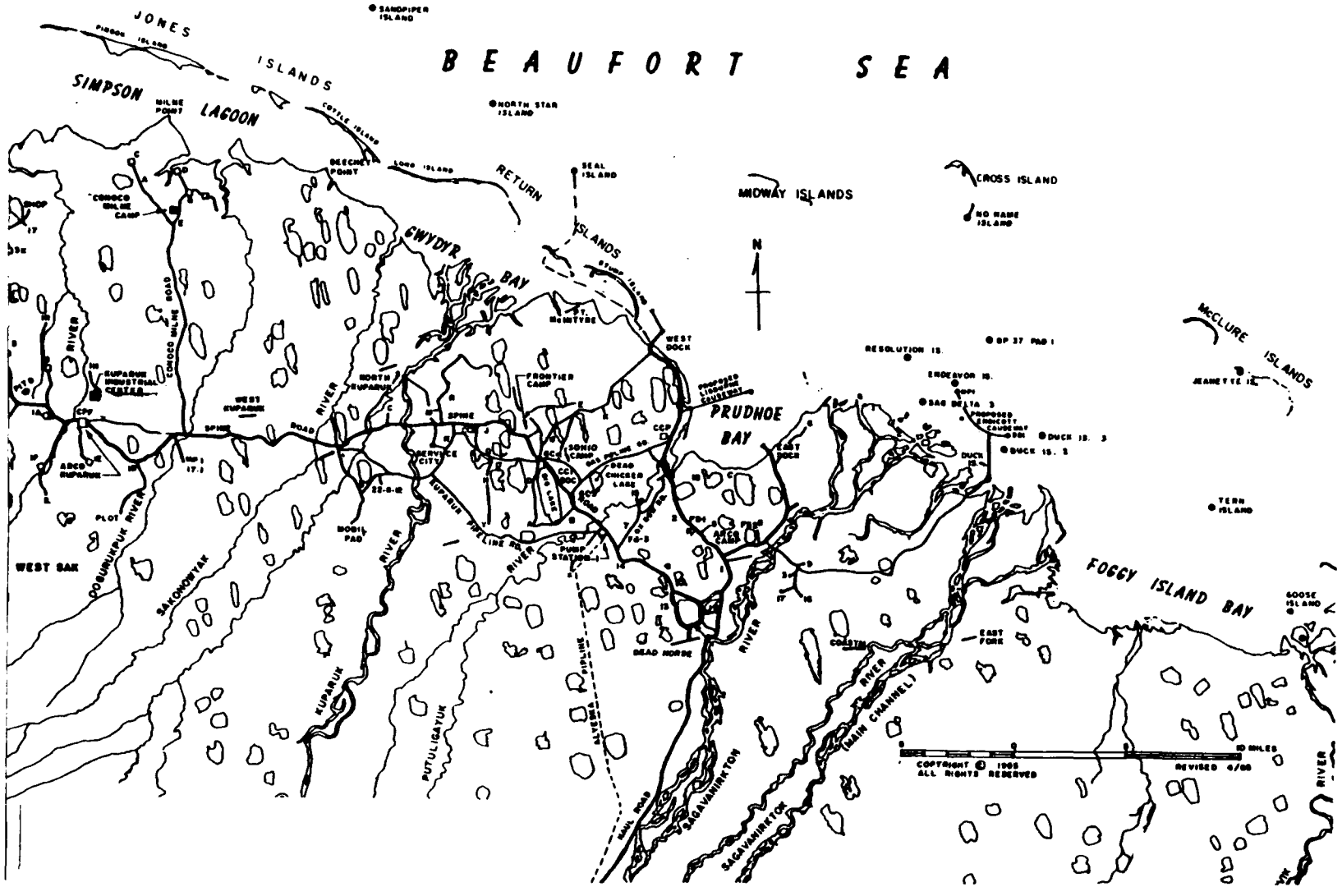


Figure 1. Existing and proposed oil-industry-related projects in the Prudhoe Bay area (used with permission from Alaska Telecom, Inc.)

REGIONAL MODELING METHODOLOGY

In addition to the causeway projects mentioned above, several other potential causeway sites have been identified for the North Slope area. Each project individually has the potential to significantly influence coastal processes in Prudhoe Bay and the neighboring vicinity. Because of the large number of projects being proposed, NPA has identified a need for a methodology to investigate cumulative impacts from multicauseway projects. Mathematical modeling is the only viable means to incorporate all the detailed dynamics influencing the North Slope area into a quantitative predictive tool. What has been suggested is the development of a regional modeling methodology, employing appropriate spatial and temporal resolution, to investigate coastal processes with established confidence limits.

To determine the benefits of a regional model and the best way to proceed in developing such a model, NPA hosted an interagency meeting of the US Army Corps of Engineers, US Fish and Wildlife Service, National Oceanic and Atmospheric Administration(NOAA)/National Marine Fisheries Service, Minerals Management Service, Environmental Protection Agency, various State of Alaska departments, and the North Slope Borough. Discussions at the meeting focused on problems dealing with fish habitat. Because native fish populations are sensitive to brackish water zones, it is important to be able to estimate project impact on these zones. Questions raised can be summed up into two: (a) what happens if a solid-filled causeway is placed so to interrupt fish migration patterns, and (b) are breaches in these causeways effective in mitigating these interruptions? All agreed monitoring is absolutely necessary; however, monitoring is insufficient to establish impacts in a predictive sense. The concensus was that some type of methodology is needed to assess cumulative impacts of existing and proposed oil exploration projects. Resource agency responses echoed that the key point in the development of a regional model is making the hydrodynamic model operational.

In developing components of a regional oceanographic modeling system, many aspects of the problem need to be carefully considered. Among these are the physical processes to be modeled, domain of interest, data requirements, and required computer resources. The hydrodynamic/transport models of the regional system are the key models to be developed in an initial effort.

Three other types of associated models are required to permit simulation of certain physical processes of interest: (a) a model for generation, melting, and movement of ice; (b) a storm/wind model; and (c) an oil-spill trajectory model.

Oceanographic and meteorological data will be required to calibrate and verify all of the models mentioned above. High costs may prohibit conducting a new field data collection effort to obtain synoptic data over the entire model domain. Large data sets from the Prudhoe Bay area have been compiled over recent years. These data are associated with studies performed in support of various causeway projects and with monitoring requirements as part of the Waterflood and Endicott Projects. Additional data sets exist and have been used in calibrating other models of the Beaufort Sea and Prudhoe Bay area. Availability of these data sets is unknown and should be investigated in an initial phase of the regional model development. However, modeling efforts could be initiated now and utilize available data to achieve a first cut at calibrating a regional modeling package.

The end product of a regional model development should be a model package coded in a user-friendly manner and transportable between computer systems. The model system must be well documented and training procedures established. To gain acceptability, the model system will have to be calibrated and verified (although not completely in an initial effort) and made available to any potential user. Expected usage will come from Federal, State, and local agencies, as well as private industry. Even with excellent training and documentation, the model package will be exposed to misapplication. This fact may require a review committee to be established to examine model applications and conculsions drawn from these applications.

DISCUSSION

DR. NUMMEDAL: Dr. Nummedal said one of the key questions along the whole Beaufort coast is the lack of reliable, long-term time series data on storm surge levels, separating the astronomical tide from wind-driven tides, etc. He asked what was being done to establish a basic network of gages to start developing that kind of time series.

MR. BUTLER: Mr. Butler answered that as far as he knew there is no defined effort to set up that kind of network that would provide data for a full-blown numerical study. The data being taken is attempting simply through a monitoring effort to quantify what's happening.

BG(P) ROBERTSON: BG(P) Robertson stated that the District wants to determine the accuracy of determining impacts in the natural environment as predicted by modeling. He asked if there is an equal amount of effort being made in this particular area to determine the significance of those impacts. He asked, "Who cares if it's 7 parts per million or 13 parts per million? Is there a significance? Is there an equal effort to determine that?"

MR. REEDER: Mr. Reeder answered yes, there is. He said the District is very sensitive to that "so what" question. He said, "The only way we have to address it right now is with the little bit we know about the life histories of the various fishes and organisms that may be affected."

He said right now all they have to go on is very little real hard scientific information and a lot of professional expertise and professional opinions. "The bottom line is we really don't know and that's why we're in a quandary in making some of the decisions. We truly don't know how to accurately predict the impact on the organisms that may be affected."

BG(P) ROBERTSON: BG(P) Robertson noted that there's a recent push to do away with the worse-case analysis situation which was in the realm of hypotheses. He asked if doing away with the worse-case analysis is going to help in making decisions to get to the 70-percent assurance level rather than 95-percent assurance level on significance of impact.

MR. REEDER: Mr. Reeder answered that the new guidance on that will help relieve some of the documentation and the strenuous application of the worse-case analysis. However, in the particular instance in Prudhoe Bay, Endicott, the four or five years of monitoring have provided a little clearer picture of what was happening with the habitat. Mr. Reeder stated further that one of the things modeling will do is will help better quantify the amount of habitat that is being affected and how much that change is.

BG(P) ROBERTSON: BG(P) Robertson asked if the data collected through the monitoring program was plugged back into the modeling for verification.

MR. BUTLER: Mr. Butler answered that a portion of the data that was collected was used to attempt to calibrate and verify that modeling.

MR. REEDER: Mr. Reeder pointed out that Batelle Northwest Pacific Lab used 4 years of physical oceanographic data that were generated by the monitoring program in running their models.

DR. LE MÉHAUTÉ: Dr. Le Méhauté asked what time of the year was the worst impact.

MR. BUTLER: Mr. Butler answered that the open season is only from mid-June to September. That's the only time you have the open water season and the greatest impact. The Sag River is just to the east of Prudhoe Bay and is the major discharge in the area. The winds change from west to east at night and the warm water, which is a habitat for the fish, seems to move back and forth in the lagoons to the west of Prudhoe Bay and back again on the other side of the Sag. The question is what is the impact on the movement of that water mass.

DR. LE MÉHAUTÉ: Dr. Le Méhauté asked if it is ice covered at that time.

MR. BUTLER: Mr. Butler said no but broken ice can move in and out. In the major open water season between July and September, ice is not really a major problem.

DR. MEI: Dr. Mei asked what the most important input parameters are in this model and what is the most important output.

MR. BUTLER: Mr. Butler said primarily the driving force, the wind and nailing down the calibration of the bottom friction and then looking at the stratification. It's basically a two-layer system.

DR. MEI: Dr. Mei asked if there is a reliable model to predict the motion of ice pieces.

MR. BUTLER: Mr. Butler said the Ram Corporation has done a lot of work on that subject.

DR. MEI: Dr. Mei said that even in the physical size of the model there is some substantial lack of information. "For example, I would tend to believe that the prediction of ice motion is still at its infancy."

MR. BUTLER: Mr. Butler said the primary problem occurs from July to September, when ice really has no influence. All models discussed were only for the open water season.

BG KELLY: BG Kelly asked about the time schedule and funding for this project.

MR. BUTLER: Mr. Butler said it's probably a two- to three-year time frame and in the neighborhood of $500,000 to $800,000.

DESIGN EVALUATIONS IN SUPPORT OF OIL PRODUCTION, MAJOR PROJECTS IN PRUDHOE BAY REGION, ALASKA

Mr. Victor Manikian
Staff Engineer
Civil/Geotechnical
ARCO, Alaska, Inc.

Development of oil resources in northern Alaska has involved the design of nearshore and offshore facilities in the Beaufort Sea. These developments also necessitated the bridging of many arctic streams. Studies have been conducted to establish design criteria for the safe and economical construction of projects to withstand their production life. This presentation addresses our experience on a number of arctic-related civil engineering topics and constructed projects in the Prudhoe Bay region.

1. West Dock and Seawater Treating Plant (Reference 1).
2. Annual sealift and Dock No. 3 design.
3. Putuligayuk (Put) River bridge ice breaker design.
4. Slope protection evaluations for arctic gravel islands (Reference 2).
5. Sagavanirktok (Sag) River training structure project.
6. Method for weakening the seasonal ice cover and reduction of ice forces on structures in northern rivers (Reference 3).
7. Culvert design considerations in the arctic for minimization of wetlands impact.
8. Effects of external loading on large-diameter buried pipelines and culverts - summer versus winter construction (Reference 4).
9. Arctic offshore seafloor hazards - strudel scour, ice gouging, ice pounding, and thermally related settlements.
10. Driving of thermally modified piles in permafrost and load tests for the Kuparuk Pipeline System (Reference 5).
11. Kuparuk River Pipeline crossing and module crossing bridge designs (Reference 6).
12. Waterflow nesting island installations in lakes in Prudhoe Bay as wildlife habitat enhancement.

REFERENCES

1. "Offshore Seawater Treating Plant, Waterflood Project, Prudhoe Bay Oil Field," ARCO Alaska, Inc. Publication, December 1984.

2. "Design Evaluations in Support of Offshore Facilities and Gravel Islands in the Arctic," Proceedings, Fourth International Cold Regions Specialty Conference, ASCE, Anchorage, Alaska, pp 235-251, March 1986 (V. Manikian, J. Machemehl, and P. Gadd).

3. "Method for Weakening the Ice Cover in Northern Rivers," Proceedings, Arctic '85 Conference: Civil Engineering in the Arctic Offshore, ASCE, San Francisco, California, pp 239-250, March 1985 (V. Manikian and G. N. McDonald).

4. "Effects of External Loadings on Large-Diameter Buried Pipelines," Proceedings, Arctic '85 Conference: Civil Engineering in the Arctic Offshore, ASCE, San Francisco, California, pp 754-762, March 1985 (H. P. Thomas and V. Manikian).

5. "Pile Driving and Load Tests in Permafrost for the Kuparuk Pipeline System," Proceedings, Permafrost: Fourth International Conference, Fairbanks, Alaska, pp 804-810, July 1983 (V. Manikian).

6. "Facility Designs in the Arctic for the Kuparuk Pipeline System," Proceedings, Pipelines in Adverse Environments II, ASCE, San Diego, California, pp 84-107, November 1983 (V. Manikian, K. J. Nyman, and U. J. Baskurt).

DISCUSSION

BG KELLY: BG Kelly asked how the concrete skirts or mats worked out as erosion control.

MR. MANIKIAN: Mr. Manikian said light mats are suitable for rivers. In open water areas in the arctic, there are more than just river problems--you have ice to contend with. He does not like gravel bags. They don't act as riprap. They don't act as a unit. He said that concrete mats are good. They are flexible to the foundation problems of sediment. He said they're using larger blocks these days, four-by-four blocks. He doesn't like large blocks because when you use large blocks there's a rule of thumb that you have to use tempered steel and reinforcement for handling the blocks which causes future corrosion problems. He prefers 2-ft blocks. They're more flexible to foundation needs and don't have corrosion problems.

The Endicott Project used a specially designed block. They thought it would be economical, and they had to manufacture it there. He said he likes to use companies that have gone through the process of developing the blocks. "We don't want to be experimenting on a jobsite. So, we're leaning toward previously established manufacturer standards. We might be casting them at the jobsite." He went on to say that's an economic problem because a block machine can be shipped over, while to have a concrete plant set up requires a minimum of so much placement. He thinks the concrete mats are great replacement to riprap. "Down in the lower 48 there's good quality rock but you don't have it up here and we just have to use some other means to fight erosion."

DEEP-DRAFT NAVIGATION FOR ALASKA OIL

Captain Andy D. Santos
Port Captain
The Standard Oil Company

Before the final decision to build the pipeline from Prudhoe Bay to Valdez was made, several alternative means of transporting the oil were considered and eight intra-Alaska routes were studied. These studies included the ice-breaking F. S. MANATTAH, giant flying tankers, large nuclear-powered submarines, extension of the Alaska Railroad, and a TransCanada pipeline. The present plan offered the best solution, i.e. a year-round, ice-free, and well-protected port.

Tankers enter Prince William Sound (PWS) at the Hinchinbrook Entrance, (6 miles wide) where the PWS Traffic Separation Scheme begins, and travel northward 65 nautical miles through PWS and Valdez Narrows (0.8 mile wide) to the terminal in Valdez Arm. A pilot is required the last 18 miles, and tug assistance is used for the final berthing at one of the four berths operated by the Alyeska Pipeline Service Company. The route is well marked and maintained by the US Coast Guard with over two dozen Aids to Navigation. Leaving tankers must be escorted to the Narrows by a tug. A tug also stands by at the Narrows for arriving tankers.

Traffic in PWS can be very heavy with over 500 fishing vessels operating in the area at certain times, in addition to other pleasure and commercial craft and the Alaska State Ferry. This requires caution and reduced speeds to prevent wake damage and to reduce the risk of collision. An anchorage area at Knowles Head is reserved for tankers and is used only with notification to the PWS Vessel Traffic Service (VTS) operated by the Coast Guard. The VTS is designed to prevent collisions and groundings and to protect the control area from environmental harm resulting from such collisions and groundings. The VTS comprises three major components: a traffic separation scheme (TSS), vessel movement reporting system (VMRS), and radar surveillance. The TSS comprises a network of one-way traffic lanes with a separation zone between. Traffic lanes (north and south bound) are 1,500 yd wide with a 2,000-yd separation zone, narrowing to 1,000 yd each at the entrance to Valdez Arm. The

VMRS is controlled by the Vessel Traffic Center which maintains continuous radio telephone communications with vessels in the service area. Radar surveillance covers the Valdez Arm, the Valdez Narrows, and the Port Valdez area. A continuous radar watch is maintained.

The diurnal tide range is 12.4 ft and 11.2 ft and occurs about the same time as Cordova, Alaska. Currents range from 1 knot to 2.5 knots, depending on location. The ebb current running out against a large swell causes overfalls which have been mistaken for breakers near the Hinchinbrook Entrance. There are also tide rips around Cape Hinchinbrook.

After the vessel is securely moored, the Chief Mate is in charge of all transfer operations, which can take from 12 to 24 hr depending on vessel size. There will be a Preload Conference between ship and terminal personnel to ensure that safety precautions and regulations are observed. Amount, loading rate, and other items are discussed to remove any doubts between vessel and terminal personnel. The ballast water is pumped ashore to be treated at the ballast water treatment facility and a dry certificate issued. Loading then begins, slowly at first, gradually increasing then gradually decreasing until topping off and shutdown. There are many methods of loading a tanker; however, the oil is generally spread more or less evenly throughout the tanks, equalizing stresses and preventing dangerous hog or sag conditions plus maintaining trim and list. When the last tank is loaded and valves secured, the amount of cargo is calculated and compared with the shore figures, and the vessel departs.

Various other items such as clean ballast, dirty ballast, storm ballast, and shore gaugers were described in the actual presentation. Also, a more detailed description of the trip into the terminal from Hinchinbrook Entrance was given. Additional details of the tankers in the Trans-Alaska Pipeline System Trade were also provided. The above items could not adequately be described in this short summary paper.

DISCUSSION

BG(P) ROBERTSON: BG(P) Robertson said that in 1977 there was pressure to blow that rock out in the middle of the approach to Valdez. He said someone said you can get eight ships abreast in there and not have to worry about it.

MR. SANTOS: Mr. Santos said that's true. There was a consideration to blow that up, but he said you could take one of those ships and go sideways through there.

BG(P) ROBERTSON: BG(P) Robertson said millions of dollars was saved on that debate.

MR. SANTOS: Mr. Santos agreed. He said the ships come in here, check in, and reduce to maneuvering speed. This means the chief engineer goes down into the engine room to put the engines on standby and they reduce the RPM's making about 14 knots and they get the pilot up in this area at Rocky Point. All the vessels from that point on until they get back to this point are navigated by a member of the Southwest Pilot's Association, a State-licensed pilot. The master of the vessel does not dock the vessel. And when the ship gets to Valdez, there are three tugs that are operated by the Crawley Corporation that help the vessels to dock. One tug has 9,000 hp, the other two 7,000-hp engine. In addition, there are two small line boats which take the line out to the end of the docks.

Mr. Santos went on to say that it's been a very safe and successful operation. The tankers transit this area, and larger vessels go to Puerto Armuelles in the Republic of Panama where the oil is pumped into a pipeline into the Caribbean side of Mexico called Cherokee Grande. From there smaller tankers take it to refineries on the gulf and east coasts of the United States. The others are smaller ships and take the oil to San Francisco, Long Beach, some to Hawaii, and some into the Puget Sound area.

Because of all the traffic that the oil has brought, the Coast Guard has more ships and aids throughout the State of Alaska then anywhere else in the United States. From the Aleutians to the southeastern end of the state, the ship lanes are covered by Loran Sea Coverage for navigation. It's been a very safe operation when considering the millions of tons that go into and out of this port.

DR. LE MÉHAUTÉ: Dr. Le Méhauté asked about the rate of occupancy of the berths.

MR. SANTOS: Mr. Santos answered that the large ship takes about 20 to 24 hr, and the smaller ships about 12. He said the problems they have which delay them are that in heavy weather as the vessels travel light from Panama, they put in extra ballast to reduce the draft of the ship to lessen the working of the ship in a heavy sea. All that dirty water has to be pumped to shore in Valdez and all ships have to pump the water out before they can load, so it may take up to 12 to 13 hr to pump out about a million barrels of contaminated water. All American ships engaged in the oil industry today have what is known as clean segregated ballast tanks. These are tanks on the ship that are dedicated completely to clean saltwater. There's no pipe, no pumps that connect it to the oil-carrying tanks. In other words, you can discharge that water in the harbor. But sometimes that isn't enough when bad weather occurs, as the ships are big and by being big you've increased stress problems. So, you start putting water in it to lessen the movement of the iron.

Mr. Santos went on to say that another common thing in the state is fog. A Japanese current that crosses down the gulf warms the water. Sometimes the

water might be 48 deg and the outside temperature is 10 deg. That causes thick fog. The old rule of thumb that the fair weather sailors out in California say is if the wind picks up, the fog will dissipate. "I've been in a gale and still couldn't see the bow of the ship." He said those rules of thumb don't work up in this part of the country and you can't buy experience just because you've got a piece of paper saying you're a mate or a master. "It takes experience. And over the eight years of our operation, our masters have become extremely experienced as you can tell from their record. Probably the safest port of this type of operation in the world."

BG KELLY: BG Kelly said he assumed the oil goes everywhere.

MR. SANTOS: Mr. Santos answered no. This oil by law is used for United States domestic use only.

DR. LE MÉHAUTÉ: Dr. Le Méhauté asked if there are four or five berths.

MR. SANTOS: Mr. Santos said there are four berths. They never built a two berth.

DR. LE MÉHAUTÉ: Dr. Le Méhauté asked about the downtime due to queuing.

MR. SANTOS: Mr. Santos answered that sometimes during adverse weather conditions they do have to put ships at Knowles Head. Generally, weather permitting, they just tell them to slow down till a berth is available.

THE COASTAL COMMUNITY IN THE STATE OF ALASKA

Dr. John B. Olson
Special Assistant to the Commissioner
Department of Transportation and Public Facilities
State of Alaska

INTRODUCTION

With three fourths of its population in coastal communities, waterborne transportation is the principal mode for movement of goods in Alaska. Tourism, in-state recreation uses, commercial fishing, timber, and petroleum companies also make substantial use of the state's waterways and waterfront facilities. With this strong dependence on marine transportation, the state is frequently faced with requirements to add or upgrade facilities. Engineering development for such facilities in the arctic and subarctic is in a number of ways different from settings elsewhere in the United States. Let's examine some of the distinguishing features of coastal development in Alaska.

DISTINGUISHING FEATURES OF ALASKA COASTAL DEVELOPMENT

Figure 1 tabulates some of the project development features that are common to Alaska, and relatively uncommon elsewhere in the United States. The features are grouped into physical, environmental, socioeconomic, and user composition categories. Shown with each feature is a checklist of representative communities where the feature is germane to planned or pending coastal development.

GOVERNMENTAL AGENCY COOPERATION

Cooperation between the Corps of Engineers and the State of Alaska will facilitate development on our coast. Naturally, we will continue to share information useful to our individual and collective projects. We should look beyond this traditional relationship to see how we can work more closely, both in technical development and in project financing. Following are two areas

EXAMPLE LOCATIONS

	KODIAK	CHENEGA	PORT LIONS	NINILCHIK	WHITTIER	HOMER	PRIBILOFS	UNALASKA	NOME	DILLINGHAM	AUKE BAY	BETHEL	ANCHORAGE
PHYSICAL FEATURES:													
o high tidal ranges:				*		*					*		
o low tidal ranges:							*	*	*				
o swell condition:	*		*				*						
o high winds:	*				*			*			*		
o currents:				*		*							*
o ice:				*					*			*	*
o socketed piles:	*	*	*					*					
o earthquake effects:		*				*							
o remoteness:		*	*		*		*	*	*	*		*	
o material availability:		*	*	*			*	*				*	
o no wind/wave data:		*	*	*	*								
o siltation:				*					*	*		*	*
o deep water:	*										*		
ENVIRONMENTAL FEATURES:													
o fish/crab:	*								*				
o bird/mammal rookeries:					*		*						
SOCIO-ECONOMIC FACTORS:													
o recreation/tourism:					*	*					*		
o military/Coast Guard:	*												
o fisheries:	*	*		*			*	*		*		*	
o resource/oil development:							*		*				
o trans-shipment:											*	*	*
USER COMPOSITION:													
o resident:		*	*									*	
o transient/seasonal:	*			*	*					*		*	
o weekend recreationists:					*	*							

Figure 1. Selected features that are prominent in Alaskan coastal development

where cooperation could be particularly advantageous.

Data Gaps

Our Department has sought funding from the State legislature for a coastal data collection program. We have had mixed success, and most recently the funds have not been forthcoming. If we can demonstrate how the data collection program leads to more cost-effective designs, and even more practically to earlier cash flow into projects, I think we will be more successful in obtaining the funds in future years. Our budgetary requests to the legislature for joint State/OCE data collection activities would be far more persuasive if they relate to projects having strong cost-sharing potential. A planning product jointly authored by the State Department of Transportation and Public Facilities (DOT&PF) and the Corps could be particularly helpful in this respect.

Cost-sharing

Sharing the developmental costs for projects provides the Federal government a demonstrated consensus of project need and a source of State-level project funding. State needs are also served by being able to leverage the State capital budget with Federal funds. We have worked on a cost-sharing basis with the Federal Highway Administration and the Federal Aviation Administration for many years. Our match percentage with these agencies is less than 10 precent, however, and our cost-sharing percentage with the Corps is typically 50 percent or more. Management of DOT&PF understands these are different programs, with totally different funding sources and legislative authorizations, and we are quite willing to participate. More importantly, as State revenues decline, such a proposition should also be attractive to our State legislature. We look forward to doing business with the Corps as full and equal partners on pending coastal work.

DISCUSSION

BG(P) ROBERTSON: BG(P) Robertson said that Trading Bay was favored by the Corps of Engineers in its feasibility study in 1975. However, the Corps was prevented from using Trading Bay because of the tremendous crab population there. He asked about the status of the return of the crab industry to Kodiak, and if there has been any change in the nesting patterns which allows the use of Trading Bay.

MR. OLSON: Mr. Olson answered that the fish and wildlife protection people believe that if you have a choice, all other things equal--equal cost, equal value in terms of facilities siting--they would prefer Dog Bay but they would not consider the crab in Trading Basin now to be so critical to keep the boat harbor out of it. He said there has been a change in attitude by the environmental protection people.

BG(P) ROBERTSON: BG(P) Robertson asked Mr. Olson if he could see the State regenerating its interest and potential funding for a broader regional programmed wave data collection system.

MR. OLSON: Mr. Olson said "Yes, I do. I don't want to say without checking, but it's possible that some of those funds survived this legislative session. We have put the money in at DOT and it's either been removed at the governor's level or the legislative level. We may have money in this year, I don't know. A common problem, with the State working with the Federal agencies, is that we view one another being somewhat monolithic, but when we look at it from our side, we are grossly pluralistic. We have the governor, we have the legislature, we have factions and individuals within the legislature. We don't understand the Federal process really at all well. What I would suggest is possibly a plan, a jointly issued technical memorandum that would identify the needs of this wave data collection program so it can be assimilated by these various people. I'm not sure everyone can nod in agreement, but at least we have something that has been delivered."

BG(P) ROBERTSON: BG(P) Robertson said that this was an excellent suggestion. He asked Mr. Olson if he thought there was any way that the Board, the body of the Board, not just Corps of Engineers, could help in suggesting to someone in the State that we initiate such a sit-down discussion on developing a memorandum agreement.

MR. OLSON: Mr. Olson said he certainly thought the Board would have a very important and prominent role in doing that.

BG(P) ROBERTSON: BG(P) Robertson asked if the Board should send a letter to the govenor.

MR. OLSON: Mr. Olson suggested he could work with Colonel Gregory, someone from the Board, or someone on the staff of the Corps to define a plan for how best to do that. It would involve certain letters to legislatures and the governor. He thought that if they were well outlined and conceived and orchestrated correctly in terms of how it would come up in the budgeting cycle, it would ensure success.

ST. GEORGE HARBOR
LOW-COST BERM BREAKWATERS IN ALASKA'S BERING SEA

Mr. Jeff Gilman, Senior Engineer
Mr. Brent Drage, Vice President
Peratrovich, Nottingham & Drage, Inc.
Anchorage, Alaska

BACKGROUND

St. George is a small island located in the Pribilof Islands in Alaska's Bering Sea. The waters surrounding St. George contain the largest concentration of bottomfish in the world and unverified but possibly vast reserves of oil and natural gas. Over the past several years the State of Alaska and the City of St. George have funded a total of $13.5 million for the design and construction of a harbor at Zapadni Bay on the southwest side of St. George.

AIMS AND OBJECTIVES

The designers were faced with the task of providing a protected moorage for a small resident fishing fleet, processors, and transient freighters. The deepwater, 50-year significant wave height was determined by others to be 34 ft with a spectral peak period of 18 sec. Because of limited funding and the remote location, it was necessary to develop a design which would maximize the use of locally available materials for construction.

TECHNIQUES USED

As a result of physical model studies at Oregon State University and at the Danish Hydraulic Institute on structure stability in Anchorage, the berm breakwater concept was developed along the lines of W. F. Baird's concept originally developed for the Unalaska Runway Extension Project in Dutch Harbor, Alaska. The berm breakwater concept consists of a large mass of stones (whatever is locally available) placed in the form of a horizontal berm. The relatively high porosity of the berm allows waves to propagate into the

structure and dissipate their energy within the berm mass.

A contract for construction of the St. George breakwaters was let in October 1984. Brice, Inc., a heavy contractor from Fairbanks, mobilized equipment to the island in November. In early November a severe storm struck the Western Aleutians generating a very high and long period swell wave train that reached the Pribilof Islands on November 13. These waves severely damaged the newly constructed breakwater on St. Paul Island 40 miles northwest of St. George. Again, on December 7, the St. Paul breakwater suffered even more extensive damage due to a severe local storm generating very high seas offshore (up to 50 ft high).

As a result of these storms, the designers undertook an assessment of the St. George design to determine if it was adequate to withstand the new design conditions posed by these storms. From this assessment came the decision to do more extensive stability modeling of the berm design. Two sets of tests were performed at the Delft Hydraulics Laboratory in the spring of 1985. The first set of tests comprised scale effects performed at scales of 1:7 and 1:35.

The second set of tests verified stability of the berm breakwater and were carried out in a basin at the 1:35 scale. The "storm" used to test the breakwater in the basin was comprised of six steps, each about 6 hr long in prototype. The storm was composed to simulate the worst possible storm wave conditions for the depth-limited situation at the harbor site in Zapadni Bay.

The construction contractor's quarrying operations produce the largest armor possible by lightly shooting bottom-loaded holes on wide centers and subsequent ripping with a super-hardened penetration point mounted on a Liebherr 966 backhoe.

RESULTS, CONCLUSIONS, AND RECOMMENDATIONS

This project is unique in several ways:

a. The utilization of a berm design for a breakwater in the most severe wave conditions a berm breakwater has been built in to date.

b. The extent of physical modeling used in the design--five laboratories in four nations.

c. The use of a worst possible storm for design, based on the depth-limited site, and the extremely high frequency of storms.

d. The consideration of 20- to 25-sec wave periods in design and modeling.

The successful completion of this project in December 1986 will demonstrate the utility of the berm concept for a severe wave environment. With the proposed completion of the rebuilt St. Paul breakwater using a conventional two- to three-layer design employing large imported armor, the cost advantages of the berm breakwater concept will be very clear. Under the current contracts, the St. George berm breakwater is running less than one third the "per linear foot" cost of the St. Paul conventional breakwater. The low cost and high stability of the berm breakwater experience at St. George implies that small communities in many of the other underdeveloped parts of Alaska and the world can now afford harbors by using locally available materials.

ACKNOWLEDGMENTS

The authors wish to point out that the City of St. George, represented by Mayor Maxim Malvansky and City Administrator Richard G. Wilson, have administered the project since 1984.

DISCUSSION

DR. LE MÉHAUTÉ: Dr. Le Méhauté asked about the depth and cost of the breakwater, also the per foot cost.

MR. DRAGE: Mr. Drage answered that it's going to cost about $13 million construction money and about an additional $2 million for the administration during the modeling. That comes out to about $3,500 per foot for the breakwater arms. The depth is going to be to -20.

DR. LE MÉHAUTÉ: Dr. Le Méhauté asked about the design wave height.

MR. DRAGE: Mr. Drage said they don't have a design wave height and that they are in a depth-limited situation. The offshore waves can get up to 50 ft. He said because of the depth-limited situation they can have the designed storm virtually every year.

BG KELLY: BG Kelly asked if the berm is all rock.

MR. DRAGE: Mr. Drage said that it is all rock. This particular rock has gradations between 1.7 and 10 tons and the gradation is very important, as well as the rock. The salt formation here produces rock between 2 and 10 tons

quite readily. He said you need a little bit of rock between 10 and 14 tons.

DR. NUMMEDAL: Dr. Nummedal said that he assumes that during certain winters ice forms around these islands and no mention was made of any effect of ice push on the berms during spring breakups.

MR. DRAGE: Mr. Drage said the ice breakups are minute. They're really not considered in the design. The reason is that St. George Island is right on the melting front of the Bering Sea ice that migrates southward. The harbor is located on the south side, so even when it encounters the island, it flows out and around. Ice is not a big factor here.

MR. LOCKHART: Mr. Lockhart asked if an estimate of the maintenance requirements for the breakwater was made.

MR. DRAGE: Mr. Drage said yes, and they are based on the available data, which include the model studies, the wave available data, the frequency, etc. One of the benefits of the berm breakwater is that it is forgiving in a sense. "You don't have your catastrophic type failures."

DR. MEI: Dr. Mei noticed that all testings were in foreign laboratories. He asked if they had considered using CERC facilities.

MR. DRAGE: Mr. Drage said that they had inquired with WES to see whether or not they could utilize their facilities. They were always under the gun with respect to time. The foreign labs were selected because of the capability of the people and the availablity.

MR. SMITH: Mr. Smith said he was involved at CERC with review of this project. He wanted to point out to the Board the extreme importance of physical modeling in the engineering and design of this project. He said "I think it's clear we were working in a realm much beyond the analytical tools available in the Shore Protection Manual. And this was the only way to design a breakwater of this innovative nature. But I would also point out that these analytical tools have their limitations in the best and most traditional of circumstances. Within the Corps we do not take advantage of the design tool of physical modeling as much as we should."

HOMER SPIT BEACH EROSION PROJECT
HOMER, ALASKA

Mr. Carlton A. Davenport, Jr.
Civil Engineer
US Army Engineer District, Alaska
Anchorage, Alaska

The two major concerns regarding the erosion of Homer Spit are the loss of the paved road which connects the City of Homer with several major commercial and recreational facilities at the seaward end of the spit, and the long-term effects of erosion of the spit. There have been erosion problems resulting in damage to the road since it was first constructed in 1927. Since 1964 the State of Alaska has spent $6 million in road maintenance costs.

The Corps of Engineers has conducted studies and investigations to determine the cause and nature of the erosion, and there have been at least six different schemes tried for the purpose of protecting the roadway. These have ranged from groins and old car bodies to a concrete slab revetment and steel sheet pile wall, all of which have proven unsatisfactory in one way or another. The most recent Corps of Engineers study (a reconnaissance report in 1984) was a combined effort between the City of Homer, State of Alaska, the Alaska District, and CERC. The City of Homer provided an observer for the Littoral Environmental Observation (LEO) program. This program provided additional data on wave and climatological characteristics. The State of Alaska participated by providing a survey and cross sections for beach and offshore profiles. The State has also provided funding for gathering data and other information. The Alaska District and CERC organized and carried out the study.

Wind and wave data available for the region were collected and statistically analyzed. Deep-water wave forecasts were made based on the wind statistics. A finite difference numerical model for the near-shore areas of Homer Spit and adjacent beaches was applied to predict refraction, diffraction, and shoaling of the forecast deep-water waves. The model was also used to predict breaker characteristics, expected longshore energy flux, and sediment transport rates.

Beach sample size gradation data along the spit shoreline were statistically analyzed. These studies revealed that natural hydrographic features near the base of the spit may cause a net reversal of longshore sediment transport capacity just northward of the roadway damage area. The net transport energy toward the tip of the spit apparently again rises where erosion is occurring. These results suggest sediment starvation is occurring in the trouble area with a consequent scour of the bottom and recession of the beach profile. Tidal currents in the area do not appear to be a significant factor.

This effort has resulted in formulation of a plan for storm protection of the roadway at its most vulnerable area. The concepts considered were beach groins, offshore breakwater, protective beach fill, and scour protection. The protective beach fill combined with an extension of an existing revetment was the most favorable option. Further observation, investigations, and studies are planned for the recommended detailed feasibility study.

DISCUSSION

DR. NUMMEDAL: Dr. Nummedal said that the spit is a very common feature along the Alaskan coastline and they're common all over the world. In all probability, it is a perfectly natural feature built by a littoral drift rather than a glacial process. This spit was clearly built by the same processes that are now destroying it and if that's the case, then something has changed in those key processes. Either the sediment source was depleted or the directional wave climate has changed. It seems to Dr. Nummedal that the road was put in the wrong place to begin with. He asked about the cost of putting the road where it should be, perhaps farther back inland and making the road follow the natural curvature of the spit itself.

MR. DAVENPORT: Mr. Davenport said that that is one of the things that is under consideration and will be investigated in the detailed study.

UPDATE ON DUCK '86 AND CRESCENT CITY DOLOS MONITORING

Mr. Thomas W. Richardson
Chief, Engineering Development Division
Coastal Engineering Research Center
US Army Engineer Waterways Experiment Station
Vicksburg, Mississippi

Crescent City is located in California near the Oregon border. The breakwater construction used several types of armor material including tetrapods and dolosse. The dolos units are the same size as those used at Humboldt City, 42-ton units. The ones in place now are unreinforced units and they've suffered a considerable amount of breakage over the years. The wave environment at Crescent City is quite severe. Estimates are that each year the breakwater is subjected to a design wave condition which is a depth-limited wave.

This has resulted in very significant breakage of the units. In fact, over this past winter, the breakwater began experiencing accelerated breakage of the dolos units. The most typical break occurs at the shank/fluke interface. There are a number of theories as to what causes dolos unit breakage. The most widely accepted theory is that stress in the dolos unit is a combination of static loading due to the weight of the unit itself, the weight of any surrounding units that are lying on it, a pulsating stress that's tied to changes in the sea surface elevation such as wave action, and an impact stress which is also caused by changes in the water surface elevation but which results when dolos units either strike the core of the breakwater or strike each other.

What we're in the process of doing right now in conjunction with the San Francisco District, Los Angeles District, and South Pacific Division is to make field measurements to establish boundary conditions and provide verification of a finite element model of dolosse under dynamic conditions. What this is intended to do is to provide a basis for rational structural design of dolos units to withstand the stresses that might be imposed in future applications.

To do this we'll be obtaining data on wave-induced motion of the dolosse and the impact loading in the dolosse. We will have comprehensive monitoring of the dolosse, measuring stresses that occur during casting and placement,

thermo stresses, and stresses that occur after the dolosse are placed. To do this we're going to instrument 20 new dolosse. I should have mentioned at the outset that there is a major rehabilitation project currently under way at Crescent City. The initial contract calls for casting 500 replacement dolosse. Twenty of these will be instrumented with strain gages at the shank/fluke interface. Of those twenty, six will also contain accelerometers. We'll be able to measure both physical translation and rotation of the dolos. We'll be instrumenting the breakwater matrix itself with pressure gages to measure pore pressure, and we'll be taking measurements of the forcing function that causes the breakage by making offshore directional measurements.

What we hope to get out of the program is dolos prototype stress data, including temperature stress, which is casting stress caused by temperature differentials while the concrete is curing, and stresses that are incurred during transport and placement. In addition, our Structures Laboratory at WES has produced a dolos finite element model. We will calibrate that model with the prototype data; ultimately, we hope to come up with a structural design procedure for dolosse. The casting process at Crescent City has been under way now for approximately a month, and we've been gaining some experience in the trials and techniques of placing instrumentation inside the 42-ton armor units. The contractor has just cast 10 instrumented dolosse. In the first one that we tried, we learned a very valuable lesson. The contractor was pouring concrete into the form without a tremie or any kind of a guide, and the mass of concrete falling into the form washed out a lot of our instrumentation. After that, the contractor added a tremie to his technique for pouring instrumented dolosse. In the second and third instrumented dolos we encountered a very unusual phenomenon. The contractor, after the first dolos, went to a conveyor belt system. He now pours five 4-yd buckets of concrete into each form. What the contractor is doing with the Crescent City dolosse, which is quite different from the way the Humboldt rehabilitation project was done, is to use a fluid concrete mix and to vary the fluidity as he goes up through the dolos unit. He pours a relatively fluid mix in the lower part of the vertical fluke. Then, as he works his way up, he uses a stiffer and stiffer mix. We encountered no problems with the instrumentation during the pour, but during the curing process what appears to have happened is that the fluid concrete shifted a slight amount and that shift of 42 tons of concrete

was enough to rip some of the cables from our instrumentation, so we ended up with several nonfunctional strain gages. We have gone to a stiffer reinforcing for our strain gage rosettes and the contractor also agreed to go to a slightly stiffer concrete mix. Since that time, we have poured six additional dolosse, and all of those have been satisfactory pours as far as the instrumentation is concerned. Our present schedule calls for some drop tests to begin shortly. What we'll be doing there is taking perhaps one or two instrumented and noninstrumented dolosse and dropping them to verify, first, the basic finite element theorem and how it predicts the force that will be required to break the dolosse and, secondly, whether there are any real differences between the behavioral characteristics of instrumented and noninstrumented dolosse.

The SUPER DUCK experiment is basically a very intensive field data collection effort to collect multiprocess, multiresponse type data. In September we'll be conducting primarily low wave energy processes experiments. In October the weather around Duck usually cooperates very well by entering into the northeaster storm season, so we anticipate the month of October to be oriented mainly towards storm process type experiments. We'll also begin several long-term experiments. We have $\pm$20 experiments right now, comprising investigators from approximately 16 different organizations, including the Corps of Engineers, universities, foreign universities, foreign countries, people from other Federal agencies, and at least one State agency as well.

We will be conducting a photopole experiment designed to measure the change in wave transformation characteristics and water-surface elevations through the surf zone. Dr. Hota from the Tokyo Metropolitan University will be joining us and contributing his expertise with high-speed photography, which is a very integral part of that experiment.

We will also be conducting a surf zone sediment transport or trap experiment. Dr. Kraus will be the principal investigator on that experiment. We'll also be including people from Louisiana Geologic Survey, the University of Lund in Sweden, University of Trondheim in Norway, and Queens University in Canada. We also sent letters to all the Districts and Divisions soliciting participation by District and Division people in SUPER DUCK. What we're proposing is enlarging participation in the surf zone sediment transport experiment. This is a very good experiment for people to learn some of the

basics of field data collection and at the same time learn more about where the frontiers of research are in this area. We have two surf zone current experiments. One will be conducted by CERC where we'll be verifying some of our numerical models, such as nearshore current generation by wave action. Dr. Dalrymple from the University of Delaware will be conducting a study of rip current formation at low wave energy conditions. Dr. Fisher from North Carolina State University will be conducting a dune erosion experiment where he'll be putting in approximately 1 cu m of sand in a two-dimensional cross section of the dune profile and watching how that erodes under the processes during September. We'll be continuing to evaluate seabed drifters as a device for tracking water motion in the nearshore zone. We will be evaluating Littoral Environmental Observation (LEO) techniques, both existing and proposed techniques. As a part of that experiment, we will be producing a videotape that can be used in the future for training LEO observers. Finally, we will be doing the dredged material studies.

The storm experiments have been divided up into two major sections. The first one deals with nearshore processes. In the first experiment, storm-induced surf zone processes, we'll be looking at both the causes and effects of the nearshore three-dimensional morphological change under storm activity. Principal investigators there will be from CERC and Dr. Thornton from the Naval Post Graduate School in Monterey. Dr. Suzette Kimball from CERC will be conducting a study of morphological sedimentological interactions. Dr. Sallenger from the US Geological Survey will be evaluating acoustic altimeters for taking very detailed measurements of bottom change elevation in real time. Dr. Holman at Oregon State will expand some of the earlier work he did at DUCK '85 on photographing and videotaping for the quantification of nearshore morphological change. Then Dr. Thornton, again, will be conducting a major experiment on determining momentum flux balance in the nearshore zone.

The second part of the storm experiments will be concentrated in the offshore zone. Dr. Sethurama from North Carolina State University and several investigators from CERC will be looking at air/sea interactions, measuring wind stress and transferring that stress to the water surface to determine currents in the offshore zone. We'll have CODAR there during October to take offshore directional wave measurements. In conjunction with that we'll be evaluating the use of float transponders with CODAR for real time tracking of

surface currents. Dr. Don Wright from the Virginia Institute of Marine Science will be conducting an experiment designed to quantify shore response to wind events. Dr. Mike Andrew from CERC will be installing a short baseline slope array that will be used for directional wave measurements. We're making plans right now to install a linear array at Duck in time for SUPER DUCK in conjunction with Dr. Joan Oltman-Shay from Oregon State University.

DISCUSSION

MR. PFEIFFER: Mr. Pfeiffer asked the depth of the two arrays.

MR. RICHARDSON: Mr. Richardson answered that the short baseline slope array will be in approximately 10 m of water. A decision has not been made on the depth for the linear array.

DR. NUMMEDAL: Dr. Nummedal asked about the submerged berm concept and what precisely will be conducted to test that concept.

MR. RICHARDSON: Mr. Richardson said he hoped to be looking at two major aspects. "We divided it up into three areas, sediment transport, hydrodynamics, and bottom characteristics. We're hoping to define some of the major processes that impact on a nearshore berm or in fact on any type of open water dredged material disposal, and then secondly to demonstrate and possibly improve some of the monitoring techniques available to the field right now for physical monitoring of dredged materials. We will not actually build a berm; we'll be dealing with the material as it exists on the bottom."

THE AUTOMATED COASTAL ENGINEERING (ACE) SYSTEM

Mr. Charles C. Calhoun, Jr.
Assistant Chief
Coastal Engineering Research Center
US Army Engineer Waterways Experiment Station
Vicksburg, Mississippi

Mr. Orson P. Smith
Research Hydraulic Engineer
Coastal Engineering Research Center
US Army Engineer Waterways Experiment Station
Vicksburg, Mississippi

For the past several years, CERC has been very much involved in computer-aided design. Over the the last two or three months, we've been taking a very hard look at the overall concepts of computer-aided design to see where we are, where we need to be, and, in fact, where we want to be. What we want computer-aided design to accomplish is technology transfer, which automatically implies it will be very practical, something that can be used easily by the people in the field or, in fact, by our own people. It should be applicable not just to the engineering side of the house or engineering divisions, it should also be applicable all the way: planning, design, construction, operations, maintenance.

Coastal engineering occurs in a very complex environment. It is probably more complex than any of the other civil engineering specialties; and many of the physical processes are not very well understood, for example, in comparison to structural engineering and the strength and failure modes of concreted steel structures. Because of this, design problems tend to be more challenging in the area of criteria development and actually defining what the problem is because analytical solutions at this point really aren't that complicated. For example the Hudson formula is not so complex, but defining the numbers that go into it can be quite difficult.

Coastal engineering is also a rapidly advancing field. The Corps leads in engineering research in the field of coastal engineering. What this means in the Automated Coastal Engineering (ACE) System project is that we're setting our own standards as we go. We don't have the National Aeronautics and

Space Administration (NASA) or anyone else leading the way. We're going to advance the state of the art as we go for computer-aided coastal engineering. We have some existing efforts in a pioneer mode, foremost of which is the MACE program, Microcomputer Applications for Coastal Engineering.

We published individual microcomputer programs typically for the IBM PC as technical notes. For a long time CERC has distributed coastal engineering technical notes. Once a quarter we send out a package of these to District Offices. There's now a section in there for the MACE programs.

Work on MACE began about two years ago and since that time we estimated we have spent on the order of $300,000 a year with heavy reliance on contracted workers and college students.

Development of the ACE system involves first and foremost field office involvement. We plan to have six regional cornerstone workshops from the six designated geographical regions: Northern Atlantic, Southern Atlantic, Gulf of Mexico, Great Lakes, Southern Pacific to include the Pacific Ocean, and Northern Pacific. We have picked cities (Portland, Los Angeles, New Orleans, Detroit, Jacksonville, and Baltimore) in each of those regions for a workshop where we hope to gather the journeymen, the first level supervisors, the middle managers, and anyone else who has an interest to have open discussions about the software needs that they perceive for their work.

We'd like also to discuss the hardware options and how these field people would like to see us do the development. We will have six or seven of our most imminent coastal experts from District and Division Offices, along with representatives from OCE and CERC as members of a committee responsible for the detailed execution of our software development. We would follow their directions in terms of identifying in-products, the procedures for development, and the review of the in-products; and we would also expect this group to review the overall goals and progress of the ACE system development.

In the case of individual in-products, once they are identified, we may appoint task groups dedicated, for example, to rubble-mound breakwater design and construction and monitoring. These groups would then design a system of software with complete continuity from beginning to end. The end product would be usable in the District to plan, design, build, and monitor a rubble-mound structure.

Our initial schedule is by the end of this month to request some

information from the field, perhaps through OCE, possibly even General Kelly himself, concerning the workload of coastal engineering. We might categorize this by the types of coastal structures in planning and design; or we might look at types of coastal problems more as a planner might see it, identify the problem, formulate solutions. We want to have some information before the workshops on what the workload is now and in the foreseeable future. We'd like also by the end of this month to send out our invitations to the six workshops. By the end of July, we hope to have held these workshops, identified a large mailing list of interested people and a smaller list of key experts for future participation, and established the pilot committee or task groups. By the next CERB we hope to have had our first pilot committee and a firm plan under way on the execution of the ACE system development. We would like to present that at the next CERB. We have drafted a program plan and hopefully we will have begun to redirect some of CERC resources within our control at the lab towards this new, high-priority project.

We want this to be a practical system for application by the field offices. We hope they will increase the planning and design efficiency of all our work; and even though that's the normal benefit of using computers, I would point out that we do more than streamline our in-house planning and design process. We make our in-products more cost-effective. By looking at more alternatives in a more plural manner, you end up with a better, more maintainable product in the field.

Our MACE experience in the last two years indicates that a much more ambitious program will take more resources. By redirecting some resources at CERC we can cover part of that, perhaps not all. Our goals are ambitious, but they will only be achieved to the extent we can come up with the funding. Like everything else we've discussed today, we're going to have to look at some innovative means in financing this work if we're to keep a fast pace.

DISCUSSION

DR. NUMMEDAL: Dr. Nummedal said he was very impressed by what is going on. It's clearly the correct direction in which to go. Since some of these programs are in existence now for 18 months, he asked to what extent these programs are being used by District personnel at this time.

MR. SMITH: Mr. Smith said that right now the distribution of the programs is a burden on the staff of the Design Branch at CERC. "We distribute new sets of these microcomputer programs at a rate of three or four a week, approximately half of those to private industry or universities. We also have discovered that it is quite a maintenance burden. We have a checklist of quality control features we look for before we release a program; but even after that care, we're overwhelmed with suggestions either for corrections or improvements from the field. So, right now we're actually getting a little bogged down in trying to keep up with the released programs." The MACE programs are pretty straightforward applications out of the Shore Protection Manual with a few enhancements here and there.

MR. PFEIFFER: Mr. Pfeiffer had a comment regarding the growing burden on the labortories with regard to updating and distributing information on computer-aided programs. He said this is a growing problem, not only in the field of coastal engineering, but in every field where there is a heavy development of new numerical models. He thinks that it is something that the Corps is going to have to face by providing some funding because it is an evergrowing piece of the R&D budget that up to this time has not been funded. "It's getting to the point where it's really starting to nibble into the ability to do the work, and it's going to get worse."

BG(P) ROBERTSON: BG(P) Robertson asked if it is a manpower or dollar constraint problem.

MR. PFEIFFER: Mr. Pfeiffer answered, dollar. He thinks the manpower end of it can be handled by contracting. CERL has done it by working with universities. After a model gets to a certain maturity, spin it off and have the universities do a lot of that distribution work, routine updating kind of work, and leave the laboratory the important updating, the high-tech work.

BG(P) ROBERTSON: BG(P) Robertson cited some success in NPD in computer software development where it's just updating something that's already there, by using the "stay in school" program with computer science students. He said you can't use them for programmers because they don't have all the background and engineering, but for correcting programs it's an inexpensive answer.

DR. MEI: Dr. Mei said that this computer-aided design is a new mission that CERC can provide in the future, and this mission will probably be as important as model testing to aid design. In particular, there are many kinds of problems for which computer programs and techniques are well developed, and it may be a good idea for CERC to initiate some sort of an effort to translate these existing numerical techniques into engineer applications. One particular example is the two- or three-dimensional defraction studies which may be used for floating breakwater designs. This kind of numerical technique can now be packed into a PC disc. Naval architechs have done something like this, and it looks like the Corps could also because of its interest in floating breakwaters and bottom-seated breakwaters.

ALASKAN FLOATING BREAKWATER EXPERIENCE

Mr. Kenneth J. Eisses
Civil Engineer
US Army Engineer District, Alaska
Anchorage, Alaska

The Alaska District designed and constructed a ladder-type floating breakwater, 23 ft wide by 6 ft deep, at Bar Point Harbor in Ketchikan, Alaska. This floating breakwater was installed in 1980 and has performed favorably with little maintenance required. The Alaska District is also completing plans and specifications on a 14-ft-wide, box-type floating breakwater for Juneau, Alaska. Plans and specifications have been initiated on a ladder-type breakwater for Saxman, Alaska, approximately 10 miles south of Ketchikan. Two of three potential harbor sites for the Whittier detailed project report include floating breakwater designs.

The State of Alaska Department of Transportation designed and installed a ladder-type breakwater at Sitka, Alaska, in 1973. They also installed a similar breakwater at Tenakee, Alaska, in 1972. This breakwater is showing signs of aging, especially at the connections, and the prediction is another 5 years of useful life. An innovative design was placed at Tenakee during the fall of 1985 consisting of three 48-in.-diam urethane-coated steel pipes connected together by a 40-ft grid. Fresh water was used as ballast and the breakwater was designed to withstand a 5-ft wave and swell condition with an accompanying 4.8-sec period. Performance data are not available at this time. The State of Alaska Department of Transportation also has installed floating breakwaters at Auke Bay near Juneau, Chenega, and Dog Bay on Kodiak.

CHARACTERISTICS OF ALASKAN DESIGN FOR FLOATING BREAKWATERS

Wind Data

This type of data is next to nonexistent in Alaska. Many of the sites currently being looked at are in fjord type environments, which make correlations from known wind sites meaningless because of the funneling effect of the wind.

Four-Foot Wave

Many designs are now bordering on or above the 4-ft wave and 4-sec period accepted economic practice. The only manual to size these large breakwaters with is Technial Report R727 "Transportable Breakwaters - A Survey of Concepts," May 1971, sponsored by Naval Facilities Engineering Command. The technical report contains dimensionless curves which allow depth of water, wave height, period, and draft to be taken into account to size the breakwater. The ladder- and box-type breakwaters must be treated the same in terms of transmission coefficient because the dimensionless Navy curves are for a box structure.

Deep Water

The water depths at many of the harbor sites being investigated are greater than 30 ft, in most cases between 50 and 200 ft.

Rocky Bottom

Rocky bottoms are routinely encountered at various harbor sites. Even when a site is in a marginal depth of water, rock or glacial till is often encountered which rules out the use of a pile anchoring system.

Transportation

There are no concrete casting yards in Alaska capable of fabricating a floating breakwater. The ladder-type breakwaters have been barged up in pieces and assembled onsite. It would be possible to tow a large structure to southeast Alaska, but anything brought to south-central Alaska would probably have to fit on a barge.

Transient Moorage

Strong consideration is being given to designing transient moorage as an integral part of the floating breakwater design since previous floating breakwaters have been appropriated for this service in the past.

RESEARCH NEEDS THAT WOULD BENEFIT THE ALASKA DISTRICT

A computer model is being developed by the Alaska District to help determine anchor forces on floating breakwaters. The model balances wave, wind forces, and harborside anchor forces against F=MA, shear force, and ocean-side anchor forces. This computer model was reviewed by CERC's consultant Tek-Marine and found to be fundamentally sound to the limits of a two-dimensional

model. Seattle prototype data are being used to verify the model's applicability.

There are several other areas of research which would greatly benefit the District's use of floating breakwaters. First and foremost is the need for good wind or wave data at the proposed design sites. The Alaska Coastal Data Collection Program is attempting to bridge this gap. WES hindcast analysis does not work in the majority of our fjord-type environments.

Model studies would greatly benefit the understanding of the differences between the ladder and the box structure, especially in the areas of transmission coefficient and draft for larger structures. A ladder-type structure needs to be instrumented as well as a floating structure in a very severe wave environment. Additional prototype measuring is needed to determine transmitted boat wave heights.

There is one model test result which depicts how the angle of wave attack reduces the transmission coefficient. This is Figure 11 from WES Technical Report HL-79-13, which applies to a 12-ft-wide box breakwater. This result has been used on all floating breakwater designs which have a design wave attacking at less than 90 deg. An expansion of this chart into different breakwater shapes and sizes would be very beneficial.

A good analytical method for determining wave forces on a floating structure is needed. Currently, a modified Seattle District design approach is used which employs the Miche-Rundgren wave force approach and then scales it down. Miche-Rundgren assumes that the structure is bottom connected.

DISCUSSION

DR. MEI: Dr. Mei said that, with regards to floating breakwaters, he felt that there's a lot of theoretical knowledge that has been in existence. He and his students have worked and published papers on this since 1967 and, in fact, most of these computational schemes for rectangular breakwaters were done as a topic of a Ph.D. Thesis by Dr. Jarrod Black. For more complicated cross sections, the hybrid finite method was developed long ago. It seemed to him that this type of thing would fit very well into the computer-aided design program.

DR. LE MÉHAUTÉ: Dr. Le Méhauté said he has been working with a naval architect for many, many years, and it is a naval architectural problem from a dynamic viewpoint. He said for them, this kind of a problem is a snap. It's state of the art, and they are extremely good.

DR. MEI: Dr. Mei said there exists quite a body of experimental knowledge which verifies the numerical studies. He did not think it was necessary to perform new experiments.

ANCHORAGE HARBOR DEEP-DRAFT NAVIGATION FEASIBILITY STUDY

Ms. Lynn M. Hornecker
Hydraulics and Waterways Section
US Army Engineer District, Alaska
Anchorage, Alaska

Mr. Joseph T. Weber, Jr.
Plan Formulation Section
US Army Engineer District, Alaska
Anchorage, Alaska

The Upper Cook Inlet study area comprises an area of approximately 420 square miles and includes the areas northeast of the Forelands, Knik Arm, and Turnagain Arm. The Forelands is a natural constriction, 15 miles in width, which divides Cook Inlet into the upper and lower sections. Cook Inlet is a northeast-southeast trending tidal estuary, approximately 175 miles long and 60 miles wide at the entrance, which is located in a highly active seismic zone. The upper inlet waters are relatively shallow and turbid, with turbidity varying from 100 mg/ℓ at the Forelands to 2,000 mg/ℓ at Anchorage. Several large glacial rivers, heavily laden with silt, discharge into the inlet, and the estimated annual sediment load is 75 million tons. Cook Inlet has one of the largest tidal ranges in the world, and the mean tidal range varies from 15 ft at the entrance to the inlet to 28 ft at the Port of Anchorage. The 40-ft extreme tidal range near Anchorage and the inlet geometry create currents exceeding 5 knots and tidal bores along Knik and Turnagain Arms.

The Port of Anchorage has little room for expansion at the existing harbor site. The Municipality of Anchorage has investigated a potential harbor site on the southwest end of Fire Island, and the Matanuska-Susitna Borough has prepared a preliminary study for a port at Point MacKenzie. The Anchorage Deep-Draft Navigation study will investigate tidal circulation and sedimentation at the Port of Anchorage and the proposed future harbor sites.

The Alaska District is conducting this study in collaboration with WES, and together the two agencies have developed a detailed plan for study for the project. A description of the work which each office is performing is presented below. The Alaska District is involved with the following studies:

a. The Planning Branch is investigating navigational problems identified by the users of the Port of Anchorage and by the various Federal, State, and local agencies which regulate or monitor marine activities within Upper Cook Inlet. The users/agencies are providing information regarding navigational problems related to shoals, ice, currents, tides, dredging depths, navigational aids, docking, vessel handling characteristics, and existing and potential queuing problems.

b. The Planning Branch is performing an economic analysis which includes an evaluation of regional resource development and transportation requirements.

c. Both the Planning and Hydraulics Branches are providing administrative and technical support for the studies being conducted at WES.

WES has completed or is presently conducting the following studies:

a. A comprehensive computerized literature search and literature analysis. The existing studies and field observations will be used to verify navigational problems identified by users/agencies, and selected field observations will be used as input to a hydrodynamic model.

b. A computerized analysis of historic hydrographic survey data of Upper Cook Inlet. The primary source of the data is NOAA surveys (boat sheets) for the period 1910 through 1982. The data are being analyzed using the CPS-1 program; the products of this study will be detailed contour plots, profiles, and volumetric calculations of changes in sediment volume over the 72-year period of record.

c. A two-dimensional hydrodynamic model study of Upper Cook Inlet. This model will define gross circulation patterns and verify observations of navigational problems provided by users/agencies.

The feasibility study may be followed with a general design memorandum if the feasibility-level recommendations for Federal navigational projects are economically viable. The general design memorandum may include an extensive data collection program, additional sediment transport studies, navigability studies, and pilot training on a ship simulator.

DISCUSSION

DR. NUMMEDAL: Dr. Nummedal said that the kinds of problems the Corps is faced with in the upper part of Cook Inlet, very high tide range, are somewhat different from the more wave dominated coastlines in the lower 48 states. He said, however, it is very similar to the experience in the central part of the German coastline, the estuaries to Hamburg and Bremerhaven harbors. They too have these large sandbars [illegible] perpendicular to the direction [illegible] to that

problem is to move the navigation marker and move the channels on the other side of the shoals. He asked if that kind of approach is included in the feasibility study.

MS. HORNECKER: Ms. Hornecker answered, yes. That was one alternative considered as a possible solution to the problem.

WAVE ENGINEERING TESTS IN THE CERC DIRECTIONAL BASIN

Dr. James R. Houston, Dr. Charles L. Vincent,
Mr. Michael C. Briggs, Mr. Douglas G. Outlaw
Coastal Engineering Research Center
US Army Engineer Waterways Experiment Station
Vicksburg, Mississippi

CERC's directional spectral wave generator is now being used in research and mission support studies in addition to the developmental studies required to generate the testing and analysis software needed to use the generator. The wave generator consists of 61 paddles each 1.5 ft long, giving an overall generator length of 90 ft. Each paddle may be individually controlled allowing very complex wave patterns to be generated. The wave forms range from monochromatic waves to fully directional, irregular waves typical of coastal storm conditions. The basin is shallow, approximately 3 ft deep, so emphasis is placed on testing coastal rather than offshore problems.

Until this past year primary emphasis has been placed on developmental studies. The software to generate complex wave conditions such as a directional spectrum and to acquire and analyze data represents a major developmental effort. Rigorous testing of the software is required before use in specific engineering studies. Further, exploration of the capabilities and idiosyncrasies of such a complex system as this generator requires extensive testing. CERC has surveyed other institutions with directional basins and has been able to cooperate with the National Research Council of Canada in the exchange of software since both generators are somewhat similar and are controlled by the same type of computer. The Canadians provided us with their wave absorber design as well.

This year a mission support effort [illegible] fect of nuclear-explosion-generated [illegible] Sound. The wave maker [illegible] sured from a field test [illegible] River facility. This [illegible] problem.

Two [illegible] [illegible]

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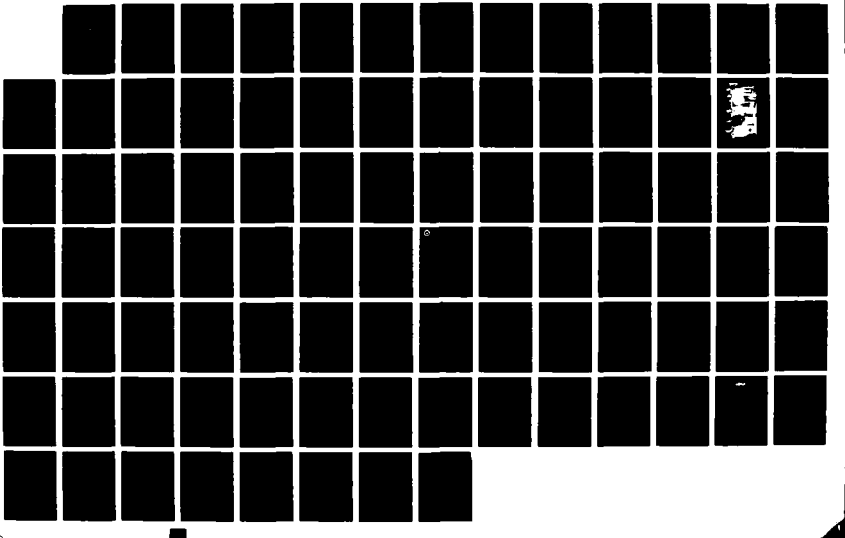

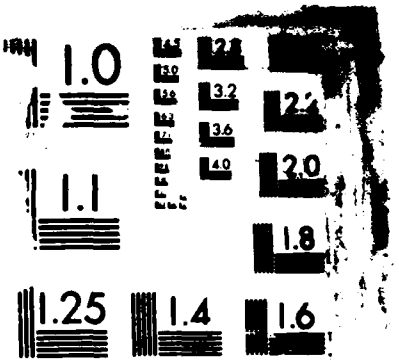
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Florida with Professor Joseph Hammack. Some of the support for this effort is being supplied by the National Science Foundation. The study is a basic research effort on the nonlinear interaction of waves intersecting at an angle. The generator is being used to develop data for verifying the theoretical work. The research will lead to a better theory for two-dimensional cnoidal waves.

The second research effort is the Wave Engineering Tests (WET). The objective of WET is to analyze the differences between the use of irregular versus monochromatic waves in common coastal engineering problems. Much of the Corps' design methods are based on using monochromatic waves to represent natural wave conditions. With the directional generator it is possible to make controlled, repeatable experiments in which irregular sea states of different frequency and directional spread characteristics can be generated; and tests can be run with a particular basin configuration (a mound, a slope, a breakwater, etc.) and then compared with a set of tests with the monochromatic waves. The design of the tests emphasizes a quick look at each problem so that a more detailed program can be developed to investigate those problems where major differences are seen. The tests also give CERC experience in what sort of reflection or other test problems may arise in performing basic tests.

Tests with a "semi-infinite" breakwater have been completed. The results indicate substantial differences in the lee of the breakwater. This result is not unexpected, and several investigators have proposed solution techniques. The data collected will allow detailed investigation of proposed diffraction models. Tests with an elliptical-shaped mound are under way. This test represents the classical case used to evaluate nonlinear monochromatic wave theories for refraction and diffraction. The data will be used to design and test spectral refraction/diffraction models.

The directional spectral generator represents a major resource for evaluating how coastal problems should be engineered for natural sea states. Although developmental efforts will still continue, the primary emphasis in testing with the generator has now shifted to research and mission support problems.

DISCUSSION

DR. MEI: Dr. Mei said that, for the explosion-generated waves, the most difficult part is to look at how a given amount of explosive can cause a given amount of disturbance very near the origin. This was done theoretically and then the subsequent part of propagation away from the source is done by using spectral generator simulation. He wondered whether this really avoided the most difficult part. He said that when the source is moved, the theoretical part is the most nonlinear, the most difficult. He was curious as to how that was done.

DR. LE MÉHAUTÉ: Dr. Le Méhauté said that it is surprising how a complex phenomenon such as an underwater explosion can be mathematically analyzed by linear wave theory and fit the data. "It isn't like a box approach in a sense that we determined the wave at some distance from the explosions where the waves are linear and by matching the experimental result with a theoretical mathematical model, we were able to relate a theoretical distance advance to a yield and depths of bursts and we get extremely good results. And we have data from half a pound of TNT to a megaton of nuclear explosions which we have done in the past. So, we are fairly confident that this approach is very reliable. We are now investigating the extremely shallow-water explosions in which much less work has been done. We have developed a mathematical model which will use the approximation that we are using in the deep-water case. We don't use the stationary phase approximation which is not valid in shallow water. We have solved the medium depth wave problem which cannot use special approximation data. And based on 10 experiments which have been done in Vicksburg, it looks like the theoretical model matches again, extremely well, the experimental curves. We're also investigating all the nonlinear problems and dissipation problems at the explosion itself."

MR. MURDEN: Mr. Murden asked whether capping mounds, caps to contain contaminated material, could be another use for the wave generator.

DR. HOUSTON: Dr. Houston answered no, not the directional spectral wave generator, because it can only generate fairly limited size waves. He thought it would be better to use some of the other facilities where the scales can be larger. For example, the L-shaped wave flume can generate rather substantial waves and its use would eliminate some of the scale effects, which are a problem when looking at sediment motion.

THE ALASKA COASTAL DATA COLLECTION PROGRAM

Mr. Carl D. Stormer
Chief, Hydraulics and Waterways Section
US Army Engineer District, Alaska
Anchorage, Alaska

PROGRAM DESCRIPTION

The Alaska Coastal Data Collection Program (ACDCP) was conceived in 1981 and 1982 by the US Army Engineer District, Alaska (NPA), with CERC and the State of Alaska Department of Transportation and Public Facilites (DOT/PF) as a cooperative effort to collect the vital coastal data necessary to respond effectively to Alaska's urgent port and harbor development needs. Other interested agencies, local communities, and individuals have also provided valuable input to the ACDCP during its 4-year history.

The goals for the ACDCP are:

a. Collection of field data for coastal engineering purposes.

b. Storage of collected field data at a central location for ready retrieval as public information.

c. Establishment and maintenance of a state-wide regional network of long-term coastal field data collection sites.

d. Development of coastal field data collection instrumentation and telemetry.

e. Development of coastal field data storage, retrieval, and analysis procedures and computer software.

The overall direction of the ACDCP is monitored and directed through an Interagency Coastal Data Technical Committee meeting twice a year to review process of activities, confirm future plans, and hear input from the interested parties. Day-to-day activities are accomplished by the Alaska District.

Operations and maintenance of existing instrumentation have been the emphasis of the ACDCP in the last few years. Instrumentation is varied to include Waverider buoys, wave spar buoys, and current-pressure sensor installations. Improvements to existing systems are presently under way to improve the reliability and data retrieval percentage. Procurement of a Waverider buoy with satellite communications via GOES is under way. Buoys such as this

will be used for the long-term regional sites.

The primary immediate goal for the ACDCP is to renew the emphasis on the program and strengthen it administratively, financially, and operationally. Continued support and involvement from the Coastal Field Data Collection Program administered by CERC are appropriate. Similar support and involvement are needed from NPA and the State DOT/PF.

DESIGN CONCERNS

The ACDCP with CERC can provide additional data and spearhead research into several design concern areas to improve the design effort in Alaska.

Limited or Lack of Site-Specific Data

The lack of or limited site-specific data is most common. The ACDCP can improve this situation by being the base for systematic data collection from program sponsored buoys and from other available sources, by providing the guidance for regional data collection, and by providing the repository for the data in formats suitable for the widest use.

Complex Topography

High mountains, narrow valleys, and glaciers combine to funnel and channel winds into directions along the valleys--quite often different from general weather fronts. Combined with little or no data, the job of developing design parameters becomes quite uncertain and relies on substantial judgment. The ACDCP through its data collection efforts can assist in arriving at a better definition of the effects of complex topography.

Offshore Long Period Waves

Concern has recently been raised over long period waves generated in distant areas intermingling with locally generated waves. Data collection and spectral analysis through the ACDCP will assist in determining the characteristics and source of this type of wave energy.

Material Sources

Finding suitable and available material for rubble structures can be a significant problem in Alaska. Additional data through the ACDCP will lead to more economical designs. Evaluation of alternate designs such as the "berm" type breakwater may also be useful.

Coastal Erosion and
Related Protection Measures

Lack of adaquate wave climatology is the major stumbling block. Reliable directional instrumentation and regional or site-specific data collection are areas for ACDCP involvement.

Instrumentation Reliability

It is desirable and an objective of the ACDCP to develop good, reliable data collection systems. Experience has shown that the instrumentation must be self-sufficient, highly reliable, and easy to deploy, maintain, and retrieve. Procurement and maintenance costs must be low. Ongoing development, testing, and modification are necessary to improve performance and reliability.

CONCLUSIONS

Because of its important role, the ACDCP deserves the continued support both technically and financially of the Corps of Engineers through CERC and the NPA, the State of Alaska, and others working in the Alaska coastal environment.

DISCUSSION

DR. NUMMEDAL: Dr. Nummedal indicated that during the tour of Valdez Harbor just before landing, one thing that really struck him was the observation of all kinds of surface slicks indicating a lot of internal waves in that fjord. He expected to see a great deal of that in this kind of a setting where you have a density stratification due to freshwater outflow on top or in a salinity stratification or a thermal stratification very well developed in fjord settings in general. He said internal waves can do all kinds of interesting things when it comes to keeping sediments in suspension and sedimentation of small boat harbors along the edges of your fjords.

He asked if there are any efforts to study things like internal waves.

MR. STORMER: Mr. Stormer answered that the Coastal Data Collection Program as it is set up now is strictly data collection as opposed to analyzing that data into a spectral form or summary type form that the design engineers can use. He thinks it would be up to the individual designer or researcher who is using that information to carry on and look at these types of problems.

Mr. Stormer went on to say that they haven't considered the geotechnical aspect either. He said right now the thrust is with wind and waves and related topics.

DR. LE MÉHAUTÉ: Dr. Le Méhauté said that not much work has been done on shingle beaches in general and he asked if this is something unique to Alaska and whether there are a lot of problems here with shingles.

MR. STORMER: Mr. Stormer answered that there are all kinds of beaches in Alaska, from a shingled beach like Homer Spit to sands to littoral material that is almost like a 12-in. boulder. He said it goes back to the geotechnical problem in knowing what your littoral material is and what are the driving wave forces. In Alaska, they are concentrating on trying to find the wave climate driving force.

DR. NUMMEDAL: Dr. Nummedal said that studies on shingles and supporting internal waves and on submarine sliding, etc., in general would be considered basic research everywhere else. He would like to see the Alaska District take a long lead in looking at problems that go beyond what they normally address in many of the other Districts.

MR. STORMER: Mr. Stormer answered "I'm positive that there are many people, at least within my office in the District, that would be more happy to spend a lot more time in research; but part of our particular problem is to put out projects and so forth. Given the opportunity, we'll jump right in."

MR. BOUZOUN: Mr. Bouzoun stated that one of the questions that was asked earlier by the members of the Board is what information other than wind and current velocity and so forth is being collected, if any. He said historically CRREL has collected a tremendous amount of these data, particularly on the northern shoreline of Alaska. The other thing he commented on was with respect to deployment of instruments in a relatively hostile environment, "Again, historically, for about 20-25 years now we do have a branch at CRREL that's been strictly devoted to that area. There's a lot of corporate memory and ability that exists right now that's there for the tapping. So, if you need some help in those areas, I'd like to offer that right now to the District to get the program back up to speed where we can help you."

BG(P) ROBERTSON: BG(P) Robertson suggested that Mr. Pfeiffer and Dr. Choromokos ensure that there is technology transfer between the two organizations.

SOUTH ATLANTIC DIVISION COASTAL RESEARCH NEEDS

Mr. Theodore A. Abeln
Supervisory Hydraulic Engineer
US Army Engineer Division, South Atlantic
Atlanta, Georgia

INTRODUCTION

The South Atlantic Division (SAD) has the largest coastline of any Division in the Corps if you exclude Alaska. With its 14,600 miles of tidal shoreline, 3,600 miles of coastal beaches, and 32 million acres of wetlands, the South Atlantic Division has a very active coastal program distributed among its five Districts. There are 23 ongoing coastal projects in the design or construction stage. We operate and maintain 52 channels and harbors, with the FY 87 budget programmed at $109 million for that item. As a result of this extensive coastal program, our research needs are pointed toward improving our capability in finding better ways to design and operate our coastal projects.

SHORELINE RESPONSE TO COASTAL PROJECTS

The first area I'll discuss is the determination of the shoreline response to the construction of coastal projects such as navigation inlets, jetties, groins, and beach fill. More and more responsibility is being placed on the Corps for projects built decades ago. SAD has several controversial issues concerning coastal inlets and their impact on shoreline erosion. One issue may even cause a suit to be brought against the Federal government by the State of Florida over the disposal of material dredged from a navigation inlet. Although this research need has experienced considerable advance during the past 5 years, it appears that we will have to improve our ability to predict the structure/shore interaction caused by our coastal projects.

EROSION PROTECTION ON COASTAL WATERWAYS

The next two areas for suggested coastal research needs are concerned

with navigation. Erosion of the banks along our coastal waterways has caused a very costly maintenance problem for the Districts involved. This bank sloughing, caused primarily by waves generated by private and commercial vessels, has undermined residential and commercial development along the waterways. The most common form of slope protection used is some variation of rock protection which usually results in a very expensive fix. Some Districts have tried innovative methods with mixed success. There is a definite need to develop effective and economical means of protecting the waterway banks because of the rapid development along the waterways and the increase in traffic.

CHANNEL DESIGN CRITERIA FOR SMALL VESSELS

The primary benefits associated with many tidal inlet projects are realized from relatively small commercial boating activities. Commercial fishing vessels normally have lengths ranging from 50 to 115 ft and have static drafts between 6 and 12 ft. Mobile has a small navigation channel project which will be primarly used by highly maneuverable minifreighters 212 ft in length, 31 ft wide, and with a draft of 20 ft. Channel design criteria for these small vessels are lacking. The Corps' design criteria are based on channel design requirements for large vessels. Design information on channel depth and width required for these smaller commercial vessels is needed in order to develop safe and economical channel designs.

PREDICTING TIDAL INLET CHANNEL SHOALING

Many tidal inlets along the Atlantic and gulf coasts of the United States are maintained by dredging. When a channel is dredged across an inlet's ocean bar, the dredged channel will shoal back to its natural depth. The rate at which this shoaling occurs depends on many factors such as the depth of the dredged channel relative to the inlet's natural channel depth, the rate of influx of littoral materials, and the tidal flow through the inlet. The Wilmington District has developed empirical methods of evaluating channel shoaling in order to determine dredging frequency required to maintain authorized project dimensions. However, a more universal method of evaluating channel shoaling potential is needed so that a more uniform approach to the

problem can be applied by all Corps Districts.

DEVELOPING SLOPING FLOAT BREAKWATER DESIGN

The Wilimington District has been actively involved in the design of a Sloping Float Breakwater (SFB) in connection with the Oregon Inlet stabilization project. SFB's, which consist of a series of bargelike structures moored with their landward end submerged and their seaward end protruding above the water surface, are to be used to protect a conventional cutter-suction pipeline dredge as it performs sand bypassing. (The sand bypassing will remove material from the accretion fillets adjacent to the jetties and transport it to the downdrift beach.) Model tests on the SFB have demonstrated extremely good wave attenuation characteristics. Also, a preliminary structural design of the SFB has been developed. The next step in the development of the SFB would be to perform field tests of a prototype unit. Such a test of an actual unit would probably cost $1-1/2 to $2 million. Funding for the Oregon Inlet project is presently delayed pending the resolution of differences between the Corps of Engineers and the Department of Interior. It would seem that the SFB concept could be used Corps-wide to initiate sand bypassing around existing stabilized inlets which do not have a sound bypassing feature as part of their basic design. Sand bypassing at these inlets could save millions of dollars in erosion damages associated with the accumulation of littoral sediment by the inlet stabilization structures.

SUMMARY

We realize that most of the areas I have discussed are included in ongoing or proposed research by CERC. However, I have emphasized the items that would be most beneficial to SAD in conjunction with their present coastal program.

DISCUSSION

DR. NUMMEDAL: Dr. Nummedal asked if the contractors charge a different rate when they call it "bioengineering" rather than "revegetation."

MR. ABELN: Mr. Abeln answered that it is very much more. But it is a widely used method. He understands it's widely used in Europe and has been for 100 years and it's been used with great success in certain areas. But it's very sensitive to water and if you don't get it in at the right time of the year, you may not have a successful project.

DR. LE MÉHAUTÉ: Dr. Le Méhauté asked weather the erosion problem in the channel was mostly due to ship waves.

MR. ABELN: Mr. Abeln answered that the problems he was pointing out are primarily due to small craft in the intercoastal waterways. This is a 12-ft navigation depth, and the waves are thrown up by commercial craft, small shrimp boats, or pleasure cruisers that come ripping down there about 20-25 knots.

DR. LE MÉHAUTÉ: Dr. Le Méhauté stated that there was a study done for San Francisco in the delta where ships were accused of causing a lot of erosion. An estimate made of the erosion due to ships and erosion due to wind waves found that wind wave erosion was much smaller than ship wave erosion but the wind waves were there permanently while the ship waves were there only once in a while. From an erosion point of view, assuming that the rate of erosion is proportionate to the energy, the wind waves as a natural effect cause as much erosion if not more than the ship waves. He asked if this kind of consideration will also show that erosion is partly due to wind waves and therefore decrease the liability of the Corps.

MR. ABELN: Mr. Abeln said these intercoastal waterways are used quite heavily. It's not just an occasional passing barge or something like that. They get a lot of traffic. He thinks the general assumption has been that most of the problem has been caused by the waves from the pleasure craft.

DR. NUMMEDAL: Dr. Nummedal said that the kind of problems at the St. Mary's River Inlet are fairly common in the southeast and west. The idea of trying to recover some of the material dredged in the channel and placing it in shallow waters has also been used for Tybee Island. It seemed to him to be a method that could help a great deal in the southside erosion of many of the southeastern barrier islands. Grain size is correct in most of the tests that he has seen for the material that can be recovered from the dredge channel where it cuts across the tidal delta. He asked why the Corps is reluctant to get into that.

MR. ABELN: Mr. Abeln answered that it's cheaper for the Corps to take it out to the deep-water disposal area and that's what they plan on doing with the big percentage of the 10 million cubic yards. They are going to place some on the beach and some just in a shallow area, but the bulk of the material, just for economic reasons, is going to be taken to a deep-water disposal site. This is what the State of Florida is objecting to.

MR. MURDEN: Mr. Murden said that in the North Pacific Division, in the Portland District, they have placed material inside the estuary to keep it within the cycling system as opposed into deeper water and therefore lost to access. "The St. Mary's situation I can only parrot what Ted said but I heard that the most economical solution for the predominance of material was offshore and I believe the reason is that you have to fix your offshore channel somewhat

outside the mouth of the gorge there as opposed to the considerable yardage that is within the bay area proper. So, you have two major channels: one offshore entrance approach channel and another within the estuary. I think the area he's speaking of here is that area that's in the offshore zone. So, to haul it back into the estuary probably would be a longer distance."

DR. NUMMEDAL: Dr. Nummedal stated that it should be on the seaward side of the barrier, where the ebb tidal delta attaches to the shoreline. On Amelia Island, the ocean area of Amelia Island is downward of the jetty on the Atlantic side and probably 80 percent of the South Atlantic Barrier Islands are eroding right there for a variety of reasons. Dr. Nummedal thinks you can solve a major regional problem if you look at the economics of bringing a great deal more of the material back on the beach in that particular location.

MR. ABELN: Mr. Abeln said he didn't quite understand the solution himself. They are placing 1.3 million cubic yards on the shore and 3 million adjacent to the shore where it's expected to get back into the system, but why it's more economical for this other deep-water disposal--that's the argument.

DR. NUMMEDAL: Dr. Nummedal wondered though in the economic analysis "are we looking only at the cost of the dredging and the dredge disposal itself or are we looking at the total cost of dredging plus doing some alternative solution to mitigate shoreline erosion on the adjacent area? If you look at that total picture, the economics could be very different."

MR. ABELN: Mr. Abeln stated that as far as he knows, it was an economic analysis.

BG(P) ROBERTSON: BG(P) Robertson asked if the State offered to pay the differential.

MR. ABELN: Mr. Abeln answered they were offered that opportunity. They don't want to pay anything.

RESEARCH NEEDS IN THE NORTH PACIFIC DIVISION

Mr. John G. Oliver
Civil Engineer
Engineering Division
US Army Engineer Division, North Pacific
Portland, Oregon

The North Pacific Divison has numerous research needs in coastal engineering. Fortunately, most of these needs are being researched to some extent at this time.

Our most repetitive need is for accurate wave information. Alaska has some special needs as it has numerous isolated areas where we lack wind data, where topography controls fetches and generating areas, and where the combined effects of swell and sea are difficult to evaluate. The National Wave Information Study will aid us in obtaining deep-water information in Oregon and Washington but the Alaska Coastal Data Program will have to be the keystone for information in the Alaska area. Both programs need to be expedited as much as possible. Continued work on transformations and on methods of expanding short-term records into statistically valid long-term records is required.

Floating breakwater research is of continued interest. The prototype program in Seattle advanced our state of knowledge tremendously. Math modeling developments since then have further increased the knowledge base, but we still have work to do as far as developing simple model procedures and confirming the extent of our ability to extrapolate present knowlege to different design conditions. Research is progressing, and I believe that we will extend the base enough to handle most design problems in this area within the next several years.

Wave transformations by currents is an arena that needs an infusion of Corps interest as these transformations affect both coastal structures and the navigability of many of our entrance channels. NOAA is performing some work in this area at the mouth of the Columbia River, but more is required. The work NOAA is doing was initiated during conditions of ebb flow where there is a doubling of wave heights. If we can get a handle on the phenomenon, then we can, through other efforts, develop a relationship between navigability, incident wave fields, and changes required in structural design.

Stability of coastal structures is a pressing problem. Both the stability of the foundation and elements of the structure must be considered. With regard to foundation stability, some recent modeling efforts using the WES Implicit Flooding Model (WIFM) and Vemulakonda models lead one to believe that we can qualitatively analyze the scour potential around major structures. Bringing the state of knowledge into the quantitative arena is another challenge that will require some basic research in sediment transport phenomena. Stability of structural elements is to some extent being researched, but expansion of that research to allow some rational interpretation of the rate of deterioration of the structure and the effect of deterioration on the project's functions does have a great deal of value. A comprehensive program of establishing stability indexes has been, and continues to be, an outstanding need.

Scour around the head of breakwaters and its effect on breakwater stability is evident at the North Jetty at Yaquina Bay, which has failed twice since its construction in the 1960's. Its initial destruction was attributed to toe scour and to a modest underestimation of wave forces on the structure. The most recent failure gave us a clue that we had either grossly underestimated scour potential or wave heights; therefore, a much more rigorous analysis was undertaken. WIFM was used to develop tidal currents and the Vemulakonda model was used for wave-induced currents. The District also examined wave heights. The analysis indicated that we had underestimated both waves and scour. I will expand on the scour analysis. The jetty was originally constructed in about 23 ft of water and the channel later dredged to its authorized depth of 40 ft. A 15 May 1985 survey showed the scour and shoal patterns in the channel. Vector plots of the flood and ebb current patterns did not indicate concentrated velocities or an extreme variance in sediment transport along either jetty. The generalized effect of the entrance contraction was to contain the flows in the center of channel. This tranquil picture is modified dramatically when wave-induced velocities are superimposed on the tidal velocity vector in the scour area and the effects of waves on the flood flow are to shift and concentrate the entrance contraction to the north. The zone of flood flow expansion is also in the proximity of the inner bar shoal. The combined vector plots identify the dominant cause for conditions being experienced. The plots do not, however, identify the depth of maximum scour

nor do they establish the magnitude of shoaling that can be expected. Recent records of shoaling do give us some evidence of shoaling rates and the benefits associated with jetty reconstruction. The solution to total depth of scour to anticipate will in this instance be estimated by balancing tractive forces at peak flows. The research need here is for development of effective designs that protect against structure undermining, which may have to include budgeting for deferred construction. The need for deferred construction is evident as there is no rationale that would allow us to believe that a weighted toe design would protect against 20+ ft of scour nor is it possible to excavate and place toe protection. All methods of protection have a high risk of failure, and the most positive approach would be to place protection as scour develops. This, however, does not fit into our budgeting schemes for construction.

Sediment transport in the coastal environment is the research area that initiated the Beach Erosion Board and the area where answers continue to elude us. Needs are still critical and evident as our navigation projects, dredging programs, modifications of river flows, and other construction projects have a great influence on sources and sinks.

There are field studies that give us some insight into the transport processes and possible impacts of manipulating the system. The Portland District has for a number of years been evaluating dredged material disposal sites along the Oregon coast. Some of their findings are that sand supply is limited and that depths of sand in offshore storage for the most part are shallow. Repetitive samplings of inlets along the coast indicate that little, if any, new sands are being supplied by rivers. If the rivers do represent a source, that source is intermittent and associated with extreme hydrologic events. Measurements of headland losses from Tillamook Bay south indicate that direct erosion is about 780,000 cu yd per year. Our dredging program however, manipulates about 2,000,000 cu yd within this region on an annual basis. We, therefore, appear to have a controlling interest in the sediment budget.

The sensitivity of the region to our manipulations of sediment is unknown but probably critical if we remove sediments from the system or create large zones of dead storage. Sediment grain sizes are in the fine sand size class of about 0.2 mm. Clays and silts are not present to a depth of nearly

600 ft. There is bed form evidence that sediments move to a depth of 600 ft and Dr. Komar, from Oregon State University, has estimated that summer wave activity could reach 150 to 300 ft deep. Net sediment transport is from south to north as evidenced by southern coast sands dominating northern beaches. Tidal, density, wind-generated, and wave-induced currents and wave stirring of the bottom must all integrate to form the boundaries of sediment transport conditions. Upwelling is also a phenomenon that should be considered.

Overall the system is extremely complex, and it appears that sediment transport cannot be dealt with on the basis of wave radiation stress dominating sediment transport. The records of 1 year of measurements with an SXY gage off the coast of Washington indicate a net littoral transport of 2 mcy toward the south in a zone where dominant sediments from the Columbia River show a south-to-north transport predominance.

In a materials disposal area near Yaquina Bay we inadvertently concentrated a disposal operation in 1984 and built a mound about 20 ft high. The total disposal pile contained about 600,000 cu yd and was dropped in about 60 ft of water. In March of 1986 that disposal pile is still in evidence. Besides the positive benefits of allowing us some insights as to the dispersion rates of sediments in that depth of water, the disposal pile identifies some absolute short-term problems and some possible long-term ramifications.

In the short term, the pile has had some effect on wave focusing in or near the navigation channel. The increased hazard to navigation is real, and we have received numerous complaints. In the long term, it indicates that there may not be adequate transport capability available at this depth to prevent locking some sediments into dead storage or the buildup of sediments at or near an entrance channel. If the material is indeed being put into long-term storage, we can develop both a navigation hazard and a beach erosion problem. Definition of transport rates and directions is a major research need in our navigation program.

DISCUSSION

MR. SMITH: Mr. Smith stated that at the Pacific Congress on Marine Technology which he attended, one of the overriding themes was the exclusive economic zone. The 200-mile limit was established in 1983 to govern mineral resources and not just the fisheries within a 200-mile zone. There were people from the USGS and NOAA and private groups speaking on the swap technology.

Mr. Smtih said, "I was noticing John's slides of the contours around the mouth of the jetties where they were monitoring this mound. This is where I spotted the parallel between this demonstration that several presenters gave of this side-scan sonar adapted for mapping purposes. Now, the signal was digitized such that it could be corrected within the entire sweep of the side-scan transducer to give depth information, but the additional benefit was the geological interpretations that could be made. And these two separate presenters showed underwater volcanoes in the deep ocean. First they would show the map, the traditional contours. Well, you could sort of tell there was a mound there that might be interpreted as a volcano, but then they showed that additional information was available from the signal itself, its strength related to the reflectance of the bottom material. And you could easily see lava flows in a certain direction that weren't revealed at all by the straight hydrography. It occurs to me that in a shallow-water mode this would be ideal for monitoring these dredge material disposal areas, the Murden's Mound, and all these problems where you can make a distinction between the dredged material and the native material."

MR. OLIVER: Mr. Oliver said he was aware of that capability with side-scan sonar.

PUBLIC COMMENT

BG(P) ROBERTSON: As you know, the board is Congressionally authorized and we're mandated to make these biannual meetings open to the public and include a period for public comment. The next half hour is set aside for that purpose. We have at least one presentation, and we're glad to have with us Mr. Richard Spears and Dr. T. J. Tzong from Wave Power Industries, Inc., of Santa Anita, California.* They'll be giving us a presentation of new breakwater design.

THE NEPTUNE SYSTEM

The purpose of this presentation is to introduce the Neptune System, its potential benefits for shore protection and the feasibility of integrating Neptune System technology with breakwater designs.

The Neptune System is a hydraulic float-pump-reservoir (or pressurized tank) - resonant chamber system which extracts energy from ocean waves. This new invention utilizes a caisson structure which acts as a resonant chamber into which ocean waves are guided in order to create significantly larger heave motions inside the chamber than are occurring in the sea outside the chamber. A float-pump system inside the resonant chamber pumps water to a pressurized tank on top of the caisson and generates power through a hydroelectric-generating plant. The generated power is transmitted ashore via a submarine cable. For the onshore alternative design, seawater is pumped ashore to a reservoir and released into a land-based hydroelectric-generating system.

The idea of incorporating the Neptune System into a new breakwater design to achieve both the goals of energy production and shoreline protection is proposed. Since a portion of energy will be extracted from the waves by the Neptune System through a hydraulic design, the wave energy which can erode the shore is reduced. An example with the help of a computer model developed in Reference 1 is used to demonstrate the idea. This example includes a row

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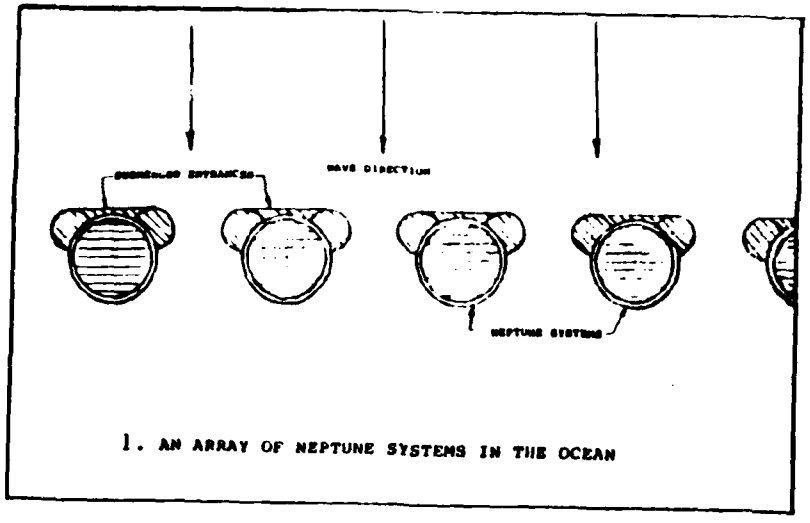
* Richard H. Spears received his M.A. from the University of Southern California and is the financial vice president of Wave Power Industries, Inc.

Tsair-Jyh Tzong received his Ph.D. in civil engineering from the University of California. He serves as a research structural engineer for Wave Power Industries, Inc. His expertise is in the areas of structural dynamics, fluid dynamics, finite element method, and numerical applied mechanics.

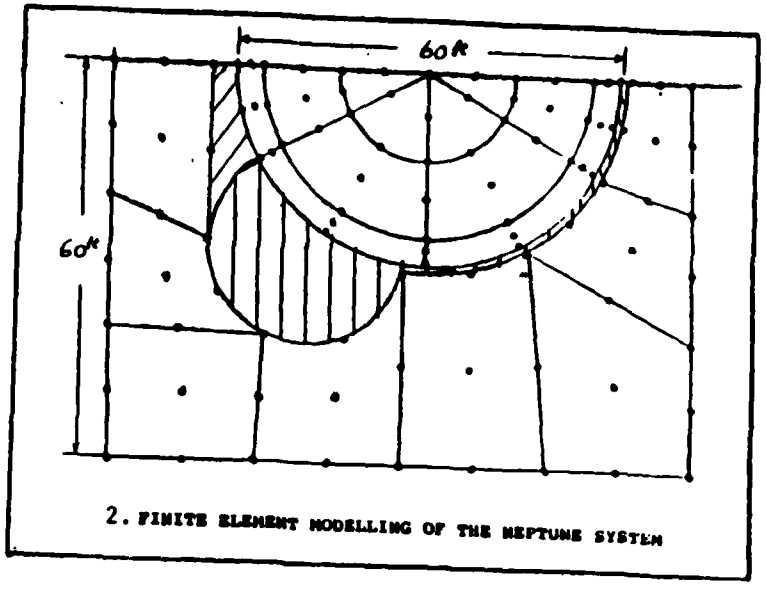
of Neptune Systems along a shoreline with an equal distance between the caissons, as shown in Figure 1. The energy which is extracted by the Neptune System and which is left behind the system is to be calculated. The computer model simulates the entire ocean by separating it into a near field and far field. The near field including the Neptune System and a small portion of surrounding water is modeled by three-dimensional quadratic finite elements (Reference 2). The far field is the water region beyond the boundary of the near field and is modeled by a hybrid element (Reference 3). The float connected to a double action hydraulic pump is enclosed inside the caisson which is the supporting structure of the Neptune System, and is modeled by a rigid body equation of motion. This equation is then combined with the finite element formulation by considering the equilibrium of dynamic forces on the float. The energy loss observed at the entrance of the caisson due to the fluid separation is simulated by using a friction force term in the float equation of motion. Since a row of Neptune Systems is deployed in the sea, an equivalent analysis of this problem can be performed by considering a single Neptune System in the wave flume. The corresponding finite element model is shown in Figure 2.

The Neptune System used for this analysis has the following specifications: caisson diameter = 60 ft, water depth = 40 ft, float diamter = 57 ft, float draft = 3.75 ft, pump diameter = 4.84 ft, reservoir head = 300 ft, and entrance loss coefficient = 1,000. The center-to-center distance of two caissons is 120 ft. The power which can be generated by each Neptune System with an assumed 72 percent of turbine and generator efficiency over the entire wave spectrum is shown in Figure 3. The result indicates that at least 300 kw of electricity can be generated within the system's operating range of wave periods which is from 7 to 18 sec. Figure 4 shows the residual wave power behind the Neptune System. Less than 50 percent of the original wave power is observed in the range of periods of 7 to 18 sec. At the best case, which corresponds to the period of 11 sec, more than 80 percent of the wave energy is blocked by the system. It can therefore be concluded that the use of the Neptune System to function as an assistant to the breakwater is feasible. It is also realized that the new breakwater design has the following advantages:

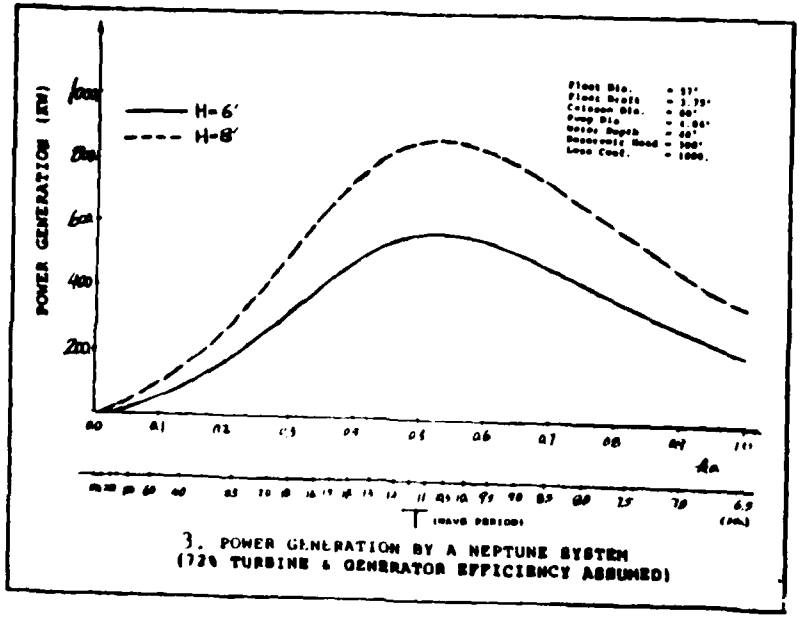
a. The new design can generate revenue to support itself and to realize a profit.



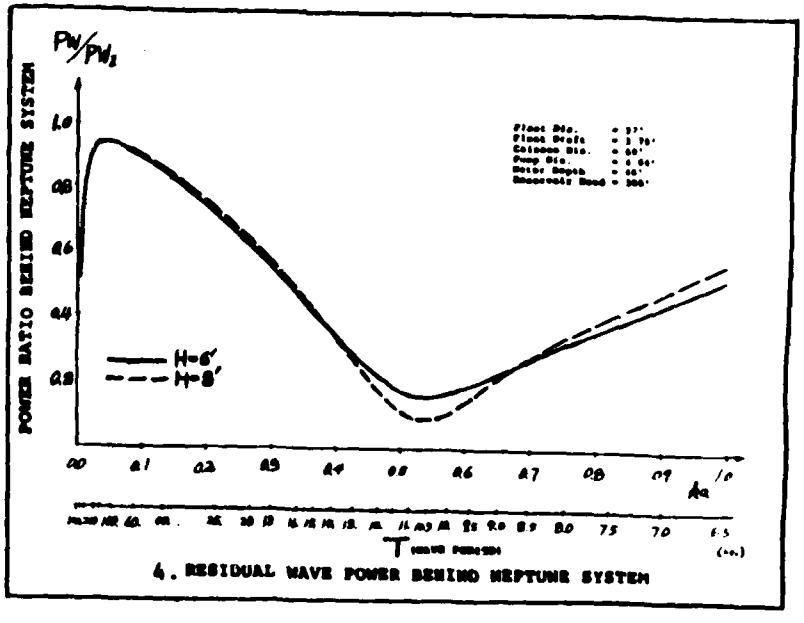
1. AN ARRAY OF NEPTUNE SYSTEMS IN THE OCEAN



2. FINITE ELEMENT MODELLING OF THE NEPTUNE SYSTEM



3. POWER GENERATION BY A NEPTUNE SYSTEM
(72% TURBINE & GENERATOR EFFICIENCY ASSUMED)



4. RESIDUAL WAVE POWER BEHIND NEPTUNE SYSTEM

b. The caisson functions as a strong breakwater and takes most of the wave force within the operating range of wave periods.

c. Even without using a breakwater, the Neptune System protects the shoreline to a certain degree.

Although a very promising result has been shown in the numerical example, more studies need to be done to further demonstrate the feasibility of the new breakwater design and to select the most appropriate design for a specific site. The following are the suggested studies:

a. Determining all possible ways to combine the Neptune System and the breakwater and perform the corresponding economic analysis.

b. Estimating the wave force on the new breakwater design and calculating the required strength of the caisson and the breakwater, respectively.

c. Estimating the dynamic interaction effect of the caisson and the breakwater.

d. Performing the dynamic scale model study to verify the computer model.

Incorporating Neptune System technology in breakwater designs could substantially reduce the cost of breakwaters by permitting them to be built with both private and public funds. Because of the reduced length of the conventional part of this type of a breakwater, the amount of private monies used to build the Neptune Systems could reduce the amount of public monies needed to construct the conventional portion of such a breakwater.

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3. Yue, K. P., Chen, H. S., and Mei, C. C., "A Hybrid Element Method for Diffraction of Water Waves by Three Diminsional Bodies," International Journal for Numerical Methods in Engineering, Vol 12, pp 245-266, 1978.

DISCUSSION

DR. LE MÉHAUTÉ: Dr. Le Méhauté asked whether this is a float which goes up and down and compresses air.

MR. SPEARS: Mr. Spears said that it is a float that goes up and down within the caisson but doesn't compress air. The Swedish system uses an air compressor, neumatic system; but this is a water-generating system. It just simply uses the energy of the float going up and down to pump a piston inside a shaft of a valve of a pump with double-acting valves so it pumps both on the upstroke and the downstroke. It pumps water or a hydraulic fluid within a closed system. "We've been able to theoretically pump just in the experimental models that we did down at OTC, went up to what was it, 2,000 ft of head? Anyway, a large amount of head was generated as far as we could stick the shaft out the roof to figure out what it was." The system has been tested to a 1/12-scale model at OTC. Dr. Frank Wu at Tetra Tech has done a great deal of work as well as many many scientists around the world.

DR. NUMMEDAL: Dr. Nummedal asked who is the Australian customer and what's the time scale for that development.

MR. SPEARS: Mr. Spears answered that they are presently negotiating with the people at Rocknest Island to place one of the first prototype systems there. They are doing a public offering, an underwriting to obtain the funds to do this throughout with Australian underwriting. They intend to put one or two systems, depending on how the underwriting goes. Mr. Spears said they can produce the energy at approximatley 5 cents and that compares with oil at 6 cents, winds 11 and hydroelectric at 1-1/2. He said it's very competitive when it's done on a production basis at a commercial level.

DR. MEI: Dr. Mei asked a question about the slide used in the presentation where it's proposed to use this as a breakwater. The figures seem to indicate that the structure will completely block the waves. If that is so, that seems to be a most expensive way to build a breakwater because you don't save any material. Dr. Mei asked what is it that they have in mind.

MR. SPEARS: Mr. Spears answered that one of the purposes that originally got them thinking about this was the fact that, "if we were going to do this, say in conjunction with whoever wanted a breakwater, that it would be paid for by somebody other than the person who wanted to have the breakwater and there would be a cost savings to that degree. There are some trade-offs because it would go into water a little bit deeper than a normal breakwater would go, as I understand it. I'm not an expert in that at all. But the idea would simply be that the cost would be reduced to the degree that the space required by a breakwater would be reduced by the width of the caissons themselves. That's in a solid configuration and all the way from a solid to nothing."

DR. MEI: Dr. Mei asked whether any economic studies had been done.

MR. SPEARS: Mr. Spears answered that they don't have the economics worked out. It's too new an idea and it's not of a primary interest to them. It's ancillary to the primary purpose of generating the energy. They would like to be able to do more research to determine the feasibility of the system used in breakwater designs or simply the use of the system per se as a shore protection device.

BG(P) ROBERTSON: BG(P) Robertson thanked Mr. Spears and Dr. Tzong for coming and making the presentation.

DISCUSSION OF DATE AND PLACE OF NEXT MEETING

BG Kelly began a discussion on where to have the next few Board meetings. Some of the candidates are New Orleans, Galveston, New Jersey, Savannah, and North Central Division. After a lengthy discussion, Galveston and Savannah emerged as likely locations and BG Kelly said he would contact the South Atlantic and Southwestern Division Commanders to get their input on when and where they could hold the meetings. It was agreed that the next Board meeting would be in October 1986.

CLOSING REMARKS BY COASTAL ENGINEERING RESEARCH BOARD PRESIDENT

BG Kelly had to leave the Board meeting early and he asked BG(P) Robertson to take over for him. He then issued the following statement: "In the next 30 days I'm going to ask that John, Jay, and Charles get together to put together a letter to the Chief based upon what we discussed last fall, what we discussed in January, and what we discussed today on basically those four initiatives that we felt were worthy of consideration for the Corps to get involved in. And these initiatives are innovative funding, big payoff, private industry, and education and training. So, within the next 30 days, we'll have a draft that I will send to all the Board members for your review. You can hack or do anything you want with it. Thirty days from now is mid-June so we'll try and get it to the Chief somewhere about mid-July time frame.

"And what we're going to do then for our theme for '86 and '87 is to generally pursue those four avenues, where we stand, and have we made any progress. You can see we already have made a lot of progress between January and right now."

COASTAL ENGINEERING RESEARCH BOARD
45TH MEETING, 14-16 MAY 1986
FAIRBANKS AND HOMER, ALASKA

COMMENTS AND RECOMMENDATIONS
BY COASTAL ENGINEERING RESEARCH BOARD MEMBERS

DR. LE MÉHAUTÉ

Dr. Le Méhauté was quite excited and impressed about the progress which has been made lately at CERC and the plan which has been developed. He said CERC has changed tremendously over the last five years for the better. It seemed to him as if the change will continue, "I'm very pleased to see what's going on. The momentum is there, and it has to be kept up. We have new leadership now. I know Robert Whalin is still over there, but we have new leadership and I'm confident that with this new leadership progress will continue. We cannot slow down at this point. All that we have talked about today is very important and I hope it will be implemented step by step in the near future. I know as time progresses not everything will be the way we hope, but a lot can be done and a lot has to be done. I'm very optimistic about the future of CERC."

DR. NUMMEDAL

Dr. Nummedal echoed what Dr. Le Méhauté said and added that he was also extremely pleased with what he had seen in the individual Districts, particularly during this visit to the Alaska District.

One point that was quite important to him was the continued education of coastal engineers within the employ of the Corps and of those coming on board in the future. An interaction seems to have become established between CERC, specifically their field research facility, and the individual Districts that brings coastal engineers from the Districts to help out with the field experiments. The logical next step is to bring them into research acitivites at CERC. It's a very good step in the right direction and brings a lot of enthusiasm and excitement that is an important part of every human being's furtherance of his intellectual capabilities. Jay Lockhart will be taking some time off from OCE to actually help out in the field. Seeing more of that kind of interaction between all the components of the Army Corps is a very stimulating and encouraging development.

Dr. Nummedal closed by thanking COL Gregory and the members of the Alaska District for all that they've done for the Board during the week. He said "It's been probably my most remarkable visit to Alaska. I really appreciate all you've done."

DR. MEI

Dr. Mei felt the same about the excitement expressed by Dr. Le Méhauté and Dr. Nummedal. In addition, he wanted to reiterate several points he made in the course of the conference. Given the tremendous facilities and manpower at CERC, it may be very beneficial for CERC to put even greater emphasis on doing more and more work on model testing for the benefit of the Corps and for producing additional income. The second task that perhaps CERC could also be very instrumental in is to help in building a national wave data collection. In view of the requirements by the various Districts, it seems that CERC is in a unique position to take an active leadership role to improve wave data collection and analysis. This is an area where CERC is in an excellent position to do something in conjunction with NOAA.

He went on to say another aspect where CERC can play an even greater role is in transferring known techniques in numerical modeling towards engineering use. He thinks it's very exciting that CERC has already started on this Computer-Aided Design program. CERC's expertise in tsunami modeling, three-dimensional defraction, interaction of waves with floating bodies, interaction of short waves with fixed structures, and things that have been developed in the past 10 years is ready to be translated into practical use by the Corps in its design.

He feels that on the proposed dredging programs, dredging research must include some aspect of the basic coastal processes. And last but not least he hopes the Corps keeps on exploring the potentials of the national laboratories as outlined by Jesse Pfeiffer. To reach this kind of goal will take quite a few years, but he feels this is a step in the right direction.

CLOSING REMARKS

BG(P) ROBERTSON

"Unfortunately two long time members of the board--well, one long time, Don Palladino, and one short time, Paul Kavenaugh, will not be at our next meeting. Paul Kavenaugh has been reassigned and Don Palladino has announced his retirement from the Corps of Engineers. We do not know who their replacements will be, but I'm sure they will be announced and on board at our next meeting in October. I'd like to congratulate all of those who have worked on implementing the Chief's initiatives, particularly the dredging community led by Bill Murden who moved out so quickly to implement a program to realize the big payoff. Bill, I think you guys have done a great job on that in working with CERC.

"This has been a rather exciting meeting, not only due to the expanse that we covered but an introduction to the tremendous challenges of arctic engineering, both the instrumentation and the unique problems caused by this environment. I'd like to issue sort of a challenge to Diane, in her official capacity as PAO, to work with CERC and come up with a joint article for publication in the the 'Engineer Update,' not only to give more visibility to the CERB and CERC and what we're attempting to do but to some of the unique problems here in Alaska. Perhaps we can gain a little emphasis, a little more funding and more manpower resources to solve some of our coastal problems."

MR. MURDEN

"General Robertson, it would be entirely wrong of me to take the credit you've indicated. Jesse Pfeiffer, the Director of Research and Development, the Coastal Engineering Research Center, and others have been an enormous help in putting this dredging proposal together; and it's only proper that I recognize that because it would have been absolutely impossible without them. The other announcement is a quick thing that everyone here will be interested in. I just talked to Washington, and the first local cooperation agreement between the Corps and the Port of Hampton Roads has been signed. Mr. Dawson applauds

it as being the mark of a new era. So, if the Congress chooses to go along with the Senate version, we can expect the other deepenings projects like Baltimore to sign their agreements early. So, that is a landmark and I wanted to be sure that you and our colleagues were aware of that. Thank you very much, sir."

BG(P) ROBERTSON

"One other piece of good news that we got that General Kelly found out yesterday was that the House has appointed its members of the conference committee to initiate the joint conference between the Senate and the House on HR6. So, perhaps after a 15-year-long dry spell, we're getting a little bit closer, one more step.

I declare this 45th meeting of the CERB adjourned."

BIOGRAPHIES OF SPEAKERS/AUTHORS

THEODORE A. ABELN

Mr. Abeln is a supervisory hydraulic engineer, and Chief of the Hydraulics Section in the Technical Engineering Branch of the Engineering Division, South Atlantic Division, US Army Corps of Engineers, Atlanta, Georgia. He joined the Corps of Engineers in the Jacksonville District in 1956. Since then his 30 years of Corps service has included two tours in the Jacksonville District and one in the Mobile District. He has been in the South Atlantic Division since 1980. Mr. Abeln received a B.S. degree in civil engineering from Rutgers University, the State University of New Jersey, and an M.S. in fluid mechanics from Georgia Institute of Technology. He is a registered professional engineer in the State of Florida, and a member of the American Society of Civil Engineers.

MICHAEL J. BRIGGS

Mr. Briggs is a research hydraulic engineer in the Wave Processes Branch, Wave Dynamics Division, Coastal Engineering Research Center, US Army Engineer Waterways Experiment Station. He joined CERC in 1983 after 13 years in the offshore petroleum industry where he was involved in structural dynamics, spectral analysis, and structural model testing. In his current position at CERC, Mr. Briggs is responsible for the development and use of the directional spectral wave generator including wave generation, measurement, and analysis. Prior to this, he was responsible for the processing and analysis of CERC's prototype wave and current measuring instruments. Mr. Briggs received a B.S. degree in petroleum engineering from the University of Texas at Austin in 1970, and an M.S. degree in ocean engineering from the University of Southern California in 1974, and an Ocean Engineer's degree from the Massachusetts Institute of Technology/Woods Hole Oceanographic Institution Joint Program in 1981.

H. LEE BUTLER

Mr. Butler currently serves as Chief, Research Division, Coastal Engineering Research Center, US Army Engineer Waterways Experiment Station. He directs a broad range of laboratory and field research studies/projects on forces and processees involved in beach erosion, hurricane action, sedimentation, and tidal hydraulics. He joined WES in 1973 as a team leader in the Wave Dynamics Division of the Hydraulics Laboratory directing numerical and analytical studies concerning tidal circulation, hurricane surge, tsunamis, and sediment transport. A singular achievement was the development of a generalized long-period wave model to simulate tide, surge, and tsunami phenomena, as well as explosion- and landslide-generated water waves. The model is known as the WES Implicit Flooding Model (WIFM). When CERC moved to Vicksburg in 1983, Mr. Butler was selected to serve as Chief, Coastal Processes Branch, where he supervised over 25 multidisciplined, high-level engineers and scientists in coastal engineering, oceanography, coastal geology, and civil engineering research. Prior to joining the Corps of Engineers, he was a senior scientist with the National Engineering Science Company and Tetra Tech, Inc., during the years 1964 through 1973. His responsibility involved the development and application of numerical models in many subfields of civil engineering with emphasis in the field of hydrodynamics. Mr. Butler received a B.A. degree in physics and mathematics from the University of St. Thomas at Houston, Texas, and an M.A. degree in mathematics from the University of North Carolina at Chapel Hill, North Carolina.

CHARLES C. CALHOUN, JR.

Mr. Calhoun is Assistant Chief of the Coastal Engineering Research Center of the US Army Engineer Waterways Experiment Station. Prior to joining CERC in 1984, he held the following positions at WES: manager, Environmental Effects of Dredging Programs; manager, Dredging Operations Technical Support Program; Manager, Disposal Operations Project, Dredged Material Research Program; and project engineer, Geotechnical Laboratory. He has been the recipient of various awards, including the Director's Research and Development Award in 1979 and the ASCE Moffatt-Nichol Harbor and Coastal Engineering Award in

1984. Mr. Calhoun holds professional membership in the American Society of Civil Engineers, the Engineers Club of Vicksburg, the World Dredging Association, and the Permanent International Association of Navigation Congresses. He has been a lecturer and an instructor of various Corps of Engineers and university courses, and he has a long list of publications to his credit. Mr. Calhoun is a registered professional engineer in the State of Mississippi.

CARLTON A. DAVENPORT, JR.

Mr. Davenport is a civil engineer in the Hydraulics and Waterways Branch of the Engineering Division, US Army Engineer District, Alaska. Mr. Davenport joined the Alaska District in November 1985 and is presently working on the evaluation of potential port and harbor sites for coal, oil, and gas terminals in Alaska. Previously he was a supervisory engineer with Bechtel, Inc. Mr. Davenport has a B.C.E. degree from North Carolina State University and a Diploma in Hydraulic Engineering, Delft, The Netherlands. He is a registered engineer in three states and a member of the American Society of Civil Engineers and the Permanent International Association of Navigation Congresses.

BRENT DRAGE

Mr. Drage is the Vice President of Peratrovich, Nottingham, & Drage, Inc. He joined PN&D in 1981 and directs the firm's hydrologic engineering, coastal engineering, and highway projects. Mr. Drage has over 15 years of professional engineering experience throughout Alaska and western Canada. His background includes extensive field work and complex analyses of hydraulic and hydrological criteria for design, development, and construction of coastal facilities and river structures in northern regions. Mr. Drage is the project manager for the St. George Harbor Project. He received a B.S. degree in civil engineering from Utah State University and an M.S. in civil engineering from the University of Alaska-Fairbanks.

KENNETH J. EISSES

Mr. Eisses is a civil engineer in the Hydraulics and Waterways Section,

Hydraulics and Hydrology Branch, Engineering Division, US Army Engineer District, Alaska. He joined the Alaska District in July 1981 and is presently involved with floating breakwater design at Whittier and Juneau, Alaska. Other duties include coastal engineering design and structural and river hydraulics. Ken Eisses received a B.S. degree in civil engineering from the University of Washington at Seattle, Washington.

JESSE A. PFEIFFER, JR.

Mr. Pfeiffer is General Manager, Civil Works Research and Development, Office, Chief of Engineers, Directorate of Research and Development. His responsibilities include developing, programming, and defending the Civil Works research and development program and supporting the Director of Civil Works in defending the program to the Office of Management and Budget and to Congress. His duties also include development of policies and procedures for the management of R&D, monitoring program execution, and ensuring transfer of technology. Mr. Pfeiffer began his employment with the Corps of Engineers in 1963. Mr. Pfeiffer is a 1955 graduate of the University of Texas at Austin, with a B.S. degree in civil engineering. Mr. Pfeiffer is a licensed professional engineer in Texas. He is a member of the American Society of Civil Engineers and the Permanent International Association of Navigation Congresses.

JEFF GILMAN

Mr. Gilman is a Senior Engineer with Peratrovich, Nottingham, & Drage, Inc. He joined the firm in 1981 as a civil engineer specializing in marine design, coastal engineering, and project management. He has been responsible for the design of a wide variety of marine and transportation structures including docks, breakwaters, floating facilities, coastal protection works, highways, streets, roads, and drainage structures. He is currently resident engineer for the St. George Harbor project. Previously he was the project's design engineer, with responsibilities including coordination of twelve major subconsultants and subcontractors for design of the breakwater system. Mr. Gilman has a B.S. degree in civil engineering from the University of

Washington and is currently working on an M.S. degree at the University of Alaska-Anchorage.

LYNN M. HORNECKER

Ms. Hornecker is a civil engineer in the Hydraulics and Waterways Section of the US Army Engineer District, Alaska. She joined the section in October 1984 and is primarily involved with coastal engineering studies. Ms. Hornecker received B.S. degrees in geological sciences and civil engineering from the University of Washington.

JAMES R. HOUSTON

Dr. Houston is Chief of the Coastal Engineering Research Center of the US Army Engineer Waterways Experiment Station. Prior to becoming Chief of CERC, he served as Chief of the Research Division. Dr. Houston has worked at WES since 1970 on numerous coastal engineering studies dealing with explosion waves, harbor resonance, tsunamis, sediment transport, wave propagation, and numerical hydrodynamics. He is a recipient of the Department of the Army Research and Development Achievement Award. Dr. Houston received a B.S. degree in physics from the University of California at Berkeley, an M.S. degree in physics from the University of Chicago, and an M.S. degree in coastal and oceanographic engineering and a Ph.D. in engineering mechanics from the University of Florida.

VICTOR MANIKIAN

Mr. Manikian has 39 years of experience in engineering of which 11 years were spent on projects in Alaska. Mr. Manikian has been with ARCO Alaska, Inc., since 1979 as staff engineer in civil and pipeline engineering projects on the North Slope. Prior to joining ARCO, he was a consultant in the Alaska Pipeline Office of the Department of Interior in monitoring the design of the Trans-Alaska Pipeline System.

WILLIAM R. MURDEN, JR.

Mr. Murden is Chief of the Dredging Division, US Army Corps of Engineers Water Resources Support Center, a component of the Directorate of Civil Works. Prior to moving to Washington, he was an engineer with the Norfolk District where he was involved in the construction and operation of the J. H. Kerr and Philpott multiple-purpose hydroelectric projects and in the dredging program. He attended The Citadel prior to serving as a command pilot during World War II. Later he attended Elizabethtown College in Pennsylvania, where he received a degree in mechanical engineering, and Heed University in Florida, where he earned the M.B.A. degree. Mr. Murden has been Chairman of the Corps of Engineers Marine Engineering Board for the past 12 years. He is a registered professional engineer in the District of Columbia and Louisiana; Chairman of the Corps of Engineers Committee on Dredging Technology; Honorary Chairman of the Board of Directors of the Western Dredging Association; and Chairman of the Finance Committee of the Permanent International Association of Navigation Congresses. Mr. Murden also belongs to the National Academy of Engineering, the American Society of Mechanical Engineers, the Society of American Military Engineers, and the Society of Naval Architects and Marine Engineers.

JOHN G. OLIVER

Mr. Oliver is a civil engineer involved in study formulation for all coastal and open channel work in the Hydraulic Design Review Section of the Technical Engineering Branch, US Army Corps of Engineers, North Pacific Division (NPD). He was Chief of the Coastal Engineering Section at NPD, Portland District, from 1968 to 1972. He obtained a B.S. degree from Oregon State University in 1961 and a Postgraduate Diploma in hydraulics from the International Institute of Hydraulic and Environmental Engineering, Delft, The Netherlands, in 1974.

JOHN B. OLSON

Dr. Olson is a special assistant to the Commissioner for the Alaska Department of Transportation and Public Facilities. He joined the Department in 1983 and has had a variety of assignments in the planning, design, and

construction of transportation and public building projects. Before assuming this position, he managed applied science investigations and engineering development for a consulting engineering firm and for a large public utility. His speciality is engineering management and decision analysis using systems and numerical modeling techniques. Dr. Olson received B.S., M.S., and Ph.D. degrees in civil and environmental engineering from the University of Southern California.

DOUGLAS G. OUTLAW

Mr. Outlaw is Chief of the Wave Processes Branch, Wave Dymanics Division, Coastal Engineering Research Center, US Army Engineer Waterways Experiment Station. He has been employed at WES since 1972 and was transferred to CERC in July 1983 from the WES Hydraulics Laboratory. He has been involved with coastal studies of harbor protection, harbor resonance and sediment transport, wave and tide data acquisition and analysis, and tidal circulation. Mr. Outlaw received a B.S. degree in civil engineering and an M.S. degree in hydraulic engineering from the Georgia Institute of Technology. He also is an Engineer Officer with the US Army Reserves.

LARRY L. REEDER

Mr. Reeder is Chief of Special Actions Section, Regulatory Branch, US Army Engineer District, Alaska. He has been with the Alaska District Regulatory Program since June 1979. He manages the Regulatory Branch environmental documentation and permit evaluation workload and supervises special projects/ studies. He authored the existing Abbreviated Processing Procedure for North Slope Oil and Gas Activities, supervised the preparation of 15 Regional Permits for the Alaksa District, supervised the preparation of Regional Conditions to the Nationwide Permits which helped to settle the national lawsuit against the Regulatory Reform Regulations issued by OCE, and directs the Corps' technical involvement in the Endicott Monitoring Programs. Prior to coming to the Alaska District, he was assigned to the Tulsa District for 7 years as a project manager at several flood-control and hydropower multipurpose projects. Mr. Reeder received a B.S. degree in fish and wildlife management from Southeastern Oklahoma State University.

THOMAS W. RICHARDSON

Mr. Richardson is Chief of the Engineering Development Division, Coastal Engineering Research Center, of the US Army Engineer Waterways Experiment Station. He joined CERC in June 1983 as Chief of the Coastal Structures and Evaluation Branch. For 11 years prior to this, he was a research hydraulic engineer in the WES Hydraulics Laboratory, where he specialized in dredging, sand bypassing, and general coastal engineering studies. Mr. Richardson received a B.S. degree in civil engineering from The Citadel, an M.S. degree in civil/ocean engineering from the University of Miami, and a Diploma in hydraulic engineering from the International Institute for Hydraulic and Environmental Engineering in Delft, The Netherlands.

CAPTAIN ANDY D. SANTOS

Captain Santos is the Port Captain at the Valdez Terminal for the Standard Oil Company. His duties there are concerned with the safety and efficiency of Standard Oil's fleet of chartered tankers. He first came to Alaska as a deck boy aboard a sailing vessel. In the early 1950's he returned to Alaska as a seaman and later as an officer on Navy troop ships sailing into Whittier, Kodiak, and Adak and on to the Far East. Captain Santos sailed for the Standard Oil Company of California (Chevron) in the 1960's and 1970's. After serving on several of their larger tankers, he was assigned to a coastal tanker for about 10 years plying the waters of Alaska from Ketchikan to Nome, literally carrying oil for the lamps of Alaska Marine Highway System homeported in Seward, Alaska.

ORSON P. SMITH

Mr. Smith holds a B.S. degree in mechanical engineering from the University of Kentucky, a Diploma in Hydraulic Engineering from the International Institute for Hydraulic Engineering at Delft, The Netherlands, and an M.S. in civil engineering from Mississippi State University. He is a registered civil engineer in the State of Alaska. He worked for the Alaska District in Anchorage from 1973 to 1983 in operations, engineering, and planning. He is now a

research hydraulic engineer in the Coastal Design Branch of the Coastal Engineering Research Center, US Army Engineer Waterways Experiment Station.

CARL D. STORMER

Mr. Stormer is the Chief of the Hydraulics and Waterways Section of the US Army Engineer District, Alaska. He began his career with the Alaska District in 1968 becoming the section chief in 1980. He has spent 16 years working on hydraulic and coastal projects since joining the District. Mr. Stormer has a B.S. degree from New England College, Hennicker, New Hampshire, and an M.E. degree from Thayer School of Engineering at Dartmouth College, Hanover, New Hampshire. He is an affiliate member of the American Society of Civil Engineers and a member of the American Section of the Permanent International Association of Navigation Congresses.

CHARLES L. VINCENT

Dr. Vincent is senior scientist at the Coastal Engineering Research Center, US Army Engineer Waterways Experiment Station, and program manager for the four coastal research programs in the coastal engineering functional area of the Corps of Engineers Research and Development Program. Dr. Vincent's areas of research include hindcasting wave spectra, shallow water wave mechanics, air-sea interaction, and tidal inlet mechanics. He has a B.A. in mathematics and an M.S. and Ph.D. in environmental sciences (earth science) from the University of Virginia.

JOSEPH T. WEBER, JR.

Mr. Weber is a hydrologist/project manager in the Plan Formulation Section of the Planning Branch, US Army Engineer District, Alaska. He joined the section in December 1980 and is primarily involved with navigation studies. Mr. Weber received a B.S. degree in forestry from Michigan Technological University and pursued graduate studies in watershed management and hydrology at the University of Arizona.

APPENDIX A

DREDGING OPERATIONS RESEARCH AND DEVELOPMENT (R&D) PROGRAM

NEEDS AND PRIORITIES

DAEN-CWZ-B 1 May 1986

SUBJECT: Dredging Operations R&D Program Needs and Priorities

SEE DISTRIBUTION

1. The Corps of Engineers is the nation's dredging agency, spending more each year on that one mission than on any other item in the civil works budget. Over the past decade, the nature of Corps dredging has changed significantly. Contract dredging now accounts for the majority of our work, and environmental concerns play a large role in our decision-making. Over the next decade, our position will change even more. Cost sharing, user fees, and deep draft ports often will place us in the role of a joint venture partner with state and local authorities. Congress as well as our partners will watch carefully the way we do business and utilize resources. We must begin now to lay the foundation for this new role so that we can continue and even expand our traditional position as dredging leaders.

2. General Heiberg addressed the last meeting of the Coastal Engineering Research Board (CERB) in November 1985, directing the Board to recommend ways in which Research and Development could generate significant payoffs for the Corps. He specifically identified dredging as a principal mission area for such an approach. As President of the CERB and Chairman of the R&D Review Board, I responded to this charge by asking the Dredging Division of the Water Resources Support Center (WRSC-D), the Directorate of Research and Development, and the U.S. Army Engineer Waterways Experiment Station to take several steps toward establishing a new Dredging Operations Research and Development (R&D) program. This program will have one goal: reducing the cost of Corps dredging operations, both in-house and contract. We can best accomplish this goal if we use the experience and abilities spread throughout our entire organization. Needs and priorities for research should be articulated by the Field Operating Agencies (FOA's), since they are tasked with accomplishing all Corps dredging. Toward this end, operations representatives from a number of FOA's attended a workshop sponsored by WRSC-D at Ft. Belvoir on 11 February 1986. Development and execution of the R&D program now must continue as a cooperative effort between the FOA's, the Directorate of Civil Works, the Directorate of Engineering and Construction, the Water Resources Support Center, and the Directorate of Research and Development.

3. I have enclosed for your information and comments several documents that summarize the work accomplished to date toward establishing a dredging operations R&D program. Each document represents a different facet of the overall

picture. It is particularly important that all dredging and dredging support components of your organization be given the opportunity to review this package, as the scope of this program encompasses a variety of responsibilities and activities. The enclosed documents are:

a. Enclosure 1 - presents the needs and priorities expressed by FOA operations representatives in the 11 February 1986 meeting at Ft. Belvoir. Attachment 1 to this document is a restatement of a portion of these needs and priorities submitted subsequent to the 11 February meeting by Mr. Robert Hopman, chairman of that part of the meeting. Attachment 2 is a list of attendees at the workshop. (For your comments, modifications, additions, and prioritization)

b. Enclosure 2 - discusses the need for and purpose of a dredging operations R&D program and presents a proposed structure and execution mode for the program. (For your information)

c. Enclosure 3 - lists comments from several sources on needs and priorities. Attachment 1 to this document is an early version of potential operations topical areas that was the basis for the comments in section A of this enclosure. (For your information)

4. Your response and those from other addresses will be used in developing a final set of needs and priorities. This in turn will be used by the Corps laboratories to prepare an initial draft R&D program, which will be sent to you for comment. The final draft program will incorporate your comments and will serve as the basis for a decision to proceed.

5. Contacts for information on this program are Mr. Jesse A. Pfeiffer, Jr., DAEN-RDC, telephone (202) 272-0257 (FTS 272-0257) or Mr. Charles W. Hummer, WRSC-D, telephone (202) 355-2235 (FTS 385-2235).

6. Please furnish your comments on the enclosed material directly to Mr. Pfeiffer NLT 7 May 1986, so that a summary assessment of needs and priorities can be presented at the next CERB meeting on 14 May 1986.

FOR THE COMMANDER:

(signed)

Encls

PATRICK J. KELLY
Brigadier General, U.S. Army
Deputy Director of Civil Works

SUMMARY OF OPERATIONS WORKSHOP 11 February 1986

Please review and:

a) Rank the topical areas according to your priorities in the appropriate column.

b) Modify topical areas as deemed suitable.

c) Add new topical areas where needed.

FUNCTIONAL AREA:

MATERIAL

Workshop Priority	Your Priority	Topical Area
1		Instruments for measuring in-situ bottom density. Probable major application is for hopper load measurement; includes sand as well as fine-grained.
2		Improved definition of navigable depth in fine-grained sediment, to include methods for measuring.
3		Evaluation of critical shear stresses for in-situ and maintenance materials. Oriented toward determining dredgeability of material and toward information needed as input to sediment transport calculations.
4		Suitability of materials for capping contaminated material.
5		Development of standard dredging-related descriptors for in-situ material such that engineering properties are directly given or can be readily implied for dredgeability predictions. Existing PIANC classification is not sufficient for harder material. Secondary applications extend over entire dredging cycle, including disposal.
6		Fate and stability of dredged material disposed on the bottom in open water.

Encl 1

FUNCTIONAL AREA:

MECHANICS

Workshop Priority	Your Priority	Topical Area
1		Guidelines for the use of high density polyethylene pipe in dredging. Potential applications: weight savings on new Corps dredge designs (sidecaster, dustpan) and retrofit on existing Corps dredges.
2		Improved draghead geometry. Applications-specific improvements to generate large increases in efficiency.
3		Improved technology for localized transport. Ways of helping nature maintain channels (skimming sand waves, training structures, underwater berms etc.).
4		Optimal use of water jets for suction heads. Methods for cutting and fragmenting consolidated clays and sands.
5		Improved dustpan dredge design. Approach should consider dredge as a system and not focus just on individual components.
6		Design of eductors for fixed emplacement. In particular, consider West Coast needs as well as general applications.
7		Portable single point mooring design for hopper dredge pumpout. "Portable" is key. Stowable aboard dredge for transport?
7a		Capping vehicle. Equipment for placing capping materials. Puget Sound specifically mentioned, with 200-300 ft water depths. Materials topical area priority 4 should be complementary task.

FUNCTIONAL AREA:

MECHANICS (CONT.)

Workshop Priority	Your Priority	Topical Area
8		New concepts for dredging shallow draft coastal channels. Include examination of transportable breakwaters for sheltering dredges.
9		Methods for adding assists to dredge suctions. Eductors and ladder pumps; other possibilities unclear.
10		Methods for gas removal from dredge suctions. Draw on European technology.
11		Improved dredge pump design for specific materials. Hardened casings, volute designs, 3-4-5-vane impellers, etc.
12		Methods for coping with wear of dredging components. Oriented toward evaluating or improving existing methods.
13		New dredge pump designs for high density material.

FUNCTIONAL AREA:

MONITORING

Workshop Priority	Your Priority	Topical Area
H*		Methods for obtaining real-time instantaneous sea surface measurements. Include tides, waves, seiches, atmospheric effects, etc. Also include interpolation and possibly extrapolation in addition to instruments.

*All topical areas under monitoring and management were rated as high (H) priorities by the workshop participants.

FUNCTIONAL AREA:

MONITORING (CONT.)

Workshop Priority	Your Priority	Topical Area
H		Improved technology for measuring dredged material in pipeline flow. Important for contract monitoring and possibly environmental performance on contracts. Include flow properties as well as possibly material properties.
H		Technology for monitoring hopper load. Oriented toward environmental requirements as well (material properties and vertical gradients, etc.).
H		Technology for real-time monitoring of dredge suction position, primarily depth.
H		Instruments for real-time horizontal positioning of dredges and dump barges. Need to know where contractor dump scows are and where they dump.
H		Silent inspector. Collect, disseminate, and quantity information on what is happening with the dredging operation. Ability to monitor remotely could be added to this, or could be integral part of other monitoring areas.
H		Applications of satellite technology to dredging. Include satellite positioning and use of satellites for data transmission for dredging or surveying.
H		Vertical positioning technology. Oriented toward correcting survey vessel heave.
H		Technology for bathymetric surveying by remote sensing.

FUNCTIONAL AREA:

MONITORING (CONT.)

Workshop Priority	Your Priority	Topical Area
H		Improved fathometer depth measurement technology. Oriented toward ways of dealing with low-density material.

FUNCTIONAL AREA:

MANAGEMENT

Workshop Priority	Your Priority	Topical Area
H		Management of all aspects of dredging operations. Includes surveys, estimates, plans and specs, contract admin, budgeting, etc. Possibly oriented toward operations research assessment showing cost savings justification.
H		Improved methodology for dredging cost estimating. Include predicting production rates, risk analysis, data base, determining actual contractor costs, etc. Need better estimating data base for long-haul projects.
H		Forecasting models for dredging operations. High degree of interpretational latitude; especially needed for long-term disposal planning.
H		Review and design of channel dimensions. Include performance assessment of self-maintaining channels, applicability of side slopes, models for evaluating economic alternatives, ship simulator assessment, etc.
H		Alternative methods for dredging. Include agitation, advance maintenance, structural alternatives, deposition basins, etc.

FUNCTIONAL AREA:

MANAGEMENT (CONT.)

Workshop Priority	Your Priority	Topical Area
H		Disposal area creation and management. Include methods for creating shoals and reefs, guidelines for designing nearshore sand placement, etc.
H		Assessment of dredging training and manpower needs.
H		Methods for forecasting maintenance dredging requirements.
H		Policies for establishing B/C ratios for O&M dredging projects.

FUNCTIONAL AREA:

TECHNOLOGY TRANSFER

Workshop Priority	Your Priority	Topical Area
H		Civil works dredging manual. Should serve function analogous to that of Shore Protection Manual in coastal engineering or other such document; major tech transfer item.
?		Guidelines for standardized core storage and handling for dredging investigations for both rock and non-rock materials.
?		Coring methods and equipment for dredging investigations.
?		Guidelines for the use of discharge line booster pumps.

DEPARTMENT OF THE ARMY
NORTH PACIFIC DIVISION, CORPS OF ENGINEERS
P.O. BOX 2870
PORTLAND, OREGON 97208-2870

REPLY TO
ATTENTION OF:

February 28, 1986

Construction-Operations Division

Waterways Experiment Station
Corps of Engineers
ATTN: Mr. Charles Calhoun, WESCV-A
P.O. Box 631
Vicksburg, Mississippi 39180-0631

Dear Mr. Calhoun:

As agreed upon at the 11 February 1986 meeting to review the proposed submission of the Dredging Management Research Program, I have reprioritized the mechanics portion based on further assessment by some of the group. You will note additional items have been included on the list and also have been prioritized according to their potential worth.

The new prioritized list follows:

Priority	Item	Remarks
1.	Guidelines and examination of the use of high density polyethylene pipe in dredging	3-year study $1.5 million
2.	Improved draghead geometry	NPP has ongoing, inexpensive program
3.	Improved technology for localized transport (agitation) dredging	Sand wave skimmer 3-5 year study $1.3 million
4.	Optional use of water jets for for drag or suction heads	Follow industry experience - claim is for 30% production increase
5.	Improved dustpan design	Marine Design Center is active on this. Do more than dust off 1930 designs
6.	Design of eductors for fixed emplacement	Would reduce dredging requirement. Could have tremendous savings

Attachment 1 to Encl 1

Priority	Item	Remarks
7.	Portable single point mooring design for hopper dredge pumpout	"Portable" is key word, DPO committee headed up by R. Kreh has input
8.	Capping vehicle	Barge; dredge (platform) able to dispose effectively in depth down to 300'
9.	New concepts for dredging shallow draft coastal harbors	Potential big payoff could include side-casting aspects. 3-year study
10.	Methods for adding assists to dredge suctions	Not needed with ladder or submerged pumps
11.	Study and examine hydraulic vs electric outboard motors	Hydraulic motors produce more power per weight and have continuous full range variable speed, 2-year study $100,000
12.	Methods for gas removal from dredge suctions	Europeans are big on this. R&D may have already been done. Do literature search
13.	Improved dredge pump design for specific materials	Important to speed up pump change in conjunction with the R&D potential by savings 4-year study
14.	Training Structures	R&D new ways to eliminate need for dredging by concentrating currents to create self-maintenance. Big payoff potential. 5-year study $1.5 million

Priority	Item	Remarks
15.	Componentization	R&D dredge components for throw away purposes or for modular repair. Examine B:C ratio of existing repairs vs components
16.	Methods for coping with wear of dredging components	Documentation is needed here. Examine rubber pump liners; Tapco plating vs hard plating and its B:C ratio. This R&D could be very cost effective
17.	New dredge pump designs for high density material	Generally, Corps does not design pumps
18.	Methods for predicting cutter suction dredge response to waves	Has not been a Corps problem. R&D could be helpful to industry
19.	Improved swell compensation methods for cutter suction dredges	Potential big improvement for industry for work in heavy swell
20.	Improved cutter design for all kinds of excavation	Rock cutterheads, matchbox cutterhead, horizontal rotating cutterheads
21.	Improved design of grab bucket for underwater excavation	Environmental R&D. Study to begin 5 years from now for $1 million
22.	Standardized technology for agitation dredging	New Orleans has done a lot of R&D on this
23.	Improved cutterhead design for non-rock excavation	See #20 above

Priority	Item	Remarks
24.	Guidelines for the use of discharge line booster pumps	Technology transfer. Numerous small, inexpensive to operate pumps could replace one large pump. Big payoff potential
25.	Equipment for reducing shoaling in slips and berthing areas	Not a Corps responsibility potentially a big payoff.
26.	Improved dredge pump suction relief valves	Not used on hopper dredges. Have never heard of problems with this item
27.	Guidelines for the use of explosives in dredging	Safety manuals provide some of this
28.	Standardized transportable breakwater designs for dredge sheltering	Check with U.S. Navy to see what they have done. Very costly item but could have payoffs

As you see, all items have been prioritized; albeit this does not mean all items merit R&D in the near future. I suggest those items with a ranking of 1 to 16 be the higher category for R&D. These can be considered "winners" and could produce handsome improvements in dredging operations. One the other hand, items with a priority of 17 to 28 should be considered for R&D only, at a later date. Expected payoffs are lesser.

Finally, I again emphasize the two issues we stated at the 11 February meeting. The first is that R&D development, evaluation, and study must be thought of in terms of cost effectiveness. We do not want to see R&D for just R&D sake, but with the overal aim of benefit to the field's changed dredging mission. The second is that the proposed R&D program must be directed and evaluated by knowlegdeable dredging engineers with appropriate input from the labs and with technical monitoring and adjustments accomplished by field participants.

If you have any questions on this matter, feel free to contact Jake Redlinger or me at FTS 423-3778.

Sincerely,

Jake Redlinger

Bob Hopman
Chief, NPDCO-O-NP

CF: Mr. Bill Murden, WRSC-D

DREDGING R&D PROGRAM MEETING

FT. BELVOIR, VA

11 FEBRUARY 1986

NAME	ORGANIZATION
C. W. HUMMER, JR.	WRSC-D
VINCE MONTANTE	WRSC-D
CARLOS AGUILAR	SWD
JOHN MIKEL	CWO-M
BILL ROPER	RDC
CURT MASON	WESCD-F
CLARK MCNAIR	WESHE
DOUGLAS PIRIE	SPDCO-ON
HARDY SMITH	WESGR-M
GERALD GREENER	WRSC-D
JESSE A. PFEIFFER, JR.	RDC
LEN JUHNKE	NPSOP-NP
CHARLES CALHOUN	WESCV-A
TOM RICHARDSON	WESCD
BARRY HOLLIDAY	SAWEO-N
CARL BOUTILIER	NEDOD-N
RON KREH	NAPOP
HENRY SCHORR	NOD-LMNOD-A
RAY MONTGOMERY	WESEE
PAT LANGAN	SAMOP-O
HERBIE MAURER	SWGCO-M
BUDDY BOREN	LMVCO-O
ADAM HEINEMAN	NPP-OP
BOB HOPMAN	NPDCO-O
JIM BRADLEY	SADCO-O

Attachment 2 to Encl 1

DREDGING OPERATIONS RESEARCH AND DEVELOPMENT

INTRODUCTION

Need

The Corps of Engineers at present is involved in one way or another in virtually every dredging operation performed in the United States. Within the Corps, dredging is the largest single item in the civil works budget. Although dredging historically has been a primary function of the Corps, the last 10 years have seen drastic changes in the nature of this function and its interaction with others. Environmental concerns, contract dredging, and the oil embargo and its consequences are some of the national and international trends that have generated often conflicting demands on the historical Corps dredging mission. Cost sharing, user fees, deep draft ports, dredged material resource management, and the general shift of responsibility away from the Federal Government are examples of newer trends that will combine with the existing ones to produce even more change over the next 10 years.

Where change in past years often was manifested by restrictions, limitations, and increased cost, change in the near future could open new areas of opportunity. However, to participate in these new areas, the Corps must affirm and enhance its traditional role as a leader, especially in the operational aspects of dredging. A proven way to help accomplish this is by implementing a Research and Development (R&D) program of a size and scope sufficient to generate significant technological advances and new directions that the Corps and others will adopt or follow. The Corps did just that in response to the environmental concerns of a decade ago, and the result was a position of world leadership that continues today.

Purpose

The new Research and Development program should have one major purpose: reducing the cost of dredging operations to a minimum consistent with mission performance. This can be done in a variety of ways, including:

a. Increasing the efficiency of a process, operation, or piece of equipment.

b. Reducing the impact of contract claims.

c. Comprehensively defining operational requirements.

d. Sharing FOA successes in cost reduction and modifying or expanding them for Corps-wide application.

In addition to the primary benefit of saving Federal funds, a program with the purpose of cost reduction can have other important benefits:

a. Demonstrating to Congress that effective use of dredging funds is a top Corps priority. This has obvious importance, particularly during periods of cut-backs and budget scrutiny.

b. Showing potential cost-sharing agencies that the Corps can help them get a maximum return for their dredging investment, thereby making the Corps a desirable cost-sharing partner. By lowering the cost of dredging, it can also make proposed cost-sharing projects more feasible.

c. Serving as a focus for technological advance in dredging operations and bringing together through one mechanism the Corps, other Governmental agencies, the dredging industry, universities, private research organizations, and foreign interests. The Corps can benefit in a variety of ways from being the center of this focus.

PROGRAM

A Research and Development program directed toward reducing the cost of dredging operations has to be structured so that it:

a. Addresses the needs of Corps Field Operating Agencies (FOA's).

b. Produces demonstrated results that are immediately implementable by FOA's.

c. Provides for FOA input throughout the R&D process in a team work effort with the Directorate of Civil Works (DAEN-CW), the Directorate of Engineering and Construction (DAEN-EC), and the Directorate of Research and Development (DAEN-RD).

d. Facilitates interaction between all interests involved in the program.

The initial R&D topics in the program are developed directly from needs expressed by FOA representatives as well as input from the Office, Chief of Engineers (OCE) and the Water Resources Support Center (WRSC). During the life of the program, these topics are refined and modified based on recommendations made at periodic program reviews.

In addition to program reviews, the program should have a Field Review Group (FRG) continually involved in the R&D, serving as a source of both input and information. A Field Review Group usually is composed of representatives from the major organizations involved in the program (FOA's, DAEN-CW, DAEN-EC, and DAEN-RD). As a topic moves through the R&D phase into demonstration and implementation, the FRG plays an increasingly direct role in accomplishing the goals of the program.

An R&D program of this type is in essence a joint effort between the FOA's and the R&D community, with OCE and WRSC providing overall management and leadership. FOA's generate the majority of program direction in terms of what is needed, and Corps laboratories perform the R&D and provide day to day program management for pursuing the R&D phase of the program. Technical monitors from elements such as WRSC, DAEN-CW, and DAEN-EC have the responsibility for finalizing needs, priorities, and work areas, and overseeing the technical progress and sufficiency of the R&D. The actual R&D usually is performed by a variety of talents, including contractors, universities, FOA's,

Corps R&D laboratories, and other Corps organizations with particular talents, such as the Marine Design Center. Emphasis always is on finding and utilizing the best resource for the particular type of R&D needed.

An R&D product is useless unless FOA's can employ it. This means that the product should be demonstrated in typical field applications and refined as a result of the lessons learned from these demonstrations. The demonstration and R&D phases should interact, with information flowing in both directions. The FRG plays several important roles in R&D product demonstration: (a) advising on necessary demonstration characteristics, (b) cooperatively establishing demonstration sites or situations, (c) monitoring execution of the demonstrations, (d) evaluating demonstration results, and (e) recommending refinements to the R&D products. Ideally, demonstrations should be conducted such that FOA personnel have the opportunity to utilize the R&D products and make first-hand recommendations.

One advantage of having the FRG involved in the entire program process is that planning for product implementation can begin at the earliest possible time. When a product leaves the demonstration phase, it should be in a readily implementable form. The FRG plays a strong role in implementing program products and providing the R&D managers with specific information on the required forms and scope of implementation.

FUNCTIONAL AREAS

The subject of dredging operations can be subdivided into a number of functional areas. An R&D program dealing with dredging operations can utilize the following set of functional areas as a means of grouping similar R&D topics according to the nature of R&D required and the professional disciplines that may be involved in performing the R&D. This grouping is also a good reflection of how interests and responsibilities are divided in planning for and executing dredging operations:

a. Material - What is dredged and its properties that affect dredging operations.

b. Mechanics - Equipment and systems used to carry out dredging operations.

c. Monitoring - Measuring, reporting, and recording what needs to be dredged, characteristics of the dredging operation, and results.

d. Management - Means for directing and controlling a dredging operation or a program of operations.

e. Technology Transfer - How to place existing and new technology in the hands of those who need it, in the most readily usable form.

Input to Needs and Priorities from Sources Other Than
11 February 1986 Meeting

A. Review of Dredging Operations Improvement Assessment List (Attachment 1)

1. Source - John Mikel, reviewed by Cecil Goad and Bill Goetz

a. Instruments for detecting subbottom obstacles is not a dredging topic.

b. Methods for applying geologic investigation techniques should be deleted.

c. Question worth of improved cutter designs for rock excavation from the standpoint of how much rock dredging we actually do.

d. Equipment for reducing shoaling in slips and berthing areas is not a Corps activity except possibly for some work we may do for the Navy.

e. Guidelines for the use of explosives in dredging should be deleted.

f. Standardized transportable breakwater designs for dredge sheltering should be a spinoff from the Coastal R&D program.

g. The following items should be obtained somewhere else:

(1) System for real-time tide elevations in open water

(2) System for real-time wave measurement for dredging operations

(3) Methods for real-time extrapolation or interpolation of tide measurements

h. Microcomputer applications in dredging operations is too broad a topic.

i. Techniques and equipment for rapid ocean transport of dredging plant should be obtained somewhere else.

j. O&M will not pay for assessment of potential dredging problems at overseas sites.

k. Risk analysis and risk factors for dredging operations is too broad a topic.

l. A data base on field measurements of dredging process parameters should be considered only after R&D to determine if there are parameters.

m. Delete operations research model(s) to optimize dredging as a port management activity.

Encl 3

n. Review of channel dimensions using ship simulator technology is a channel design consideration, not O&M.

o. Agree with everything else as listed.

2. Source - Don Cluff

a. Methods for applying geologic investigation techniques to dredging work is a high priority.

b. There will not be much chance to apply improved cutter designs for rock excavation after the current new starts are done.

c. Equipment for reducing shoaling in slips and berthing areas is a low priority; not a Federal cost.

d. System for real-time tide elevations in open water is a high priority.

e. Instruments for measuring hopper load are a high priority.

f. Methods for predicting equipment-and-site-specific production rates are a high priority.

g. Techniques and equipment for rapid ocean transport of dredging plant is a low priority.

h. Physical environment forecasting models for dredging operations is a high priority.

i. Performance assessment of self-maintaining channels is a high priority.

j. Sediment management methods for dredging projects are a high priority.

k. Assessment of potential dredging problems at overseas sites is a low priority.

l. Assessment of dredging training needs in the U.S. is a low priority.

m. Guidelines for designing nearshore placement of dredged sand is a high priority.

n. Suggest adding:

(1) Methods for charting/measuring and controlling or influencing natural movement of bottom material

(2) Methods for disposing of material below the natural bottom

(3) Methods for transferring dredged material to low cost barge type vessels for transport and dumping.

o. Additional comments:

(1) Highest potential pay back areas:

(a) Reducing haul distances

(b) Reducing sedimentation

(2) Should include some more projects directed toward these goals.

p. No opinion on everything else as listed.

B. Dredgenet (Bill Goetz)

1. Include mobile land plant for handling dredged material on land. Should look specifically at tractors with elevated final drives.

2. The following topical areas might be incorporated in the new survey systems St. Paul District is presently attempting to acquire:

a. Technology for real-time monitoring of dredge suction position.

b. Instruments for real-time horizontal positioning of dredge.

c. Microcomputer applications in dredging operations.

3. Some of the best equipment in several areas is either foreign made or sole source. Relief should be allowed in these new acquisitions.

DREDGING OPERATIONS IMPROVEMENT ASSESSMENT

DREDGING OPERATIONS AREA	IMPROVEMENT COST SAVINGS POTENTIAL	SHORT TERM IMPROVEMENT POTENTIAL
MATERIAL		
Instruments for detecting subbottom obstacles	H	M
Critical shear stresses for in situ and reworked maintenance material	M	M
Instruments for measuring in situ bottom density	H	M
Development of standard dredging-related descriptors for in situ material	H	H
Guidelines for standardized core storage and handling for dredging investigations	M	H
Improved definition of "navigable depth" in fine-grained sediments	H	L
New or improved coring methods and equipment for dredging investigations	M	M
Methods for applying geologic investigation techniques to dredging work	H	H
MECHANICS		
Improved cutter designs for rock excavation	H	M
Improved draghead geometry	M	L
Portable single point mooring design for hopper dredge pumpout	M	H
Improved design of grab bucket for underwater excavation	M	H
Equipment for reducing shoaling in slips and berthing areas	H	M
Guidelines for the use of High Density Polyethylene Pipe in dredging	M	H

DREDGING OPERATIONS AREA	IMPROVEMENT COST SAVINGS POTENTIAL	SHORT TERM IMPROVEMENT POTENTIAL
MECHANICS (cont)		
Improved dredge pump design for specific materials	L	L
Methods for coping with wear of dredging components	M	M
Guidelines for the use of explosives in dredging	M	M
Improved cutterhead design for non-rock excavation	L	L
Standardized technology for agitation dredging	H	H
Design of eductors for fixed emplacement	L	H
Optimal use of water jets for drag or suction heads	M	M
Methods for adding assists to dredge suctions	L	L
Methods for predicting cutter suction dredge response to waves	M	M
New dredge pump designs for high density material	M	L
Improved technology for agitation dredging	M	M
New concepts for dredging shallow draft coastal channels	H	M
Improved dustpan design	M	M
Improved swell compensation methods for cutter suction dredges	H	L
Guidelines for the use of discharge line booster pumps	L	L
Methods for gas removal from dredge suctions	M	M
Improved dredge pump suction relief valves	L	L

DREDGING OPERATIONS AREA	IMPROVEMENT COST SAVINGS - POTENTIAL	SHORT TERM IMPROVEMENT POTENTIAL
MECHANICS (cont)		
Standardized transportable breakwater designs for dredge sheltering	M	L
MONITORING		
System for real time tide elevations in open water	H	H
Technology for real time monitoring of grab bucket position	L	H
Improved pipeline flow velocity measuring devices	L	L
Improved pipeline flow density measuring devices	M	L
System for real time wave measurement for dredging operations	M	H
Instruments for measuring hopper load	H	H
Technology for real time monitoring of dredge suction position	H	M
Instruments for real time horizontal positioning of dredge	L	L
Methods for real time extrapolation or interpolation of tide measurements	H	H
Technology for real time wave measurement for dredging operations	H	H
Technology for remote monitoring of dredge parameters	M	M
MANAGEMENT		
Methods for predicting equipment-and-site-specific production rates	H	M
Microcomputer applications in dredging operations	M	H

DREDGING OPERATIONS AREA	IMPROVEMENT COST SAVINGS - POTENTIAL	SHORT TERM IMPROVEMENT POTENTIAL
MANAGEMENT (cont)		
Techniques and equipment for rapid ocean transport of dredging plant	?	H
Physical environment forecasting models for dredging operations	M	H
Performance assessment of self-maintaining channels	H	H
Design and use of channel side slopes	M	H
Sediment management methods for dredging projects	H	H
Technology for bathymetric surveying by remote sensing	H	M
Assessment of potential dredging problems at overseas sites	?	H
Improved fathometer depth measurement technology	H	L
Guidelines for the use of deposition basins in maintenance dredging	H	H
Risk analysis and risk factors for dredging operations	M	H
Guidelines for creating artificial reefs and shoals with dredged material	M	H
Assessment of dredging training needs in the United States	H	H
Data base on field measurements of dredging process parameters	M	M
Operations research model/s to optimize dredging as a port management activity	H	H
Guidelines for designing nearshore placement of dredged sand	H	H
Methods for improving personnel safety in dredging operations	M	H

DREDGING OPERATIONS AREA	IMPROVEMENT COST SAVINGS POTENTIAL	SHORT TERM IMPROVEMENT POTENTIAL
MANAGEMENT (cont)		
Improved methods for determining actual contractor dredging costs	M	M
Methods for forecasting maintenance dredging requirements	M	H
Review of channel dimensions using ship simulator technology	?	M

APPENDIX B

SUMMARY OF COASTAL ENGINEERING RESEARCH BOARD TASK FORCE MEETINGS

Two task forces appointed by BG Kelly met on 14 January 1986 to respond to LTG Heiberg's challenge to the Coastal Engineering Research Board (CERB) to augment coastal engineering research for the Nation. The two task forces addressed nine issues either suggested at the 44th CERB meeting or through correspondence afterward:

a. Innovative Funding for Research.
b. Big Payoff Research Areas.
c. Federal Coastal and Ocean Engineering Research Commission.
d. National Laboratory Status for the Coastal Engineering Research Center (CERC).
e. CERC Work For Private Industry.
f. Dredging Research.
g. Education and Training.
h. Basic/Fundamental/Applied Research.
i. National Augment Coastal Laboratory.

The items were assigned to the two task forces who met in the morning session (the list of members of the task forces and a summary of each meeting are provided as Attachments 1 and 2). Although each task force addressed different topics, considerable overlap on all the items occurred, and in some instances differing opinions were generated. In the afternoon, the two groups met in an open session. This summary provides the conclusions of the joint session. A list of action items was developed.

One significant issue that underlies the proposals and some of the differences of opinion is the interpretation of the intent of the Legislative Charters of CERB and CERC. The Charters can be interpreted as requiring both CERB and CERC to consider the Nation's coastal engineering needs. Historically, emphasis has been placed on the Corps' part of the national need. How the Charter is interpreted determines the degree to which these organizations should respond to the broader need and open themselves to wider participation. A definitive interpretation was not reached by the task force members.

INNOVATIVE FUNDING AND CERC WORK FOR PRIVATE INDUSTRY

The most significant source of non-Corps funding for coastal engineering research is private industry. Current Corps constraints do not encourage CERC

to work for or with US private industry. This has been detrimental to US national interests because US industry goes abroad to seek this assistance which weakens the foundation for a better national research program. The opinion of both task forces was that CERC should work both with and for private industry, not in competion with it, where CERC facilities or expertise are unique. A study of what regulations or restraints need to be removed to facilitate such cooperation is required. A 5-year pilot program allowing CERC to respond to private industry requests by removal of constraints (perhaps through the concept of a model laboratory program) was suggested. One task force strongly indicated that the work for outsiders should be undertaken only if it meshed with the priorities of the Corps' research activites. The other task force indicated that if CERC is to meet its national support mission and obtain significant financial support from outside the Corps, the center might need to be spun off as a quasi-Government institution or laboratory. Significant resources also are available from other Federal agencies and state and local governments. Primary restraints on CERC are those related to current manpower levels. Removal of constraints similar to those discussed above would be necessary.

The concept of assessing an additional fee on permits or other economic activites in the coastal region appears to be a source of funds for general reseach and data collection activities. The fees would be paid into a national revolving fund which then could be used to help fund research, data collection, and facilities. This concept was considered to be attractive to the Office of Management and Budget (OMB) relative to asking for direct funding for such items. A study of the total economic impact of a Corps coastal project was suggested to see how the Corps' policy of calculating benefits might be realistically changed to reflect the actual (including private) benefits generated.

The National Science Foundation or a consortium of universities is considered as a potential source of funds for construction of large new facilities for dredging and coastal research, with the Corps contributing operational expenses. Such a combination of funding may well require joint control of facilites and determination of their use. Discussions in Task Force I pointed out that the Corps is the primary user of coastal research and that

its contributions to an augmented program would have to be significant in order for it to be credible.

DREDGING RESEARCH PROGRAM

Dredging research was identified as the biggest payoff area for the Corps and perhaps the Nation. When Corps and non-Corps dredging is considered, even modest improvements from research could effect more than a $100 million savings. Components of the research should include improved dredging technology, operations, and procedures, as well as studies of inlet and channel processes. The studies should include laboratory and field research. The Directorate of Research and Development (DRD) is assembling dredging research needs to formulate a program. The development of this program by DRD, the Water Resources Support Center-Dredging (WRSC-D), and the US Army Engineer Waterways Experiment Station (WES) should be accelerated. The CERB will be kept abreast of the progress and consulted on the final development of this program.

OTHER BIG PAYOFF RESEARCH

Other areas of potential cost savings include the field data collection program, and operations and maintenance programs related to channel deepening, breakwater repair, and beach restoration. Although the savings are more modest compared to the dredging program, improved funding of this research should be sought.

ENHANCED FACILITIES

Major progress in the dredging program and in many other areas of coastal research requires large-scale facilities in which the processes and procedures can be modeled at scales where scale effects can be largely eliminated. The size and complexity of such facilities are great with capital construction costs possibly exceeding $25 million. A world-class facility to meet the dredging and coastal process research needs of the Nation probably cannot be funded through the Plant Replacement and Improvement Program (PRIP)

because of the size of the yearly payback costs. Such a facility would be a national resource for Government, industry, and academia and funding through a combination of National Science Foundation, university consortium, and Corps funds should be explored.

NATIONAL LABORATORY STATUS

Legal review of the legislation authorizing CERC indicates that, by intent, though not by name, CERC is a national laboratory. There was debate over whether the change of CERC's name to reflect the national status was needed or beneficial. The task force considering the problem recommended no name change but emphasis of the national status in the publications, etc. The other task force concluded that if CERC is going to meet its mandate and attract large resources from outside the Corps, some change in name or status relative to the Corps might need to evolve. A structure similar to the National Center for Atmospheric Research was suggested as a possibility.

EDUCATION AND TRAINING

The need for better trained coastal engineers for the Corps and the Nation was recognized by both task forces and a variety of proposals was put forth. These included an international course, augmented short courses, summer training institutes, on-the-job training, improved advanced degree programs available through work at CERC but granted through individual or a consortium of universities, and a coastal engineering associates program similar to the Planning Associates Program in the Corps. The facilities and staff of CERC, in cooperation with academia, should be able to generate enhanced programs that will benefit and should be open to Corps employees, industry, Federal and other governmental employees, students at universities, and foreign students. Such activites also would serve to introduce potential users of CERC facilities and expertise to the capabilities available. The increased educational emphasis is considered attainable without significant new authorities. Both task forces were excited by the potential benefits to the Corps and to the Nation by increased activity in education and training. This was also recognized as a major mechanism for marketing of CERC and Corps

capabilities and for increasing communication and professionalism in coastal engineering.

BASIC/FUNDAMENTAL/APPLIED RESEARCH

Basic research, defined as knowledge for knowledge's sake, was not considered a Corps responsibility although the Corps should help justify increased emphasis to those funding agencies. Fundamental and applied research is within the Corps' funding realm. The conclusion was that where increased funding is needed, the Corps, through its General Investigation, Research and Development budget or through other budgetary areas, should make the funds available.

FEDERAL COASTAL AND OCEAN ENGINEERING COMMISSION

The development of an additional Federal commission was thought infeasible at this time. The Charter of the CERB was thought to be sufficiently broad to allow inclusion of other agencies or even private industry associations, if desired. Such actions were perceived as a method for increasing more coordination of the Nation's coastal research and building a constituency for a broader national laboratory in the future.

ACTIONS TO BE TAKEN

- CERC should define those constraints that affect work with private industry.
- CERC should develop a proposal for an enhanced educational program.
- DRD, WSCR-D, and CERC should define a dredging research program.
- CERC should develop lists of contacts to aid in developing national coastal research needs and to aid future development of coastal engineering as a profession.
- CERC should develop a list of facility requirements for a dredging and enhanced research program.

ATTACHMENT 1
TASK FORCE I MEETING

INTRODUCTION

Task Force I considered three issues: innovative funding, big payoff research areas, and a Federal coastal and ocean engineering research commission. The participants were:

BG(P) G. R. Robertson, Chairman, CERB
BG D. J. Palladino, CERB
Dr. D. Nummedal, CERB
Dr. R. W. Whalin, WES
Mr. J. R. Mikel, OCE
Mr. J. G. Housley, OCE
Dr. J. R. Houston, WESCV
Dr. C. L. Vincent, WESCR, Facilitator

DISCUSSION OVERVIEW

The Task Force recognized that the Corps and the Nation have basic and applied research needs that are not being met by Government, academia, or industry. Further, the Task Force was informed that US industry is often forced to go abroad for facilities or expertise available at CERC to the Federal community but not generally so to the academic or industrial sector. Consequently, US industry is at a disadvantage in competing for foreign work. Foreign firms and laboratories also are beginning to be active in pursuing work within the United States. CERC had, in the past, been asked to assist US industry, but restrictions and limitations rarely made cooperative assistance viable. The Task Force recognized that today most CERC funds, and hence the prioritization of work, are from the Corps of Engineers. Building a coastal engineering program with commensurate facilities that meets the wider needs of the Nation and answers key research questions central to solution of many of the Corps' coastal engineering problems requires broader Federal, State, and local government, academic, and industrial support and cooperation. The Task

Force saw that the limits and restrictions placed on CERC today make it difficult to attract the resources and respond to national needs. Review of the sources for innovative funding and big payoff research areas indicates that the significant opportunities for infusion of new resources, development of new facilities, and development of closer cooperation with academia and industry suggests that modifications to ways in which CERC can perform work are needed. The funding sources and payoff areas will be summarized below, but the key conclusions of the Task Force were based on the assumption of a CERC more flexible at obtaining and using outside resources than is now possible. A suggestion was made to consider the ultimate spinoff of a national laboratory built on the concept of the National Center for Atmospheric Research but largely sponsored by Corps funding that could attract wider support, serve more diverse needs than just the Corps, and cooperate more directly with academia and industry. A 5-year pilot program was proposed to eliminate many of the limitations and restrictions placed on CERC and to allow CERC to more freely seek out other non-Corps resources to see if a national center is viable.

The inclusion of industrial organizations such as the American Society of Engineers and the American Geophysical Union among others on the CERB was suggested as a base for building a constituency for a more national Federal/industrial/academic program. The concept of a specific Federal commission was considered to require an Act of Congress and not necessarily conducive to developing a national program. Further, it was thought that the CERB, through its Charter, was established to perform this role if a wider initiative is desired. Coordination with the Department of Commerce would be necessary due to their responsibilities under the Coastal Zone Management Act.

INNOVATIVE FUNDING

Work for private industry is considered the main source of significant untapped resources for coastal research and support of national facilities. The essential problem is that the limitations and restrictions placed on these activities revolve around manpower restrictions, advertising, surcharges, litigation, competition, technical control of output, and other regulations that would inhibit rapid response to industry requests. The Task Force envisioned

a center that could work with industry, not compete against industry. Development of an international course for coastal engineers was seen as an effective collateral mechanism for training engineers and providing a thorough introduction to the capabilities of such a center. Significant opportunities also appear possible in support of other Federal agencies and State and local governments, especially if the center is perceived as a national, not just Corps, resource. CERC has traditionally performed such studies. However, the manpower restraints now in place make effective utilization of outside resources difficult.

The National Science Foundation was suggested as one source for the funds to build new facilities for a national dredging, sediment transport, and coastal and ocean engineering center if the facilities could be used also by academia to perform basic research on processes. Since the Corps is perceived as the largest significant user of this research, the Corps might provide the land and operational funds for the facility for a fixed period. Academia might rent some facilites from CERC but is seen more as a source of additional manpower, especially in cooperative research and education programs. Sources of Corps funds to help support such a center or augmented research program include specific studies for operations and maintenance and increments in the General Investigation Research Program. An innovative suggestion involved fees or surcharges on coastal permits or activities that affect the coast, or on dredging costs that would be placed in a revolving fund to help fund the Field Data Collection Program, the new facilites, and the research program. Such charges on essentially users of the coastal zone are seen as an attractive option for funds by OMB. Such fees would require changes in law. Another opportunity is to review the Corps' policy dictating the method for calculating benefits from coastal projects to evaluate the total benefit. An increase in benefits can justify additional cost-sharing and yield a wider constituency for coastal research.

BIG PAYOFF RESEARCH AREAS

Dredging in coastal and estuarine areas costs the Nation about $1 billion per year. Research efforts that reduced the costs by 10 percent would generate a net savings of $100 million. The savings would not only be to the

Corps but also to local interests and industry that either cost share with the Corps or pay for it themselves. There is a need for a research center and program that can look at dredging technology as well as the mechanics of where sediment is deposited, channel design, etc. The user fee concept discussed above provides a mechanism by which research that would help reduce costs to non-Federal parties could be funded. A dredging program is under development, but it is a fixed time frame effort--approximately 5 years. A longer term program is needed to sustain the progress to be made under that program. Since the size of some of the facilities in such a center would be useful for theoretical research studies, connection to the National Science Foundation funding should be sought. One element of the research program should include extensive field measurements at inlets or other channel deepening projects. The techniques or equipment developed would impact dredging worldwide and should attract considerable industrial and foreign government attention. Other areas such as the Field Data Collection Program, dredged material mounds, sedimentation, channel deepening, breakwater and jetty rehabilitation, and beach restoration are areas of potentially high payoff. However, the potential impact of these programs individually is probably an order of magnitude lower than a dredging program.

FEDERAL COASTAL AND OCEAN ENGINEERING RESEARCH COMMISSION

The suggestion tendered was that a Federal group drawn from Federal agencies involved with these problems could meet to coordinate research, lobby for resources, and build a greater awareness for the needs for research in these areas. The Task Force concluded that CERB has the role to do this for the Nation although the role of the Secretary of Commerce in Coastal Zone Management must be recognized. Establishment of a separate commission requires an Act of Congress at a time when there is a desire to limit such additional commissions. Therefore, it was recommended that the Corps exercise leadership to expand CERB to include groups such as the American Geophysical Union, the American Society of Civil Engineers, and other agencies in order to build a constituency for eventually developing the national center.

ATTACHMENT 2
TASK FORCE II MEETING

Task Force II considered the following items:

a. National Laboratory Status for CERC.
b. CERC Work for Private Industry.
c. Dredging Research.
d. Education and Training.
e. Basic/Fundamental Applied Research.
f. A National Augmented Coastal Laboratory.

The participants were:

BG P. J. Kelly, Chairman, CERB
COL C. E. DeWeese, NAD
Dr. B. J. Le Méhauté, CERB
Mr. W. R. Murden, WRSC
COL A. F. Grum, WES
Mr. J. A. Pfeiffer, OCE
Mr. C. C. Calhoun, Jr., WESCV
Mr. J. H. Lockhart, OCE
Mr. W. N. Lovelady, WES
Mr. C. Mason, Facilitator, WESCD
Dr. C. C. Mei, CERB

NATIONAL LABORATORY STATUS

The Task Force noted that CERC is unique within the Corps' laboratory system since it was created by Congress with a national mission. Since CERC has a congressionally mandated national mission, the proposition was presented that CERC should be designated a "national" laboratory and the name changed to reflect the designation. The representative from the Office of Counsel agreed that CERC met criteria for a national laboratory but the name change would require congressional action. Benefits of having CERC as a national laboratory may include more recognition of the Center's capabilities and missions both within and outside the United States, thus focusing national resources on

coastal engineering problems. Goals of such a laboratory are to establish the worldwide center of excellence in coastal engineering and to obtain funding outside the Corps to maintain and increase the facilities.

There was considerable discussion and disagreement over the benefits of the name change. There was no disagreement over the fact that CERC is, in fact, a national laboratory. The main concern expressed was that name changes can cause confusion and not necessarily attract additional resources. Concern was expressed that CERC's uniqueness and eminence are associated with the CERC name and that it may be diminished by a name change. Others believed there would be no confusion since the only change would be to put the word "national" in front of CERC. The Task Force recommended that CERC, at present, not change its name. The Task Force agreed that the national status is important and CERC should emphasize this status in brochures and other mechanisms that reach the desired audience.

WORK FOR PRIVATE INDUSTRY

The goal of CERC performing work for private industry is to obtain additional resources and to meet overall national needs. The proposition was presented that CERC should be allowed to work with (not in competition with) US industries when those industries are in competition with foreign industries that have access to national or subsidized labs. In this concept, facilities would be made available to private industry and others such as city and State governments. This again would benefit the Corps in that payback on these facilities would be borne by these non-Corps users while the facilities would be available to the Corps. Necessary features of obtaining such work would include continued high response in a timely and cost-effective manner. Benefits include improved technology transfer, more effective use of facilities, and enhancement of the CERC reputation.

The Task Force concluded that CERC should work for foreign governments, private industry as outlined above, or whenever the facilities and capabilities at CERC are unique. The work should fit in with the Corps' research and development programs and certainly take into account District and Division priorities. A reevaluation of appropriate regulations should be made in order to eliminate surcharges, etc., that increase the cost of doing business with

private firms. Relief from present manpower restrictions would be necessary to do the work outside the Corps. The Office of Counsel should thoroughly research this to determine if any congressional actions are required. Work with private industry may involve studies of a proprietary nature. The legalities and policies involving proprietary information must be considered. A review of other agencies and facilities (such as the David Taylor National Research and Development Center) should be made to determine how they do work outside their respective agencies. Because this involves what may be considered major changes in the way the Corps does business, one approach may be to implement the concept for a finite (say 5-year) pilot basis.

DREDGING PROGRAM

At the last CERB meeting in California and in written comments received from the civilian CERB members, there was considerable discussion over the need of a research program to address dredging. It was noted that the Corps has done an outstanding job in evaluating the environmental impacts and minimizing any adverse impacts of dredging. The Board agreed that on-going work in the environmental areas was being effectively conducted and implemented. The Task Force agreed that for a Corps mission as large as dredging and because of significant changes in the Corps' way of doing business in this area, R&D is needed to improve dredging techniques and operations. It was noted that WES had developed a list of topic areas where it was believed R&D could produce improved operations and cost savings. This list had been provided to OCE and WRSC-D. It also was noted that a meeting with the field already has been scheduled to review and prioritize these topics as well as adding any other topics that require R&D. The President of CERB asked DRD, WRSC-D, and WES to place a high priority on developing this program. The CERB is to be kept abreast and consulted on the final development of this program.

EDUCATION AND TRAINING

There was unanimous agreement that the Corps needs better trained coastal engineers, and the bulk of the training and education process will have to be carried out by the Corps. In addition to the conventional coastal

engineering training and education, training in dredging is a priority need. It was recommended that courses in coastal engineering should include significant emphasis on dredging. Numerous scenarios on training and education were discussed. These ranged from simple short co ses to CERC's granting degrees. It was recommended that several of these sce arios be investigated further. They incuded CERC's expanding its present 1-week short courses to perhaps 3 months. Facilities and capabilities of staff at CERC should be tied in with a university or a university consortium to provide credit for training received at CERC. Facilities at the Field Research Facility should be used more for training and perhaps expanded. Of considerable interest was CERC's developing a training program for coastal engineers similar to the Planning Associates Program. This educational program is an ideal marketing tool for CERC capabilities.

The Task Force recommended that CERC augment and increase the scope of its short courses and begin development of an intense longer term program where students will have access to the CERC laboratory and field facilities. The Task Force recommended that the course for designers include experience in inspection to make the designers aware of the complexities of constructing coastal structures. There was considerable excitement by the Task Force over this whole concept of education and training. Implementation of these training programs requires little or no change in regulations.

BASIC AND APPLIED RESEARCH

There was considerable discussion over the definition of basic and applied research. The following definitions were agreed to: basic research is development of knowledge for its own sake with no immediate payoff apparent. An intermediate type of research was defined as fundamental research or knowledge. Work in this area is directed at understanding a process that has a general application. Applied research is the direct application of knowledge on a specific project or problem. The Task Force recommended that basic research be left to universities and be funded primarily by such groups as the National Science Foundation. Fundamental research could be performed by the Corps, universities, or private industry and should probably be funded by the Corps' R&D programs. Applied research would be funded in some instances by

the R&D program but most often by District, Division, or other OCE elements. Specific project studies would be performed by the Districts.

There was agreement that more R&D funds are needed for all of the types of research discussed. There is a critical shortage in both basic and fundamental R&D in the coastal engineering area. The approach offered is to work closely with groups such as the National Science Foundation/universities to combine resources on basic research. The Corps should increase its funding of fundamental research.

NATIONAL AUGMENTED COASTAL LABORATORY

A recommendation had been made previously that a large laboratory complex be developed that would allow modeling tidal inlets and harbor entrance problems. These facilities would be used to better understand the processes involved and would minimize dredging. Since dredging is such a large portion of the Corps' budget, such a facility should pay for itself in savings from reducing the amount of dredging required. Consideration was given also to this facility having the capability to evaluate dredging equipment. Funding of this facilty may come from the National Science Foundation, consortium of universities, or private industry. It was the opinion of the Task Force that this facility would benefit both the coastal engineering and the dredging missions of the Corps. WRSC-D and WES should investigate the facility further. It was decided that any detailed planning of the facility would best be done after the priorities in the dredging program have been sorted out. At that time, more specific needs that can be answered by such a facility will be better defined.

APPENDIX C

RECOMMENDATION LETTERS FROM NONMILITARY COASTAL ENGINEERING RESEARCH BOARD MEMBERS

UNIVERSITY OF
Miami

(305)361-4636

4 June 1986

B. G. Patrick J. Kelly
President
Deputy Director of Civil Works
U.S. Army Corps of Engineers
20 Massachusetts Avenue, N.W.
Washington, D.C. 20314-1000

Sir:

I want to thank you and B. G. George R. Robertson for the opportunity to be exposed to some of the engineering problems in the Arctic environment. The presentations by CREEL were most informative and a collaboration between CERC and CREEL to deal with coastal engineering problems in this environment should be most beneficial.

It is always with great satisfaction that one is able to follow the progress made at CERC year after year. CERC has changed significantly over the past five years, for the better. If one excepts the loss of some old timers at CERC and in the districts, whose experience is unvaluable, I am confident that the new generation of coastal engineers will mature into a stronger CERC under Dr. Jim Houston's technical leadership and also a stronger capability throughout the Corps.

The active participation of CERC in the dredging program will further enhance CERC capabilities and stature. Since a major portion of dredging operations take place in tidal inlets, the contribution of CERC to the dredging research program can be significant.

However, we cannot rest. The momentum is given. Let's keep moving ahead. If there is one single important issue to be raised in response to the chief initiative, it concerns the slowness of time response to opportunities, requests for investigation, and needs.

The enlargement of CERC activities, the collaboration with the private sector, the opening of new markets - public, private, or foreign - will not be possible as long as CERC operation remains entangled in a cumbersome bureaucratic system, and a mode of management which is not compatible with the demand. This does not imply at all that the CERC personnel, administrative as well as technical are slow. It is the system. For example, how long does it take to publish a final report after the study is completed? Does not the threshold for CERC to initiate a study without approval from OCE too low? etc. The issue is operational. Delegation

Rosenstiel School of Marine and Atmospheric Science
Division of Applied Marine Physics
4600 Rickenbacker Causeway
Miami, Florida 33149-1098
(305) 361-4160

of authority at the lowest possible level, decentralization, shortening of bureaucratic procedures and paperwork, modifications of regulations and liberization of what CERC is allowed to do are the necessary steps for fast response.

Of course, this problem is not unique to CERC. It was initiated by Colbert in the XVII Century. It is a rampant tendency of all large bureaucracies which has to be continuously fought.

The issue is also a matter of leadership, and incentives, so that the CERC personnel follow aggressively opportunities rather than finding in the regulations a reason to turn down business opportunities.

The CERC personnel, with their facilities at WES, have unique capabilities and it remains for me a pity that this national resource is not more used in preference to foreign laboratories, because "We don't have the time". "We are not allowed to do that", or "We need authorization from Washington"...

Sincerely,

B Le Mehaute

Bernard Le Mehaute

BLM:st

cc: J. Houston, CERC

RALPH M. PARSONS LABORATORY
DEPARTMENT OF CIVIL ENGINEERING, BLDG. 48-
MASSACHUSETTS INSTITUTE OF TECHNOLOGY
CAMBRIDGE, MASSACHUSETTS 02139

Hydrodynamics and Coastal Engineering
Hydrology and Water Resource Systems
Aquatic Science and Environmental Engineering

Phone (617) 253-
Telex: 92[illegible] MIT CAM

June 15, 1986

Brig. General Patrick J. Kelly
President, CERB
Office of the Chief of Engineers
Department of the Army
20, Massachusetts Ave.
Washington D. C. 20314-1000

Dear General Kelly:

May I thank you and the Corps officers for organizing another stimulating meeting. In this meeting and on the group tours we were priviledged to see the vast resources of Alaska and the magnificent accomplishments by the dedicated engineers there within and without the Corps. I feel proud just to have been there.

First of all the unique expertise and facilities of CERC make the it a spendid idea to start an M.S. degree program which will surely become an important institution. Bringing additional income is just a side benifit. On doing tests for private projects by CERC, it is interesting that some tests for the berms of the St. Georges Harbor project (reported by Messrs. Drage and Gilman) were made in an European laboratory but not at CERC. This seems to lend support to the suggestion that at present CERC may be too shorthanded to respond to Corps' own needs. Manpower or its management appears to be an important factor in privatization. Possible growth of private laboratories may also affect the role that can be played by federal laboratories.

Mr. Pfeiffer presented very far-sighted plans for new research facilities the need of which has been the subject of two NSF workshops. The proposal for facilities such as a large wind wave flume and a large basin strikes sympathetic cords among all of us who have seen the emergence of modern facilities in Europe and Japan. Such facilities will yield direct benifits to coastal engineering design and construction, for they remove many constraints of small scale models. They will also render it possible to advance basic research important to coastal engineering practise. In view of the large costs involved, such facilities are more readily justified if they will be used to full capacity. Arguments in their favour can be much strengthened if enthusiatic support and active participation are obtained from academic institutions at the earliest stage. With that it is also much easier to gain the support of the National Academy of Engineering.

One of the most powerful experimental facilities at CERC is its new spectral wave basin. From the reports at Homer, there are as yet not many Corps projects and only two university-related projects currently occupying this new basin. I wonder whether CERC might consider aggressive policies and well-publicized procedures so that the basin and other first rate facilities can be used both for Corps tests and for collaborative research with universities on a nation-wide basis. If modeled after other national laboratories such as the National Center for Atmospheric Research and the four Super-Computing Centers, CERC can offer greater service as a national laboratory.

In Mr. Murden we certainly have a most articulate champion for dredging research. He gave a thoughtful survey of research items that could modernize the very traditional dredging industry. I am looking for a rapid take-off of the dredging progam in the very near future. On this topic my view is that we must keep in mind that continued advances in our knowledge of the transport of cohesive and noncohesive sediments, and the effects of waves, currents and structures, are essential to the improvement of dredging technology. In fact the dredging technology is probably at the top of a pyramid of coastal engineering research, and cannot be singled out as a new emphasis without placing equal emphasis on other research efforts wihich are already going on at CERC and elsewhere.

May I take this opportunity to elaborate my belief in the importance of close ties between Corps and the universities in coastal engineering education and research. In education the proposed link-up between CERC, Mississippi State, LSU and Texas A & M is certainly a ground-breaking event. The research ties used to be stronger a decade ago when the total research volume at CERC was smaller. BEB and CERC supported unsolicited proposals which covered both basic and applied topics. Although there are new arrangements such as IPA and the WES Broad Agency Announcement, the objectives and contract regulations appear rather restrictive as to exclude most basic research contracts that can be fruitful to the Corps in the long run. In the past decade there have been a lot of advances in oceanographic engineering and sciences made mainly outside the Corps and are potentially very useful to its tasks. I believe that exclusive emphasis on mission-specific and in-house research can slow the process of information transfer and of mutual nourishment of engineering science and practise. To cite a specific example, a great deal of recent research spurred in the past 15 years by the offshore engineering has been done, largely by university researchers, in the interaction of waves and large floating or submerged structures. A variety of computational schemes are now available and are routinely applied in the design of arbitrarily shaped ships and offshore semi-submercibles. Such programs can be readily adapted for the Alaskan floating breakwater and similar projects in coastal engineering. It

would be a useful function of CERC to become a resource center for such programs so that theoretical estimates for future floating breakwaters can be made quickly on the basis of modern research. As another example, CERC could be instrumental in attracting more research on steep and breaking waves in shallow water problems. Presently great strides are being made primarily for deep water waves.

Many coastal engineering tasks facing us have been vital endeavours of mankind since antiquity. Yet we are still searching for new, economical and effective ways of combatting depositon and scour. I am hopeful that through its efforts in innovative funding, and its deep commitment to coastal engineering education and research, the Corps will help accelerate the pace of technological advance in the protection and development of our shoreline resources.

Sincerely yours,

Chiang C. Mei
Professor of Civil Engineering
Member, Coastal Engineering
Research Board.

Department of Geology
LOUISIANA STATE UNIVERSITY AND AGRICULTURAL AND MECHANICAL COLLEGE
BATON ROUGE · LOUISIANA · 70803-4101
504/388-3353/3354

July 11, 1986

General Patrick J. Kelly
President, Coastal Engineering Research Board
Department of the Army
Office of the Chief of Engineers
20 Massachusetts Avenue, NW
Washington, D. C. 20314-1000

Dear Pat,

The 45th meeting of the Coastal Engineering Research Board, held in Alaska in May, 1986, filled me with a sense of great encouragement. The major new initiatives, developed at the request of General Heiberg at the 44th meeting, are well on their way towards implementation. They promise to foster a more vigorous, and technically astute, Corps of Engineers in years to come. These new initiatives come at a time when local cost sharing in major coastal projects is going to force the Corps into a more competitive position than it formerly was. This competitition is probably very healthy and will, in itself, cause both technical and managerial improvements throughout the entire agency. It is very appropriate that the Board pursues a concurrent active program of new initiatives in coastal engineering.

The Dredging Technology Research Program is of the highest priority; the rapid developments in the design of this program is to the credit of the R & D Directorate at OCE. The budget level for the initiation of this program seems appropriate in view of the cost to the nation for maintenance and upgrade of our harbor facilities. In fact, some comparative statistics on the national costs and benefits of our harbors help putting this cost in its proper perspective. According to a recent study done for the maritime industry, the annual contribution to the national GNP by water-borne commerce is on the order of $70-80 billion. The estimated annual cost of harbor maintenance is on the order of $700 - 800 million or about 1% of the contribution the maintained facilities make to the GNP. The initiation of a Dredging Technology Research Program at an initial level of $6 million, with a possible growth to $30 million, would put the cost of research and development at about 3.5% of project cost. In a high-science and high-tech era, this percentage is certainly not too high, it is possibly too low. Relative to the national benefits of better, more modern and more efficient harbors the R & D cost is totally negligible.

From a technical and scientific point of view there are a number of dredging-related problems that need immediate attention:

1) Circulation, sediment dispersal and sediment deposition in harbors. Most of America's natural harbors are estuaries, e.g. New York, Charleston, San Francisco, etc. etc. They are subject to complex, but predictable, sedimentation patterns. We have come a long way since the 1930's when the Santee River in South Carolina was diverted into Charleston Harbor to "flush it out". Obviously, the opposite happened, sedimentation rates increased by about one order of magnitude, and the river was, last year, re-diverted back into its old course. Pritchard's and Schubel's work on Chesapeake Bay has over the last 20 years made us appreciate the pattern of stratified estuarine circulation. There is little evidence, however, that this understanding of sediment dynamics is routinely used in the design of dredging operations and dredge disposal sites, except in some major estuaries, San Francisco Bay, for example. Considering the significance of estuarine sedimentation to the maintenance of many harbors the Army Corps of Engineers should make every effort to become the world's leading authority on estuarine sedimentation dynamics. As of now, the agency is far from that position.

2) Disposal of dredged sand.
For too long, all dredged material has been considered "spoil", connotating that it is an undesirable substance. Much dredged material, unfortunately, is contaminated by heavy metals and other pollutants and does deserve the "spoil" designation. However, a lot of material dredged from the outer harbor entrance channels is clean sand. This material should, to an increasing degree, be put to beneficial use on adjacent eroding beaches. The submerged mound concept proposed by Mr. Murden is one step in this right direction. Concurrent with the development of this concept we need to look at natural pathways of sand migration and accumulation around the outer harbor entrances. My own studies of tidal inlets on the South Carolina and Georgia coasts convinced me that these patterns are predictable. The alteration in sediment accumulation patterns in response to man-made harbor entrance modifications is also, in principle, predictable. An agressive research program aimed at predicting the sedimentary response to our actions is now feasible and should be given high priority in the Dredging Technology Research Program.

3) Dredging technology.
Even though I am no expert on this it is clear from conversations I have had with knowledgeable individuals that we are behind many other nations in dredging technology. To some extent this may be a function of lack of competition in the dredging business. The new program must give high priority to the development of new technology; if possible, through active cooperation with the affected private industry.

4) Information transfer.
Finally, and not the least important, there are major problems with information transfer in all rapidly developing fields of science and technology. I see it very clearly in the petroleum industry where most field practitioners continue working with yesterday's concepts. The same is generally the case in district offices of the Army Corps of Engineers. Information transfer has to be separated from technology transfer which is much easier. Most people are willing to utilize new "gadgets"; it is a lot more difficult to challenge well-entrenched concepts and attitudes. Continuing "education" in a mode based on close interaction between the R & D personnel at WES and university and private laboratories, and the district office personnel, is one way of accomplishing this. An effort must be made to generate enhanced awareness of its significance.

Another encouraging development, which should, if possible, be strengthened is the advanced education program in science and engineering at the Waterways Experiment Station. Initially designed as an advanced degree program for existing WES personnel, this program should be considered expanded to enable WES to become a national center for education in coastal engineering. Qualified teaching personnel from anywhere could be brought to Vicksburg for a diversity of educational functions, much of which could be combined with research programs at the station. Since there is no university at Vicksburg, which normally would handle some of these functions, it is important that the Waterways Experiment Station itself considers education one of its own major functions.

Initial efforts by Col. Grum and Dr. Whalin have been highly effective and are apparently being met with great enthusiasm among many WES employees. This program should be encouraged to grow.

In general, I think we are seeing the beginning of a greater awareness within the Army Corps of Engineers of the need for technical excellence. The agency has to become more than a "construction management agency"; it should become the leader in technology development in its area of responsibility. This can be accomplished only by giving the agency more competition, which may be brought about by a new cost sharing structure. The next years will place greater demands on the Army Corps of Engineers, and with that, greater opportunities.

Sincerely,

Dag Nummedal
Professor of Geology
Member, Coastal Engineering Research Board

DN:nad
cc: Col. A. E. Grum, WES

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