BLM HEARING

ON

PROPOSED LEASING

NORTHERN GULF OF ALASKA

WRITTEN PRESENTATION

OF

GULF OF ALASKA OPERATORS COMMITTEE

T A B L E   O F   C O N T E N T S

VOLUME I

1. Summary of GOAOC Presentation
2. GOAOC Comments on Draft EIS
3. Statements Delivered at August 12-13 Hearing
   A. William M. Meyers
   B. Dr. Howard A. Slack
   C. John H. Silcox
   D. Sherman H. Clark
   E. Paul L. Horrer
   F. John H. McKeever
   G. H. J. Fitgeorge
   H. Dr. John H. Wiggins
   I. Leland E. Wilson
   J. Dr. Kenneth A. Blenkarn
   K. A. D. Mookhoek
   L. Guenter M. Conradus
   M. Joe W. Tyson
   N. William F. Gusey
   O. Dr. Clayton D. McAuliffe
   P. Dr. Dale Straughan
   Q. Edward W. Mertens

R. Dr. Albert H. Lasday

S. Jesse P. Johnson

VOLUME II

1. Silcox Exhibit I - Oil Industry Comments on the CEQ Report
2. Clark Exhibit I - Report: "The Need For Oil and Gas Resources from the Gulf of Alaska"
3. McKeever Exhibit I - Maps and Drawings
4. Blenkarn Exhibit I - Report: "Development and Production, Gulf of Alaska"
5. Mookhoek Exhibit I - Report: "Marine Transportation and Tanker Terminals - Gulf of Alaska"
6. Conradus Exhibit I - Report: "The Economic and Social Impact of Oil Related Activities in the Northern Gulf of Alaska," prepared by Mathematical Sciences, Northwest, Inc.

VOLUME III

1. Tyson Exhibit I - Pamphlet: "The GURC Offshore Ecology Investigation"

2. Gusey Exhibit I - Report: "Fish, Wildlife and Petroleum Production - The Gulf of Alaska"
3. Gusey Exhibit I, Appendix 1: "Birds of the Gulf of Alaska and Coastal Zone; and National Wildlife Refuges"
4. Gusey Exhibit I, Appendix 2: "Terrestrial Wildlife of the Gulf of Alaska Coastal Zone"
5. Gusey Exhibit I, Appendix 3: "Marine Mammals of the Northern Gulf of Alaska"
6. Gusey Exhibit I, Appendix 4: "Threatened Species - Gulf of Alaska"

VOLUME IV

1. Gusey Exhibit I, Appendix 5: "Fishery Resources of the Gulf of Alaska"

VOLUME V

1. Gusey Exhibit I, Appendix 6: "Fish, Wildlife and Petroleum Production: The Gulf of Mexico, Santa Barbara Channel, California, and Cook Inlet, Alaska

2. Gusey Exhibit I, Appendix 7: "United States and Regional Fishery Statistics, 1939-1974"

3. Gusey Exhibit I, Appendix 8: "Exploratory Fishing Drags for Demersal Fish and Shellfish, the Gulf of Alaska"

4. McAuliffe Exhibit I - Report: "Chevron Main Pass Block 41 Oil Spill: Chemical and Biological Investigations"

5. Johnson Exhibit I: Inventory of Oil Spill Cleanup Equipment of Several Cleanup Cooperatives

6. Johnson Exhibit II: Draft Agreement for Alaskan Gulf Cleanup Cooperative

7. Johnson Exhibit III: Brochure, Oil Spill Control School, Texas A & M University

DEPARTMENT OF THE INTERIOR

HEARING ON PROPOSED LEASING

IN THE

NORTHERN GULF OF ALASKA

ANCHORAGE, ALASKA

AUGUST 12 - 13, 1975

WRITTEN PRESENTATION

on behalf of the

GULF OF ALASKA OPERATORS COMMITTEE

SUBMITTED BY:

WILLIAM M. MEYERS
J. BERRY ST. JOHN, JR.
Suite 2211, 225 Baronne Street
New Orleans, Louisiana 70112

Attorneys for the Gulf of Alaska
Operators Committee

WRITTEN PRESENTATION

OF THE

GULF OF ALASKA OPERATORS COMMITTEE

INTRODUCTION

As was noted in the testimony of Dr. Howard A. Slack, the Gulf of Alaska Operators Committee (hereinafter sometimes referred to as the GOAOC), is comprised of twenty-eight companies interested in mineral development in the Gulf of Alaska. This committee was organized in November, 1971 to develop an assessment of the impact of oil exploration and development on the environment of the Gulf of Alaska, and to prepare and coordinate the presentation of testimony at the BLM public hearing on proposed leasing in the Gulf of Alaska.

Appreciation is expressed to the Administrative Judge and Panel for the advance permission granted for a special presentation by the GOAOC. It was felt that the presentation in this form not only effected a savings of time by elimination of individual presentations from a great majority of the member companies of the GOAOC, but that it also permitted consideration of important technical issues in an orderly fashion.

PRESENTATION OF THE GULF OF ALASKA OPERATORS COMMITTEE

Submitted herewith are the following:

(1) The opening statement of William M. Meyers, attorney for the GOAOC.

(2) The written statement of Dr. Howard A. Slack, Chairman of the GOAOC.

(3) The written statement of John H. Silcox, with exhibit.

(4) The written statement of Paul L. Horrer.

(5) The written statement of John H. McKeever, with exhibit.

(6) The written statement of H. J. Fitzgeorge.

(7) The written statement of Dr. J. H. Wiggins.

(8) The written statement of L. E. Wilson.

(9) The written statement of Dr. Kenneth A. Blenkarn, with exhibit.

(10) The written statement of A. D. Mookhoek.

(11) The written statement of Guenter M. Conradus, with exhibit.

(12) The written statement of Joe W. Tyson, with exhibit.

(13) The written statement of William F. Gusey, with exhibits.

(14) The written statement of Dr. Clayton D. McAuliffe, with exhibit.

(15) The written statement of Dr. Dale Straughan.

(16) The written statement of E. W. Mertens.

(17) The written statement of Dr. Albert H. Lasday.

(18) The written statement of Jesse P. Johnson, with exhibits.

SUMMARY OF GOAOC PRESENTATION

In the hope that it may be of assistance in the preparation of the Final Environmental Statement, the following summary is given of the GOAOC presentation. In addition to this summary, the GOAOC has included in this presentation detailed written comments on the Draft EIS.

INTRODUCTORY PANEL

Dr. Howard A. Slack
Vice President, Atlantic Richfield Company
and Chairman, Gulf of Alaska Operators Committee

Role of the GOAOC: Environmental Studies Conducted by GOAOC

Dr. Slack is Vice President and Resident Manager of Atlantic Richfield Company in Alaska, and is currently serving as the Chairman of the GOAOC.

After reviewing the member companies and the various working sub-committees of the GOAOC, Dr. Slack summarized the studies and activities undertaken by the GOAOC and by certain member companies. Following this summary, Dr. Slack observed that never has industry entered a new area so well informed, well equipped and well trained as it is now for the proposed exploration and development of the Gulf of Alaska.

John H. Silcox
Vice President and General Manager
Exploration Department, Western Operations, Inc.
Standard Oil Company of California

Commentary on the Report Prepared by the Council on Environmental Quality entitled "OCS Oil and Gas - An Environmental Assessment."

Mr. Silcox is Vice President and General Manager, Exploration, Standard Oil Company of California, Western Operations, Inc. His testimony focused on the report entitled "OCS Oil and Gas - Environmental Assessment" prepared by the President's Council on Environmental Quality. Mr. Silcox noted that this report has become to some the final authority on environmental issues associated with oil and gas operations in the Gulf of Alaska, and is erroneously regarded as a scientifically complete and objective appraisal. The major shortcomings in the CEQ Report identified by Mr. Silcox are summarized below:

(a) The Report gives little notice to the sweeping technical advances which the oil industry has achieved in offshore drilling during the past 25 years.

(b) The Report gives superficial treatment to complex technical subjects.

(c) The spill trajectory probability forecast set forth in the Report makes no allowance for the effects of evaporation, biodegradation, emulsification and dispersion of spilled oil.

(d) The Report overstates the effects which oil operations in the Gulf of Alaska will have onshore, both in Alaska and in the lower 48 states.

(e) The Report fails adequately to recognize that hydrocarbon emissions from refinery operations are strictly controlled by regulations.

(f) The Report contains a superficial discussion of natural phenomena and the technology which has been developed to minimize problems caused by natural phenomena.

(g) The Report leaves the reader with a false impression of the overall severity and potential for damage resulting from the tsunami.

(h) The Report gives insufficient recognition to the oil industry's experience in offshore drilling in the Gulf of Mexico.

Detailed comments on the CEQ Report are found in the volume entitled "Oil Industry Comments on the CEQ Report," which is attached hereto as Silcox Exhibit I.

PANEL A

Sherman H. Clark, Economist
President, Sherman H. Clark Associates

Need for Oil and Gas Resources of the Gulf of Alaska; Alternatives to Leasing in the Gulf of Alaska

Sherman H. Clark is the President of Sherman H. Clark Associates, a firm specializing in energy and resources economics.

Mr. Clark's oral testimony covered three basic points:

(1) Is there a basic need for the oil and gas resources of the Gulf of Alaska?

(2) What are the hazards of delaying development of this region?

(3) Is it desirable to forestall development until a national energy policy is prepared?

In his analysis of the need for the resources, he observed that domestic oil and gas production have both been declining for several years and that a downward trend is a near certainty to 1980. He stated that the conclusion is inescapable that federal OCS production will only offset or help to offset the production decline in old fields. Short of accelerating the exploration effort in all frontier areas, such as the Gulf of Alaska, there is no way that U. S. oil and gas production will exceed present levels. He also concluded that energy requirements would not be met by other energy sources, and that the nation will have to continue to rely on oil imports of increasing magnitude.

Such reliance, he notes, is not sound policy because of the lack of security of this supply, an already uncertain outlook as to the availability of the quantities required without full U. S. development, and the potential economic distortion if the reliance is too extreme.

On the topic of delaying OCS development in these areas, Mr. Clark observed that there is substantial net economic benefit to the development of OCS production. Any delay - even for a few years - cannot be made up later and will reduce those benefits in constant present dollars, as well as incurring a greater risk of inadequate energy supplies over a longer period of time.

Finally, Mr. Clark focused on the question of delaying development until a national energy policy has been adopted. He noted that however desirable such a policy may be, it can not alter the basic facts of energy supply and demand. He further noted that a complete national energy policy may never be developed, but that in any event it could not create onshore oil and gas resources that do not exist, bring on new resources held back by legal or environmental hurdles, or make new technology and capital instantly available. He concluded that delaying development until a national energy policy is available will help to defeat the potential of any such policy because a domestic energy supply is needed now.

His comprehensive 66 page report covering these topics in greater detail is attached as Clark Exhibit 1.

PANEL B

PHYSICAL OCEANOGRAPHY AND OCEAN GEOLOGY

Paul Horrer
President, Intersea Research Corporation

Climate, Winds, Waves, Tides, Storms, Tsunamis

Mr. Horrer is the President of Intersea Research Corporation, La Jolla, California. He has more than 19 years experience as a consultant oceanographer and has been involved in a number of oceanographic projects in the Gulf of Alaska.

Mr. Horrer's testimony concentrated on the physical marine environment of the Gulf of Alaska, particularly as this environment affects offshore petroleum operations.

He reviewed the oceanographic studies conducted by various groups, then presented salient results of those studies. Included was information concerning monthly variation of wind speeds, wind distributions, and recurrence intervals of winds. Seasonal variation of wave heights, recurrence interval of significant wave heights and maximum wave heights were also set forth in his testimony. He noted that while the Gulf of Alaska has earned a reputation as being a stormy area, it is not markedly different from other areas in which the offshore petroleum industry has successfully conducted operations. The indicated extreme winds of the Gulf of Alaska are substantially less than those associated with Gulf of Mexico tropical hurricanes and the persistence of storm winds in the Gulf of Alaska does not appear to suggest more severe conditions than are encountered in the Norwegian North Sea. In both of these areas the petroleum industry now operates successfully.

Turning to the important question of tsunamis, Mr. Horrer stated that in the CEQ Report the potential damage to underwater oil storage systems on the open coast due to tsunamis was assessed improperly. He then compared the tsunami to a storm wave, noting that drag and inertial forces on a hypothetical storage vessel due to a tsunami will be much smaller than those due to the maximum storm wave for which the industry is confident it can safely design.

He concluded by expressing his belief that sufficient knowledge is already available concerning the physical oceanography of the Gulf of Alaska to permit operations to be conducted there with safety to the environment and to personnel.

John H. McKeever
Staff Geologist, Amoco Production Company

Seafloor sediments; seafloor characteristics, industry surveys of bottom conditions

John H. McKeever is a Staff Geologist and Exploration Representative in Alaska for Amoco Production Company. He has been employed in that capacity, resident in Alaska, for 9 years.

In his opening remarks, Mr. McKeever emphasized that the Gulf of Alaska seafloor is not free from problem areas. He did, however, state his firm belief that industry has the information and the knowledge to identify these areas and that the industry's operations can be safely conducted.

Mr. McKeever described two methods of obtaining information concerning the seafloor, these being seafloor sampling and high resolution acoustic seismic surveys. Detailed descriptions of these methods are found in his presentation, along with examples of the data gained by these surveys.

Commencing on page 7 of his presentation, he described the Gulf of Alaska Continental Shelf, noting that offshore formations are less structurally disturbed than they are onshore, and that they were planed off by marine and glacial erosion during rather late geologic time. He notes that the Gulf of Alaska has undergone a long history of earth movements that have folded and tilted the underlying bed rock. However, there has not been any extensive folding or faulting offshore since the late Pleistocene era. This can be demonstrated because no deformation or only occasional incidents of deformation of the glacial recent overburden layer can be seen. Since this recent overburden layer blankets most of the Shelf, its stability as a foundation layer is especially important.

H. J. Fitzgeorge
Vice President, Mobil Oil Corporation

Geology; oil and gas potential

H. J. Fitzgeorge, Vice President of the Western Exploration and Producing Region, North American Division, Mobil Oil Corporation, described the geology and the oil and gas potential of the Gulf of Alaska.

He noted that the prospective sedimentary rocks of the Gulf of Alaska are sands and shales of Tertiary and Pleistocene age, and are both marine and non-marine in depositional origin. Numerous structural features have been identified both onshore and offshore. Within the designated sale area there are large anticlinal structures mapped by the seismograph. Structures of the magnitude outlined can contain significant reserves.

Analysis of crude oils from the Katalla Oil Field and the various seeps indicate that the Gulf of Alaska has the potential for high quality, low sulphur crudes. Mr. Fitzgeorge stated that his company's most recent estimates in the Gulf of Alaska of the potential recoverable oil and gas are of similar magnitude as the USGS estimate set forth in the Draft EIS. He concluded by stating that in the Department of the Interior's survey of the oil industry the Gulf of Alaska ranked No. 1 in OCS priority for its probability of large potential.

Dr. John W. Wiggins
J. H. Wiggins Company

Seismicity; consideration of seismic hazards in the design of facilities.

Dr. Wiggins holds a Doctor of Philosophy degree in Civil Engineering with a specialty in Structural Dynamics. He is one of four persons selected to develop seismic risk maps for the United States National Bureau of Standards earthquake code study. His testimony deals with the probabilistic response of offshore platforms to seismic excitation in the Gulf of Alaska.

Dr. Wiggins noted that earthquake engineering is made up of three disciplines in the scientific community. The first deals with the seismic environment in which principally seismologists work. From the knowledge of the seismic environment, one can estimate ground shaking, structural response and the failure of various structural elements and components. The latter two disciplines are left to the structural engineer and the specialist in engineering mechanics.

In discussing the "proneness" of an area to earthquake activity, he set forth six methods of estimating future seismicity. Thereafter, Dr. Wiggins presented seismic risk maps showing hard rock velocities to be anticipated in the general sale area.

Turning to the structural analysis and response procedure, he explained how actual test site borings have been taken in the Gulf of Alaska and how typical offshore structures have been analyzed and modeled. Concluding, Dr. Wiggins stated that with appropriate consideration of each probabilistic term, enough knowledge and know-how is available so that structures can be designed for the Gulf of Alaska within an acceptable level of risk.

PANEL C

TECHNOLOGY FOR OCS DEVELOPMENT

L. E. Wilson
Petroleum Engineer
Atlantic Richfield Company

Exploratory Drilling Operations; the North Sea Experience

Mr. Wilson, a registered Petroleum Engineer in the State of Alaska, has worked with the Atlantic Richfield Company since 1950, primarily in drilling and production activities. For the past three years he has been associated with his company's operations in the North Sea.

He observed that the North Sea was quite different from other major operating areas where the offshore oil industry had previously worked. The Gulf of Mexico, although severe at times, did not generate the continual storm environment of the winters in the North Sea. Describing the environmental constraints present in that area, he noted that as demand increased for year round exploration, as well as for exploration in the far North, more sophisticated equipment was built to cope with the sea conditions. He stated further that the developments which had occurred as a result of North Sea operations will be of significant benefit in the Gulf of Alaska. These developments include; better weather forecasting, utilizing computers and satellites, use of long range helicopters with large load capacities, and creation of specially designed supply ships capable of working in heavy seas. Mr. Wilson concluded by stating that the success of the North Sea operations reflects the ability of the oil industry to explore and develop in a hostile environment similar to that which will be encountered in the Gulf of Alaska.

Dr. Kenneth Blenkarn
Special Research Group Supervisor
Amoco Production Company

Development and production; pipelines; design of structures to withstand wave and seismic forces

Dr. Kenneth Blenkarn is a special research group supervisor for Amoco Production Company. His engineering

PhD degree emphasizes training and research in theoretical and applied mechanics.

Dr. Blenkarn's testimony described the equipment and methods employed in the production of offshore petroleum resources, as well as the special aspects of engineering for application in the Gulf of Alaska. He described the manner in which offshore platforms are constructed onshore, barged to location, and emplaced on the ocean floor. He then noted that after construction of the platform is completed, well drilling is initiated through specially driven structural well conductor pipes. Following a brief description of the environmental safety features to be found on a platform, he stated that generally the preferred and safest way to transport offshore production away from a platform is to transport it through a subsea pipeline to shore facilities. The pipeline construction operation was described.

Turning to specific consideration of the Gulf of Alaska, be observed that there is no question of industry's ability to design platforms to resist the conditions in the Gulf of Alaska. He stated that there may emerge special platform designs for Gulf of Alaska operations, but that designs will not be dictated because wave conditions are more severe than encountered elsewhere.

On the question of design for earthquakes, Dr. Blenkarn concluded that on balance, there is little doubt but that industry can design offshore platforms with appropriate levels of earthquake resistance. He noted that extensive drilling and producing operations have been conducted in the seismically active area of Southern California. While a few wells there have suffered casing damage by fault movement, such damage has not occasioned release of well fluid to pose a pollution threat.

A. D. Mookhoek
Port Operations Manager
Exxon Company, U.S.A.

Transportation; terminals

Mr. Mookhoek is the Ocean Operations Manager for the Marine Department, Exxon Company, U.S.A. During his 27 years in the company, he has been associated with all aspects of marine transportation, including the technical, economic and operational aspects. He is also the Chairman of the Marine Services Sub-committee of Alyeska.

Mr. Mookhoek first focused on the vessels which might be used to transport Gulf of Alaska oil. He noted that for obvious reasons, no one can determine the size tanker to be used for this purpose, since this is a function of crude production and the location of the terminal. However, to place the issue in perspective, he presented a table indicating, for various ship sizes and different production levels, the number of port calls which would occur. He then observed that the traffic separation system presently under development for all ships travelling between Valdez and the West Coast will also aid ships carrying crude from the Gulf of Alaska.

Turning to the second subject, he noted that a marine terminal or terminals will be necessary to receive crude delivered from the wells, store the oil, and then load it into tankers for delivery to market destinations in the lower 48. He pointed out that a number of potential site locations exist in the Gulf of Alaska, including Yakutat Bay, Ice Bay, Kayak Island, Middleton Island and Montague Island. The advantages and disadvantages of each of these were discussed. Finally, he described the environmental safety features which would be incorporated into any terminal or system.

PANEL D

Guenter Conradus
Mathematical Sciences Northwest, Inc.

Report on study on
Socio-economic Impacts

Mr. Conradus is employed by Mathematical Sciences Northwest, Inc., of Bellevue, Washington, as a Senior Economist. In January of 1975, Math Sciences was requested by the Gulf of Alaska Operators Committee to undertake a study of the economic and social impacts which would be felt in Alaska as a whole and specifically in six coastal communities (Juneau, Yakutat, Cordova, Seward, Whittier and Kodiak) as a result of likely exploration, development and production activities on the OCS of the Gulf of Alaska. Mr. Conradus directed that study.

His testimony presented a very brief summary of the study itself, and further summarization will not be attempted here. Mr. Conradus' testimony is included in the written presentation and his full report, "An Economic and Social Impact Study of Oil Related Activities in the Gulf of Alaska," is attached as Conradus Exhibit I.

PANEL E

ENVIRONMENTAL EFFECTS

Joe Tyson
Senior Scientist
Gulf Universities Research Consortium

Report on Gulf Universities Research Consortium Offshore Ecology Investigation

Mr. Tyson is a Senior Scientist for the Gulf Universities Research Consortium (GURC), Houston, Texas. He reported on the results of the GURC Offshore Ecology Investigation (OEI), a study conducted to answer the question "What is the measurable impact of drilling for oil and later producing it on the estuarine and marine environment of the Louisiana Outer Continental Shelf?" While noting that there are significant differences between the environment of the Gulf of Alaska and that of the Gulf of Mexico, Mr. Tyson stated that the OEI must be given serious consideration whenever offshore leasing is proposed. This, he said, is because the OEI is by all odds the most thorough and comprehensive study of the environmental effects of offshore drilling and production ever undertaken.

The salient results of the study may be summarized as follows:

(1) The results question the universal necessity for conducting a "before the fact" baseline study to subsequently determine the environmental impact of this type of man's activity.

(2) Natural phenomena such as seasonality, floods, upwellings, and turbid layers have much greater impact on the ecosystem than do petroleum drilling and production operations.

(3) Concentrations of all compounds of OEI interest which are in any way related to drilling or production are sufficiently low to present no known persistent biological hazards.

(4) Every indication of good ecological health is present.

(5) The area has not undergone significant ecological change as a result of petroleum drilling and production since 1952.

A pamphlet setting forth and summarizing certain results of the study is attached as Tyson Exhibit I.

William F. Gusey
Shell Oil Company

Effects on Fish and
Wildlife Resources

Mr. Gusey is a Senior Staff Wildlife Specialist in the Environmental Affairs organization of Shell Oil Company, and appeared at the hearing as the Coordinator of the Environment and Biology Standing Committee of the GOAOC. He submitted for the record a detailed statement entitled "Fish, Wildlife and Petroleum Production - the Gulf of Alaska". Also submitted were Appendices 1 - 5, to that document, describing the fish and wildlife resources of the Gulf of Alaska; and Appendices 6 - 8, supplementary fish and wildlife data discussing existing petroleum industry experience and the resources in the Gulf of Mexico, Santa Barbara Channel, and in the Cook Inlet. Mr. Gusey's testimony, including his written presentation, briefly summarized the salient findings of these lenghty documents and further summarization will not be attempted. The documents are attached as Gusey Exhibits I - IV.

PANEL F

OIL AND THE MARINE ENVIRONMENT

Dr. Clayton McAuliffe
Chevron Oil Field Research Company

Movement and degradation of oil spills

Dr. McAuliffe is a Senior Research Associate with Chevron Oil Field Research Company, La Habra, California. For the past five years he has devoted his time almost exclusively to a study of petroleum in the marine environment. His testimony focused on what happened to crude oil during a major oil spill as revealed by studies during and following that spill. He related these events to the Northern Gulf of Alaska to predict what would happen to the oil if a major spill should occur in the Gulf of Alaska.

In reporting on the Main Pass Block 41 spill, Dr. McAuliffe noted that during a three week period in 1970, an estimated 65,000 barrels of crude oil were discharged from a platform 11 miles East of the Mississippi River Delta. As a safety precaution, 2,000 barrels of chemical dispersants were sprayed on the platform and on the surrounding water surface. It is estimated that between 25-30 per cent of the oil evaporated during the first 24 hours, 10-20 per cent was recovered from the water surface, less than 1% dissolved, and less than 1% of the oil was identified in sediments within a 5 mile radius of the platform. The remaining oil emulsified and dispersed to undetectable levels, biodegraded, or photooxidized.

Spilled oil, identified in bottom sediments by gas chromotography, showed rapid weathering after one week to one month, and at the end of one year was reduced to a few per cent of the amount after the spill. There was no correlation of number of species, number of individuals or other biological parameters with the hydrocarbon content of the sediments for samples from within a 10 mile radius of the platform. This lack of correlation suggests lack of significant effect of oil on benthic organisms. A reprint of a paper summarizing the investigation is attached to Dr. McAuliffe's testimony.

After noting the difficulties inherent in extrapolating the results of a study from one region to another, effects of oil pollution following the Santa Barbara spill.

Dr. Straughan stated that experience in the Santa Barbara area should provide some insight in the effects of oil spillage in the Gulf of Alaska. While the area is colder than in the Santa Barbara Channel, many of the same species range through and beyond both areas.

In commenting on the results of the Santa Barbara study, she observed that on balance, biological damage was much less than predicted immediately after the spill and, at the conclusion of the study, the area was recovering. In a subsequent ecological survey of rocky shores and sandy beaches in 1974, Dr. Straughan was unable to demonstrate disruption in the distribution and abundance of intertidal species due to the Santa Barbara oil spill. Her conclusions were that any disruptions had been of a temporary nature.

E. W. Mertens
Chevron Research Company

Effects of oil in the marine environment

Mr. Mertens is a chemist for the Chevron Research Company, and currently serves as Chairman of the American Petroleum Institute Committee on the Fate and Effects of Oil in the Marine Environment.

Mr. Mertens reported on the comprehensive research program initiated by the API on the fate and biological effects of oil spills. He noted that perhaps the most serious problem concerning the potential effects of oil on marine life is whether oil, once taken up by a marine organism, would be permanently retained by that organism, and, if so, whether the oil would become concentrated as it moves up the food chain. If this were true, in time the oil would reach some member of the food chain that is used by the human race as a part of its diet. Thus, it might constitute a threat to human health. Mr. Mertens' testimony showed that such concerns have no valid scientific basis, because extensive research shows that oil does not permanently enter the food chain.

Next, Mr. Mertens noted that it is widely believed by the public that whenever an oil spill of any reasonably large magnitude occurs, the aftermath is a major devastation of marine life. Moreover, the public is conditioned to believe that this devastation will persist for an extended period of time.

Citing the results of studies, he stated that for a spill to cause significant environmental damage, three conditions must exist simultaneously. These conditions are:

(1) The oil must be spilled into a confined body of water, such as a small bay.

(2) The oil should be refined oil, such as No. 2 fuel oil.

(3) Storms or heavy surf must cause the spilled oil to be churned into the bottom sediments.

In contrast, offshore platforms are almost without exception located in unconfined areas and in reasonably deep waters. Second, a platform produces crude oil, which is substantially less toxic than most refined oils. Finally, in deep waters such as those in the proposed sale area, storms and heavy surf rarely, if ever, are able to churn oil into the sediments. Thus, the absence of all three factors minimizes the risk to the marine ecosystem.

Dr. A. H. Lasday
Texaco Inc.

Comments on Draft EIS

Dr. Lasday is a coordinator in Texaco's Environmental Protection Department. His responsibilities include advising on and coordinating the company's world wide activities in prevention and control of water pollution, including oil spills. Dr. Lasday's testimony contains detailed comments on the Draft Environmental Statement and will not be summarized at this point.

Jesse P. Johnson
Atlantic Richfield Company

Oil spill prevention,
containment and cleanup

Mr. Johnson, the Manager of Atlantic Richfield Company's South Alaska District, is responsible for company operations in South Alaska, including any which may occur in the Gulf of Alaska. His testimony related to procedures for oil spill containment and cleanup in the Gulf of Alaska. He announced that, as a result of the efforts by the GOAOC, twenty-four companies have committed to join the newly formed Gulf of Alaska Clean-Up Cooperative. He stated that company participants in this new co-op met on August 8, 1975 and transacted business, including the appointment of several committees. These committees will plan for the equipment and procedures necessary to clean up oil spills in the Gulf of Alaska. He also reviewed work already accomplished by the GOAOC designed to provide special versions of skimming equipment for use in the Gulf of Alaska. Model testing of a suitable self-propelled skimming vessel has been contracted for by the GOAOC. The Cooperative will take over this program, and is expected to commit for engineering design and drawings, and then for construction of the ocean open skimming vessel. When built, this skimmer would be the largest such vessel in operation in OCS waters.

He closed by stating that all precautions will be taken to prevent oil spills. In the event a spill does occur, contingency plans and a cooperative will be in effect to respond promptly and thoroughly.

CONCLUSION

The testimony of the GOAOC at this hearing has demonstrated beyond question that the oil industry has sufficient knowledge to operate in the Gulf of Alaska without causing significant environmental harm. The GOAOC witnesses - each a recognized expert in his or her field - have convincingly refuted arguments that the Gulf of Alaska environment is too hostile for oil and gas development. To the exact contrary, this presentation has shown that never has industry been better prepared or equipped to commence operations in a frontier area than it is for the Gulf of Alaska.

William M. Meyers

J. B. St. John

Attorneys for GOAOC

GOAOC COMMENTS ON DRAFT EIS

Pages 7, 8, 9: Resource Supply and Production Assumptions

The Draft EIS estimates that 635,000 acres in the area proposed for leasing will be productive. Although the estimate of total reserves is thought to be accurate or even conservative, at least one member company of the GOAOC believes this estimate of productive acreage to be too large.

Pages 41-44:

The damage caused by the 1964 Alaska Earthquake is well documented in the Draft EIS. However, the GOAOC suggests that mention be made of the fact that Cook Inlet production and gathering facilities as well as drilling exploratory wells (all onshore) withstood this earthquake with minor damage and with no detrimental effect to the environment. The Beluga River Gas Field, the Kenai Gas Field, and the Swanson River Oil Field were all on production or under development at that time. Such a comment could be included on pages 41-44, or in the section of the EIS dealing with probability of oil spills due to natural phenomena (pages 363 et seq.)

states that magnitude is only one part of the two part problem of deriving intensity. On pages 7 through 10 of his testimony, he points out that, using all of the historic information available and treating each earthquake as a point source, hard rock velocity contours for an arbitrary return period of 100 years have been constructed for the Gulf of Alaska. A map setting forth these contours is attached to his presentation.

In connection with the discussion of probability of spills due to natural phenomena found on pages 361-366 of the EIS, it is suggested that comments of Dr. Kenneth Blenkarn (Testimony page 10) be considered. Here, Dr. Blenkarn notes that extensive drilling and producing operations have been conducted in seismically active areas of Southern California. While a few wells have suffered casing damage by fault movement, such damage has not occasioned release of well fluids to pose a pollution threat.

<u>Page 51:</u>

It should be noted that if onshore facilities, such as tank farms, are built high enough or if they are surrounded by dikes of sufficient height, they will not be damaged. Moreover, in connection with paragraph 3, it should be noted that some major earthquakes which have ocurred in Southcentral Alaska did not produce a tsunami.

Page 71, First complete paragraph, last sentence:

Some direct current measurements (by current meters) were made in the Gulf of Alaska in 1974. These measurements are described on page 6 of the testimony of Paul L. Horrer.

Pages 341-343, 417-418: Effects of Drilling Muds on Marine Organisms

The testimony of Dr. Albert H. Lasday (pages 8-10) addresses some of the concerns set forth in the EIS, and cites a number of studies concerning the impact of drilling muds on organisms. Dr. Lasday concludes that rapid dilution by seawater renders components of drilling muds non-toxic almost instantaneously.

Pages 342-5, 424: Effects of Produced Water Discharges

Pages 10-11 of the testimony of Dr. Albert H. Lasday contains some additional references on the question of effects of produced water discharges.

Page 345, First paragraph:

On page 345 of the EIS, the authors note that in the worst case, some 1,400 barrels of oil per year could be introduced with discharged formation water. Additional perspective on this point might be gained by noting that some 40 to 45 million barrels of petroleum are introduced into the marine environment each year through many sources, and that offshore oil exploration and production contributes only slightly more than 1% of the total. ("Petroleum in the Marine Environment" - National Academy of Sciences, Washington, D.C., 1975).

Page 346, Last sentence:

The EIS notes that "an estimated 200 miles of pipeline will be buried, resulting in the resuspension of .6 to 1.6 million cubic yards of sediment." To obtain additional perspective, it might be noted that this amount of sediment is small in comparison to the discharge of sediment by rivers and resuspension of bottom sediments by wave action. An average of 200,000 tons of sediment per day enters the Cook Inlet, and the Mississippi River discharges an average of over 1 million tons of sediment per day. The sediment discharge from streams into the Northern Gulf of Alaska is likewise large.

Pages 356-357:

In its discussion of natural seeps in the Gulf of

Alaska, the BLM should consider the publications of R. D. Wilson, et al., of Esso Research, who have made estimates of seepage into the marine environment. These authors rank the Gulf of Alaska as having high seepage potential and capable of seepage rates as high as 4,500 barrels a day. (Wilson, R. D.; Monaghan, P.H.; Osanik, A.; Price, L.C.; and Rogers, M.A., 1973. "Estimate of Annual Input of Petroleum to the Marine Environment from Natural Seepage." Transactions of 23rd Annual Convention, Gulf Coast Association of Geological Societies.)

Page 392, Last sentence:

The EIS notes that "chronic oil pollution sources near major salmon spawning streams or within salmon migration paths could eliminate certain salmon runs." The authors may wish to note in the Final EIS that salmon continue to migrate through San Francisco Bay and up the Sacramento River despite the fact that 7 oil refineries are located on the Bay and that appreciable quantities of hydrocarbons are discharged into the Bay, principally from municipal sources. This amounts to approximately 30 tons per day. Moreover, petroleum generations exist, and oil spills have occurred in the Cook Inlet. Salmon continue to migrate there.

Pages 395-404: Chronic Exposure of Marine Life to Spilled Oil

While considerable speculation on this topic has appeared both in the technical and the popular literature, many comprehensive studies have been conducted or are in progress which show that such exposure is not harmful. Of particular interest is the work done by Gulf Universities Research Consortium, as well as the Battelle Northwest Laboratories study of Lake Maracaibo in Venezeula. Other literature references on this subject are to be found on pages 4-6 of the testimony of Dr. Albert H. Lasday.

Page 395, Third paragraph:

In preparing the Final EIS, the authors may wish to note that several studies show that organisms do not magnify hydrocarbons through the food web. (See authorities cited in the testimony of Edward W. Mertens, pages 1-6). Moreover, a number of investigators have shown depuration of hydrocarbons by many species of organisms. (See testimony of E. W. Mertens).

Pages 422-431: Effect of Spilled Oil on Phytoplankton

The Draft EIS discussed the effects of oil on phytoplankton in several places, and principally on pages 422-431. It is argued that both acute and chronic effects of oil would be harmful to the phytoplankton population, that the phytoplankton are the ultimate basis of the marine food chain, and thus that any disruption or harmful effects on them would sequentially and adversely involve higher trophic levels.

In connection with the preparation of the Final EIS, the authors may wish to include some additional and new information regarding the effects of oil on phytoplankton. The conclusion of these studies is that insofar as phytoplankton are concerned, any adverse effects of crude oil is temporary and phytoplankton regenerate quickly after a spill. A listing of the principle studies addressing this question is found on page 3 of the testimony of Dr. Albert H. Lasday.

<u>Pages 491-597: Impact on the Social and Economic Environment</u>

In connection with the preparation of this section of the Final EIS, it is suggested that the BLM review the report "An Economic and Social Impact Study of Oil Related Activities in the Gulf of Alaska" prepared by Mathematical Sciences Northwest, Inc., under the direction of Mr. Guenter Conradus. The salient results of that study and a brief descripton of the methodology is found in the testimony of

Mr. Conradus.

Pages 740-745: Alternative of Delaying Sale Until New Equipment is Available to Provide Increased Environmental protection

It is suggested that the Final EIS take note of the developments announced by Jesse P. Johnson at the recent hearing. Mr. Johnson announced that, as a result of the efforts by the GOAOC, 24 companies have committed to join the newly formed Gulf of Alaska Cleanup Cooperative. He stated that company participants in this new Co-op met on August 8, 1975 and transacted business, including the appointment of several committees. These committees will plan for the equipment and procedures necessary to clean-up oil spills in the Gulf of Alaska. He also reviewed work already accomplished by the GOAOC designed to provide special versions of skimming equipment for use in the Gulf of Alaska. Model testing of a suitable self-propelled skimming vessel has been contracted for by the GOAOC. The cooperative will take over this program and is expected to commit for engineering design and drawings, and ultimately for construction of this vessel.

Pages 740-752:

In connection with the discussion of all alternatives related to delaying the proposed sale, it is suggested that reference be made to the testimony of Sherman H. Clark. Mr. Clark states:

> "There are substantial net economic benefits to the development of OCS production. Any delay, even for a few years, can not be made up later and will reduce those benefits in constant present dollars as well as incurring greater risk of inadequate energy supplies over a longer period of time. There is a high degree of risk involved and the potential consequences are even lower economic growth and higher unemployment than has been incorporated in (the Clark) study. In evaluating the consequences, rather than isolating the analysis to one source such as the Gulf of Alaska, all challenged new sources should be combined together; the reduced domestic supply of 2 to 7 million barrels per day equivalent in 1985 and 5 to 12 million

barrels equivalent in 1990 entails high risks amounting to $100 - $300 billion (1975 dollars) per year reduced GNP rising to $250 - $600 billion per year by 1990; the related unemployment is in the millions of people at the extreme in excess of 20 million."

DEPARTMENT OF THE INTERIOR - BUREAU OF LAND MANAGEMENT

HEARING ON PROPOSED LEASING
NORTHERN GULF OF ALASKA

AUGUST 12-13, 1975 - ANCHORAGE, ALASKA

STATEMENT OF WILLIAM M. MEYERS

I AM WILLIAM M. MEYERS OF THE LAW FIRM OF LISKOW & LEWIS OF NEW ORLEANS, LOUISIANA. I AM APPEARING HERE TODAY AS ATTORNEY FOR THE GULF OF ALASKA OPERATORS COMMITTEE. AS WILL BE EXPLAINED LATER, THE GULF OF ALASKA OPERATORS COMMITTEE IS COMPRISED OF 28 MEMBER COMPANIES.

THE COMMITTEE HAS REQUESTED AND OBTAINED PERMISSION TO MAKE A MULTI-WITNESS PRESENTATION. THIS WAS DONE FOR TWO REASONS. FIRST, WE BELIEVE THAT A COORDINATED PRESENTATION OF THIS TYPE ON BEHALF OF THE OFFSHORE INDUSTRY WILL BETTER COVER THE PERTINENT ISSUES INVOLVED IN THIS HEARING THAN WOULD A SERIES OF SEPARATE STATEMENTS FROM THE MEMBER COMPANIES WHICH WOULD BE LARGELY REPETITIVE. SECOND, WE BELIEVE THAT CONSIDERABLE TIME WILL BE SAVED IN MAKING THIS INDUSTRY PRESENTATION SINCE A GREAT MAJORITY OF THE MEMBERS OF THE GULF OF

ALASKA OPERATORS COMMITTEE WILL NOW CONTENT THEMSELVES WITH FILING WRITTEN STATEMENTS.

OUR WITNESSES WILL COVER THE MANY IMPORTANT ISSUES RELATING TO THE EXPLORATION AND DEVELOPMENT OF THE PETROLEUM POTENTIAL OF THE GULF OF ALASKA. WE WILL DISCUSS THE NEED FOR THE OIL AND GAS RESOURCES OF THE GULF, THE PHYSICAL OCEANOGRAPHY, THE GEOLOGY, THE TECHNOLOGY, THE SOCIO-ECONOMIC IMPACTS, AND THE ENVIRONMENTAL EFFECTS. CERTAINLY, IN EVALUATING THIS TESTIMONY IT IS NECESSARY TO EXAMINE THE PARTICULAR BACKGROUND AND QUALIFICATIONS OF EACH WITNESS. WE SUBMIT THAT EACH OF OUR WITNESSES IS AN ESTABLISHED EXPERT IN HIS FIELD. EACH IS WELL-EQUIPPED BY EDUCATION, TRAINING AND EXPERIENCE TO ADDRESS THE SUBJECT WHICH HE HAS BEEN ASSIGNED IN A RESPONSIBLE AND OBJECTIVE MANNER.

OUR WITNESSES WILL BE PRESENTED IN SEVERAL PANELS. THE FIRST PANEL CONSISTS OF DR. HOWARD A. SLACK, VICE PRESIDENT, ATLANTIC RICHFIELD COMPANY AND CHAIRMAN OF THE GULF OF ALASKA OPERATORS COMMITTEE, AND MR. JOHN A. SILCOX, VICE PRESIDENT AND GENERAL MANAGER, EXPLORATION

DEPARTMENT, WESTERN OPERATIONS, INC., STANDARD OIL COMPANY OF CALIFORNIA.

\- - - - - - - - - - - -

I NOW PRESENT DR. SLACK WHO WILL DISCUSS THE PURPOSES OF THE GULF OF ALASKA OPERATORS COMMITTEE AND THE VARIOUS ENVIRONMENTAL STUDIES WHICH HAVE BEEN CONDUCTED BY THE COMMITTEE AND CERTAIN OF ITS MEMBER COMPANIES.

\- - - - - - - - - - - -

OUR NEXT WITNESS, MR JOHN SILCOX, WILL COMMENT ON THE REPORT RENDERED BY THE COUNCIL ON ENVIRONMENTAL QUALITY ENTITLED "OCS OIL AND GAS - AN ENVIRONMENTAL ASSESSMENT".

\- - - - - - - - - - - -

MR. SHERMAN H. CLARK IS OUR NEXT WITNESS AND WILL DISCUSS "THE NEED FOR PETROLEUM SUPPLY FROM THE GULF OF ALASKA".

\- - - - - - - - - - - -

THE NEXT PANEL WILL DEAL WITH THE PHYSICAL OCEANOGRAPHY AND OCEAN GEOLOGY OF THE GULF OF ALASKA. THE WITNESSES ARE:

1. MR. PAUL HORRER WHOSE SUBJECT IS THE PHYSICAL MARINE ENVIRONMENT OF THE GULF OF ALASKA.

2. MR. JOHN MCKEEVER WHO WILL DISCUSS SEAFLOOR SEDIMENTS AND CHARACTERISTICS, AND INDUSTRY SURVEYS OF BOTTOM CONDITIONS.

3. MR. H. J. FITZGEORGE WHO WILL TESTIFY AS TO THE OIL AND GAS POTENTIAL OF THE AREA UNDER CONSIDERATION.

4. DR. JOHN H. WIGGINS WHO WILL DISCUSS THE "PROBABILISTIC RESPONSE OF OFFSHORE PLATFORMS TO SEISMIC EXCITATIONS IN THE GULF OF ALASKA".

\- - - - - - - - - - - -

THIS IS A CONTINUATION OF THE TESTIMONY ON BEHALF OF THE GULF OF ALASKA OPERATORS COMMITTEE.

OUR NEXT PANEL WILL COMMENT ON TECHNOLOGY FOR OCS DEVELOPMENT. THE WITNESSES ARE:

1. MR. L. E. WILSON WHO WILL SPEAK ON EXPLORATORY DRILLING OPERATIONS, WITH EMPHASIS ON THE NORTH SEA EXPERIENCE.

2. DR. KENNETH BLENKARN WHO WILL DISCUSS DEVELOPMENT AND PRODUCTION, PIPELINES, AND DESIGN OF STRUCTURES TO WITHSTAND WAVE AND SEISMIC FORCES.

3. MR. A. D. MOOKHOEK WHOSE SUBJECT IS TRANSPORTATION AND TERMINALS.

\- - - - - - - - - - - -

THIS CONCLUDES THE PRESENTATION OF THE GULF OF ALASKA OPERATORS COMMITTEE SCHEDULED FOR TODAY.

WEDNESDAY, AUGUST 12, 1975

THIS IS A CONTINUATION OF THE PRESENTATION OF THE GULF OF ALASKA OPERATORS COMMITTEE.

OUR FIRST WITNESS TODAY WILL BE MR. GUENTER M. CONRADUS WHO WILL REPORT ON THE STUDY MADE ON THE ECONOMIC AND SOCIAL IMPACT OF OIL RELATED ACTIVITIES IN THE GULF OF ALASKA.

THE NEXT PANEL OF WITNESSES WILL DISCUSS THE ENVIRONMENTAL EFFECTS OF OFFSHORE DEVELOPMENT.

1. MR. JOE TYSON WILL REPORT ON THE GULF UNIVERSITIES RESEARCH CONSORTIUM OFFSHORE ECOLOGY INVESTIGATION.

2. MR. WILLIAM F. GUSEY WILL COMMENT ON THE IMPACT OF THE PROPOSED OFFSHORE LEASING ON FISH AND WILDLIFE.

OUR LAST GROUP OF WITNESSES WILL DISCUSS OIL AND THE MARINE ENVIRONMENT.

1. DR. CLAYTON D. MCAULIFFE WILL DISCUSS THE FATE AND MOVEMENT OF OIL SPILLS.

2. DR. DALE STRAUGHAN WILL COMMENT ON THE ENVIRONMENTAL EFFECTS OF OIL SPILLS, PARTICULARLY RELATED TO THE SANTA BARBARA INCIDENT.

3. MR. E. W. MERTENS WILL REPORT ON THE RESEARCH PROGRAM CONDUCTED BY THE AMERICAN PETROLEUM INSTITUTE'S COMMITTEE ON THE FATE AND EFFECTS OF OIL IN THE MARINE ENVIRONMENT.

4. DR. A. H. LASDAY WILL DISCUSS CERTAIN AREAS OF THE DRAFT ENVIRONMENTAL IMPACT STATEMENT RELATING TO THE EFFECTS ON THE ENVIRONMENT OF CRUDE OIL AND OF OIL AND GAS DRILLING AND PRODUCTION RELATED FLUIDS.

5. MR. JESSE P. JOHNSON WILL DISCUSS OIL SPILL CONTINGENCY PLANNING.

- - - - - - - - - -

THIS CONCLUDES THE TESTIMONY ON BEHALF OF THE GULF OF ALASKA OPERATORS COMMITTEE.

STATEMENT OF

HOWARD A. SLACK
ATLANTIC RICHFIELD COMPANY

CHAIRMAN, GULF OF ALASKA OPERATORS' COMMITTEE

before the

U. S. DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT

HEARING

on

PROPOSED OIL AND GAS LEASING

on the

OUTER CONTINENTAL SHELF

NORTHERN GULF OF ALASKA

ANCHORAGE, ALASKA

AUGUST 12-13, 1975

GULF OF ALASKA OPERATORS COMMITTEE

STATEMENT OF HOWARD A. SLACK, ATLANTIC RICHFIELD COMPANY

OFFSHORE SALE ENVIRONMENTAL HEARING

ANCHORAGE, ALASKA

AUGUST 12-13, 1975

GOOD MORNING. MY NAME IS HOWARD A. SLACK. BY EDUCATION, I AM A PHD IN ENGINEERING PHYSICS. I AM A MEMBER OF THE SOCIETY OF EXPLORATION GEOPHYSICISTS, THE AMERICAN ASSOCIATION OF PETROLEUM GEOLOGISTS, AND A MEMBER OF THE BOARD OF DIRECTORS OF THE ALASKA STATE CHAMBER OF COMMERCE. I AM VICE PRESIDENT AND RESIDENT MANAGER FOR ATLANTIC RICHFIELD COMPANY IN ALASKA. MY AREA OF RESPONSIBILITY IS ALL MY COMPANY'S EXPLORATION AND PRODUCTION ACTIVITIES IN AND ADJACENT TO THE STATE OF ALASKA, INCLUDING THE OUTER CONTINENTAL SHELF. THE LATTER REPRESENTS APPROXIMATELY 383 MILLION ACRES OR ABOUT 66-2/3 % OF THE TOTAL UNITED STATES CONTINENTAL SHELF.

I AM APPEARING TODAY IN THE CAPACITY OF CHAIRMAN OF THE GULF OF ALASKA OPERATORS COMMITTEE, WHOSE MEMBERSHIP CONSISTS OF 28 COMPANIES. THESE COMPANIES ARE:

AMERICAN INDEPENDENT OIL CO., INC.
AMERICAN PETROFINA OIL COMPANY
AMOCO PRODUCTION COMPANY
ATLANTIC RICHFIELD COMPANY
ASHLAND OIL, INC.
BP ALASKA INC.
CHAMPLIN PETROLEUM COMPANY
CITIES SERVICE OIL COMPANY

CLINTON OIL COMPANY
CONTINENTAL OIL COMPANY
EXXON COMPANY, U.S.A.
GULF OIL COMPANY, U.S.
MARATHON OIL COMPANY
DEPCO, INC.
MOBIL OIL CORPORATION
MURPHY OIL CORPORATION
NATIONAL COOPERATIVE REFINERY
PANCANADIAN PETROLEUM COMPANY
PENNZOIL COMPANY
PHILLIPS PETROLEUM COMPANY
PLACID OIL COMPANY
SHELL OIL COMPANY
SKELLY OIL COMPANY
STANDARD OIL COMPANY OF CALIFORNIA
SUN OIL COMPANY
TENNECO OIL COMPANY
TEXACO, INC.
UNION OIL COMPANY OF CALIFORNIA

THE GULF OF ALASKA OPERATORS COMMITTEE WAS ORGANIZED IN NOVEMBER OF 1971 TO DEVELOP AN ASSESSMENT OF THE IMPACT OF OIL EXPLORATION AND DEVELOPMENT ON THE ENVIRONMENT OF THE GULF OF ALASKA AND TO PREPARE AND COORDINATE THE PRESENTATION OF TESTIMONY AT THE ENVIRONMENTAL HEARING FOR THAT AREA.

THE COMMITTEE ACCOMPLISHES ITS TASK THROUGH A NUMBER OF WORKING SUBCOMMITTEES. THESE SUBCOMMITTEES ARE:

ENERGY DEMAND
ENVIRONMENTAL AND BIOLOGY
GEOLOGY AND GEOPHYSICS
OIL SPILL PREVENTION
DRILLING AND PRODUCTION
MARINE TERMINALS AND TRANSPORTATION
ADMINISTRATION AND COMMUNICATIONS
PUBLIC, BUSINESS AND GOVERNMENT RELATIONS
SPECIAL PROJECTS

AND EACH IS EMPOWERED TO DEAL WITH THOSE PROBLEMS, RESEARCH AND STUDY RELATED TO ITS PARTICULAR INTERESTS. A SMALL EXECUTIVE COMMITTEE MEETS MORE FREQUENTLY THAN THE ENTIRE COMMITTEE TO COORDINATE THE EFFORTS OF THE GROUP. THE OFFICERS, THE EXECUTIVE COMMITTEE, AND THE SUBCOMMITTEE CHAIRMEN COMPRISE THE COORDINATING COMMITTEE.

THE OIL INDUSTRY HAS BEEN INTERESTED IN THE GULF OF ALASKA OCS FOR MANY YEARS, BECAUSE OF THE BELIEF THAT THIS AREA HOLDS PROSPECTS FOR MAJOR DISCOVERIES WHICH CAN SIGNIFICANTLY AID OUR COUNTRY'S GOAL OF REASONABLE ENERGY SELF-SUFFICIENCY. IN ANTICIPATION OF LEASING IN THIS REGION, THE INDUSTRY LONG AGO COMMENCED ONE OF THE MOST EXTENSIVE PROGRAMS OF ENVIRONMENTAL STUDY EVER ATTEMPTED. LET'S TAKE A LOOK AT SOME OF THE MORE SIGNIFICANT ACTIVITIES UNDERTAKEN BY THE GULF OF ALASKA OPERATORS COMMITTEE RELATIVE TO THE GULF OF ALASKA.

1. GROUP OCEANOGRAPHIC SURVEY: THIS SURVEY, UNDERTAKEN IN 1968, WAS ORGANIZED SOME TWO FULL YEARS PRIOR TO PASSAGE OF THE NATIONAL ENVIRONMENTAL POLICY ACT OF 1969. IT WAS DESIGNED TO ESTABLISH THE FULL RANGE OF PHYSICAL ENVIRONMENTAL CONDITIONS SO AS TO ASCERTAIN THEIR EFFECT ON PETROLEUM EXPLORATION, PRODUCTION, AND TRANSPORT. THIS RESPONSIBLE EFFORT RESULTED FROM THE STRONG DESIRE OF THE PARTICIPANTS TO DETERMINE WHETHER OPERATIONS COULD BE SAFELY AND ECONOMICALLY CONDUCTED IN THIS AREA. HISTORICAL DATA OF RECORD WAS COMPILED AND AN IN-OCEAN DATA BUOY WAS ACTIVATED TO GATHER WAVE DATA. THESE DATA HAVE CONVINCED US THAT CONDITIONS IN THE GULF OF ALASKA ARE NO WORSE THAN IN OTHER AREAS OF THE WORLD WHERE PETROLEUM OPERATIONS ARE CURRENTLY BEING SAFELY CONDUCTED. WITH THIS KNOWLEDGE, INDUSTRY HAS PROCEEDED WITH FURTHER ENVIRONMENTAL STUDIES AND WITH EXPLORATION COMMITMENTS PREPARATORY TO A SALE.

TO MY KNOWLEDGE, THE GULF OF ALASKA GROUP OCEANOGRAPHIC SURVEY IS UNIQUE. NOWHERE ELSE IN THE WORLD HAS THE INDUSTRY UNDERTAKEN SUCH AN EXTENSIVE EFFORT PRIOR TO MAJOR EXPLORATION AND PRODUCTION EXPENDITURES. THE DATA OBTAINED BY THE GROUP OCEANOGRAPHIC SURVEY IS PROPRIETARY TO THE PARTICIPANTS. HOWEVER, SINCE THE DATA PROVIDE THE MOST COMPREHENSIVE COMPILATION OF INFORMATION RELATIVE TO THE GULF OF ALASKA, THE PARTICIPANTS HAVE RELEASED TO THE GULF OF ALASKA OPERATORS COMMITTEE AND THEY, IN TURN, TO THE BLM AND THE COUNCIL ON ENVIRONMENTAL QUALITY, A CONDENSATION OF THE SURVEY REPORTS. THIS IS IN THE FORM OF FIVE SEPARATE DOCUMENTS. ADDITIONALLY, THE SURVEY GROUP HAS MADE CERTAIN APPROPRIATE PORTIONS OF THE INFORMATION AVAILABLE TO THE DRILLING CONTRACTING INDUSTRY FOR THEIR USE IN EQUIPMENT DESIGN.

2. Review of the Oceanography and Renewable Resources of the Northern Gulf of Alaska: THIS WORK WAS DONE BY THE INSTITUTE OF MARINE SCIENCES IN 1972, EDITED BY DONALD H. ROSENBERG AND WAS PARTIALLY FUNDED BY THE GULF OF ALASKA OPERATORS COMMITTEE. THIS STUDY WAS AVAILABLE TO THOSE WRITING THE DRAFT ENVIRONMENTAL IMPACT STATEMENT.

3. Fish, Wildlife and Petroleum Production, The Gulf of Alaska: THIS COMPILATION OF EIGHT SEPARATE REPORTS BY THE ENVIRONMENTAL AND BIOLOGY SUBCOMMITTEE OF THE GULF OF ALASKA OPERATORS COMMITTEE COVERS BIRDS, TERRESTRIAL WILDLIFE, MARINE MAMMALS, THREATENED SPECIES AND THE FISHERY RESOURCES OF THE GULF OF ALASKA.

ADDITIONALLY, IT REVIEWS THE EFFECT OF OIL ON FISH AND WILDLIFE WITH SPECIAL CONSIDERATION TO RECENT DATA ON COLD WATER EFFECTS. IT CONCLUDES WITH A STUDY CONDUCTED BY SHELL OIL ON EXPLORATORY FISHING DRAGS FOR DEMERSAL FISH AND SHELLFISH.

4. THE OIL ACTIVITY RELATED SOCIAL AND ECONOMIC IMPACT ON THE GULF OF ALASKA COMMUNITIES: THIS STUDY WAS CONDUCTED BY THE MATHEMATICAL SCIENCES NORTHWEST, INC. IN SEATTLE UNDER THE DIRECTION OF GUENTER CONRADUS AND FINANCED BY THE GULF OF ALASKA OPERATORS. COMMITTEE.

5. OIL SPILL TRAJECTORY PROGRAM: INTERSEA RESEARCH CORPORATION IS PERFORMING CALCULATIONS OF TRAJECTORIES ON THE OCEAN'S SURFACE FROM SEVERAL LOCATIONS WHERE OIL AND GAS OPERATIONS MIGHT BE CONDUCTED. MR. CLAYTON MCAULIFFE OF CHEVRON OIL FIELD RESEARCH COMPANY, USING PREVIOUS RESULTS, HAS MADE ESTIMATES OF BIODEGRADATION, DISPERSION, AND EVAPORATION OF POSSIBLE ACCIDENTAL OIL RELEASES IN THE GULF OF ALASKA. BOTH PROJECTS WERE INTIATED AND SUPPORTED BY THE GULF OF ALASKA OPERATORS COMMITTEE.

6. SEISMIC RISK ANALYSIS: THIS STUDY WAS CONDUCTED BY THE J. H. WIGGINS COMPANY OF CALIFORNIA AND REPRESENTS A PROBABILISTIC ANALYSIS OF THE GULF OF ALASKA SEISMIC ENVIRONMENT. THE LIKLIHOOD OF EARTHQUAKES OF VARYING MAGNITUDES OCCURRING AT ANY SITE HAS BEEN ESTIMATED AND THE RESPONSE AND PERFORMANCE OF OFFSHORE STRUCTURES TO SEISMIC EVENTS EXAMINED. THIS WORK FORMS A BASIS FOR THE DEVELOPMENT OF SEISMIC DESIGN CRITERIA AND THE ASSESSMENT OF THE FEASIBILITY AND RELIABILITY OF OFFSHORE STRUCTURES.

7. <u>OIL SPILL PREVENTION AND CONTINGENCY PLAN:</u> THE GULF OF ALASKA OPERATORS COMMITTEE HAS AN OIL SPILL PREVENTION AND CONTINGENCY PLAN WHICH WILL BE IN EFFECT PRIOR TO THE FIRST EXPLORATORY DRILLING ON THE OUTER CONTINENTAL SHELF OIL IN THE GULF OF ALASKA.

IN ADDITION TO THESE PROGRAMS ALREADY MENTIONED, THERE ARE MANY OTHER STUDIES THAT HAVE BEEN ORGANIZED AND SUPPORTED BY SEVERAL OF THE COMMITTEE'S MEMBER COMPANIES. SOME OF THIS WORK IS ONGOING NOW AND SOME IS IN THE PLANNING STAGES. THESE PROGRAMS INCLUDE:

(1) A <u>WAVE AND WEATHER FORECAST STUDY</u> (1971-1972)
MANAGED BY EXXON AND CONDUCTED BY OCEANOGRAPHIC SERVICES.

(2) AN <u>OFFSHORE SOIL BORING PROGRAM</u> (1973)
MANAGED BY SHELL AND CONDUCTED BY EXPLORATION SERVICES, INC.

(3) A <u>WAVE AND WIND MEASUREMENT PROGRAM</u> (1974-1976)
BEING ADMINISTERED BY MARATHON AND CONDUCTED BY INTERSEA RESEARCH.

(4) A <u>WAVE HINDCAST EVALUATION PROGRAM</u> (1975-1976)
THAT IS USING THE MANY PHYSICAL MEASUREMENTS COLLECTED FROM THE WAVE AND WIND MEASUREMENT PROGRAM TO IMPROVE WAVE FORECASTING TECHNIQUES. THIS PROGRAM ALSO IS BEING ADMINISTERED BY MARATHON AND CONDUCTED BY INTERSEA RESEARCH.

(5) A <u>SUPERSTRUCTURE ICING REVIEW</u> (1975)
ADMINISTERED BY MARATHON.

(6) AN OCEAN CURRENT MEASUREMENT PROGRAM (1974-1975) CONDUCTED BY BOLT, BERANEK AND NEWMAN.

(7) A METEOROLOGICAL AND OCEANOGRAPHIC FORECASTING PROGRAM (1975-1976) THAT WILL BE ADMINISTERED BY MARATHON AND WILL USE MUCH OF THE PHYSICAL MEASUREMENT DATA COLLECTED IN THE GULF OF ALASKA.

MOST OF THIS DATA HAS BEEN MADE AVAILABLE TO THE BUREAU OF LAND MANAGEMENT FOR ITS USE IN PREPARING THE DRAFT ENVIRONMENTAL IMPACT STATEMENT. OTHER STATE AND FEDERAL AGENCIES HAVE RECEIVED THIS INFORMATION UPON REQUEST. AS MR. MEYERS HAS INDICATED, SUBSEQUENT TESTIMONY BY REPRESENTATIVES OF THE GULF OF ALASKA OPERATORS COMMITTEE WILL CONTAIN FURTHER DETAILS OF SOME OF THESE PROGRAMS.

FROM THE ACTIVITIES WHICH I HAVE DESCRIBED, WE MUST CONCLUDE THAT THE INDUSTRY HAS THOROUGHLY STUDIED THE GULF OF ALASKA ECOSYSTEM. NOTHING HAS BEEN FOUND THROUGH THESE STUDIES WHICH PRECLUDES THE OIL INDUSTRY FROM OPERATING IN THIS AREA WITH COMPLETE ENVIRONMENTAL SAFETY.

THE GULF OF ALASKA OPERATORS COMMITTEE SUBMITS TO YOU THAT NEVER HAS OUR INDUSTRY ENTERED A NEW AREA SO WELL INFORMED, WELL EQUIPPED AND WELL TRAINED AS WE ARE NOW FOR THE PROPOSED EXPLORATION AND DEVELOPMENT OF THE GULF OF ALASKA. WE ARE PREPARED TO GO FORWARD, AND WE HAVE HIGH HOPES THAT OUR EFFORTS WILL RESULT IN SIGNIFICANT DISCOVERIES OF PETROLEUM WHICH ARE SO BADLY NEEDED FOR THE ECONOMIC WELL-BEING AND SECURITY OF OUR COUNTRY.

Testimony of John H. Silcox

Vice President and General Manager - Exploration
Standard Oil Company of California,
Western Operations, Inc.

On Behalf of Gulf of Alaska Operators Committee

At the Department of Interior, Bureau of
Land Management Hearings
On the Draft Environmental Impact Statement
For Outer Continental Shelf Leasing
In the Northern Gulf of Alaska

Anchorage, Alaska - August 12, 1975

My name is John H. Silcox. I am a geologist and Vice President and General Manager of Exploration for Standard Oil Company of California, Western Operations, Incorporated.

My company has been an active oil operator in Alaska since the late 1950's and during my career, I have been pleased to live and work in Anchorage for several years. As a result, and because of my present responsibilities, I am thoroughly familiar with the history and ongoing development of petroleum exploration in Alaska and its offshore waters.

My testimony today is on behalf of the Gulf of Alaska Operators Committee, a 28-member group of oil and gas companies engaged in exploration and environmental studies of the Gulf of Alaska.

Later in this hearing, others will offer statements on virtually every aspect of exploration, development and environmental assessment of offshore areas. They will outline the extensive efforts the oil industry is taking to minimize or eliminate entirely <u>any</u> potentially adverse environmental impact as a result of offshore operations.

My own comments will be limited to a document entitled "OCS Oil and Gas---An Environmental Assessment." This is a report to the President by the Council on Environmental Quality dated April 18, 1974. At this time, I would like to enter into the hearing record a volume entitled "Oil Industry Comments on the CEQ Report."

This volume contains detailed references to various parts of the CEQ Report, far more extensive than I can possibly cover in my brief comments. I urge your careful consideration of these observations.

First, let me say the oil industry recognizes that the CEQ---because of its presidential mandate---had only a short time to prepare its report on what is an exceedingly complex and controversial subject. We also recognize that the Council did not have the benefit of a technical staff with the scientific expertise to produce a definitive study.

Despite this, the CEQ Report has become to some the final "authority" on environmental issues associated with oil and gas operations in the Gulf of Alaska. It is erroneously regarded as a scientifically complete and objective appraisal. And it is often cited as a reference, especially by those seeking to delay leasing of the Outer Continental Shelf for oil and gas exploration. Unfortunately, it is neither complete nor objective.

Because of this, we believe it is imperative to offer this critique on the CEQ Report and some of its findings. And we appreciate this opportunity to present our views at this hearing.

Our comments are necessarily critical of the report, its lack of scope in certain instances and the false impressions it can convey to the uninformed reader who is not familiar with technical subjects. But we believe our comments are constructive suggestions for improvement. We hope they will be carefully considered in the sincere spirit in which they are offered.

We respectfully request and we trust that our comments and our documented presentation will receive fair and objective consideration in the final Environmental Impact Statement on the Gulf of Alaska.

The CEQ Report does contain a number of constructive recommendations which have been accepted and implemented--- a fact not widely known, especially among oil industry critics.

But those of us who have spent years in oil development and environmental assessment find we must strongly disagree with much of the CEQ Report.

The petroleum industry has spent more than $2 million on numerous scientific studies of the Gulf of Alaska. These studies represent the most comprehensive environmental assessment of the possible impact of oil and gas operations ever conducted in any non-producing area in the world.

This involved years of effort and the talents of some of the most knowledgeable experts ever assembled. The studies were conducted with great care and at great expense. Petroleum industry witnesses appeared and testified extensively at the hearings conducted by the Council.

Yet their testimony, the supporting documentation and the comments made by petroleum industry witnesses were given little consideration. In fact, this mass of material and expert comment was virtually ignored in the final report.

As a result, the CEQ Report falsely implies that oil and gas development in the Gulf of Alaska is an unreasonably high environmental risk operation. Yet if this factual data had been reflected properly in the final draft, we believe it would clearly demonstrate the shortcomings of the CEQ Report and offset this false impression.

One conclusion in the CEQ Report which greatly concerns the petroleum industry is the arbitrary "ranking" of the 17 OCS areas in terms of environmental "risk." The report purports to classify the Gulf of Alaska as a high environmental risk for oil and gas exploration.

Apparently, this "ranking" is based on three general concerns: Oceanographic conditions, seismic hazards and the Gulf of Alaska's geographic location---an area of major ecological interest.

In all development by man, whether of oil or any other commercial endeavor, there is some degree of environmental risk. Yet in evaluating this potential risk, great care must be made to clearly distinguish between real threats to the environment and subjective judgments that simply prohibit any proposed development.

If this had been done, we do not believe oil exploration in the Gulf of Alaska could reasonably be classified as an area of high environmental risk.

Even the term "risk" must be properly defined if it is to offer any meaningful assistance to an environmental assessment of the Gulf of Alaska. Nowhere was this done in the CEQ Report.

Everyone here "risked" the prospect of being hit by a falling meteorite on the way to this hearing. Yet the probability of being struck by a falling meteorite is so remote that this particular "risk" is almost non-existent.

By failing to make such measured distinctions, the CEQ Report leaves a clear impression that anything labeled as a "risk" must indeed be "risky" or even unacceptably "hazardous."

This is simply not true.

To rank the Gulf of Alaska on the high end of an environmental risk scale and the Eastern Georges Bank at the low end is an arbitrary judgment. It totally ignores the fact that for both areas, based on past oil industry experience, there is a very low probability of any major or permanent environmental damage from drilling and production activity.

Furthermore, to be useful, the concept of "risk" of environmental damage must be considered on a larger scale of risk evaluation---giving proper weight to all available options the U.S. has to develop the additional energy it must have. Everyone is well aware of the potential long-term energy crisis confronting the United States.

We import 40 per cent of the petroleum we use and the gap between domestic production and demand grows wider each year. It aggravates the balance of payments problem; it seriously impairs the nation's ability to recover from the worst recession since World War II. Increased dependency on foreign sources of petroleum is clearly not in the national interest. Because of this, it is the declared policy of the Federal government to encourage and hasten domestic oil exploration, particularly in the promising offshore areas.

Chronic long-term energy shortages could cause widespread unemployment and severe hardships that would create massive social and economic problems. Clearly, the "risk" of exploring for oil in the OCS is more than offset by the economic risk of not vigorously trying to become more self-sufficient in energy.

Viewed in this context, as part of the overall economic, ecological and social environment, any reasonable observer must conclude that oil and gas exploration offshore, including the Gulf of Alaska, is clearly acceptable and necessary.

Too often, excessive environmental restrictions have simply ignored economic needs. The delay in the Alaska pipeline project is an example. Yet, to the individual citizen, a job, a paycheck and energy to heat and light his home and fuel to run his car are critically important. They are part of his total environment, and must be considered, too.

Major Short-Comings of CEQ Report

Because of limited time, I will briefly outline the major shortcomings we find with the CEQ Report. But I will be happy to respond to any questions at the conclusion of this summary.

First, the CEQ Report gives little notice to the sweeping technical advances the oil industry has achieved in offshore drilling the past 25 years. It virtually ignores the research programs carried out in the Gulf of Alaska by the petroleum industry, the testimony we presented, and the several boxes of documentation entered into the record. The final report contains only one or two minor references to this research.

By way of contrast, the environmental community offered rhetoric rather than scientific fact, and yet their philosophy permeates the entire fabric of the CEQ Report.

The U.S. industry leads the world in petroleum technology. It has explored, found and developed almost all the Free World's oil reserves, including the latest major offshore area---the North Sea. Except for seismic activity, environmental conditions in the North Sea are slightly more severe than in the Gulf of Alaska.

Yet the oil industry has constructed offshore platforms, drilled, and placed sub-sea pipelines into operation. Today, the North Sea is producing oil and gas with no significant detrimental impact on the marine environment.

The result has been tremendously beneficial for the economic environment of neighboring nations. The United Kingdom expects to be self-sufficient in oil and gas in the early 1980s and Norway plans to become an oil exporter. Previously, both those nations had been almost totally dependent on foreign oil.

Secondly, a disturbing part of the CEQ Report is the superficial treatment it gives to complex technical subjects, with insufficient documentation. The report uses language which exaggerates and overstates potential environmental damage.

The use of such words as "devastate," "chaos," and "massive changes" in describing the potential impact of oil operations strongly suggests a bias against petroleum development and clearly demonstrates a lack of scientific objectivity in assessing environmental questions.

In many instances, the overall impression given by the report is a wholly unwarranted skepticism toward the oil industry and its sincere and positive efforts to act responsibly, to fully comply with all environmental safeguards.

Thirdly, great emphasis is placed on the spill trajectory probability forecasts conducted by the Massachusetts Institute of Technology. Yet the MIT calculations are misleading in several crucial respects.

They make no allowance for the established fact that oil spilled in the ocean evaporates, biodegrades, emulsifies and disperses---within relatively short periods of time---so any spill is diluted to a degree that harmful effects are eliminated or greatly minimized.

Nor do the MIT calculations allow for the fact that the industry makes every effort to contain and prevent spilled oil from coming ashore. Indeed, Federal regulations already require equipment and containment plans in all offshore producing areas.

Fourth, the CEQ Report grossly overstates the effect that oil operations in the Gulf of Alaska will have onshore, both here and in the Lower 48 states.

For example, the CEQ predicts that more refineries and petrochemical plants will be required on the West Coast because of OCS oil. This is untrue. The growth of refineries is caused by demand for refined products in a particular region, not by the presence or absence of oil production. The production of OCS oil will simply substitute domestic oil for part of the foreign crude now being processed by West Coast refineries.

The only significant onshore effects will be from those required to support offshore operations---including boat landings, heliports, staging areas, offices and possibly oil and gas treating facilities. Even this may not be required in all cases because it may be an advantage to store and ship some oil from offshore facilities.

Fifth, in another reference, the report mentions potential health hazards and makes mathematical forecasts of additional hydrocarbon emissions near U.S. refineries. But it does not document this finding.

If it had, the authors would have discovered that in areas they mentioned, hydrocarbon emissions from refinery operations are strictly controlled <u>now</u>---by rigid state, local and Federal regulations. Clearly, this type of undocumented and incomplete presentation to a non-technical audience imparts an exaggerated and erroneous impression of onshore effects of OCS oil development.

The CEQ Report could have been more useful and accurate if it had studied these subjects in more depth and if it had at least considered the testimony by the petroleum industry.

But there is one onshore impact mentioned by the CEQ with which we do agree: OCS oil production will provide substantially <u>increased</u> employment opportunities---in the Lower 48 and in Alaska.

Sixth, I must criticize the Council's superficial discussion of natural phenomena and the design technology that has been developed to minimize problems caused by natural phenomena.

Other witnesses will discuss these topics in detail, including oceanographic conditions, the effect of winds and waves, earthquakes and design practices. Here again, the CEQ has ignored the considerable factual data and information presented by the Gulf of Alaska Operators Committee. In several instances, ocean conditions presented by the oil industry differed from those cited by the CEQ. But the Council did not list its sources, nor the geographic location of the data it cites.

There are several misleading statements on the oil industry's technical ability. An example: An uninformed reader scanning the CEQ Report would get the clear impression that modern engineering is incapable of designing structures to withstand earthquakes. But such structures are being constructed in active seismic zones throughout the world.

Further, in discussing offshore operations, the report should have noted that the farther away you get from an earthquake fault or epicenter, the <u>less</u> potential there is for damage or even ground motion.

Much of the lease sale area in the Gulf of Alaska is located sufficiently distant from significant faults that the potential for severe ground motion is sharply reduced.

The report should have at least acknowledged that millions of people in the world live in active seismic regions---in Japan, California, Alaska, down the West Coast of South America and into the Middle East. To suggest that development of any kind should be prohibited in these areas because of seismic hazards is absurd. What is needed is to design structures to withstand and minimize potential damage. That is already being done in the U.S.

Seventh, the discussion of tsunamis in the Council's report also leaves a reader a false impression of their overall severity and potential for damage. The main threat from wave actions caused by seismic activity is to onshore installations---berthing facilities, docks and things of this sort. This is recognized.

But in the open sea---where much of the oil operations in the Gulf of Alaska would take place---the impact of most tsunamis would probably go unnoticed.

The Council's report makes only passing reference to the oil industry's technological accomplishments in Cook Inlet where since the early 1960's, when petroleum production activities commenced, there have been no serious structural failures or damaging oil spills.

Drilling platforms in Cook Inlet have withstood yearly batterings by 3 to 4 feet of ice moving at five knots or better, and tides whose range is among the highest in the world. These platforms have also experienced an earthquake measured at a magnitude of 6.5 on the Richter scale.

Eighth, as a final item of this critique, we believe the CEQ Report should have placed more importance on the oil industry's experience in offshore drilling in the Gulf of Mexico. The industry has drilled and produced offshore in the Gulf of Mexico for a quarter of a century. There has been extensive operations in all weather, even under storm conditions in an area noted for hurricanes. Yet the oil, fishing and other industries have operated harmoniously together over all that period of time.

There has been no evidence of lasting harm to the environment nor to marine life from offshore oil operations.

The Offshore Ecology Investigation conducted by Gulf Universities Research Consortium contains factual data on the ecological health of the Gulf of Mexico. Despite this documentation, this harmonious operation of the oil industry with fishing and other marine activities is not reflected in the CEQ Report.

In summary, we believe many parts of the CEQ Report give an imprecise picture of the Gulf of Alaska environmental assessment, a false picture of the industry's ability to design safe structures for the Gulf of Alaska, and an erroneous impression of the onshore impact of leasing OCS lands in the Gulf of Alaska.

The oil industry believes its input to the CEQ Report was not adequately considered or reflected.

With this presentation and the written documentation we have offered, the industry has tried to put the CEQ Report in its proper perspective.

We earnestly trust that the testimony being presented here today will be seriously considered and evaluated by those who prepare the final Environmental Impact Statement---and by those in the decision-making process regarding OCS leasing for the Gulf of Alaska.

Thank you. If anyone has any question----

* * *

SHERMAN H. CLARK ASSOCIATES
Menlo Park, California 94025

Statement of
Sherman H. Clark

Before the
U.S. DEPARTMENT OF THE INTERIOR
Bureau of Land Management

Hearing on
PROPOSED OIL AND GAS LEASING ON THE OUTER CONTINENTAL SHELF
Northern Gulf of Alaska

Anchorage, Alaska
August 12-13, 1975

THE NEED FOR PETROLEUM SUPPLY FROM THE GULF OF ALASKA

My presentation deals with three questions relating to the potential development of Gulf of Alaska oil and gas resources: is there a basic need for this supply, what are the hazards in delaying the development, and is it desirable to forestall development until a national energy policy is prepared?

THE NEED

Let me begin with the need, which is primarily a national issue. There are five components to the analysis: (1) outlook for domestic oil and gas production from existing sources, (2) the requirements for all energy, (3) the availability of other sources of energy, (4) resulting demand for petroleum, and (5) the implications of relying on foreign oil supplies.

1. Existing Sources

Domestic oil and gas production have both been declining for several years, and combined 1975 production will be down about 10% from the peak output. A downward trend is a near certainty to 1980. Excluding Federal OCS and all Alaskan sources, there is virtually no hope that the slide in production can be arrested thereafter. With early access to every possible resource and adequate incentives, the highest output of oil and gas combined will be no higher in 1985-90 than today. The generally prevailing estimate calls for a reduction of about 15%, or about 25% below the early 1970s peak. These estimates are not exceptional; most of the published projections in the past year or so have been in the same range.

The conclusion is inescapable; Federal OCS production will offset or help to offset, the production decline in old fields; short of accelerating the exporation effort in all frontier areas such as the Gulf of Alaska, there is no way that U.S. oil and gas production will exceed the present level. We are accustomed to thinking that new supplies imply an increase in total supply available, but this is not the case with U.S. oil and gas production.

2. Energy Requirements

The use of energy is related to the level and characteristics of economic activity. In the past 18 months, beginning with the Arab oil embargo, we have also learned that economic activity can be affected by energy availability.

Our economic projections have been influenced by the energy outlook as well as by the length and severity of the current recession, the degree of inflation in the recent past, the federal deficits and imbalance of payments, and the below normal business investment in this decade. In a deliberately conservative forecast, we estimate the growth rate in real GNP to be only 2.2% per year for 1973-80, but to increase to 3.8% per year in the 1980s. In comparison with the postwar trend through 1973, extrapolated to 1990, $4.6 trillion less GNP will be generated in 1974-90 under this forecast; that is equal to three year's total output at the current size of the economy and part of that loss is attributable to our energy problems.

The nation is using a certain amount of energy to support the present level of economic activity, just as it has in the past and will in the future. The past trend in total energy use per unit of GNP shows a decline at 1.2% per year from 1920 to 1954, but in the postwar period there has been virtually no change; that is, for every percentage increase in GNP, there has been an equal percentage increase in energy. There is no indication of any change in the relationship through the first quarter of 1975. However, we have assumed--again in a deliberately conservative manner--that commencing in 1976 the use of energy per unit of GNP will decline at 0.7% per year, equal to the average rate of change over 1920 to 1974. The decline in the ratio is assumed, in anticipation of price effects combined with the effect of conservation legislation. But there are a number of factors that will tend to offset any improvement in the energy-economic activity relationship:

- More energy is needed for energy intensive growth markets such as fertilizers and petrochemicals.

- More energy is needed for the steel industry, which will expand more rapidly than in the past 10 years.
- More energy is needed because stack gas devices and other means of improving the environment absorbs energy.
- More energy is needed because energy conversion such as coal gasification absorbs a large share of the energy input.
- More energy is needed to save energy, in producing insulation and other energy saving materials.
- More energy per unit of output will be required in energy production and mining in general because of lower grades of deposits in less accessible locations.
- In addition, remember that we are comparing the future with the past relationship in energy use and GNP. Consider the following comparisons:

  -- The power plant heat rate (or efficiency) will improve very little over the next decade, and far less rapidly than in the 1920-60 period. Higher efficiency of new plants tends to be offset by energy absorbed in scrubbers and other environmental equipment. Dieselization of the railroads increased efficiency by several orders of magnitude in the postwar period but that program is completed and future improvement will be limited.

  -- Electric power will continue to increase as a share of total energy. Electric power requires more energy input per unit of output than other energy and as stated, the efficiency is not expected to improve.

  -- The composition of economic activity will change very gradually; Services, generally considered to be non-energy intensive, will not increase as a share of GNP any more rapidly than in the past 20 years during which the energy-GNP relationship changed very little. Services will be adversely affected by the slower future increase in real disposable income and static to declining discretionary income. Moreover, Services in total is already the major component of GNP and by virtue of its large share, a rapid change in share is extremely difficult to achieve.

Combining the conservative economic forecast with an energy-GNP ratio trend that certainly appears conservative in the light of all the above factors, yields a growth rate for energy requirements of only 1.5% per year for 1973-80 and 3.1% per year for 1980-90. The low growth rate in energy use is heavily attributable to a low growth rate in economic activity. A concerted effort to achieve more rapid economic growth can be expected and may well prove to be successful; if so, energy requirements will be higher than forecast above, and this forecast should be viewed as realistic to low.

3. Availability of Other Energy

Nuclear power production is based largely upon scheduled additions through 1985 at least. The scheduled additions have been stretched out and reduced in the past year or two; if anything, the projected reliance on nuclear may be overstated because of further delays and possible cancellations. Nuclear power faces even stiffer resistance from environmentalist groups than does Federal OCS development. As a result, 10 to 13 years may be required from initiation of a nuclear project to initial operation.

Coal, despite its enormous resource base faces many constraints to rapid expansion of productive capacity. Output and use failed to increase in 1974 and there will probably be little increase in 1975. Scheduled additions to capacity amount to about 200 million tons through 1983 versus roughly 600 million tons currently, but as much as half the additions will only offset capacity that will close down because of exhaustion of the deposit or inability to meet Mine Safety Standards or environmental regulations. Additional expansion can be expected by 1983 as well as in 1984-90, but there are limitations to expansion that include environmental limits on sulfur content, delays caused by environmental hearings, problems associated with industrial conversion to coal, water availability for gasification plants, and potential limits to output in the western states that may be imposed by these states. The projected production by 1990, including coal for gasification and for exports, is in excess of 1.2 billion tons. This is not necessarily the upper limit, but it will be difficult to achieve a much greater level of output.

Geothermal capacity operating in 1980 is only that already scheduled, and will be extremely limited. While rather fantastic estimates of operating capacity in 1985 and 1990 have been made by reputable groups, this source of energy is also subject to constraints and extreme uncertainty:

- The level of R&D; the degree of success in such efforts and the timing.
- The success of exploratory activity.
- The location of new deposits in relation to the demand centers for this energy.
- The necessary incremental approach to expansion of capacity in any general location, caused by the unpredictable size of the resource available. In other words it is not practicable to install a large plant, for example, one with a 1,000 megawatt capacity. In Geyserville, a large geothermal resource, each new plant adds only 75 to 125 megawatts of capacity.

Solar energy is in an R&D stage that will last at least five years and probably 15 years or more. According to the FEA, there is at present no market for solar systems because they are not competitive; if they could be sold, manufacturers would provide the systems. For example, manufacture of high temperature solar energy collectors in 1974, at maximum Btu output, was equivalent to only 56 barrels per day of oil, largely financed by various research projects. As in any extensive R&D effort, the outcome and particularly the timing of any degree of success is extremely uncertain. The position taken in this study is that the market for solar systems will evolve gradually, will not commence before 1980, and will probably not be particularly significant until after 1990. To the extent that there is any use in the 1980s, the effect is anticipated in the lower rate of growth in conventional energy demand in the residential and commercial sectors.

4. U.S. Total Demand for Petroleum

After allowing for low economic growth, a steady improvement in the relationship between energy use and economic activity that is a substantial departure from postwar experience and questionable in magnitude, and the practical availability of all other forms of energy that recognizes all the constraints on these sources, the overall demand for oil and gas combined for 1973-80 is only 0.3% per year, and 1.8% per year for 1980-90, and part of this is coal that has been gasified. But total gas availability from all sources is certain to continue to decline to 1980, and will most probably be lower through the 1980s than at present by 10% or more. The most optimistic assumptions as to deregulation and resource base would yield no higher availability than at the peak in 1973, while the low estimate adopted is not necessarily the lowest that may be realized. To offset the gas decline and meet overall growth in oil and gas requirements, oil demand will increase by several percent per year while domestic production declines.

Thus, the results of this conservative analysis show that, even with the fullest possible access to Federal OCS lands and all other promising hydrocarbon locations throughout the country together with adequate incentives, the nation will have to continue to rely on oil imports of increasing magnitude. Depending on the oil and gas resource base and the inevitable delays in achieving new production in Alaska, imports will increase from 6 million barrels per day currently to 9 to 12 million barrels per day in 1980 and 13 to 17 million barrels per day in 1990. At the present time, the prevailing opinion as to the oil and gas resource base favors the higher estimate of import levels in 1980-90 even though the high import estimates look unrealistic today.

5. Implications of Relying on Foreign Oil

U.S. oil imports from Canada reached a peak of 1.2 million barrels per day and have since declined, with the further Canadian government objective of gradually phasing out exports completely. The oil availability from the rest of the free world (excluding OPEC and related production in the Middle East) is distinctly limited; this portion of the free world is in such a substantial net deficit position on petroleum that the expected increase in local production can do no more than offset, or partially offset, the local increase in demand. Some countries within this category, should substantial oil production be achieved, may also elect to join OPEC, which is assumed to provide the balance of the required supply; its availability is far from assured.

Based upon a free world energy balance that takes into account the net availability from the Soviet Bloc, the OPEC and related Middle East output is projected to increase from 31 million barrels per day in 1973 and 27 million barrels per day in 1975 to 32 million barrels per day in 1980 and 41 million barrels per day in 1990. This projected OPEC output assumes full availability of Federal OCS and all other U.S. oil and gas as well as nuclear power and other sources of energy. When economists declare that there will be a surplus of energy within the time period of this study, they assume that all of these sources will be available and that there will also be numerous discoveries of supergiant oil fields, but some of the same economists will then argue against the development of Federal OCS resources or other sources of energy. The discovery of supergiant fields, sufficient to alter the historical trend in the finding rate, is basically unpredictable. The past finding rate incorporates discoveries such as in the North Sea and the North Slope; if the future trend in the finding rate is to be substantially higher, such fields will have to be found with increasing frequency. Outside of OPEC, such a prospect is not supported by current evaluations of the resource base.

If new U.S. sources of energy are not made available and the U.S. economic growth projections of this study are not reduced, the need for OPEC production will be that much greater; instead of 41 million barrels per day in 1990, we could face a reliance on OPEC of 58 million barrels per day if OCS production and nuclear power are not permitted. Obviously, the less the U.S. energy production, the greater the world's reliance on OPEC. Extreme reliance on OPEC is not sound policy because of the lack of security of this supply, an already uncertain outlook as to the availability of the quantities required without full U.S. development, and potential economic distortions if the reliance is too extreme.

Of major significance with respect to excessive reliance on foreign oil, is the burden placed on the foreign exchange position of the United States. Sudden price increases by the OPEC in 1973 increased the adverse balance of payments of the United States. The weight of economic opinion is that the sudden increase had much to do with the severe inflation of 1974. The measures taken to combat that inflation as well as the basic economic distortion induced in turn, have a great deal to do with our present economic recession and high unemployment rate. The more we are dependent on foreign oil the more we are exposed to similar and indeed more severe shocks of the same sort. Gentlemen, the need clearly exists.

DELAYING DEVELOPMENT

The second question to be considered is that of delaying development. When there is a demonstrated need for oil and gas from the Federal OCS now, when there is every indication that the resource exists, when the technology is available to develop the resource, and when industry is considering investing to find and produce the oil and gas, should development be delayed? It has been argued that oil and gas are too precious to use them for their Btu content, and that development of the Federal OCS resources should be delayed until their use can be restricted to such valued uses which are generally characterized as the production of materials (i.e., petrochemicals) as opposed to heat and other forms of energy. It has also been argued that a delay of a few years is necessary for planning purposes.

There are substantial net economic benefits to the development of OCS production. Any delay, even for a few years, cannot be made up later and will reduce those benefits in constant present dollars as well as incurring greater risk of inadequate energy supplies over a longer period of time. There is a high degree of risk involved and the potential consequences are even lower economic growth and higher unemployment than have been incorporated in this study. In evaluating the consequences, rather than isolating the analysis to one source such as the Gulf of Alaska, all challenged new sources should be combined together; the reduced domestic supply of 2 to 7 million barrels per day equivalent in 1985 and 5 to 12 million barrels per day equivalent in 1990 entails high risks amounting to \$100-\$300 billion (1975 dollars) per year of reduced GNP rising to \$250-\$600 billion per year by 1990; the related unemployment is in the millions of people, at the extreme in excess of 20 million.

As for the long term delay, the same arguments are applicable. In addition, the concept that oil is too precious to use for thermal value fails to consider the potential use of coal--our abundant energy resource--for the production of chemicals and other materials.

WAITING FOR A NATIONAL ENERGY POLICY

The third question deals with delaying development until a national energy policy has been adopted. But desirable as a national energy policy may be, it cannot alter the basic facts of energy supply and demand described earlier. Energy and economic activity are so interrelated that an energy policy literally requires an economic plan, introducing many uncertainties and extreme controversy. A complete national energy policy may never be developed. In any event, no policy or portion thereof has any chance of acceptance if it is predicated on low economic growth, high unemployment, or no increase in real disposable income. No policy can create onshore oil and gas resources that do not exist, or bring on new resources held back by legal or environmental hurdles, or make new technology and capital instantly available.

The probable elements of a national energy policy have been anticipated in the earlier analysis--conservation legislation, rising real prices for energy, and encouragement in the development of all energy resources. But a policy cannot change the alternatives to Federal OCS development--either greater reliance on oil imports or a lower economic growth rate. Delaying development until a national energy policy is available will help to defeat the potential success of such a plan, because the domestic energy supply is needed now.

CONCLUSION

Developing Federal OCS resources will result in substantial net economic benefits in itself. Additionally, this development will help to support the nation in expanding the economy and creating additional jobs for an already known increase in the labor force. The alternative is lower economic growth and greater unemployment--measured in millions.

These resources should be developed as quickly as possible, in order to arrest a continuous decline in U.S. oil and gas production and to achieve a reasonable regional balance in world oil supplies. There is no economic or energy policy justification for any delay.

STATEMENT OF

PAUL L. HORRER
INTERSEA RESEARCH CORPORATION

before the

U. S. DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT

HEARING

on

PROPOSED OIL AND GAS LEASING

on the

OUTER CONTINENTAL SHELF

NORTHERN GULF OF ALASKA

ANCHORAGE, ALASKA
AUGUST 12-13, 1975

GULF OF ALASKA OPERATORS COMMITTEE

Statement of Paul L. Horrer, Intersea Research Corporation

OFFSHORE SALE ENVIRONMENTAL HEARING
Anchorage, Alaska

My name is Paul Horrer. I am President of Intersea Research Corporation. My educational background includes a BS in Meteorology from Cal Tech and MS in Physical Oceanography from Scripps Institution of Oceanography. My work experience includes 8 years as research oceanographer at Scripps and 19 years as a consulting oceanographer. The latter includes projects in Alaska beginning with the Chevron marine terminal at Nikiski in 1959. My firm, Intersea Research, is presently conducting a two-year wave measurement program at five locations in the Gulf of Alaska. Intersea's predecessor company, Marine Advisers, Inc., carried out an extensive in-office study in 1968-70 to develop and summarize data on weather, waves and currents in the Gulf of Alaska as well as two years of wave measurements at Yakutat. Both projects were financed by groups of oil companies.

Slide 1 The purpose of my testimony is to discuss the physical marine environment of the Gulf of Alaska, particularly as this environment affects offshore petroleum operations; to describe the state of present scientific knowledge of this environment; and to indicate some future improvements to be expected in such knowledge.

Generally my testimony is in agreement with the Draft Environmental Impact Statement which presents a good description of the physical marine environment. Two exceptions involve (a) ocean currents, and (b) tsunamis. Some recent information, not included in the EIS, is available on currents. The other exception is that I disagree with the broad statements made in the EIS regarding potential damage to rigs and facilities due to tsunamis. Written comments on the EIS will be filed later.

Slide 2 Past and present measurements in the Gulf that are pertinent to this testimony include both public and industry-sponsored programs which date back to the end of the last century, beginning with weather observations from ships, as well as shore-based recording of tides and sea water temperature. Those initial programs and others are continuing, and now there are weather satellites and sophisticated wave and weather telemetering buoys.

The weather plays a governing role in dictating the nature of almost all offshore operations. The knowledge of average or frequently occurring weather conditions is an important factor in planning for efficient and safe offshore operations. Evaluations of extreme or rarely occurring conditions provide the basis for the design of structures or other facilities. And, finally, prediction of weather is an integral part of the conduct of prudent offshore operations.

Slide 3 Within the Gulf of Alaska area, wind measurement data are available at coastal stations, at Middleton Island, at two weather buoys (EB-03 and

EB-33), and from some ship reports. Such information gives a first estimate of wind conditions generally to be found within the Gulf of Alaska but does not necessarily describe all offshore locations. However, there are methods by which winds can be calculated from the synoptic weather charts

Slide 4 of historical data published by the Weather Bureau. In 1967, the petroleum industry organized and supported an environmental study of the Gulf of Alaska costing $1,200,000 and requiring thirty months of effort. The prime contractor for this effort was my consulting firm, Marine Advisers, Inc. The Marine Advisers' project included wind calculations from weather maps, technically known as wind hindcasts, for twenty locations in the Gulf of

Slide 5 Alaska. An example result of this study is summarized in this slide which portrays the monthly variation of wind conditions throughout the year at one location. For example, this indicates that during the month of January winds greater than 24 knots could be expected to occur 25 percent of the time.

Slide 6 More detail is available in information about the directions of winds, presented in this slide as a typical "wind rose" at an information site. For example, this diagram indicates that winds from the east-southeast, at speeds between 11 and 21 knots, occur approximately 10 percent of the time.

Slide 7 In addition, the examination of wind information permits evaluations of the extreme events to be expected. As in all evaluations of extreme events, one must view the information in a probabilistic manner. Annual extreme winds have different sorts of probability distributions than do typical winds. A series of observed annual maximum events is fitted to one of these theoretical distribution functions and the speed occurring once per century on the average can then be determined. This slide indicates that at a typical offshore location in the Gulf of Alaska, one should expect wind gusts of 100 knots to occur on the average once every five years.

It is important to note that, in general, winds are not directly the most important parameter which influence offshore structures or operations. Instead, it is the waves generated by the winds which constitute the most important phenomenon. Winds determined from the historical synoptic weather maps may also be used to evaluate waves occurring during past history. Such historical wave evaluations, or wave hindcasts, were also a part of the industry-supported Gulf of Alaska project begun in 1967.

Slide 8

Wave calculations were verified against wave measurements, also made as a part of the project. This slide indicates the seasonal variation of normal waves at a typical station in the Gulf of Alaska. These results, for example, indicate during the month of January, sea states with significant waves higher than 12 feet should be expected to occur 25 percent of the time. Significant wave height is a technical term but one whose numerical value corresponds closely to the subjective visual impression of wave height reported by a trained observer.

Slide 9

Information on the occurrence of extreme wave events is depicted in the next slide. This indicates that a wave 95 feet high should occur, on the average, once every 100 years.

Refinement of these wave data will be accomplished, if needed, by means of the wave measurements and hindcast evaluation being performed

Slide 10

now by Intersea for a group of oil companies. "Waverider" buoys, which measure sea surface elevation fluctuations by means of a specialized accelerometer, telemeter data to shore while also analyzing and recording results on a cassette tape within the buoy. Fifteen of these were installed in five clusters of three each, for redundancy, in August and

Slide 11

September 1974. Wave data is received and recorded ashore from the Waveriders at Sitkinak Island, Middleton Island and Yakutat. Wind and other weather data are recorded ashore at these three locations. It is planned to continue this program into 1976.

The Gulf of Alaska has earned a reputation as being a stormy area of the world. However, this area is not markedly different from other areas in which the offshore petroleum industry has successfully conducted operations. The indicated extreme winds of the Gulf of Alaska are substantially less than those associated with Gulf of Mexico tropical hurricanes, and the persistence of storm winds in the Gulf of Alaska does not appear to suggest more severe conditions than encountered in the Norwegian North Sea. In both of these mentioned areas, the petroleum industry now operates successfully. The industry also copes with stormy

Slide 12

sea conditions in other areas, as well. An evaluation of various areas of the world has been made on the basis of ship reports of wave heights. This survey comparison is presented on the next slide. It is to be recognized that ship reports of wave heights reflect certain biases on the part of observers on ships with different characteristics. Nevertheless, the trends are significant in indicating that the Gulf of Alaska is not more stormy than other areas in which offshore petroleum operations have been conducted. In terms of extremes, it is worthwhile to note that the drilling vessel SEDCO 135F experienced a wave reported to be 95 feet high in drilling off Vancouver

(Petroleum Engineer, March 1969) without evidence of threat to the structural integrity or safety of the unit. Moreover, the industry has designed platforms for very large waves, and these have been utilized in the North Sea.

One familiar with the sea will recognize, of course, that conditions of wind and waves are also accompanied by various types of ocean currents. On the continental shelf, away from constricted bays, currents are not generally, however, a major factor in offshore design or routine operations. They are, nevertheless, considered in structural design and must be accounted for in any oil spill containment and cleanup contingency plan. The previously-described industry-sponsored study determined both normal current and extreme

Slide 13 conditions of current to be expected in the Gulf of Alaska. Such information is included in this slide which depicts the occurrence of normal types of current. This, for example, indicates that current velocities which exceed

Slide 14 one knot should generally be anticipated 25 percent of the time. Estimated extreme current values are shown in the next slide, where surface currents are evaluated for a typical location to be as much as 4 knots. The values for current indicated in these slides do not differ from currents found in many other areas of the world such as the North Sea or the Grand Banks area, and they are not as severe as currents in Cook Inlet.

Slide 15 Direct measurements of currents with recording current meters were carried out in the Gulf of Alaska in 1974 by Bolt, Beranek & Newman, and Intersea at seven locations and by the National Ocean Survey at three locations. Analysis of these data will permit further refinement of the Marine Advisers' study of currents.

As with traditional maritime activity, the drilling of offshore oil wells, especially exploratory wells, must be carried out with one eye on the weather. This means that weather forecasts are important. One oil company organized a trial forecasting effort, with emphasis upon those weather conditions which might, for example, call for shut down of an exploratory drilling operation.

Over a trial period of three months, routine forecasts were made for an area off Yakutat by a marine forecasting consulting firm. Particular attention was devoted to the forecast of sea states. Concurrently with the forecasting, waves were measured in the forecast area using a Waverider. Comparison of forecast and measured conditions of seas provides a measure of forecast reliability. From such comparisons the following conclusions have been established.

1. Most important, there occurred no storm conditions which were not forecast.

2. There were only a few "false alarm" forecast storms, which failed to materialize.

While experienced judgment indicates that present Gulf of Alaska forecasting is adequate for offshore operations, improvements are desirable and to be expected. A group of oil companies is considering a new year-long forecasting program using a computer-based wave model to gain practice in this science before exploratory drilling is initiated. Special forecasting generally improves rapidly with experience gained in actual operations. For the Gulf of Alaska, one may expect that this normal evolution of improvement will be augmented through expansion of the input data base by additional oceanographic buoys to be deployed by the National Oceanographic and Atmospheric Administration. One such buoy is now in operation off Kodiak, and another is off Yakutat, as shown in an earlier slide.

Slide 16 In addition to knowledge of winds, waves and currents, the offshore industry also requires estimates of the total water level rise and, especially, estimates of the probability that various design water level elevations will occur. Besides waves and the infrequent earthquake-produced tsunami, the components of raised sea surface elevations are astronomical tide and storm surge. Tides in the Gulf of Alaska are of the mixed type, containing both diurnal and semi-diurnal components. In the northeast part of the Gulf of Alaska, extreme tides range from -3 to +15 feet relative to the Mean Lower Low Water reference datum.

Storm surge is the increase in sea-surface elevation due to low barometric pressure and to wind tide. In the Marine Advisers' study, storm surge was calculated for the most severe storms of record. Depending on location and water depth, the 100-year storm may raise the water level by one to five or six feet. The 100-year combined astronomical and storm tide is on the order of 20 feet above mean lower low water or 15 feet above mean sea level. This is considerably less than in Cook Inlet.

Slide 17 Good documentation now exists on tsunami run-up elevation in harbors and bays, and thus shore facilities can be constructed at safe elevations. In the open Gulf, although the tsunami is higher at places than the tides, it is much lower than the maximum storm wave. For example, in the Good Friday 1964 earthquake, it has been calculated by numerical modeling that the water elevations about 50 miles west of the proposed lease area reached a maximum of 30 feet, five minutes after initial ground motion. In the open Gulf, the tsunami was not a bore nor was it steep like a wind wave, but rather the water level rose gradually to its maximum elevation.

Slide 18 In the CEQ report the potential damage to underwater oil storage systems on the open coast due to tsunamis was assessed improperly. In order to place it into proper perspective, it is useful to compare the tsunami with storm waves. Drag and inertial forces on a hypothetical storage vessel due to a tsunami will be much smaller than those due to the maximum storm wave for which the industry is confident it can safely design.

For example, a tsunami raising the water level 30 feet in 5 minutes at a location where the water depth is 200 feet would produce water horizontal acceleration and velocity maxima of 0.15 ft/sec^2 and 7 ft/sec. By comparison, the maxima for a storm wave 90 feet high with a 16 second period would be 8 ft/sec^2 and 20 ft/sec at the surface decreasing to 4 ft/sec^2 and 10 ft/sec at the bottom.

Buoyancy forces due to a tsunami will be comparable to those due to the design storm wave. Of course, buoyancy forces matter only for an underwater storage tank which has large volume above the still water level. A storm wave 90 feet high with 16 seconds period in 200 feet water depth would raise the water level an average of 44 feet along a 300-foot wide structure; the hydrodynamic attenuation reduces this to 25 feet differential water pressure at the sea floor. That compares with 30 feet calculated water level rise due to the 1964 tsunami in the open Gulf.

The offshore petroleum industry generally expends substantial effort in understanding the physical marine environment where offshore operations are conducted. It is to be noted that much of the detailed information is obtained to meet expanding needs as development proceeds. Specific design information, required for design of producing facilities, is most effectively gathered in the course of early exploratory phases. From the foregoing, it is quite clear that the industry has already completed the required preliminary assessment of the physical marine environment of the Gulf of Alaska. Although more complete and detailed knowledge will be gained as offshore activity in the area increases, I am confident that sufficient knowledge is already available to permit operations to be conducted with safety to the environment and to personnel.

GULF OF ALASKA

MARINE PHYSICAL ENVIRONMENT

PRESENT KNOWLEDGE

FUTURE IMPROVEMENT

SLIDE 1

METEOROLOGICAL AND PHYSICAL OCEANOGRAPHIC MEASUREMENTS

BY SHIPS OF OPPORTUNITY
- WEATHER
- SHIP'S DRIFT

BY OCEANOGRAPHIC SHIPS
- SEA WATER DENSITY
- CURRENTS

AT AIRSTRIPS, LIGHTHOUSES AND HARBORS
- WEATHER
- TIDE
- SEA TEMPERATURE

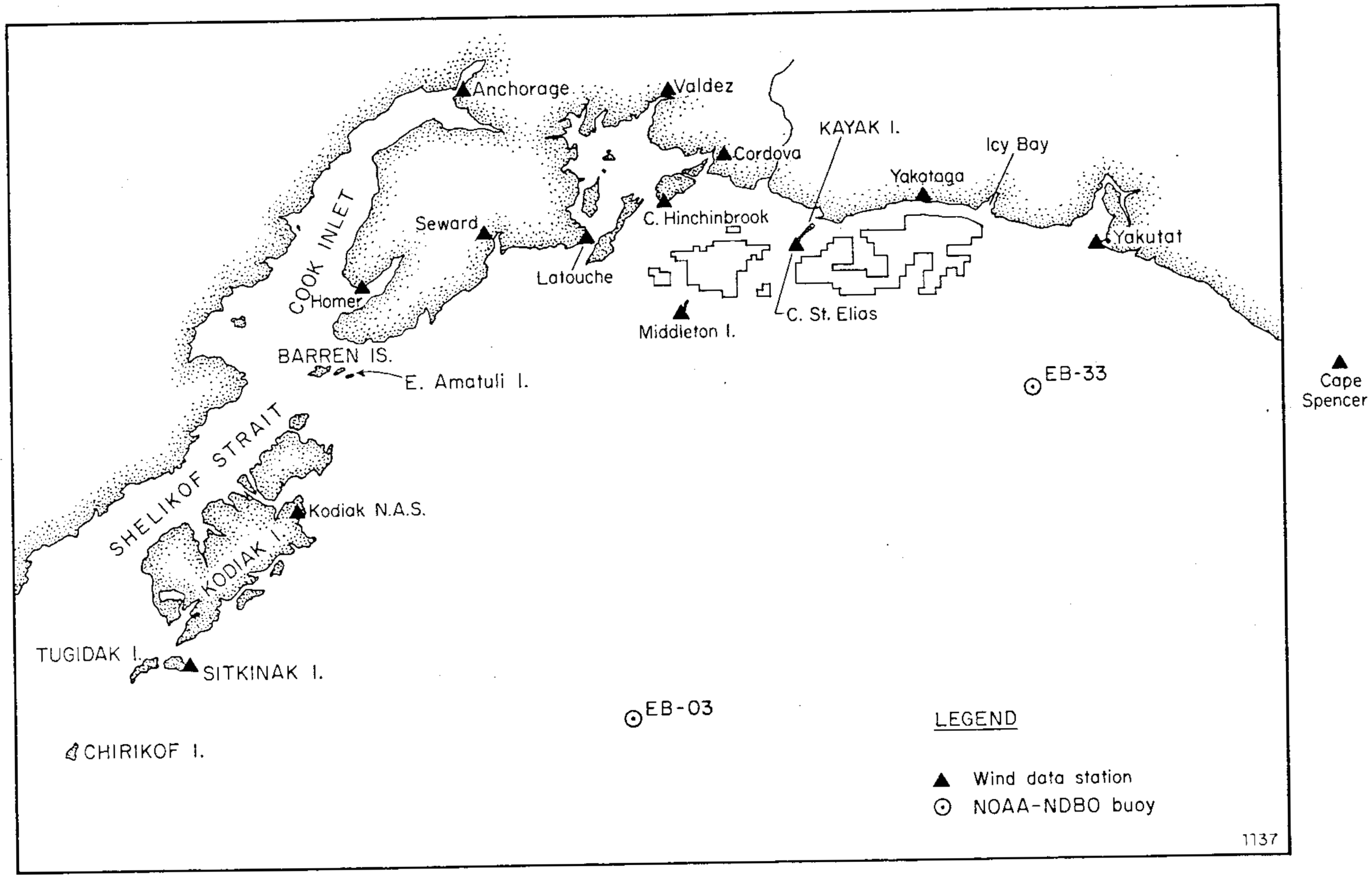
BY INSTRUMENT BUOY SYSTEMS
- WIND, AIR AND WATER TEMPERATURES, BAROMETER
- WAVES
- CURRENTS

BY UNDERWATER SENSOR CABLED TO SHORE RECORDER
- WAVES
- TSUNAMIS

BY SATELLITES
- CLOUD COVER
- SEA TEMPERATURE

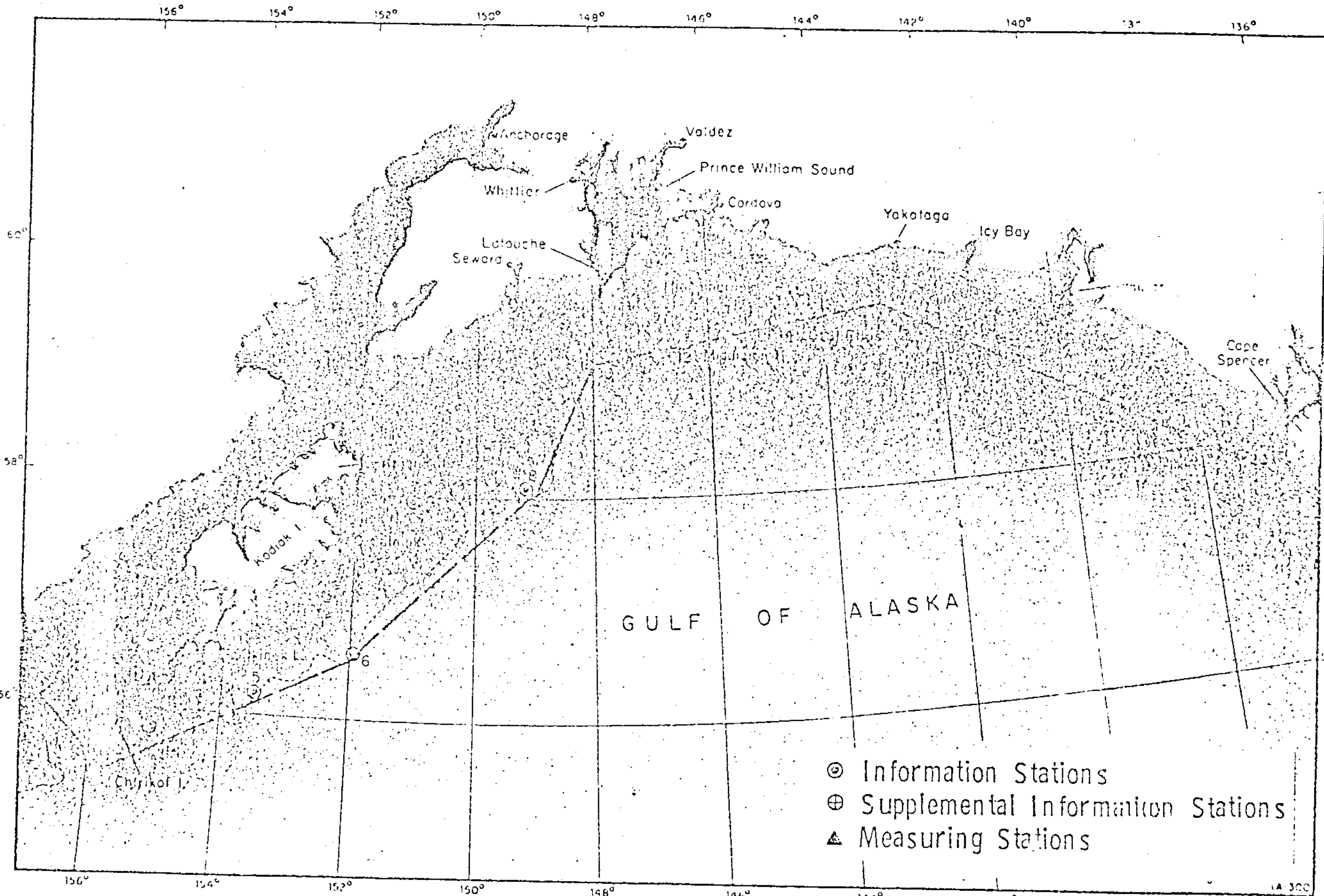
SLIDE 2

WIND DATA STATIONS



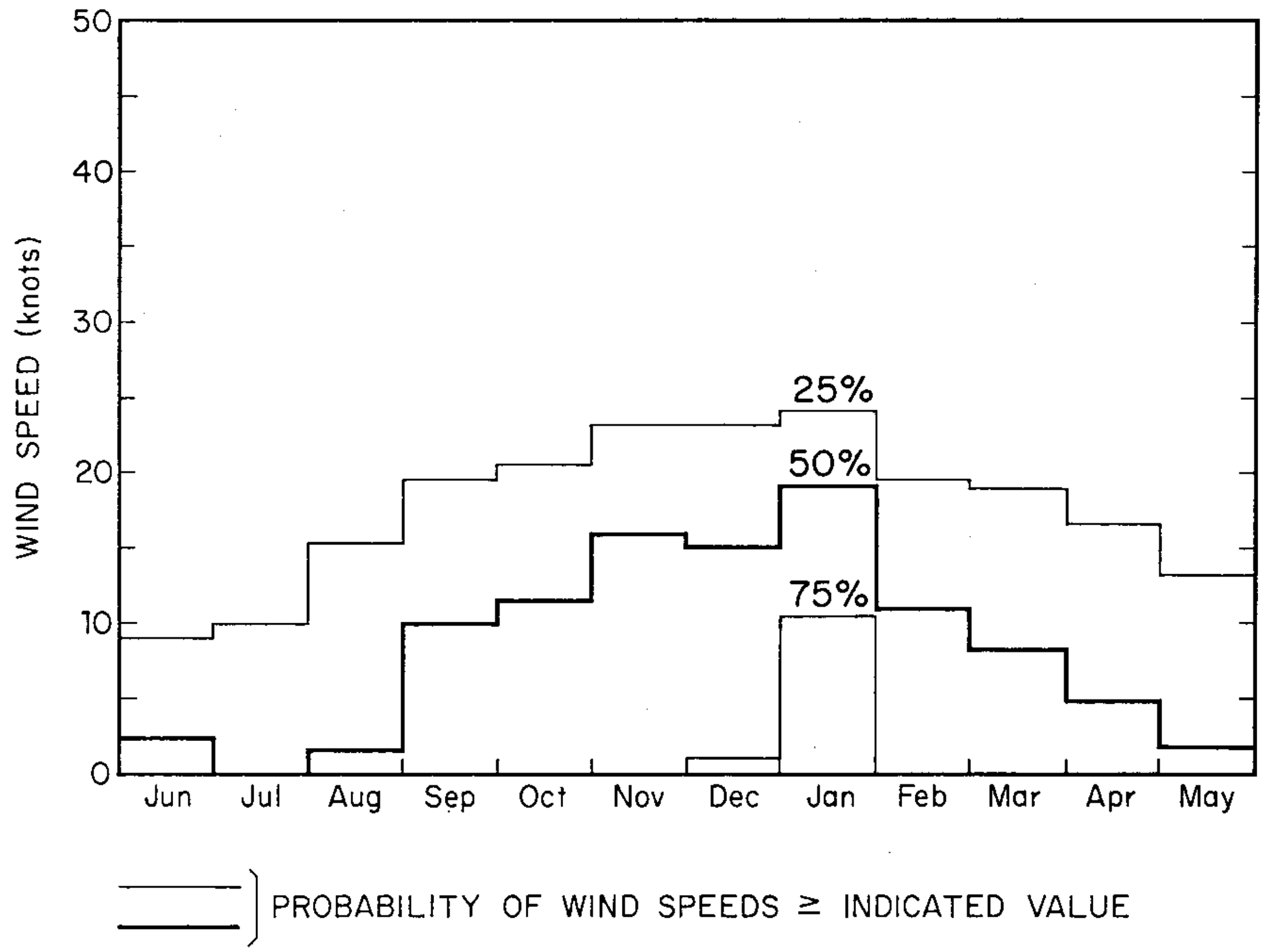
SLIDE 3

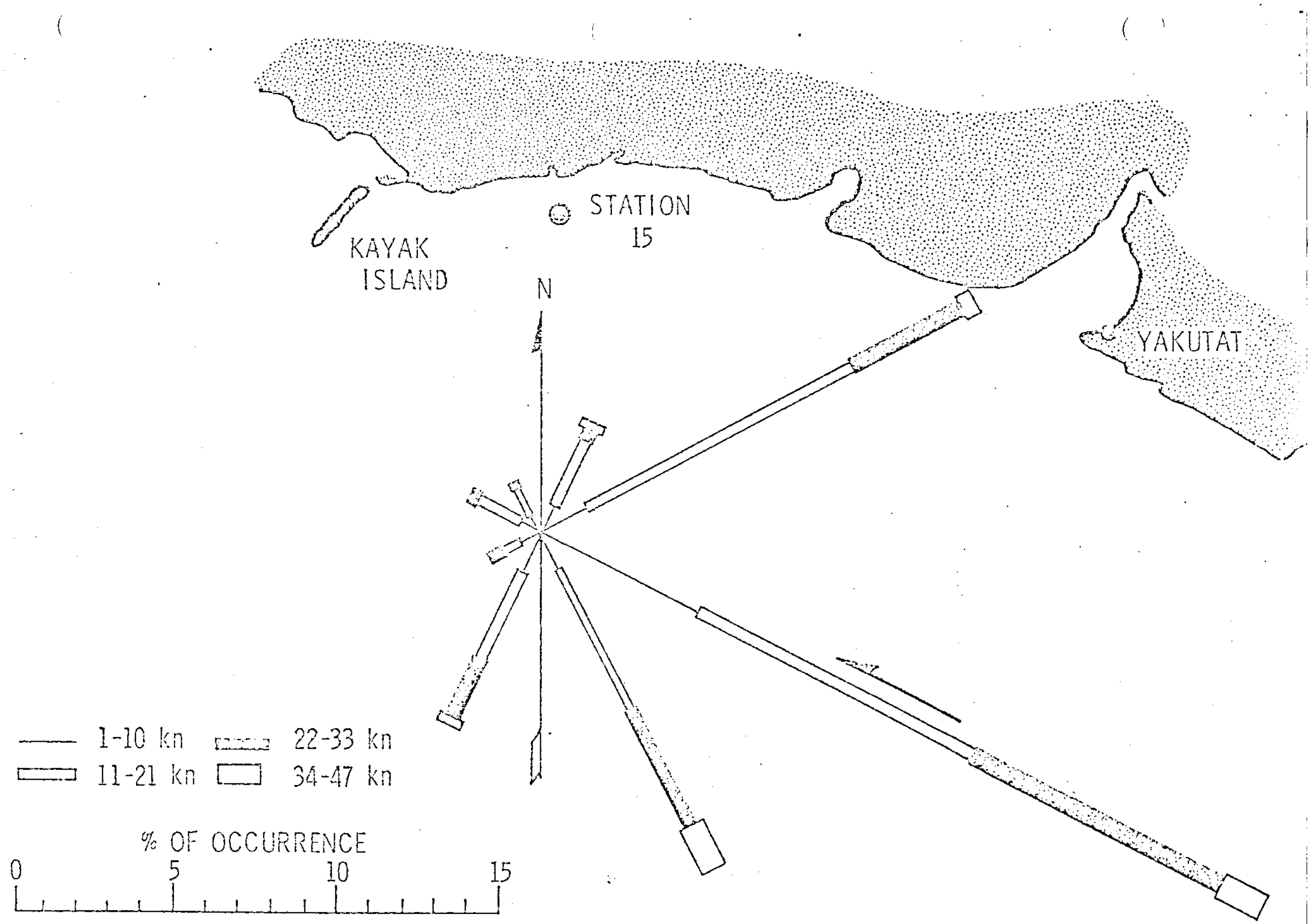
LOCATION MAP FOR STUDY AREA AND VICINITY



SLIDE 4

MONTHLY VARIATION OF WIND SPEEDS

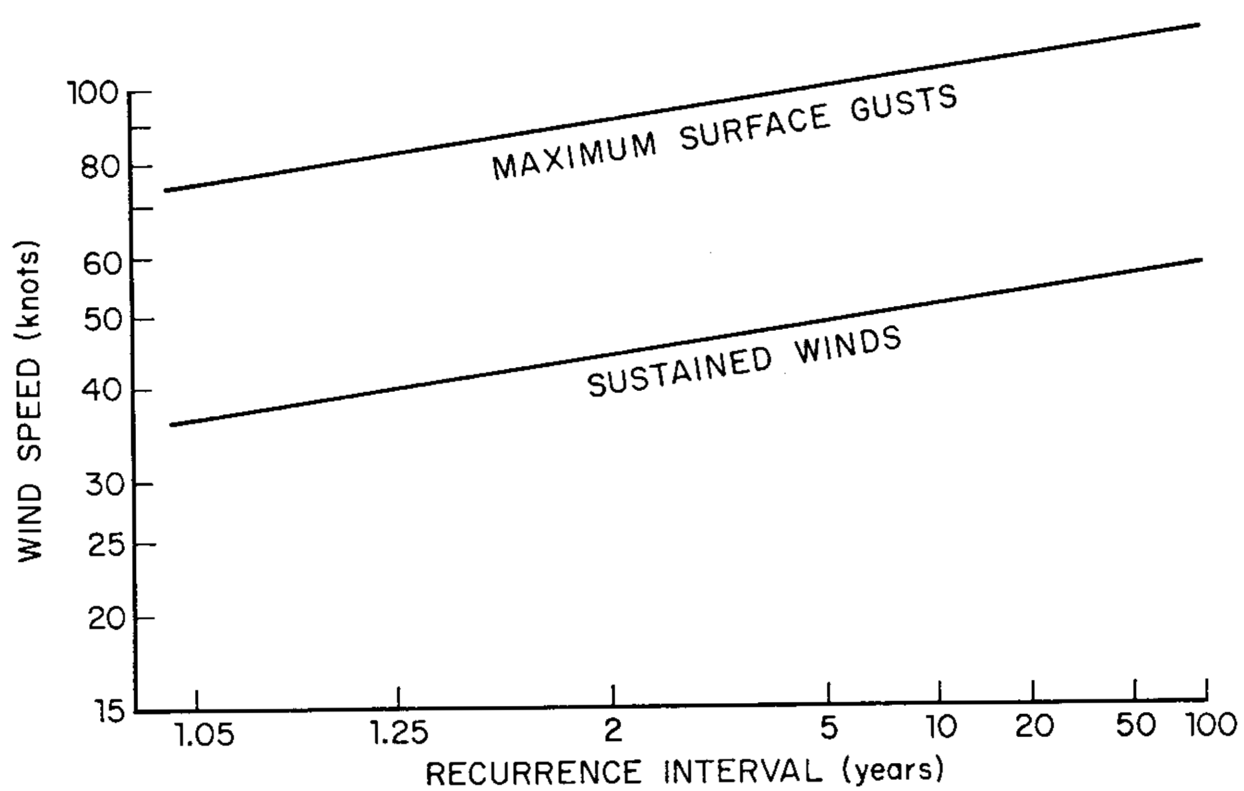




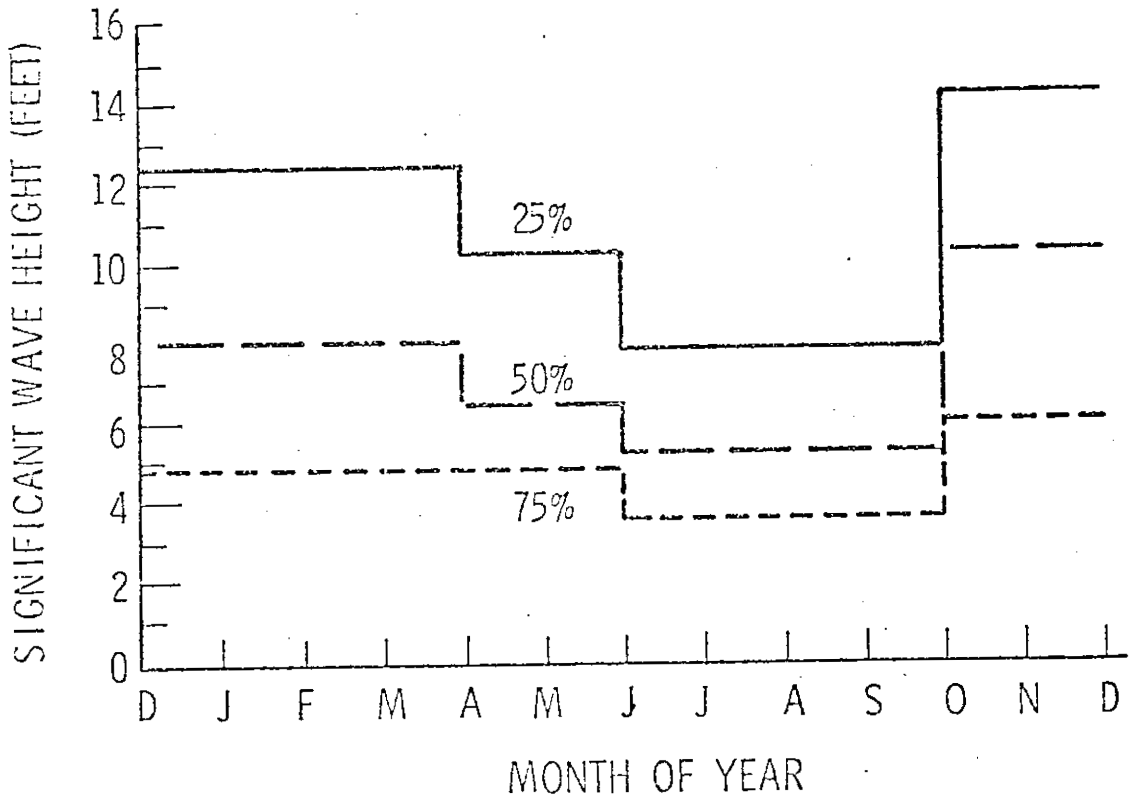
WIND DISTRIBUTION AT STATION 15 IN WINTER

SLIDE 6

RECURRENCE INTERVAL OF WINDS



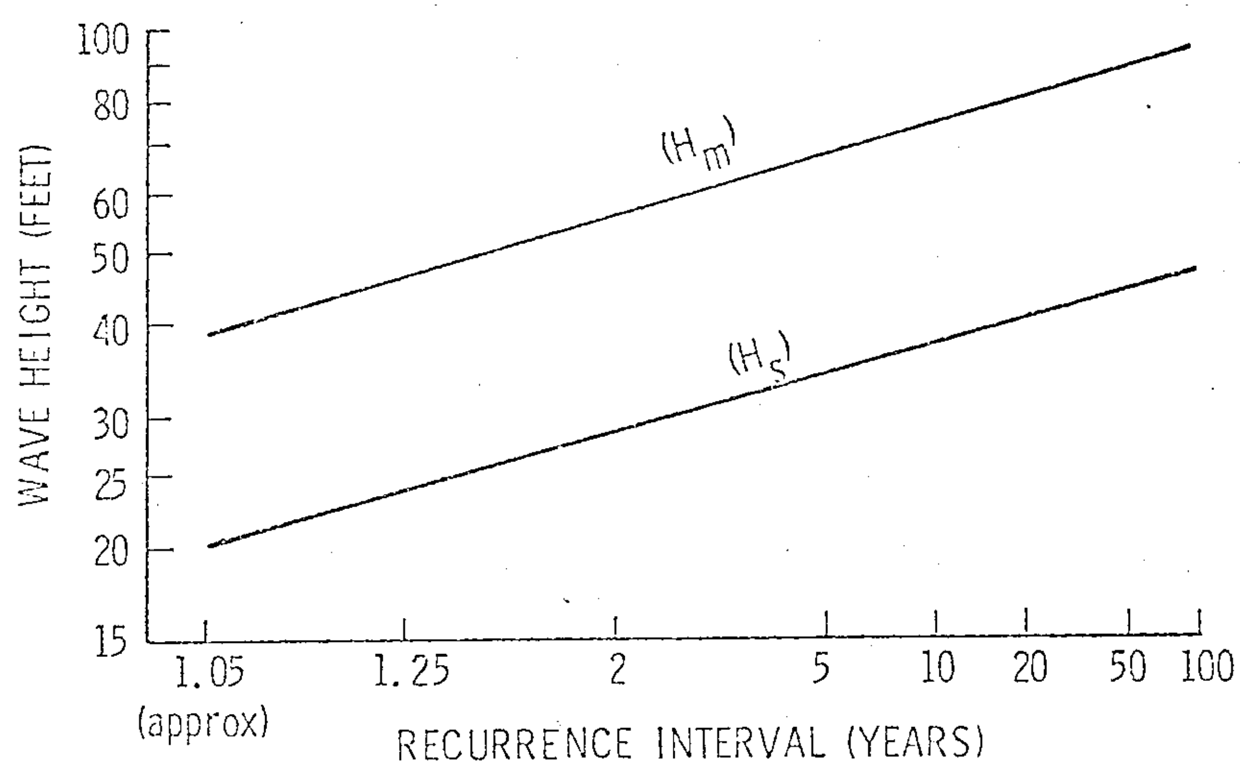
SEASONAL VARIATION OF WAVE HEIGHTS



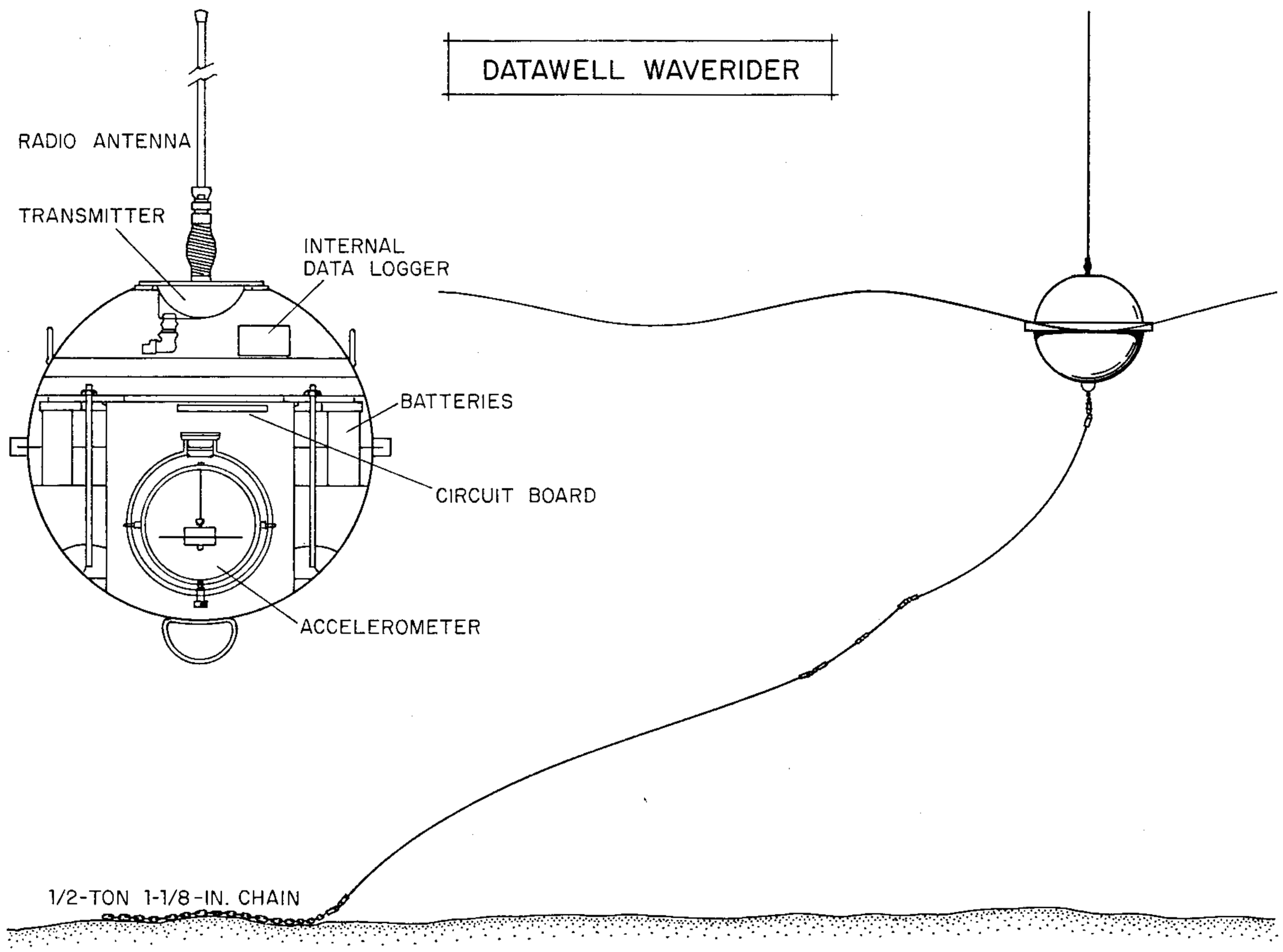
PROBABILITY OF WAVE HEIGHTS INDICATED VALUE

SLIDE 8

RECURRENCE INTERVAL OF SIGNIFICANT WAVE HEIGHT (H_s) AND MAXIMUM WAVE HEIGHT (H_m)

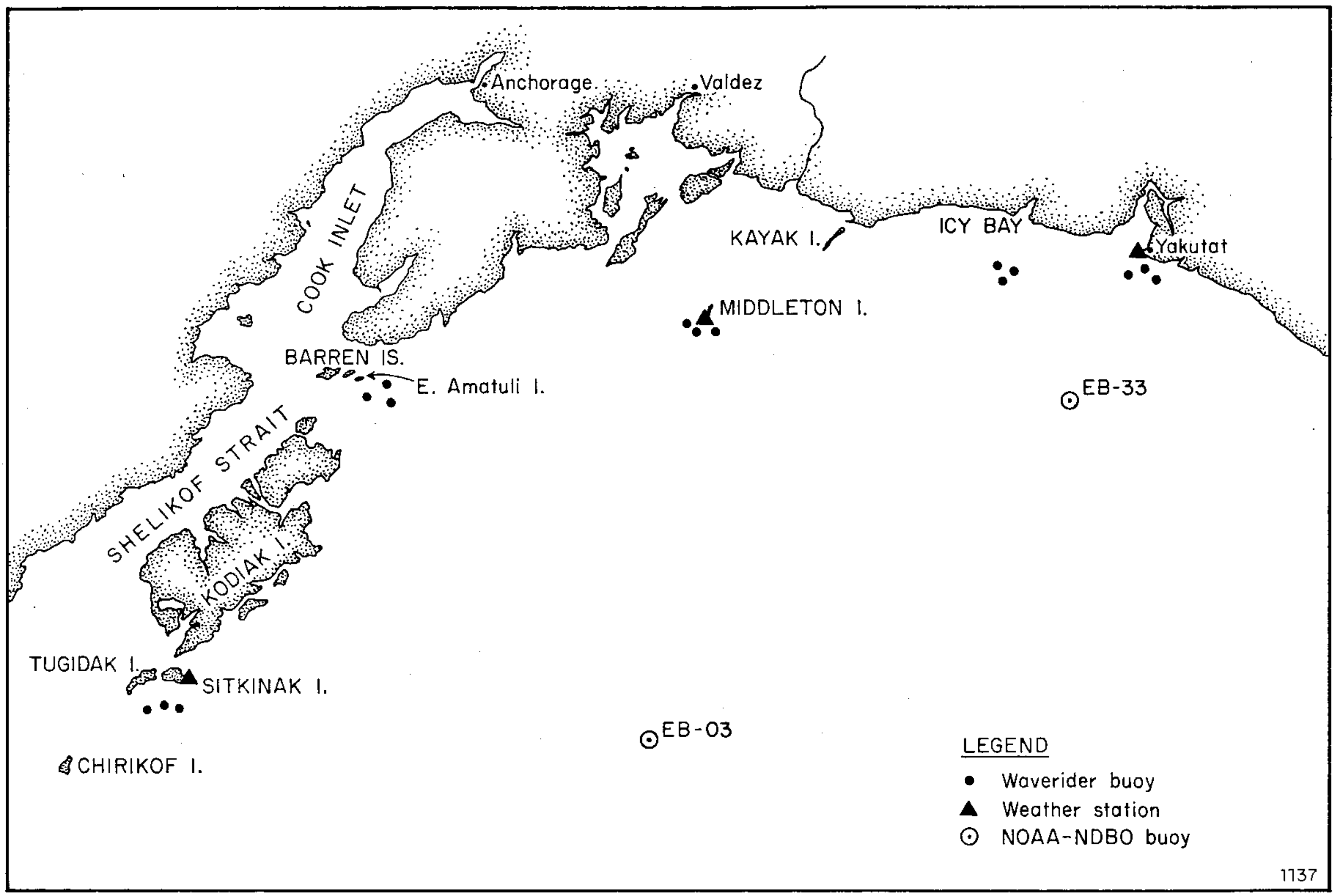


SLIDE


DATAWELL WAVERIDER
RADIO ANTENNA
TRANSMITTER
INTERNAL
DATA LOGGER
BATTERIES
CIRCUIT BOARD
ACCELEROMETER
1/2-TON 1-1/8-IN. CHAIN

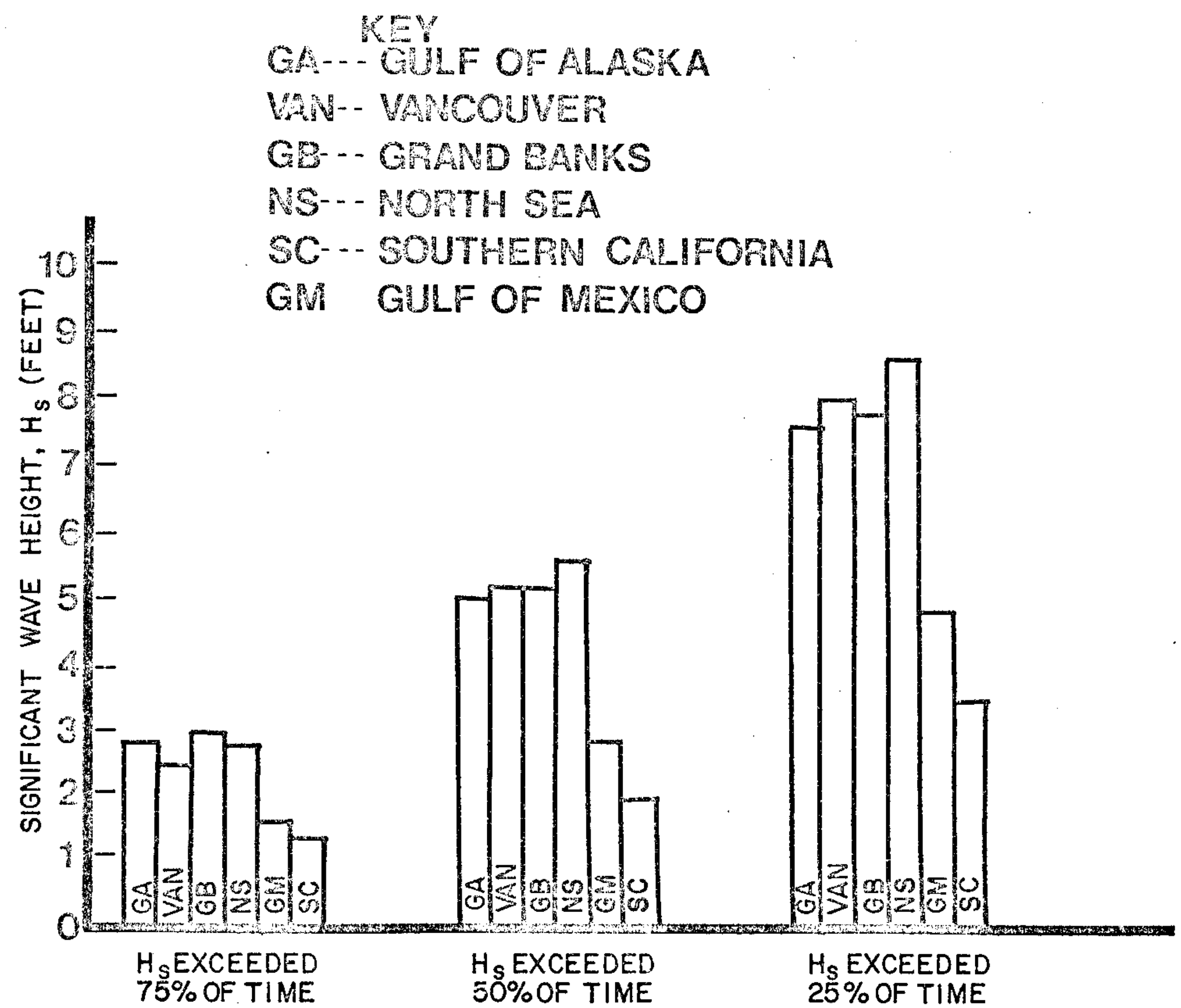
SLIDE 10

GULF OF ALASKA
WAVE AND WIND MEASUREMENT PROGRAM

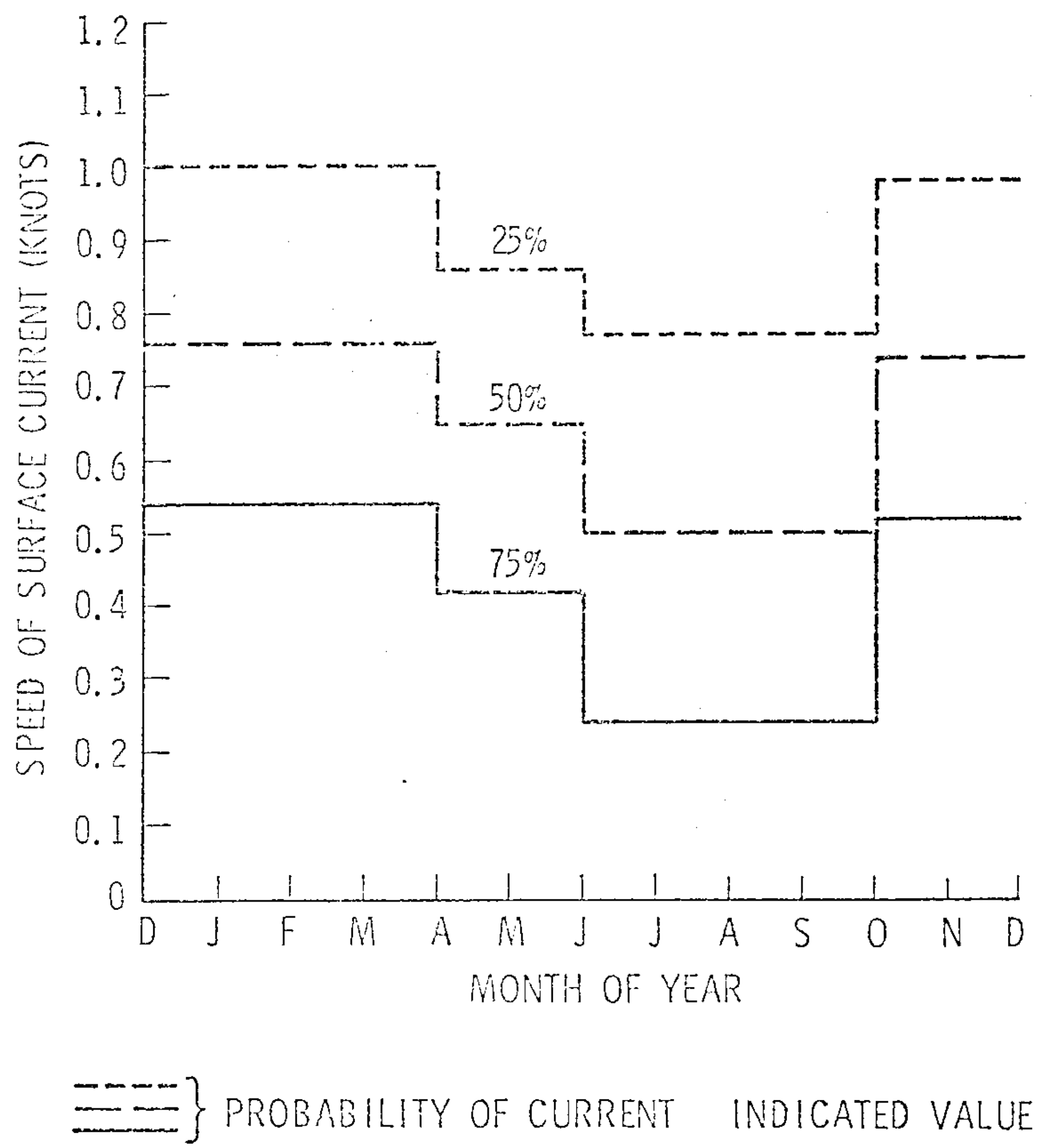


SLIDE 11

COMPARISON OF WAVE HEIGHTS IN VARIOUS OPERATING LOCATIONS

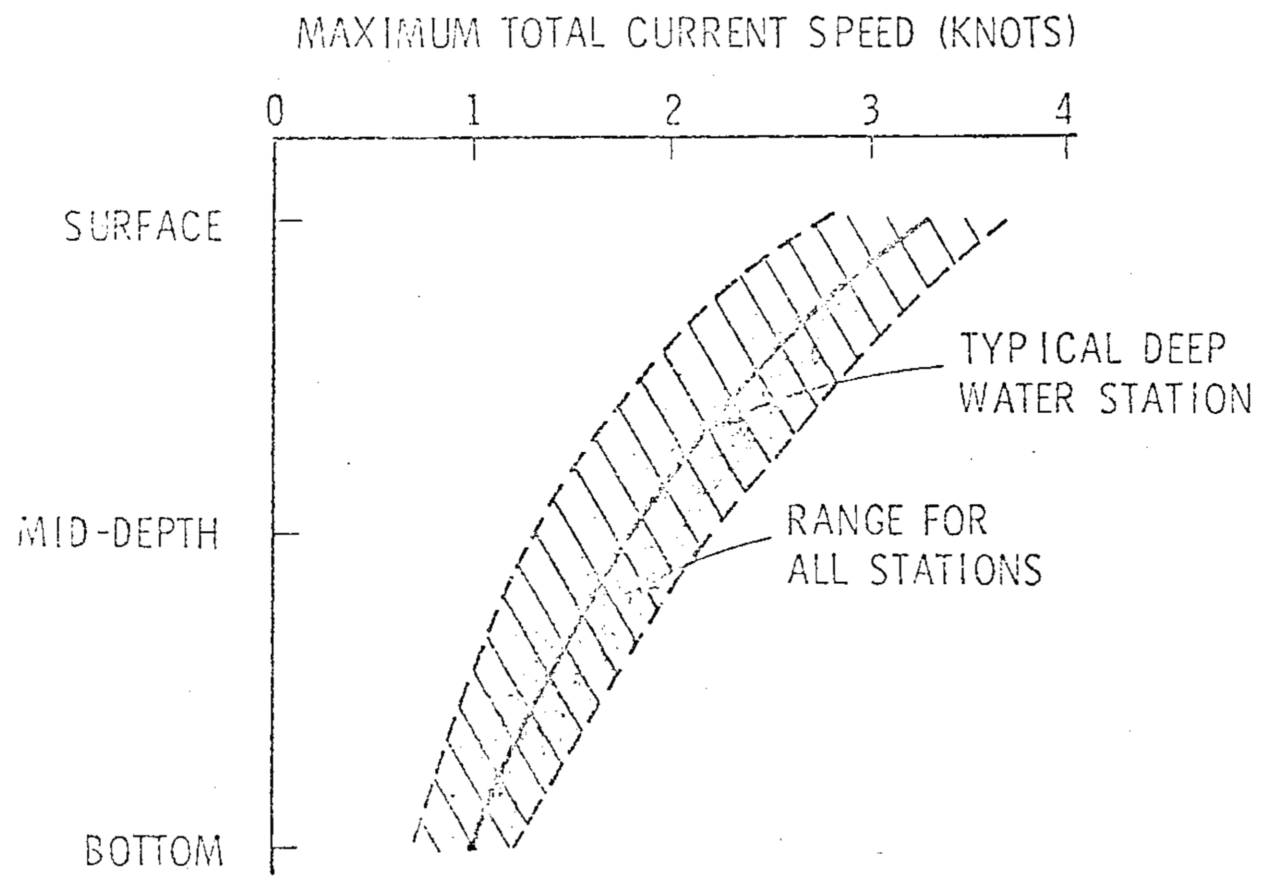


SEASONAL VARIATION OF SURFACE CURRENT SPEEDS

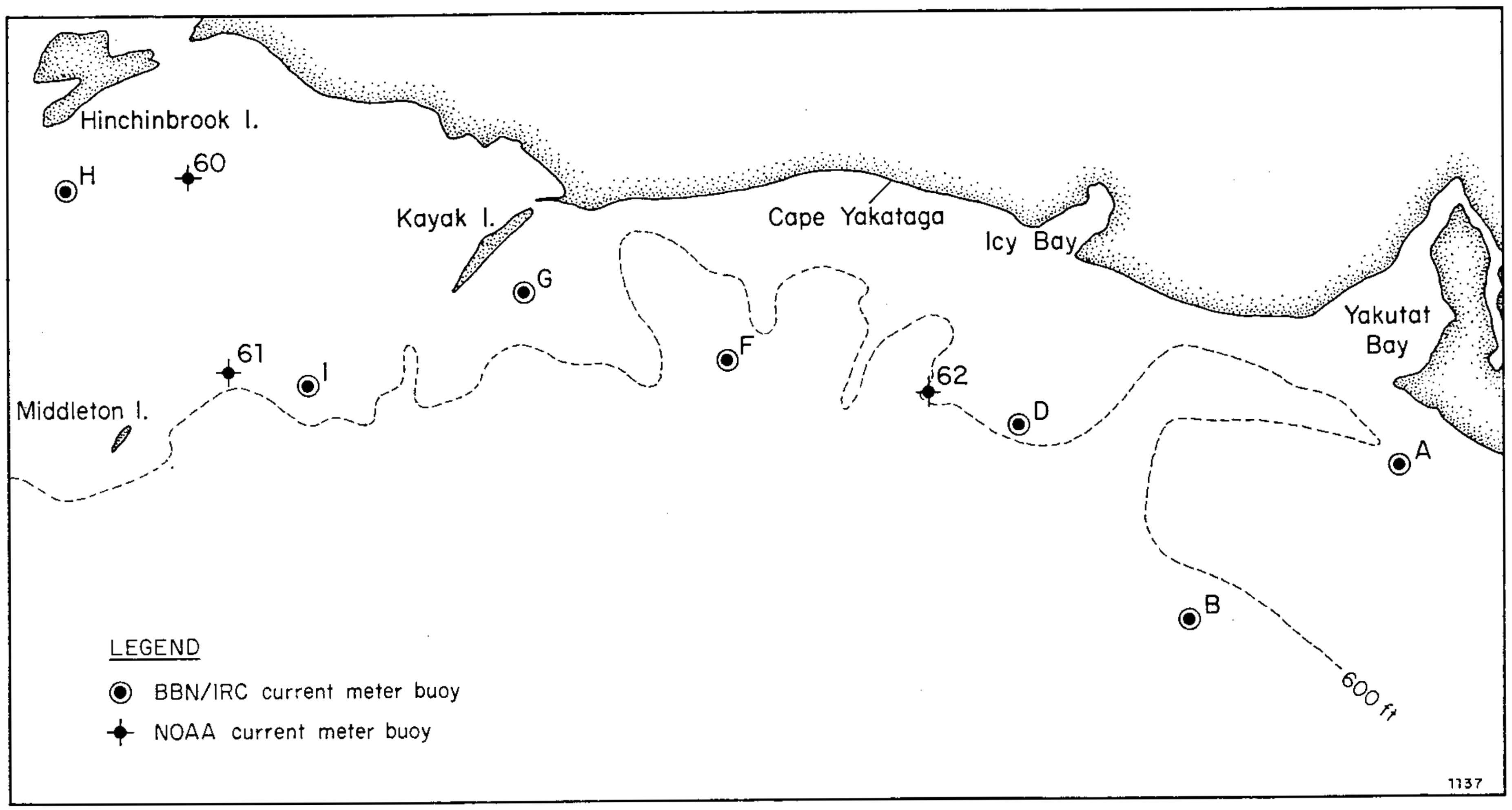


SLIDE 1?

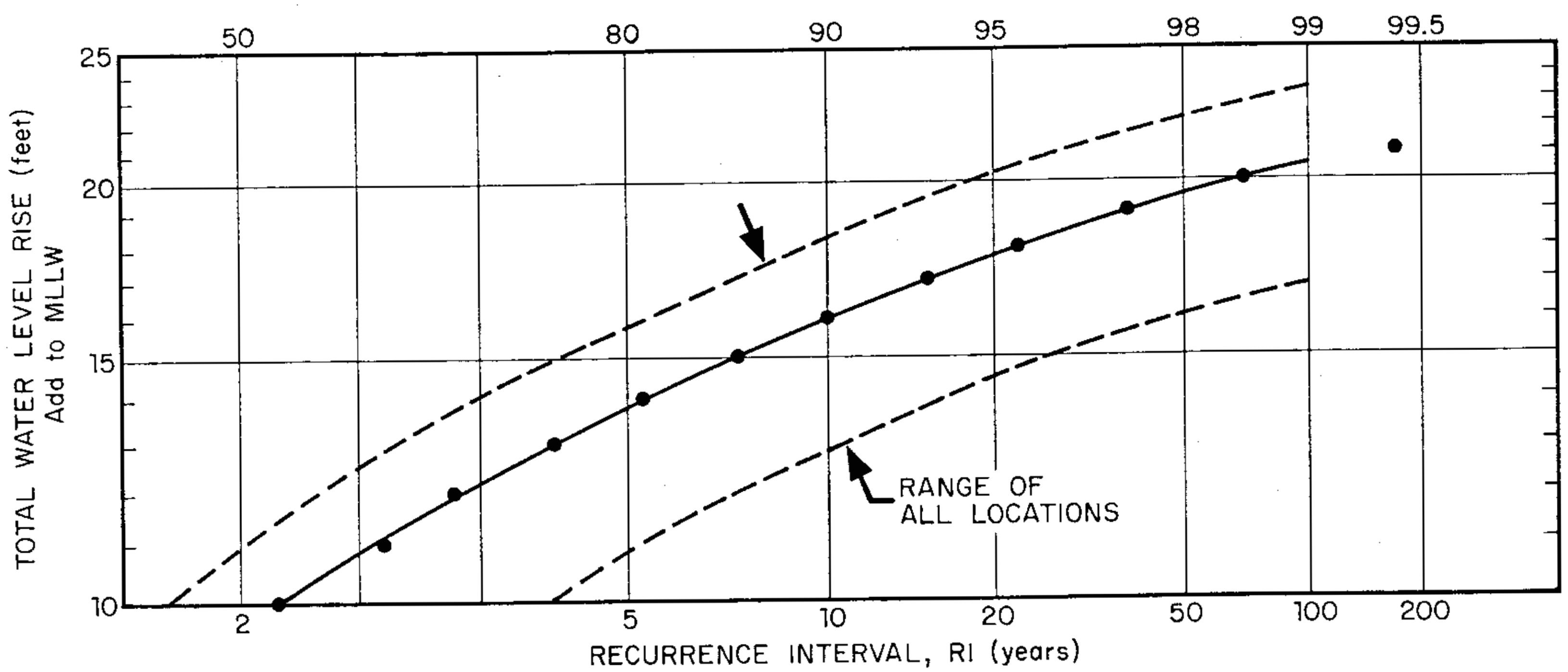
MAXIMUM TOTAL CURRENT SPEED



GULF OF ALASKA
CURRENT METER MEASUREMENTS

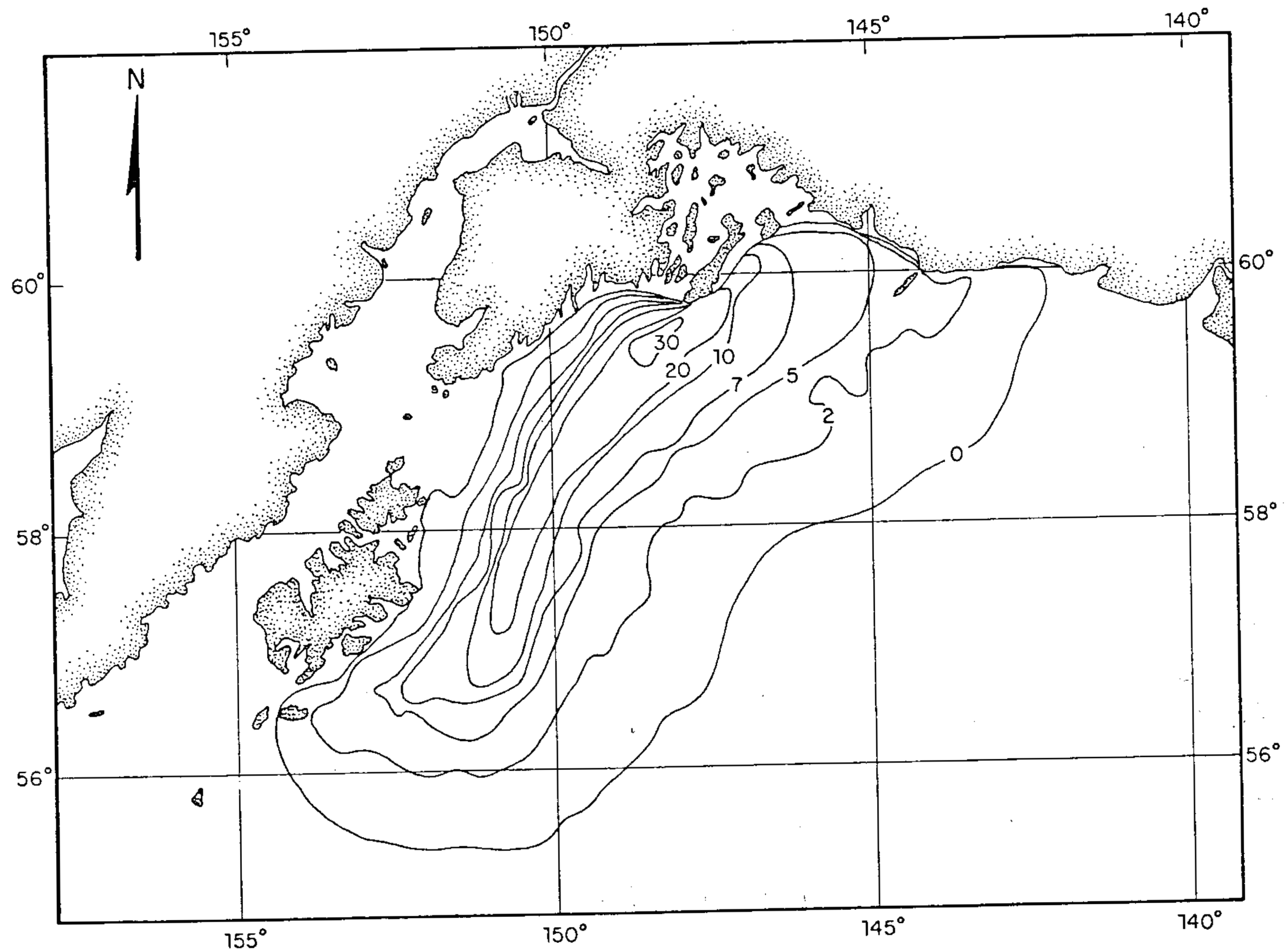


COMBINED WATER LEVEL ELEVATION DUE TO ASTRONOMICAL & STORM TIDE

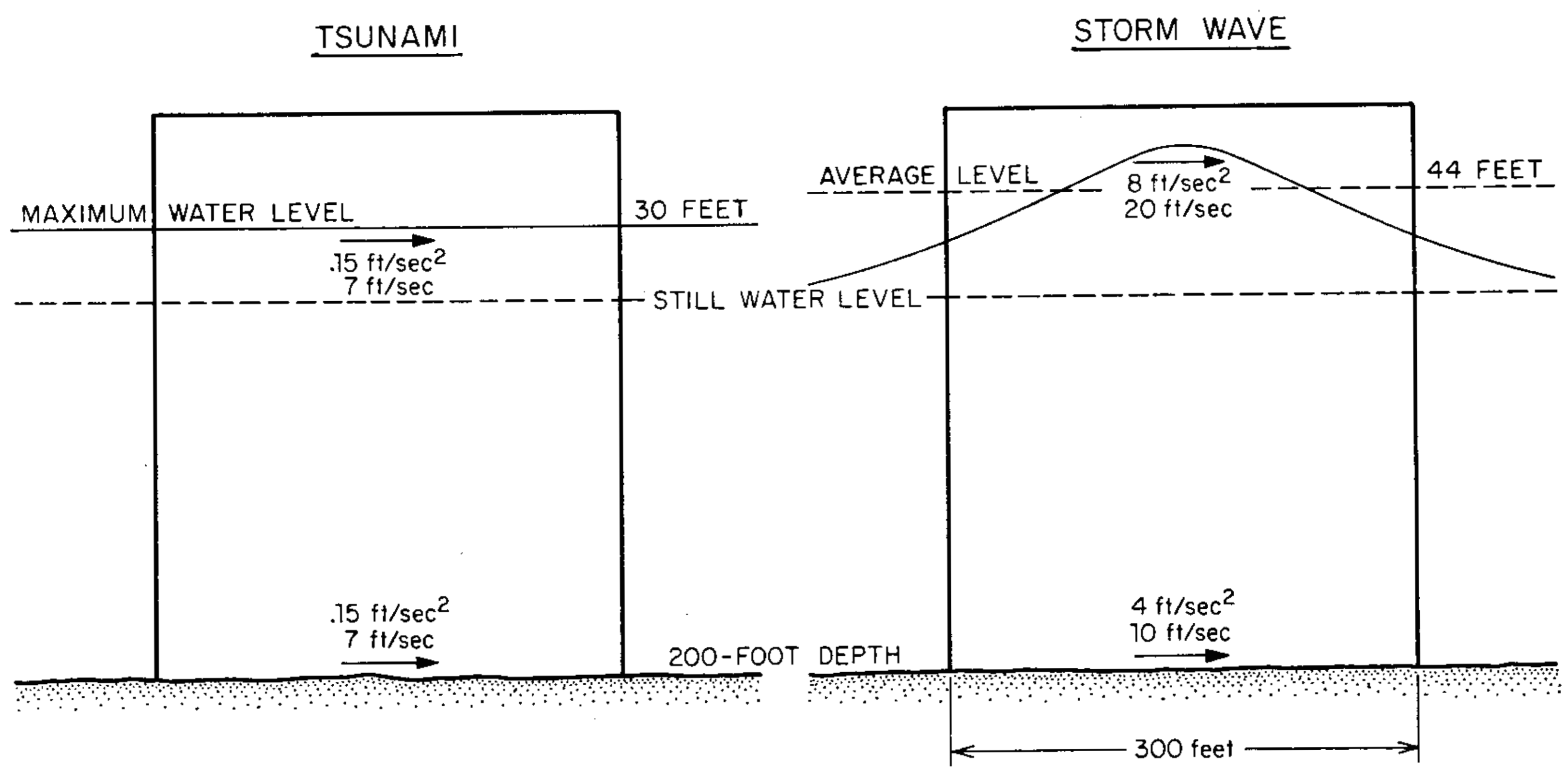


SLIDE 16
1137

COMPUTED MAXIMUM 1964
TSUNAMI ELEVATION (feet)



COMPARISON OF TSUNAMI AND STORM WAVE



Statement of

John H. McKeever
Amoco Production Company

Before the

U. S. Department of the Interior
Bureau of Land Management

Hearing on

PROPOSED OIL AND GAS LEASING
ON THE
OUTER CONTINENTAL SHELF
NORTHERN GULF OF ALASKA

Anchorage, Alaska
August 12-13, 1975

GULF OF ALASKA
SEA FLOOR

GOOD MORNING. MY NAME IS JOHN MCKEEVER. I AM A STAFF GEOLOGIST AND EXPLORATION REPRESENTATIVE IN ALASKA FOR AMOCO PRODUCTION COMPANY AND HAVE BEEN EMPLOYED IN THAT CAPACITY, RESIDENT IN ALASKA, FOR NINE YEARS. DURING THAT TIME I HAVE BEEN CONCERNED, ON BEHALF OF MY COMPANY, WITH FIELD WORK, WITH GEOPHYSICAL WORK, AND WITH BOTTOM SAMPLING IN THE GULF OF ALASKA. I HAVE REVIEWED THE DRAFT ENVIRONMENTAL STATEMENT. IN PREPARING THE FINAL ENVIRONMENTAL STATEMENT, I BELIEVE YOU SHOULD BE AWARE THAT THE OIL AND GAS INDUSTRY, AND OTHERS, HAVE ACQUIRED A VERY GREAT DEAL OF INFORMATION ABOUT THE SEA FLOOR IN THE GULF OF ALASKA, AND THAT CONSIDERABLE TECHNOLOGY TO INTERPRET THIS INFORMATION WITH RESPECT TO ENVIRONMENTAL CONCERNS EXISTS.

WE DO NOT SUGGEST THAT THE GULF OF ALASKA SEA FLOOR IS FREE FROM PROBLEM AREAS. WE DO, HOWEVER, FIRMLY BELIEVE THAT INDUSTRY HAS THE INFORMATION AND THE KNOWLEDGE TO IDENTIFY THESE AREAS AND THAT OUR OPERATIONS CAN BE CONDUCTED WITH COMPLETE ENVIRONMENTAL SAFETY.

IN GEOLOGY, AS IN HISTORY, ONE OF THE MOST BASIC PRINCIPLES IS THAT THE PAST IS A KEY TO PREDICTING THE FUTURE. FORTUNATELY, THERE IS A RECORD OF IMPORTANT PAST EVENTS IN THE GULF OF ALASKA TO AID US IN JUDGING THE SAFETY OF FUTURE OPERATIONS. THIS RECORD IS ENSCRIBED IN THE GEOLOGY OF THE GULF OF ALASKA. IT IS WRITTEN IN THE ROCKS EXPOSED ALONG THE SHORE, AND MORE GERMANE TO OUR PRESENT CONCERNS, IT IS WRITTEN IN THE SEDIMENTS UNDERLYING THE WATERS OF THE GULF OF ALASKA.

IN THE NEXT FEW MINUTES I WILL SHOW YOU HOW WE READ THE HISTORY WRITTEN IN THE ROCKS OF THE SEA FLOOR AND HOW WE CAN THEN ANSWER QUESTIONS ABOUT THE GULF OF ALASKA'S SEA FLOOR STABILITY IN RELATION TO LARGE EARTHQUAKES, STORM WAVES, TIDAL AND STORM CURRENTS, AND NATURAL OIL AND GAS SEEPS. BEFORE GETTING INTO THE TECHNICAL DETAILS OF HOW WE READ THE HISTORY OF THE ROCKS, LET'S REVIEW FOR A MOMENT WHAT WE ALREADY KNOW ABOUT THE GULF OF ALASKA. WE KNOW THERE ARE OIL AND GAS SEEPS IN THE AREA. WE KNOW THAT THE GULF IS SUBJECT TO LARGE WAVES AND SEVERE STORMS, AND THAT THESE HAVE OCCURRED FOR MANY YEARS. WE ALSO KNOW THAT WITHIN RECORDED HISTORY THE AREA HAS BEEN SUBJECT TO VERY LARGE EARTHQUAKES, AND THAT THESE ALSO TOOK PLACE IN PREHISTORIC TIMES. WE ALSO KNOW THAT SINCE ROCKS OF THE SEA FLOOR WERE

PRESENT DURING SUCH PAST EVENTS AND FAILED ONLY IN LOCAL AREAS, IT IS VERY UNLIKELY THAT WIDESPREAD FAILURE WILL OCCUR IN THE FUTURE.

NOW THEN, LET'S PROCEED TO INTERPRET GEOLOGIC HISTORY AND IF POSSIBLE TO PREDICT THE FUTURE. WE BEGIN BY GATHERING INFORMATION ABOUT THE SEA FLOOR, AND THIS IS OBTAINED IN A VARIETY OF WAYS, RANGING FROM DIRECT OBSERVATION BY PEOPLE IN SUBMERSIBLE VESSELS TO DETAILED MAPPING BY GEOPHYSICAL SURVEYS.

THE TWO METHODS MOST FREQUENTLY USED BY THE PETROLEUM INDUSTRY HAVE BEEN SEA FLOOR SAMPLING AND HIGH RESOLUTION ACOUSTIC SEISMIC SURVEYS. IN SEA FLOOR SAMPLING, AN ACTUAL PIECE OF ROCK OR OTHER MATERIAL FROM ON OR BENEATH THE SEA FLOOR IS RECOVERED BY DREDGING OR CORING. DEVICES SUCH AS CLAMSHELL OR BUCKET DREDGES, DART OR PISTON CORERS, OR ROTARY CORE DRILLS ARE USED TO OBTAIN ACTUAL SAMPLES OF THE MATERIAL ON OR BELOW THE SEA FLOOR.

HIGH RESOLUTION ACOUSTIC SEISMIC SURVEYS ARE USUALLY SPOKEN OF AS ACOUSTIC SURVEYS. ALL ACOUSTIC SURVEY SYSTEMS HAVE AN UNDERWATER ENERGY SOURCE BROADCASTING SOUND WAVES INTO THE WATER. THE SOUND IS SENT OUT IN SHORT PULSES AT PRECISELY

TIMED INTERVALS. WHEN THE SOUND PULSES STRIKE A SURFACE SUCH AS THE SEA FLOOR OR BEDS BENEATH IT, THEY ARE REFLECTED BACK, IN PART, AND ARE DETECTED BY SENSITIVE RECEIVERS, AND THE TOTAL TRAVEL TIME IS RECORDED. THE DISTANCE BETWEEN THE SOUND SOURCE AND THE REFLECTING SURFACE CAN THEN BE CALCULATED FROM THE KNOWN VELOCITY OF SOUND THROUGH THE TRANSMITTING MEDIUM.

THE RANGE OF USEFUL FREQUENCIES FOR ACOUSTIC SYSTEMS IS FROM ABOUT 40 UP TO 300,000 HERTZ. THE HIGHER FREQUENCY, SHORTER WAVE LENGTH SYSTEMS HAVE HIGHER RESOLUTION AND ACCURACY, BUT SHALLOW PENETRATION, WHILE THE LOWER FREQUENCY, LONG WAVE LENGTH SYSTEMS HAVE GREATER CAPABILITY IN DEEP PENETRATION. THE ENERGY SOURCE AND RECEIVERS OF ANY SYSTEM CAN BE TUNED TO RECORD SPECIFIC FREQUENCIES THAT PROVIDE THE BEST INFORMATION OR THE INFORMATION MOST DESIRED ABOUT A PARTICULAR AREA. SUCH SYSTEMS ARE CALLED TUNED TRANSDUCER SYSTEMS. UNDER GOOD CONDITIONS, THE HIGH FREQUENCY SYSTEMS CAN DEFINE FEATURES WITH LESS THAN A FOOT OF RELIEF ON THE SEA FLOOR AND THEY CAN ALSO DETECT SCHOOLS OF FISH AND BUBBLE COLUMNS IN THE WATER. THE LOWER FREQUENCY SYSTEMS CAN PENETRATE PERHAPS AS MUCH AS 3000′ INTO THE SEA FLOOR AND DEFINE BEDS WITH A RANGE OF ACCURACY OF 2′ TO 30′.

A NUMBER OF ACOUSTIC SYSTEMS ON DIFFERENT FREQUENCIES CAN BE MOUNTED ON ONE SURVEYING VESSEL AND WHEN THIS IS DONE THE RESULTING SURVEY IS CALLED A MULTI-SENSOR SURVEY. WHILE ACOUSTIC SURVEY DATA IS BEING RECORDED ON SHIPBOARD, THE EXACT POSITION OF THE SHIP IS ALSO BEING RECORDED CONTINUOUSLY BY NAVIGATIONAL SYSTEMS OF THE SHORAN OR LORAN TYPE. THUS, THE EXACT LOCATION WHERE EACH PIECE OF DATA WAS COLLECTED IS KNOWN AND CONSEQUENTLY, MAPS OF THE DATA CAN BE PREPARED.

EXAMPLES OF THIS DATA ARE SHOWN HERE. FIGURE 5 IS A DEPTH RECORDER PROFILE. NAVIGATIONAL STATIONS ALONG THE PROFILE ARE NUMBERED ACROSS THE TOP OF THE RECORD AND MARKED BY VERTICAL LINES. THE DEPTH SCALE ON THIS RECORD IS IN FATHOMS, AND YOU WILL NOTE THAT THE RECORD SHOWS A SCARP WITH ABOUT EIGHT FATHOMS OF RELIEF ON THE LEFT, AND BUBBLE CLUSTERS IN THE WATER COLUMN ON THE RIGHT.

A TUNED TRANSDUCER RECORD IS SHOWN IN THE LOWER PART OF FIGURE 5. THIS RECORD WAS RUN SIMULTANEOUSLY WITH THE DEPTH RECORDER RECORD ABOVE AND IT SHOWS THE SAME SCARP, THE SAME BUBBLE CLUSTERS; HOWEVER, THE HORIZONTAL SCALE IS EXPANDED.

AN ELECTROMECHANICAL RECORD IS SHOWN IN THE UPPER LEFT OF FIGURE 6. HERE WE SEE TWO LAYERS OF SEDIMENTARY ROCK,

COLORED GREEN AND YELLOW, AND WE SEE THE DETAILS OF THEIR CONTACT WITH A SERIES OF OLDER BEDS BENEATH THEM. PENETRATION HERE IS ABOUT 500' BENEATH THE SEA FLOOR. A SPARKER RECORD IS SHOWN IN THE LOWER PART OF FIGURE 6 AND IT SHOWS A SIMILAR SUCCESSION OF BEDS ALONG A DIFFERENT SURVEY LINE.

A SIDE SCAN SONAR RECORD IS SHOWN IN FIGURE 7. IN THIS SYSTEM THE SOUND IS BEAMED DOWN AND OUT ON EITHER SIDE OF THE SHIP'S TRACK AND THE RECORD FORMS A PICTURE MUCH LIKE AN AERIAL PHOTOGRAPH OF THE SEA FLOOR SURFACE.

THE ACTUAL BOTTOM SAMPLES CAN BE EXAMINED BY SPECIALISTS IN GEOLOGY AND ENGINEERING TO DETERMINE HOW OLD THE BEDS MAY BE, THE KIND OF ENVIRONMENT IN WHICH THEY WERE DEPOSITED, WHETHER THEY MAY PROVIDE SUITABLE SOURCES, OR SUITABLE RESERVOIRS, FOR OIL AND GAS, AND HOW STRONG THEY MAY BE FOR ENGINEERING PURPOSES.

WHEN THESE PROPERTIES ARE DETERMINED, THEY CAN BE CORRELATED WITH THE LAYERS OF SEDIMENTARY ROCK DETERMINED BY THE ACOUSTIC SURVEYS, AND MAPS CAN BE MADE SHOWING THE SEA FLOOR TOPOGRAPHY, THE TREND OF SEA FLOOR GEOLOGIC FEATURES, THE DISTRIBUTION OF DIFFERENT KINDS OF SEA FLOOR SEDIMENTS, AND THE GEOLOGIC STRUCTURE OF THE OLDER BEDS BENEATH THE SEA FLOOR.

These results can be used to determine the present sea floor environment as well as its recent history, and can also be used to plan further exploration activity. One of its principal uses from the environmental standpoint, is that it enables the petroleum industry to locate the areas where hazards may be involved and to avoid them or to plan around them.

A number of sea floor surveys have been carried out in the Gulf of Alaska by industry groups, by private groups, and by individual companies. The surveys have been concentrated in the general area between Middleton Island and Icy Bay. By the end of summer 1975, it is estimated that the industry will have accumulated about 6000 line miles of acoustic surveys, over 5000 dart core samples, and possibly 25,000' of drill samples, at a total cost of more than $15 million. Most of this expenditure may be credited to the petroleum industry as an investment in environmental understanding of the region.

Beneath the continental shelf lie rocks similar to those found onshore bordering the Gulf of Alaska. However, off-shore the formations are less structurally disturbed than

THEY ARE ONSHORE, AND THEY WERE PLANED OFF BY MARINE AND GLACIAL EROSION DURING RATHER LATE GEOLOGIC TIME.

DURING THE PLEISTOCENE ICE AGES THE SEA LEVEL WAS LOWERED AND MUCH OF THE GULF OF ALASKA'S CONTINENTAL SHELF WAS ABOVE THE SURFACE OF THE SEA. IT WAS THEN COVERED BY GREAT ICE SHEETS ORIGINATING IN THE MOUNTAINS BEHIND THE PRESENT COAST LINE. THE ICE APPEARS TO HAVE CUT SEVERAL MAJOR CHANNELS ACROSS THE GULF OF ALASKA CONTINENTAL SHELF FROM MONTAGUE ISLAND CHANNEL TO ALSEK CHANNEL, AND GLACIATION APPEARS TO BE THE PRIMARY DETERMINANT OF THE BATHYMETRY OF THE GULF OF ALASKA CONTINENTAL SHELF.

THE UPPER RECORD ON FIGURE 8 IS AN ELECTROMECHANICAL RECORD, AND SHOWS THE SEQUENCE OF BEDROCK FORMATION AND GLACIAL AND RECENT OVERBURDEN THAT ARE TYPICAL OF MUCH OF THE NORTHERN GULF OF ALASKA. THE BOTTOM PART OF THE RECORD SHOWS BEDROCK SLOPING UPWARD TOWARDS THE SEA FLOOR, AND TRUNCATED BY A GLACIAL UNCONFORMITY. THIS EROSIONAL SURFACE SLOPES AT A LOW ANGLE AND IS FAIRLY SMOOTH AND REGULAR WITH PERHAPS 100' OF RELIEF.

DIRECTLY OVERLYING THE BEDROCK ALONG THIS UNCONFORMITY IS A LAYER OF OVERBURDEN ABOUT 40' TO 100' THICK. ITS SURFACE

HAS A LOW UNIFORM AVERAGE DIP SEAWARD WITH ERRATIC LOCAL RELIEF OF 10'. THIS LAYER SHOWS NO STRATIFICATION AND IT IS FEATURELESS EXCEPT FOR A NUMBER OF SMALL DIFFRACTION PATTERNS. CORE SAMPLES FROM THIS LAYER SHOW THAT IT IS OF LATE PLEISTOCENE TO RECENT AGE AND WAS DEPOSITED BY GLACIERS IN A MARINE ENVIRONMENT. IT IS CALLED THE GLACIAL OVERBURDEN LAYER AND IS OVERLAIN BY ANOTHER LAYER OF OVERBURDEN WHICH HERE THICKENS UNIFORMLY FROM ABOUT 20' TO 230' IN A SEAWARD DIRECTION. AT THIS LOCALITY THE UPPER SURFACE OF THIS LAYER FORMS THE SEA FLOOR WHICH IS EXTREMELY SMOOTH WITH A GENTLE SEAWARD SLOPE. THE SMALL CYCLIC VARIATIONS IN ITS THICKNESS ARE CAUSED BY WAVES OR SWELLS AT THE SURFACE OF THE SEA. SAMPLES OF THIS LAYER SHOW THAT IT IS A MARINE DEPOSIT OF RECENT AGE, COMPOSED ALMOST ENTIRELY OF SILTY CLAY WITH SCATTERED PEBBLES AND COBBLES EMBEDDED WITHIN IT, AND IT IS CALLED A RECENT OR NORMAL MARINE OVERBURDEN.

WHERE RECENT OVERBURDEN IS ABSENT, THE SEA FLOOR LOSES ITS SMOOTH ACOUSTIC CHARACTER AND TAKES ON A CHARACTER REFLECTING ITS COMPOSITION. WHEN GLACIAL OVERBURDEN FORMS THE SEA FLOOR, ITS TOPOGRAPHY IS TYPICALLY HUMMOCKY, AND SIDE SCAN SONAR SURVEYS MAY SHOW A COBBLY SURFACE OR EVEN MAY OUTLINE LARGE BOULDERS. WHERE BEDROCK FORMATIONS FORM THE SEA FLOOR THEY ARE USUALLY TOPOGRAPHICAL HIGHS, AND SHOW A ROUGH SURFACE, OFTEN WITH RIDGES THAT FOLLOW AND TRACE THE MORE RESISTANT BEDS.

THE LOWER ELECTROMECHANICAL RECORD IN FIGURE 8 SHOWS RECENT OVERBURDEN PARTLY COVERING A SEA FLOOR TOPOGRAPHIC HIGH, BUT ABSENT ACROSS THE ROUGH, ERODED APEX OF THE HIGH. THE ROUGH TOPOGRAPHY OF THIS FEATURE, AND THE ABSENCE OF DETECTABLE GLACIAL OVERBURDEN, MAY INDICATE THAT IT WAS NEVER GLACIATED AND IS IN FACT A BED ROCK OUTCROP.

THE GULF OF ALASKA HAS UNDERGONE A LONG HISTORY OF EARTH MOVEMENTS THAT HAVE FOLDED AND TILTED THE UNDERLYING BED-ROCK. THE RECORD OF THESE EARTH MOVEMENTS IS EVIDENT FROM THE ACOUSTIC SURVEYS SHOWING FORMATION BEDROCK BENEATH THE OCEAN FLOOR. HOWEVER, THERE HAS NOT BEEN ANY EXTENSIVE FOLDING OR FAULTING OFFSHORE SINCE THE LATE PLEISTOCENE. WE CAN DEMONSTRATE THIS BECAUSE WE SEE NO DEFORMATION, OR AT LEAST, ONLY OCCASIONAL INSTANCES OF DEFORMATION OF THE GLACIAL OVERBURDEN LAYER AND THE RECENT OVERBURDEN LAYER.

THE RECENT OVERBURDEN LAYER FORMS THE SEA FLOOR, OVER ABOUT 75% OF THE SHELF AREA, AND THE GLACIAL OVERBURDEN COVERS ABOUT 10%, WHILE 15% OF THE SEA FLOOR IS COMPOSED OF BEDROCK ITSELF.

SINCE THE RECENT OVERBURDEN LAYER BLANKETS MOST OF THE SHELF, ITS STABILITY AS A FOUNDATION LAYER IS ESPECIALLY

IMPORTANT. THE FLAT PARALLEL REFLECTORS WITHIN THIS UNIT ARE BEDDING PLANES FORMED AS THE UNIT WAS DEPOSITED. BREAKS IN THESE BEDDING PLANES WOULD INDICATE TECTONIC DISTURBANCE. SUCH A BREAK IS VISIBLE IN THE BEDDING OF THE RECENT OVER-BURDEN ON THE RIGHT SIDE OF FIGURE 8B, SHOWING THAT THE SEDIMENTS HAVE SHIFTED SLIGHTLY SINCE THEY WERE DEPOSITED AND THEREFORE MIGHT NOT PROVIDE A FIRM FOUNDATION IN THE FUTURE. ACOUSTIC SURVEYS HAVE FOUND SUCH AREAS OF INSTA-BILITY AT ONLY A FEW ISOLATED LOCALITIES. IN THE REST OF THE REGION THE BEDDING IN THE RECENT LAYER IS PARALLEL AND UNBROKEN. THIS SHOWS THAT THESE SEDIMENTS HAVE BEEN UNDIS-TURBED OVER A PERIOD OF MANY THOUSAND YEARS SINCE THEY WERE DEPOSITED, AND THAT THEY WILL PROVIDE A STABLE FOUNDATION FOR ANY FUTURE CONSTRUCTION.

ACOUSTIC SURVEYS HAVE SHOWN THE DISTRIBUTION, THICKNESS AND TOPOGRAPHY OF THE VARIOUS KIND OF BEDS THAT FORM THE SEA FLOOR IN THE NORTHERN GULF OF ALASKA, AND THEY SHOW RECENT STRUCTURAL MOVEMENTS. AS MENTIONED EARLIER, THERE ARE ONLY A FEW LOCATIONS WHERE THERE HAVE BEEN RECENT MOVEMENTS WITHIN THE PROPOSED SALE AREA.

THERE ARE BATHYMETRIC TRENDS WHERE THE BOTTOM SLOPE MAY BE STEEP ENOUGH TO BE UNSTABLE AND SUBJECT TO SLUMPING. THESE

TRENDS OF SLUMPING HAVE BEEN LOCATED AND MAPPED BY ACOUSTIC SURVEYS AND SEEM GENERALLY TO BE ALONG THE OUTER EDGE OF THE CONTINENTAL SHELF IN THE AREA OF DEEP WATER. FIGURE 9A, ON THE SPARKER RECORD AT THE TOP, IS A PROFILE ACROSS THE BOUNDARY BETWEEN THE CONTINENTAL SHELF AND THE SLOPE. IT SHOWS A ZONE OF SMALL FRACTURES NEAR THE EDGE OF THE SHELF AND A ZONE OF PROBABLE SLUMPING DOWN THE SLOPE. SUCH UNSTABLE AREAS WILL BE AVOIDED DURING OFFSHORE EXPLORATION OPERATIONS.

ACOUSTIC SURVEYS CAN ALSO BE UTILIZED TO LOCATE BUBBLE COLUMNS IN THE WATER AND ACOUSTIC VOIDS IN THE BEDS BENEATH THE SEA FLOOR. FIGURE 5 SHOWS AN EXAMPLE OF BUBBLES IN THE WATER COLUMN. THE LOWER ELECTROMECHANICAL RECORD ON FIGURE 9B SHOWS A CLUSTER OF ACOUSTIC DISCONTINUITIES. IN OTHER REGIONS IT HAS BEEN FOUND THAT SUCH ACOUSTIC DISCONTINUITIES AND BUBBLE COLUMNS ARE OFTEN EVIDENCE FOR HYDROCARBON GAS SEEPS. THUS, TO REDUCE THE POSSIBILITY OF BLOWOUTS, OPERATORS WOULD AVOID DRILLING OR TAKE ADEQUATE PRECAUTIONS IN LOCATIONS WHERE SEEPS HAVE BEEN MAPPED OR ARE SUSPECTED.

THE SEA FLOOR SURVEYS UNDERTAKEN COLLECTIVELY AND INDIVIDUALLY BY COMPANIES IN THE PETROLEUM INDUSTRY PROVIDE THE KNOWLEDGE NEEDED TO CARRY OUT ENVIRONMENTALLY SAFE PETROLEUM

EXPLORATION AND DEVELOPMENT ACTIVITIES. THE SURVEYS THAT HAVE BEEN MADE SHOW THE CHARACTERISTICS OF THE SEA FLOOR IN THE REGION AND THEY HAVE LOCATED THE TRENDS WHERE PROBLEMS MAY EXIST. THE TOTAL INDUSTRY EFFORT THAT HAS GONE INTO SEA FLOOR SAMPLING AND ACOUSTIC SURVEYING WILL GO FAR TO MAINTAIN ENVIRONMENTAL INTEGRITY IN EXPLORATION FOR PETROLEUM IN THE GULF OF ALASKA.

THANK YOU.

THE OIL AND GAS POTENTIAL OF THE GULF OF ALASKA

STATEMENT BY
H. J. FITZGEORGE, MOBIL OIL CORPORATION

PREPARED FOR
GULF OF ALASKA OPERATORS COMMITTEE

GULF OF ALASKA ENVIRONMENTAL IMPACT HEARING
ANCHORAGE, ALASKA
AUGUST 12-13, 1975

My name is Harold Fitzgeorge. I am Vice-President of the Western Exploration and Producing Region, North American Division of Mobil Oil Corporation. In this position I am responsible for all exploration and producing operations for the State of Alaska and contiguous waters, and the northern two-thirds of the United States, including the West Coast and offshore areas.

Prior to this assignment, my experience included assignments as President of Mobil Oil Company de Venezuela, Exploration Manager for Mobil International, and Vice-President and Exploration Manager of Mobil Oil Canada, Ltd. In total, I have 27 years of experience in oil and gas exploration and development since I began working as a geologist in Oklahoma City.

Mobil Oil Corporation is an active member of the Gulf of Alaska Operators Committee, and I am pleased to speak here today. It provides me an opportunity as a geologist to discuss the oil and gas potential of a region that could become one of the most important oil and gas provinces of the U.S. I will elaborate on this, but wish to caution you that in spite of my scientifically based optimism, there are no certainties in oil and gas exploration.

The Gulf of Alaska Sedimentary Basin lies between Kodiak Island on the west and the coastline just west of Juneau, Alaska. It is almost 900 miles long and varies from 40 to 100 miles wide. The total area of the basin is about 40,000 square miles, of which 85%, or about 34,000 square miles, lies beneath the waters of the Gulf of Alaska. This area compares in size with the Louisiana and Texas combined offshore areas.

Oil explorationists look for several criteria when evaluating the oil potential of a basin. Two important factors are source and reservoir rocks. An oil basin must have sedimentary rocks capable of generating oil, and sufficiently thick porous rocks to contain the oil. Oil is generated from organic rich sediments by heat when these sediments are buried to depth, and it is commonly trapped in porous sand reservoir rocks in the earth. Large anticlinal structures contain much of the known world oil accumulations.

The presence of source beds and hydrocarbons in the Gulf of Alaska is well documented:

- A total of 108 oil and 15 gas seeps have been reported onshore by the U.S. Geological Survey. All are west of Yakutat Bay, with clusters of 86 of them in the Katalla area and 29 in the Yakataga area. Several offshore seep areas have also been noted.

- Shallow oil was discovered in 1902 on the north shore of the Gulf of Alaska at Katalla. Cumulative production of nearly 154,000 barrels from the Pt. Hey sandstone and fractured Poul Creek shales resulted from this and subsequent drilling between 1902 and 1933. The oils were described as high gravity, paraffin base and very low in sulfur content.

- A total of 71 wells have been drilled in the province, including one near Middleton Island, 70 miles offshore. Although no commercial discoveries by today's standards have been made, numerous shows of oil and gas have been recorded and the existence of a thick sedimentary sequence has been clearly established.

- Geological and geophysical studies indicate that the Gulf of Alaska Sedimentary Basin contains rock thicknesses in the order of 20,000 feet of Tertiary and Pleistocene rocks, of which the younger 10,000 to 15,000 feet are highly prospective for oil and gas. Estimates of the volume of these younger rocks range from 50,000 to 75,000 cubic miles.

The many onshore indications of hydrocarbons in the basin logically led to a search for petroleum offshore. In 1964 Mobil conducted their first seismic survey in the Gulf of Alaska, and in 1966 joined 24 companies in the first group survey in the Gulf of Alaska. Since then, numerous group and proprietary surveys have been conducted, and my company alone, as an example, has participated in 19 proprietary and 11 group surveys. In addition, we have obtained gravity, aeromagnetic, shallow seismic and sidescan sonar surveys plus bottom sampling and core hole data. We estimate that industry in both group and proprietary surveys has collected over 60,000 miles of seismic data, 8,000 line miles of gravity data, 14,000 line miles of aeromagnetic and 6,000 miles of shallow resolution seismic data. They have drilled 89 core holes and obtained extensive dart core coverage. Our company alone has obtained in excess of 4,500 dart cores. I estimate these surveys represent a pre-sale investment on the part of private competitive industry in the amount of $26 million dollars.

Now let us take a closer look at the geology and oil and gas potential of the Gulf of Alaska. It is important for everyone, and in particular local, state and federal government officials, who influence and directly affect offshore exploration and producing operations, to understand the potential of the Gulf of Alaska in light of our worsening domestic oil and gas shortages.

The prospective Sedimentary rocks of the Gulf of Alaska are sands and shales of Teritary and Pleistocene age and are both marine and non-marine in depositional origin. These sediments are exposed along the northern edge of the basin and have been further described in the subsurface by wells drilled along the shore and seaward by core holes, bottom sampling, geophysics and one deep test near Middleton Island.

Rocks of Cretaceous age are highly intruded, contorted and metamorphosed and are not regarded as objectives for oil and gas exploration.

The Tertiary rocks of the basin are of two distinct sequences: the lower unit is of Paleocene and Eocene age. They are usually hard, dense and highly deformed, and as such offer limited potential.

These rocks are overlain by a sequence of middle and upper Tertiary and recent sediments thought to be in the range of 15,000 to 20,000 feet thick. Beds of Oligocene, Miocene, Pliocene and Pleistocene age exhibit adequate reservoir characteristics, and the organic shales and silts of early Miocene age are thought to be potential source beds, as shown by the many oil and gas seeps from these rocks in the central part of the Gulf of Alaska.
It is interesting to note that rocks of the same age are the major producing horizons in California and the Gulf of Mexico.

Numerous structural features have been indentified both onshore and offshore. Within the designated sale area there are large anticlinal structures mapped by the seismograph. Structures of the magnitude outlined can contain significant reserves which are critically needed for the continued economic well being of Alaska and the lower forty-eight.

Analysis of crude oils from the Katalla Oil Field and various seeps indicate that the Gulf of Alaska has the potential for high quality, low sulfur crudes. The Katalla area crudes measure 41-45° API gravity, with negligible sulfur and high gasoline yields. Analysis of seep crudes show sulfur contents of .8% by weight or lower. This type of crude is a highly desirable source for our product needs in light of air quality control requirements for low sulfur products.

Published figures vary widely on the oil and gas potential of the Gulf of Alaska. Likewise, the areas covered and the methods used by various analyses differ. The Alaska State Department of Natural Resources, Division of Geological and Geophysical Survey, using a volumetric method, estimated in 1974 for the Gulf of Alaska offshore a speculative recoverable resource of 5.4 billion barrels of oil and 39.4 trillion cubic feet of gas, to water depths of 1,500 meters. The United States Geological Survey has recently published a survey for Southern Alaska offshore which gives the lowest limit at 95% probability to be 1 billion barrels of oil, and the highest limit to be 6 billion barrels with a 5% chance: gas reserves are estimated at 2 to 17 trillion cubic feet at the same probabilities. These USGS reserves are for 200 meters or less of water depth and include the Cook Inlet and Kodiak Island Province, which are not included in the aforementioned State of Alaska survey. The Draft Environmental Impact Statement contains the USGS estimate of oil and gas potential for that portion of the Gulf of Alaska contained in the proposed sale area. The lower limit, at 95% probability, is 100 million barrels of oil and 300 billion cubic feet of gas. The high side of that estimate, with a 5% probability, is for 2.8 billion barrels of oil and 9 trillion cubic feet of gas.

Mobil's most recent estimates in the Gulf of Alaska of the potential recoverable oil and gas are of similar magnitude. However, there is no way of knowing what might ultimately be found until the drill bit actually penetrates the reservoirs we think might be present. The potential of the area can only be determined by a succession of exploratory wells seeking out every stratigraphic trend, every structural trend and every combination of both until the final oil potential of the region is known.

There are those who will argue that estimates of the hydrocarbon potential for the entire U.S. offshore are too high and those who argue the other side. Mobil's as well as many other responsible published opinions is that the United States' undiscovered resources will be large in the offshore with the Gulf of Alaska being one of the significant undrilled frontier areas. We think the offshore offers the best opportunity to find large accumulations of oil that will allow us a viable alternative to increased dependence on foreign imports; however, there have been no offshore Federal sales since 1968, except the Gulf of Mexico. In the first quarter of 1975 oil imports represented 38% of total petroleum supply. Our nation should not continue its heavy and increasing dependence on foreign energy sources. Our offshore areas must be explored now. America needs to breathe new life into its domestic oil and gas exploration. In a Department of interior survey of the oil industry, the Gulf of Alaska was ranked number one in OCS sale priority for its probability of large potential. The oil industry by its already large investment in the Gulf of Alaska has shown it is prepared to carry out an exploration and producing program in an environmentally safe manner that will contribute to a greater and safer domestic energy supply.

Thank you for your attention, and if I can answer any questions you may have I will be pleased to do so.

PROBABILISTIC RESPONSE OF OFFSHORE PLATFORMS TO SEISMIC EXCITATION IN THE GULF OF ALASKA

Oral Testimony

by

John H. Wiggins, Ph.D.
Professional Engineer
Professional Geophysicist

Presented at the
Environmental Hearing:
Gulf of Alaska
Offshore Sale

SLIDE 1

My name is John Wiggins. I hold a Master of Science Degree in Geophysics, with a speciality in Seismology and the Doctor of Philosophy Degree in Civil Engineering, with a speciality in Structural Dynamics. I am a Registered Civil Engineer and Geophysicist in the State of California, and am one of four persons selected to develop seismic risk maps for the United States, National Bureau of Standards' earthquake code study. My firm has been intimately involved with developing the seismic risk maps for the State of Alaska over the last two and one half years.

My purpose here is to discuss the probabilistic response of offshore platforms to seismic excitation in the Gulf of Alaska.

SLIDE 2

Earthquake engineering is made up of three disciplines in the scientific community. The first deals with the seismic enviornment in which principally seismologists work. From the knowledge of the seismic environment, one can estimate ground shaking, structural response and the failure of various structural elements and components. The latter two disciplines are left to the structural engineer and specialists in engineering mechanics.

All of these disciplines and the knowledge inherent within them, have varying degrees of uncertainty. By combining all of the disciplines and the uncertainties, one can estimate the seismic risk of a particular structural design located at a particular geographical position.

SLIDE 3

This slide illustrates the specific steps that must be treated in an earthquake engineering analysis. Specifically, I shall first discuss the "proneness" of an area to earthquake activities. By combining the seismicity inputs with the soil-structure models, modes of vibration and estimates of damage can be computed in probabilistic terms.

SLIDE 4

Until recently, earthquake design codes, as well as almost all codes and standards, have been developed with the "hope" that absolute safety would result. We now realize that some risk is involved with every standard or code used in design practice. Earthquake codes currently being developed for the National Bureau of Standards by more than 70 national experts is being developed with a clear expectation of risk (chance of loss) in mind. It is within this risk acceptance rationale that I shall direct my testimony.

SLIDE 5

Let us first examine the factors that influence ground motions.

SLIDE 6

The mechanism of earthquake action in the Gulf of Alaska is now generally agreed to be caused by a layer of roving plates which are moving relative to one another. The Pacific Plate is being forced northwesterly in relation to the American Plate. The area of interest is located in the vicinity of the junction of the Pacific and American Plates.

SLIDE 7

On page 53 of the EIS, it is stated that there are two methods for estimating future seismicity. One of these can only be used for relative comparisons. There are actually six basic methods which have been developed in order to make estimates about future seismic motions. Method 1 is deterministic in its approach. Maximum credible earthquakes are postulated to occur on known fault lines which intersect the earth's surface. Usually an earthquake magnitude and distance from source to site is postulated by an expert.

SLIDE 8

This slide indicates the zone of the postulated maximum credible earthquake magnitude of 8.5 developed by the U.S. Geological Survey. It ranges from the dotted line to the 3,000 meter contour depth line. The major problem in determining potential future motions is specifying the location of the earthquake within this broad zone. Should it be located at the center of the zone, directly underneath the site, or at some other distance?

SLIDE 9

In order to overcome some of these objections, Method 2 assumes that a good estimate of future seismicity may be derived from examining historic seismic conditions that are not modified by judgment. Various scientists have contended, however, that historic data are too limited to derive accurate probabilistic values of seismicity.

SLIDE 10

Method 3 assumes that the "negative" of seismic history can be expected to occur in the future. Thus, where seismic "gaps" appear in the data , one can expect a large earthquake in the near future. Such a "gap" has been postulated to occur within the zone anticipated for the general sale area.

SLIDE 11

This figure indicates all earthquakes greater than magnitude 7 that have occurred since 1938. The 38 years of data alleges to indicate that there is a seismic feature missing in the area of the sale. However, if one considers a longer history, and includes the three earthquakes that occurred in the "gap" in 1899 and 1900, one can compute the amount of energy released along the eastern, western and "gap" areas. More than twice the energy per year has been released in the "gap" area per mile as compared to that for the eastern and western areas combined. On page 55 of the EIS, further evidence elaborating on the usefulness of the "gap" theory in forecasting future seismic motions is developed.

SLIDE 12

Method 4 attempts to combine the knowledge of fault locations and historic data in a manner such that all past earthquakes are judgmentally placed in "source zones." The resulting seismicity is therefore influenced heavily by human judgment. This method has the same drawbacks as Methods 1 and 2 in that criteria depend on the involved individual's judgment and the completeness of the data.

SLIDE 13

Method 5 makes the assumption that our knowledge about past seismic history is highly uncertain. Earthquakes are postulated to occur anywhere within a very large region. The major drawback to this "shoulder-shrugging" process is that major tectonic features are known and should be considered in some logical way.

SLIDE 14

Method 6 has only recently been postulated. Some earth scientists think that there is a link between the huge earthquakes which periodically erupt all around the rim of the Pacific Ocean basin. A huge tremor that shakes Japan, the scientists suspect, may trigger another large earthquake months later in Peru, Mexico or Alaska.

This view has been cautiously expressed and has not been able to meet the test or repeatability using 75 years of fairly accurate information.

SLIDE 15

I have chosen to use Method 2 for the best, first estimate of the seismicity in the Gulf. I believe that Method 2 is superior for the following reasons:

1. We have used yet another approach for mapping called the Bayesian method. It combines Methods 1 with 2 in a rigorous mathematical procedure. To date, we have constructed Bayesian maps only for California. However, those maps reveal that where data are of good quality and in sufficient number,

there is little difference between a Bayesian map and Method 2.

2. Historical data allow us to use the probabilistic method and present a logical engineering framework for decision making.

3. The rationale follows that set forth by the Structural Engineers Association of California in their earthquake design policy.

4. It has been shown in all case law involving flood plain zoning, another natural hazard, that <u>the severity of the regulation must match the severity of the historic risk</u>.

SLIDE 16

Before talking about earthquake history, let us examine something that is more familiar; namely, automobile accidents. This slide describes the number of yearly accidents that might be expected. The number of vehicles involved in an accident may be described as the magnitude of the accident. Note that the data do not fall on top of one another, because they involve different data bases. Also, the data diverge for 8 and 9 vehicles. The reliability of the information in the large magnitude is lower than that in the low magnitude range. Nevertheless, as more yearly data are plotted, they will converge on the line, even at high mangitude.

SLIDE 17

The same phenomenon is experienced in earthquake history. This slide plots the magnitude of events that have occurred in and about the City of Anchorage, using two data bases. The first is that which has been taken by NOAA since 1963. It is an accurate information base; however, the reporting period (10.5 years) is short compared to the historic Alaska data base of 74 years. The historic data base, however, is incomplete for magnitudes lower than 6.5.

The 10.5 year data base coincides quite closely with the regression curve plotted in the lower magnitude ranges. More information is available in the smaller magnitude range than that for large magnitudes. This finding reflects the automobile accident example.

However, if the historic is combined with the 10.5 year data base, the circles plot closer to the regression curve than do the triangles, indicating that the line is a good estimate of seismicity.

SLIDE 18

The ground motion that might be experienced by a structure is influenced by the distance as well as the size of the earthquake. It is suggested that the EIS make note of this fact. On pages 362, 364, 365 and 366, it is mentioned that structures are designed to resist earthquakes of a specified Richter magnitude. But magnitude is only one part of the two-part problem of deriving intensity. Unlike water waves, which occur over large regions, earthquake motions dissipate from source to site. Thus, the second part of deducing intensity is to know the attenuation properties of the geographical region in question. What are the ground motions at the epicenter and how do they dissipate with distance?

Curves used in our study to develop seismic risk maps are constructed primarily from California earthquake data. The question might arise as to whether California information can be used to discuss Alaska conditions, both near the epicenter and at some distance from the epicenter. This slide shows the difference in attenuation properties in the eastern and in the western or California region of the United States. In 1811, an earthquake slightly smaller than the famous 1906 San Francisco earthquake occurred in southern Missouri. The area of potential damage is considerably larger than that of the 1906 quake. Similarly, the 1971 San Fernando earthquake affected a much smaller area than did the 1886 Charleston, South Carolina earthquake which had a similar magnitude.

SLIDE 19

This slide plots the region in which people can notice an earthquake. I have also plotted the areas felt by six typical Alaska earthquakes. In all but one instance, the data fall well below the California line indicating that California attenutation equations are conservative in an analysis of Alaska. Page 44 of the EIS confirms our estimates of the attenuation properties for the Gulf of Alaska region.

SLIDE 20

Is the same observation correct in the near-field? It has been postulated that because Alaska earthquakes occur on "low angle" faults, this may not be the case. As you can see, the Pacific Plate being pushed under the American Plate has a very gentle slope.

The following rationale leads me to the conclusion that the use of California data in the near-field is also an adequate approximation of Alaskan conditions:

1. Alaska earthquakes have deeper foci than do California quakes. The average depth of the 1964 shocks was 26.5 kilometers. California earthquakes have an average depth of about 16 kilometers.

2. As the slide depicts, it is questionable whether or not the sale area is underlain by the low angle fault type.

SLIDE 21

3. Referring back to an earlier figure, the western Alaska aftershock zones appear to be wider than the eastern aftershock zones. When the energies are balanced, however, the length to width ratio of the zones are nearly similar.

The largest recent earthquake in California (the 1952 Arvin earthquake of magnitude 7.7) had a similar aftershock length to width ratio. This indicates that the aftershock zone width is not necessarily proof that low angle faulting contributes to large zones of high intensity vibrations.

SLIDE 22

Using all of the historic information available and treating each earthquake as a point source, hard rock velocity contours for an arbitrary return period, 100 years, have been constructed for the Gulf of Alaska. In the general area of the sale, the contours range from a low of about 3 inches per second at the southeast edge to a high of about 7 inches per second at the northwest edge of the area.

SLIDE 23

Using the fault line correction technique, in a sense combining Method 1 and Method 2, we have constructed a more realistic map. Particle velocity ranges from 4 inches per second to 8 inches per second within the general vicinity of the sale. Considering the differences in techniques for constructing maps, these differences are small and lend confidence to the analysis.

SLIDE 24

Recognizing that maps can be produced for different return periods, the question arises as to what return period or, put another way, what probability of occurrence during the structure lifetime is acceptable for design? In order to answer this question, we can examine the de facto risk associated with the current and proposed United States codes.

Present California codes have associated with them a de facto 22% chance that the level of design will be equaled or exceeded during the 50-year lifetime expectancy of a building. The U.S.G.S. is now using the 10% chance of exceedance in their map values for a 50-year building life. These percentages of exceedance may be compared with water wave exceedance estimates appearing on page 36 of the EIS. These estimates are 26% for the 100-year and 14% for the 200-year storms.

SLIDE 25

Recognizing these de facto as well as stipulated criteria, four candidate levels of shaking, reflected by the response spectra shown, have been used to analyze various offshore platform designs in various kinds of soils. Level 3 corresponds to the strongest record recorded on soil in California, and Level 4 corresponds to 1.5 times that level. Using the relative methods of determining seismic recurrence frequencies referred to on page 53 of the EIS, 0.5 inches/yr. vertical uplift has been evidenced on the average over the last 4500 years. Assuming a dip angle of 10°, the horizontal movement has been about 2.3 inches/yr. which corresponds to the California San Andreas Fault rate of movement. The base, particle velocity spectra are shown in this slide.

SLIDE 26

Herein are shown the various risks associated with the inputs used in analysis. The probability of occurrence of each level at the strongest and the weakest seismic locations are noted. Levels 3 and 4, for the most part, equal or are below current and proposed probabilistic levels.

SLIDE 27

We may now proceed to the structural analysis and response procedure. Seismograms, typical of that shown in the lower left-hand corner of this slide, were used to excite structures.

SLIDE 28

Actual test site soil borings were taken in the Gulf of Alaska. Three typical sites are shown: Soils I, II and III might be termed as soft, stiff, and semi-stiff, respectively. These soil configurations were modeled for computer treatment.

SLIDE 29

We have analyzed and modeled typical offshore structures, one of which is shown. The vibration modes have been coupled with soil as demonstrated by the lower figure on the right.

SLIDE 30

Let us proceed now to the development of an understanding of the damage that might occur from the various levels of vibration.

SLIDE 31

Three platform configurations were considered: template, outrigger and tower. These are jargon descriptions of various designs that may be considered for the Gulf of Alaska region. Five modes of failure were considered: failure of the deck structure, the template, the piles in compression and tension, and failure of the conductor pipe in which oil pipes are contained.

SLIDE 32

The performance of the tower structure in 600 feet of water can be demonstrated. Assuming the sofest soil, the normalized deck displacement relative to rock is shown for the levels of input and various types of analyses performed.

I want to make two points in this slide: First, the worst level of shaking was provided by level 3, when soil interaction is considered, because of tuning between the soil column and the structure. Tuning between the soil and the structure is therefore a very important consideration to investigate in the design of any structure located at a particular site.

Second, it can also be seen that the two different methods of analysis; namely, DYNALIST II and SAP IV, (which is used to design California hospitals and other structures) present only slightly different results.

In summary, all three possible preliminary designs are expected to survive earthquake actions of level 3 and 4 without collapse, but with some damage. This result indicates that structures can be designed using the current seismic knowledge as input.

SLIDE 33

In order to gain a perspective on how severe level 3 and level 4 earthquakes are, let us compare them with existing codes. Level 4 is higher than all of the codes, includin the California Hospital Code. Likewise, level 3 is higher than all but the 1976 Uniform Building Code which assumes the worst soil and the most importan structure.

Herein I am plotting the UBC code levels stipulated for the design of "other structures." In that code, forces are doubled for "other structures" as compared with buildings because of the usual lack of redundancy built into bridge piers and the like. But offshore drilling platforms that are highly interlaced with bracing, are very redundant types of structures and could be categorized as "buildings" when the intent of the doubling factor is recognized. Thus, for platforms of the template variety, level 3 and level 4 would be inputs well above all of the codes shown.

<u>SLIDE 34</u>

In summary, it must be recognized that the earthquake engineering problem of design is probabilistic in nature, as pointed out in the EIS. There are many factors that affect safety and the environmental risk. How big is the earthquake? Where will it be located? What is the chance that response will be equaled or exceeded? How does response affect the probability of damage? How will damage affect loss consierations?

With the appropriate consideration of each probabilistic term, enough knowledge and know-how is available so that structures can be designed for the GOA within an acceptable level of risk.

Thank you,

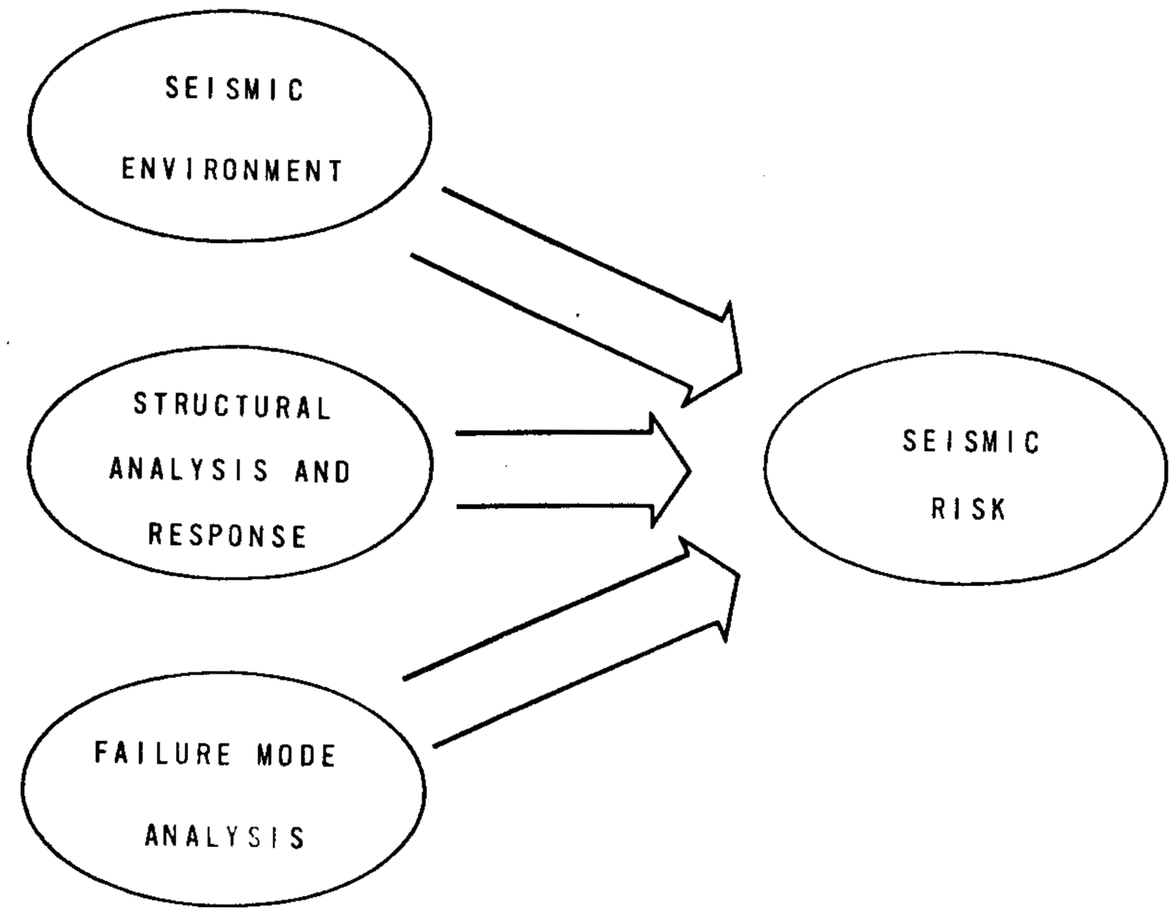
J. H. Wiggins

J. H. WIGGINS COMPANY

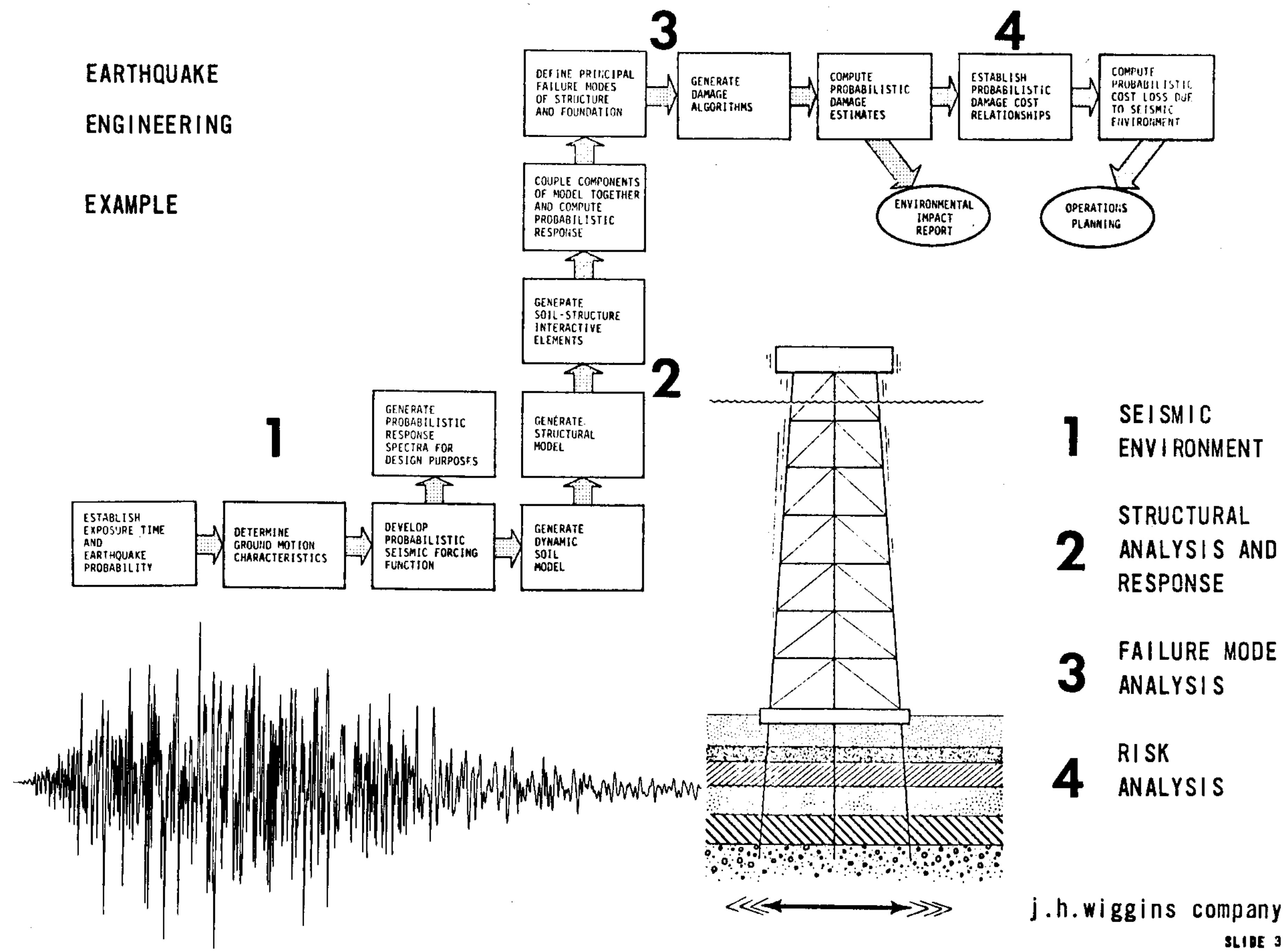
PROBABILISTIC RESPONSE OF OFFSHORE PLATFORMS TO SEISMIC EXCITATION

SLIDE 1

EARTHQUAKE ENGINEERING



SLIDE 2


EARTHQUAKE
ENGINEERING
EXAMPLE
1
ESTABLISH EXPOSURE TIME AND EARTHQUAKE PROBABILITY
DETERMINE GROUND MOTION CHARACTERISTICS
DEVELOP PROBABILISTIC SEISMIC FORCING FUNCTION
GENERATE PROBABILISTIC RESPONSE SPECTRA FOR DESIGN PURPOSES
GENERATE DYNAMIC SOIL MODEL
2
GENERATE STRUCTURAL MODEL
GENERATE SOIL-STRUCTURE INTERACTIVE ELEMENTS
COUPLE COMPONENTS OF MODEL TOGETHER AND COMPUTE PROBABILISTIC RESPONSE
3
DEFINE PRINCIPAL FAILURE MODES OF STRUCTURE AND FOUNDATION
GENERATE DAMAGE ALGORITHMS
COMPUTE PROBABILISTIC DAMAGE ESTIMATES
ENVIRONMENTAL IMPACT REPORT
4
ESTABLISH PROBABILISTIC DAMAGE COST RELATIONSHIPS
COMPUTE PROBABILISTIC COST LOSS DUE TO SEISMIC ENVIRONMENT
OPERATIONS PLANNING
1 SEISMIC ENVIRONMENT
2 STRUCTURAL ANALYSIS AND RESPONSE
3 FAILURE MODE ANALYSIS
4 RISK ANALYSIS
j.h.wiggins company
SLIDE 3

EARTHQUAKE DESIGN RATIONALE

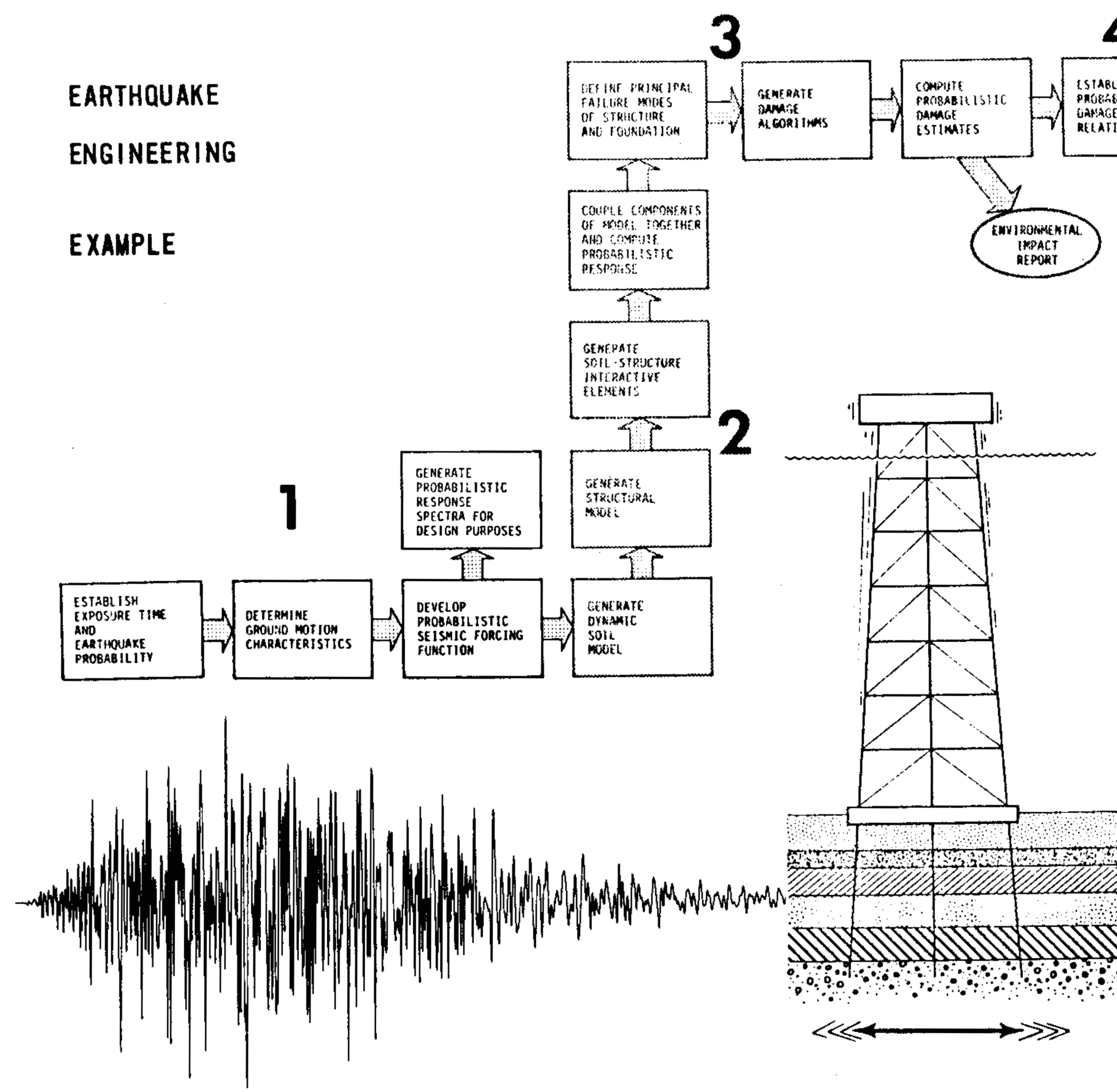
CURRENT EARTHQUAKE DESIGN
CODES ARE BEING DEVELOPED
WITH THE CLEAR EXPECTATION
OF RISK...(CHANCE OF LOSS)

SLIDE 4

EARTHQUAKE

ENGINEERING

EXAMPLE



1 SEISMIC ENVIRONMENT

2 STRUCTURAL ANALYSIS AND RESPONSE

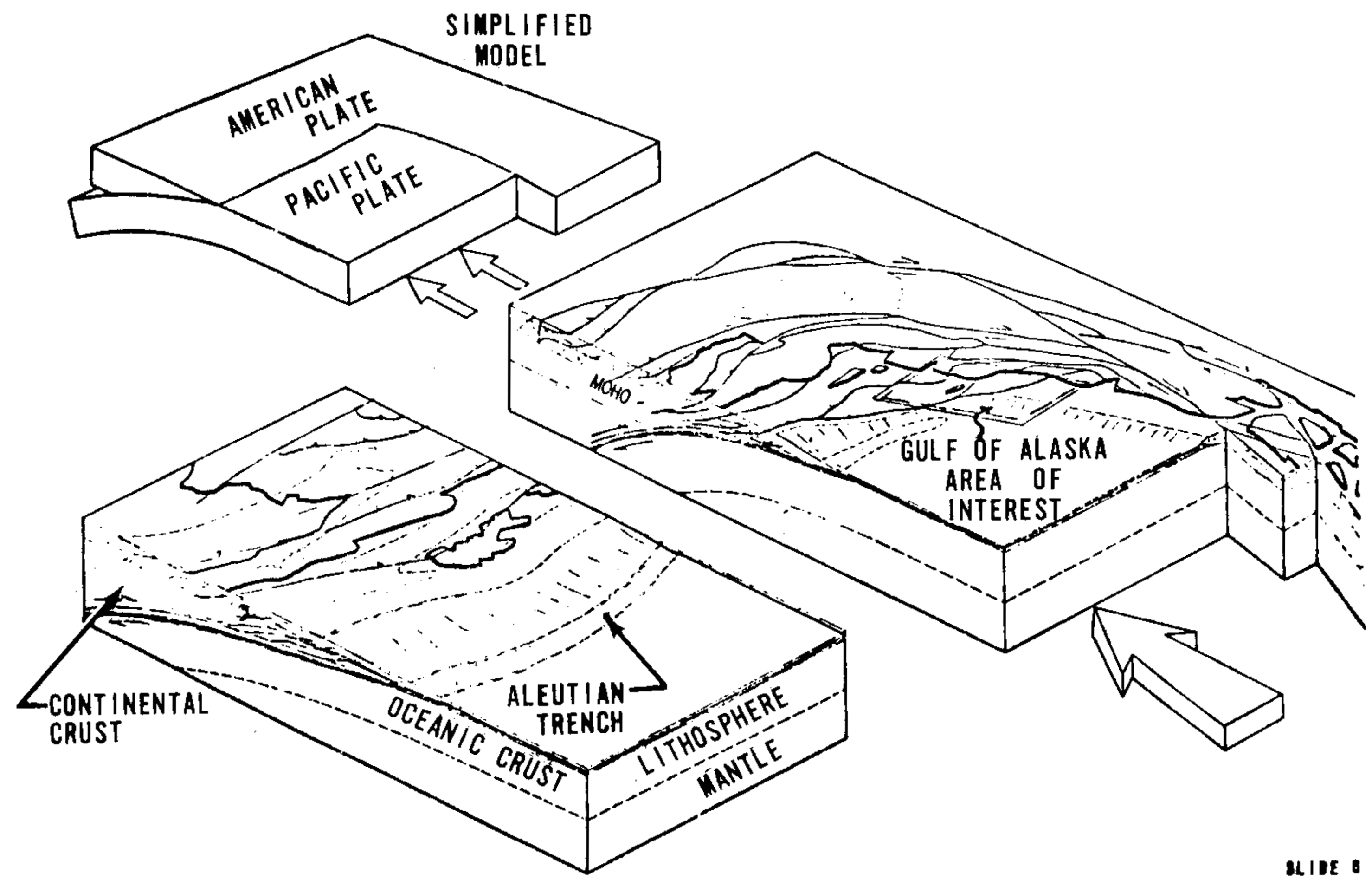
3 FAILURE MODE ANALYSIS

4 RISK ANALYSIS

j.h.wiggins company

SLIDE 5

GULF OF ALASKA PLATE MOTION

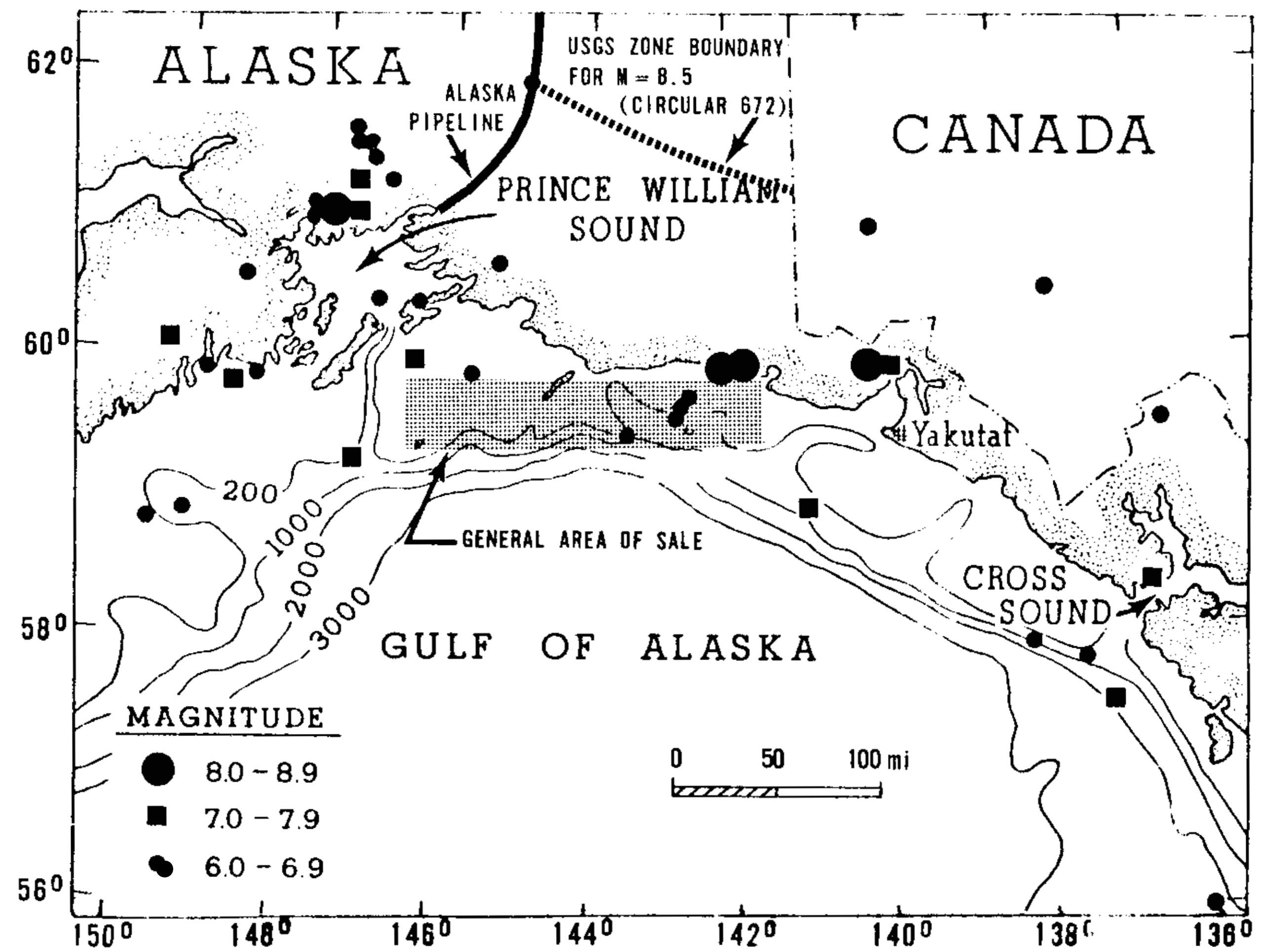


SLIDE 8

METHODS FOR CONSIDERING SEISMICITY

1. DETERMINISTIC – EXPERT JUDGMENT ABOUT MAGNITUDE AND DISTANCE

GULF OF ALASKA—EPICENTERS OF HISTORIC EARTHQUAKES



1. Submarine contours in meters.
2. After Page.

SLIDE 8

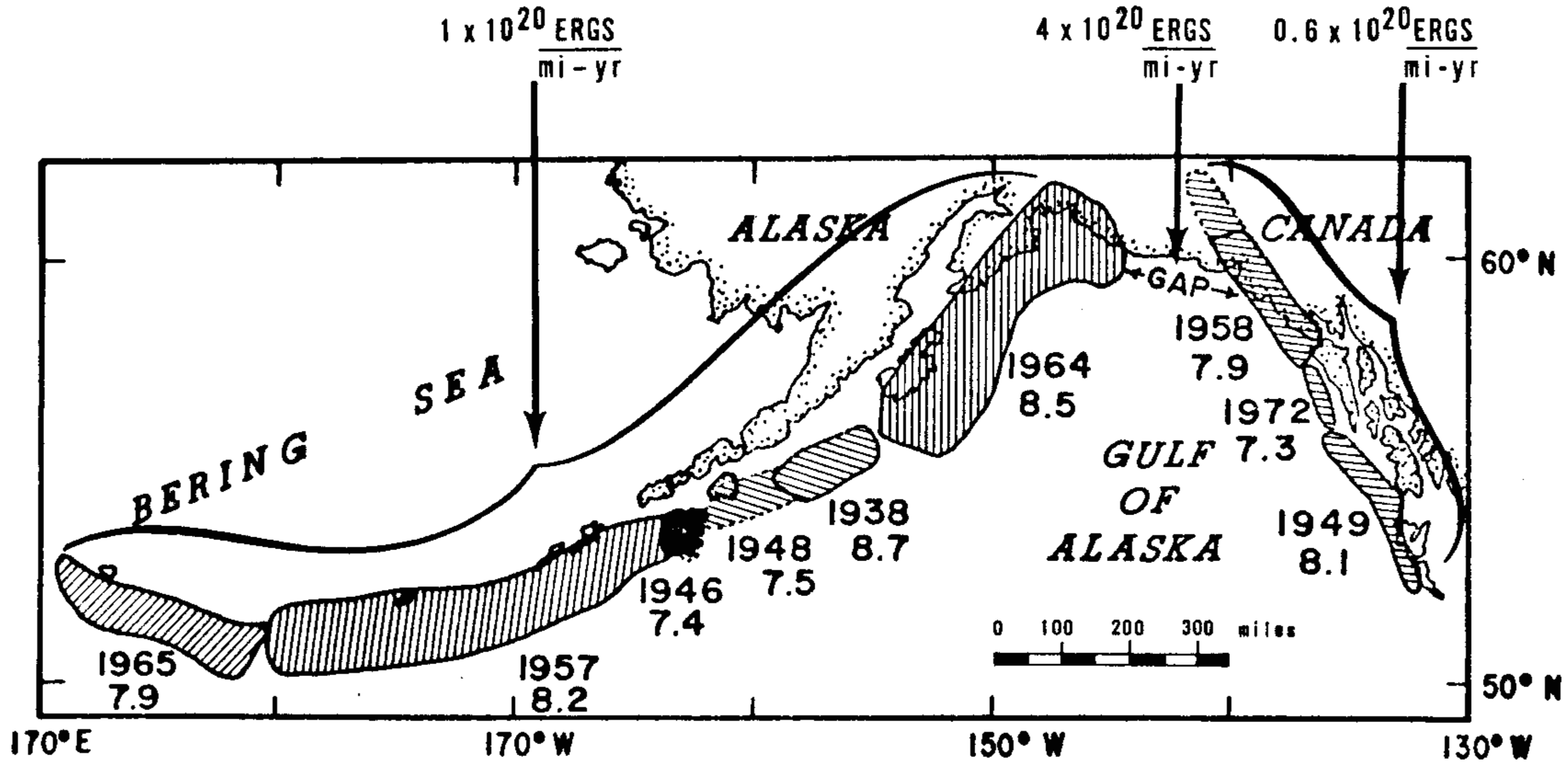
METHODS FOR CONSIDERING SEISMICITY

1. DETERMINISTIC - EXPERT JUDGMENT ABOUT MAGNITUDE AND DISTANCE
2. PROBABILISTIC - HISTORY IS LIKELY TO REPEAT ITSELF

METHODS FOR CONSIDERING SEISMICITY

1. DETERMINISTIC – EXPERT JUDGMENT ABOUT MAGNITUDE AND DISTANCE
2. PROBABILISTIC – HISTORY IS LIKELY TO REPEAT ITSELF
3. PROBABILISTIC – THE 'NEGATIVE' OF HISTORY IS LIKELY TO OCCUR

AFTERSHOCK ZONES OF EARTHQUAKES OF MAGNITUDE
7.3 OR GREATER SINCE 1938



1. Dashed where extent of zone is uncertain.
2. Dates and magnitudes given.
3. After Page.

SLIDE 11

METHODS FOR CONSIDERING SEISMICITY

1. DETERMINISTIC – EXPERT JUDGMENT ABOUT MAGNITUDE AND DISTANCE
2. PROBABILISTIC – HISTORY IS LIKELY TO REPEAT ITSELF
3. PROBABILISTIC – THE 'NEGATIVE' OF HISTORY IS LIKELY TO OCCUR
4. DETERMINISTIC:PROBABILISTIC – HISTORY REPEATS ITSELF ON KNOWN FAULTS

METHODS FOR CONSIDERING SEISMICITY

1. DETERMINISTIC – EXPERT JUDGMENT ABOUT MAGNITUDE AND DISTANCE
2. PROBABILISTIC – HISTORY IS LIKELY TO REPEAT ITSELF
3. PROBABILISTIC – THE 'NEGATIVE' OF HISTORY IS LIKELY TO OCCUR
4. DETERMINISTIC:PROBABILISTIC – HISTORY REPEATS ITSELF ON KNOWN FAULTS
5. PROBABILISTIC:UNCERTAIN – HISTORY WILL REPEAT ITSELF AT A UNIFORM RATE OVER A BROAD AREA

METHODS FOR CONSIDERING SEISMICITY

1. DETERMINISTIC - EXPERT JUDGMENT ABOUT MAGNITUDE AND DISTANCE
2. PROBABILISTIC - HISTORY IS LIKELY TO REPEAT ITSELF
3. PROBABILISTIC - THE 'NEGATIVE' OF HISTORY IS LIKELY TO OCCUR
4. DETERMINISTIC : PROBABILISTIC -
   HISTORY REPEATS ITSELF ON KNOWN FAULTS
5. PROBABILISTIC : UNCERTAIN -
   HISTORY WILL REPEAT ITSELF AT A
   UNIFORM RATE OVER A BROAD AREA
6. PSUEDO DETERMINISTIC -
   LARGE PRIOR EARTHQUAKES FORETELL
   FUTURE SHOCKS

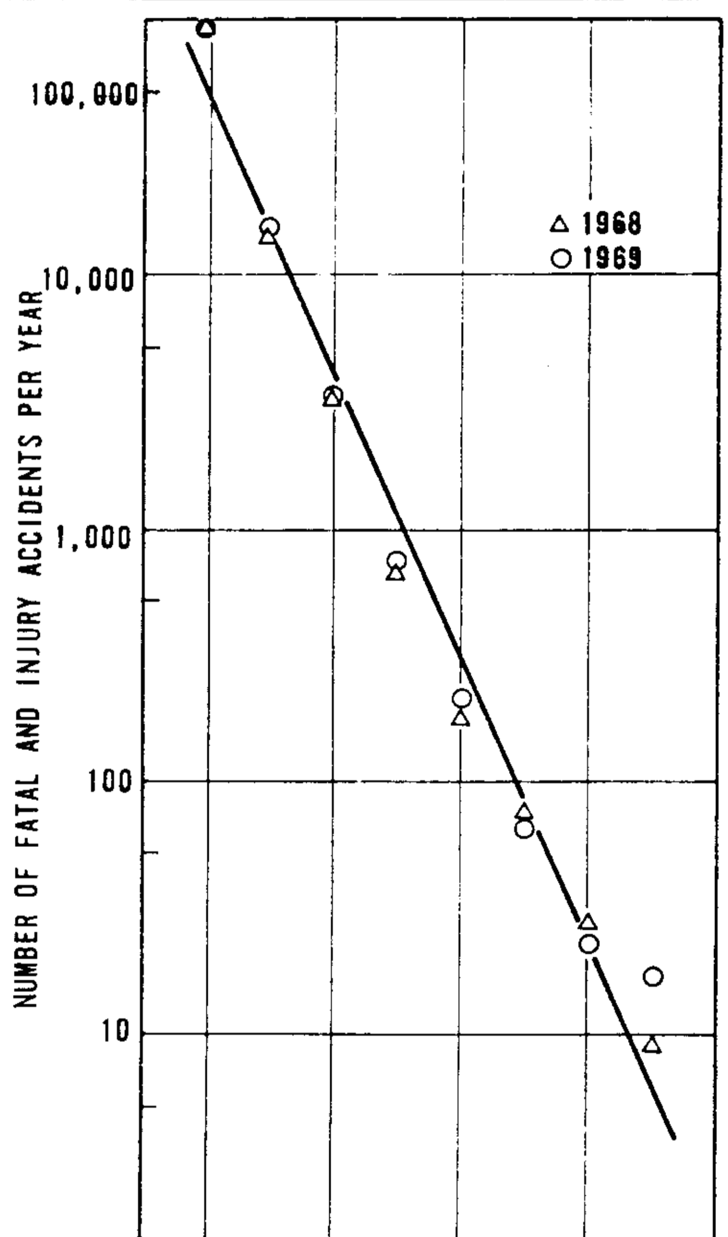
OUR METHOD OF REPRESENTING SEISMICITY

USE METHOD 2 - HISTORY IS LIKELY TO REPEAT ITSELF USING FAULT LINE CORRECTIONS IN METHOD 1

REASONS

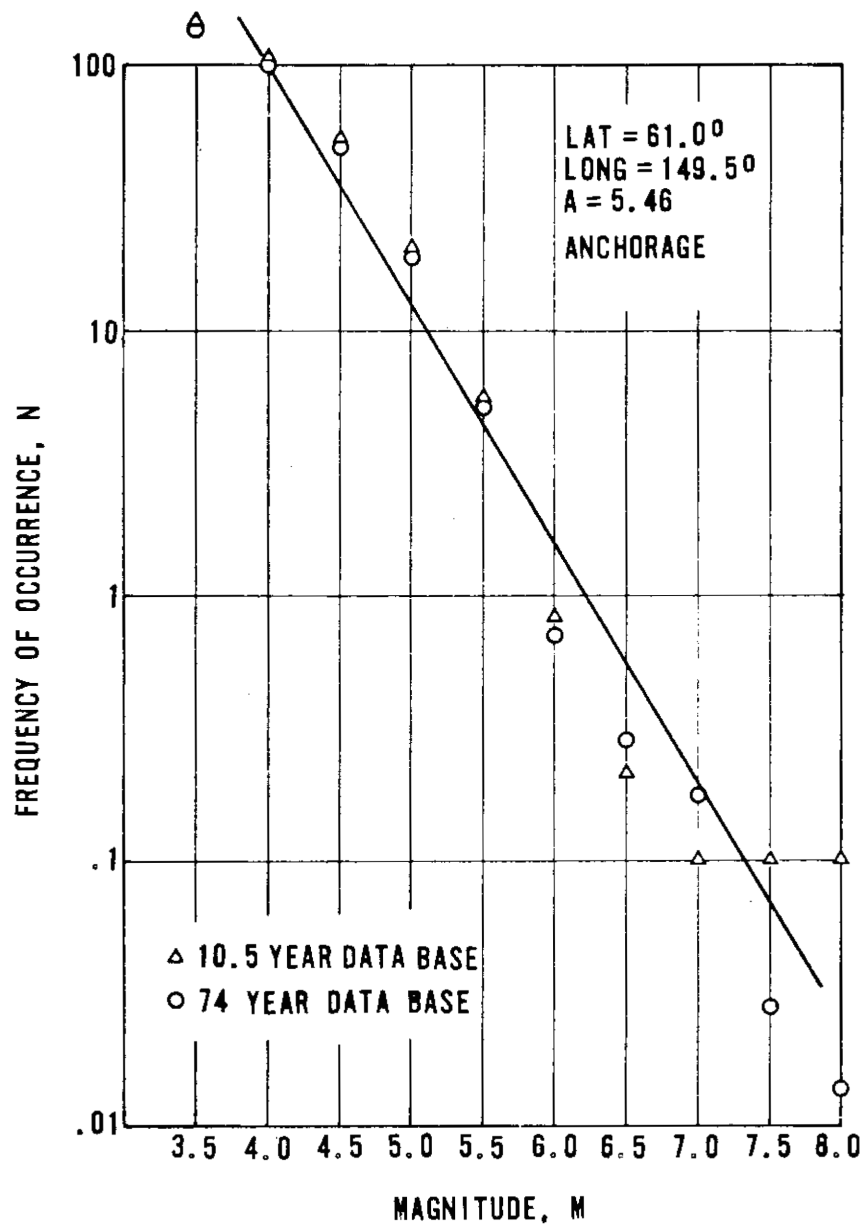
1. BAYESIAN MAPS OF CALIFORNIA
2. PROBABILISTIC ENGINEERING FRAMEWORK
3. FOLLOWS RATIONALE OF STRUCTURAL ENGINEERS ASSOCIATION OF CALIFORNIA
4. SATISFIES CASE LAW REQUIRING THAT 'THE SEVERITY OF THE REGULATION SHALL MATCH THE SEVERITY OF THE RISK.'

FATAL AND INJURY ACCIDENTS BY NUMBER OF VEHICLES (CALIF.)



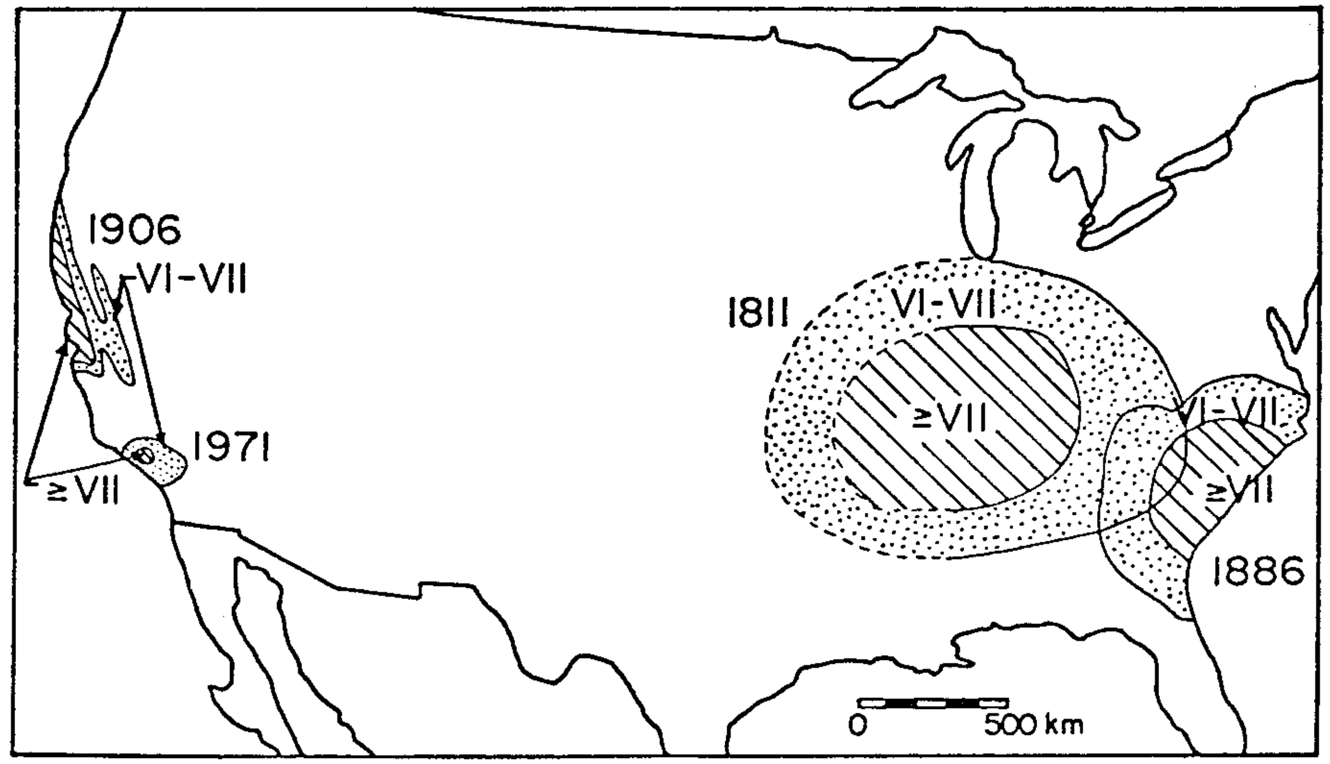
SLIDE 16

EARTHQUAKE FREQUENCY DISTRIBUTION FOR ANCHORAGE



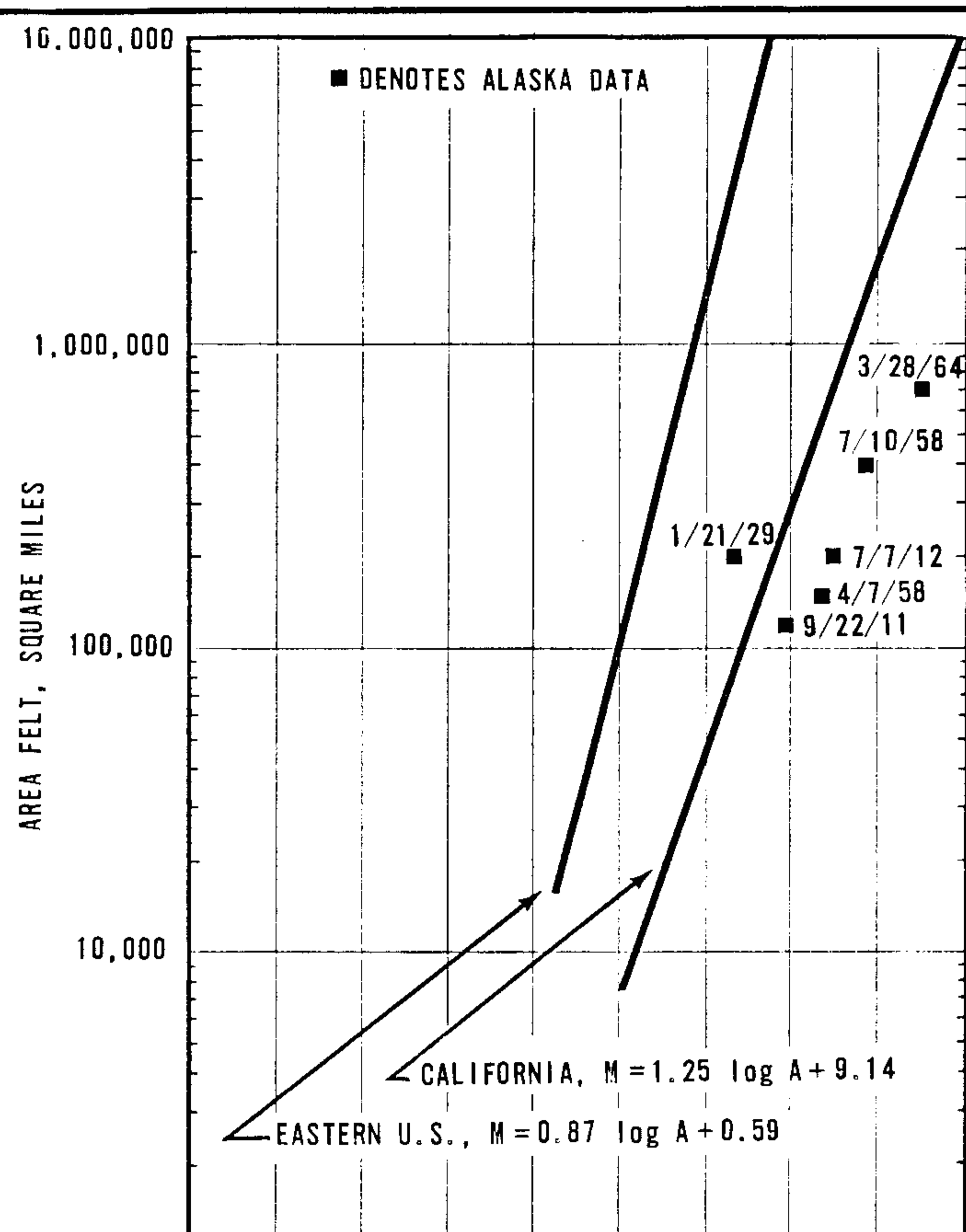
SLIDE 17

COMPARISON OF DAMAGE AREAS



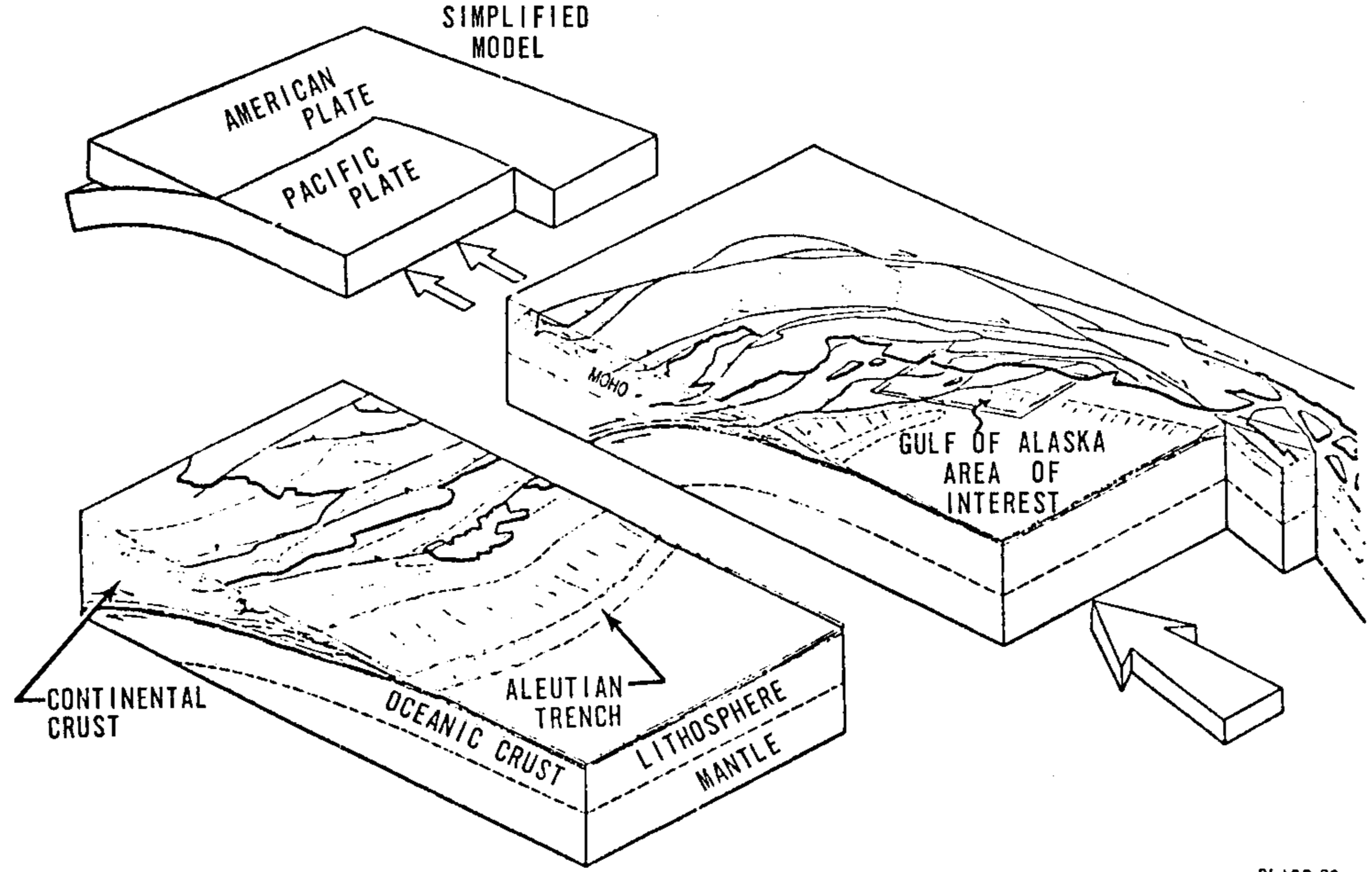
1. The 1906 and 1811 earthquakes were about equal in magnitude, as were the 1971 and 1886 earthquakes.
2. After Nuttli.

FELT AREA OF ALASKA EARTHQUAKES IS LESS THAN THAT OF CALIFORNIA OR THE EASTERN PART OF THE UNITED STATES



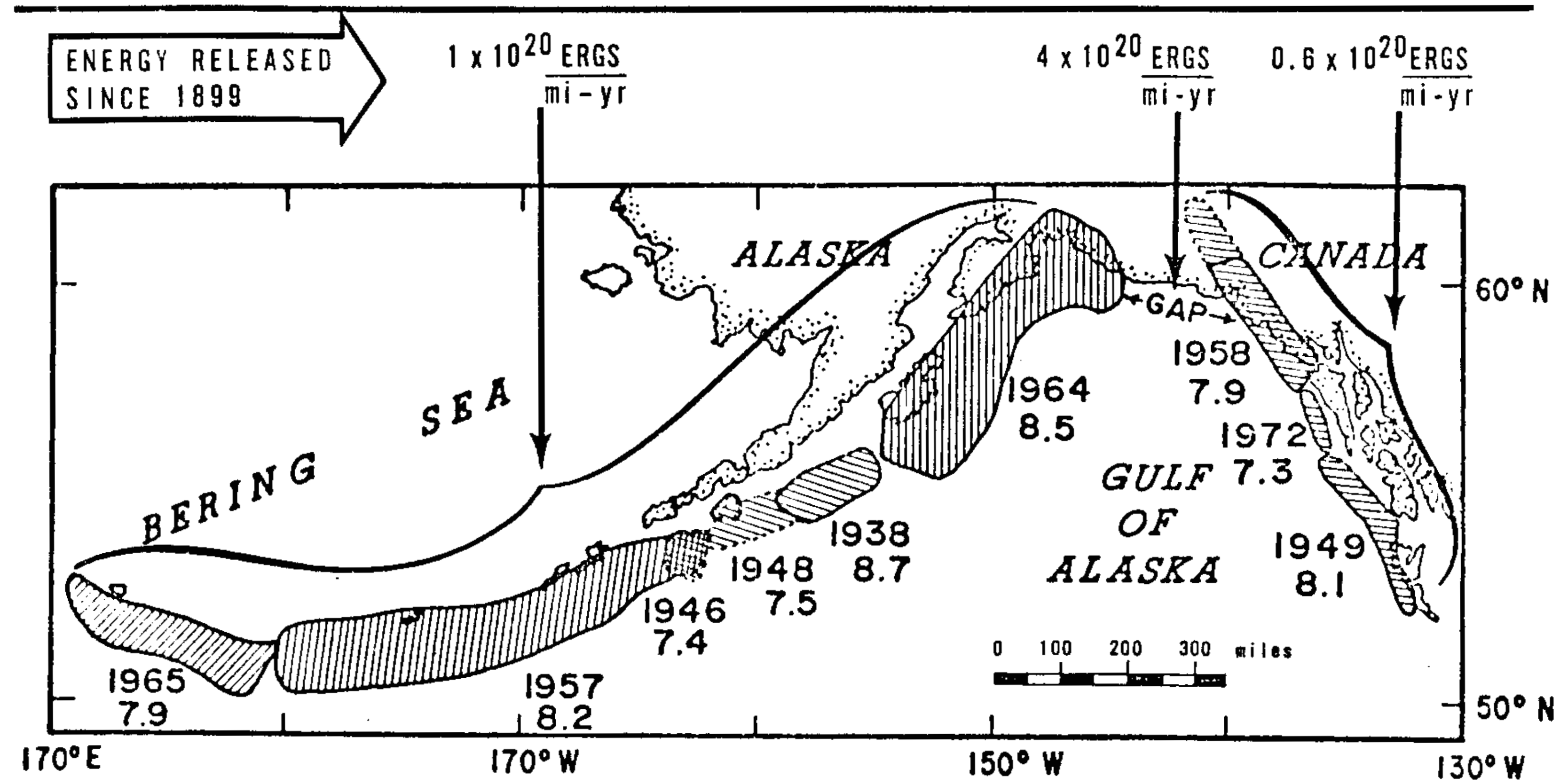
THE TWO CURVES WERE CONSTRUCTED FROM EQUATIONS IN NBS, BSS #61, ASSUMING A 'FELT' MMI OF III.

GULF OF ALASKA PLATE MOTION



SLIDE 20

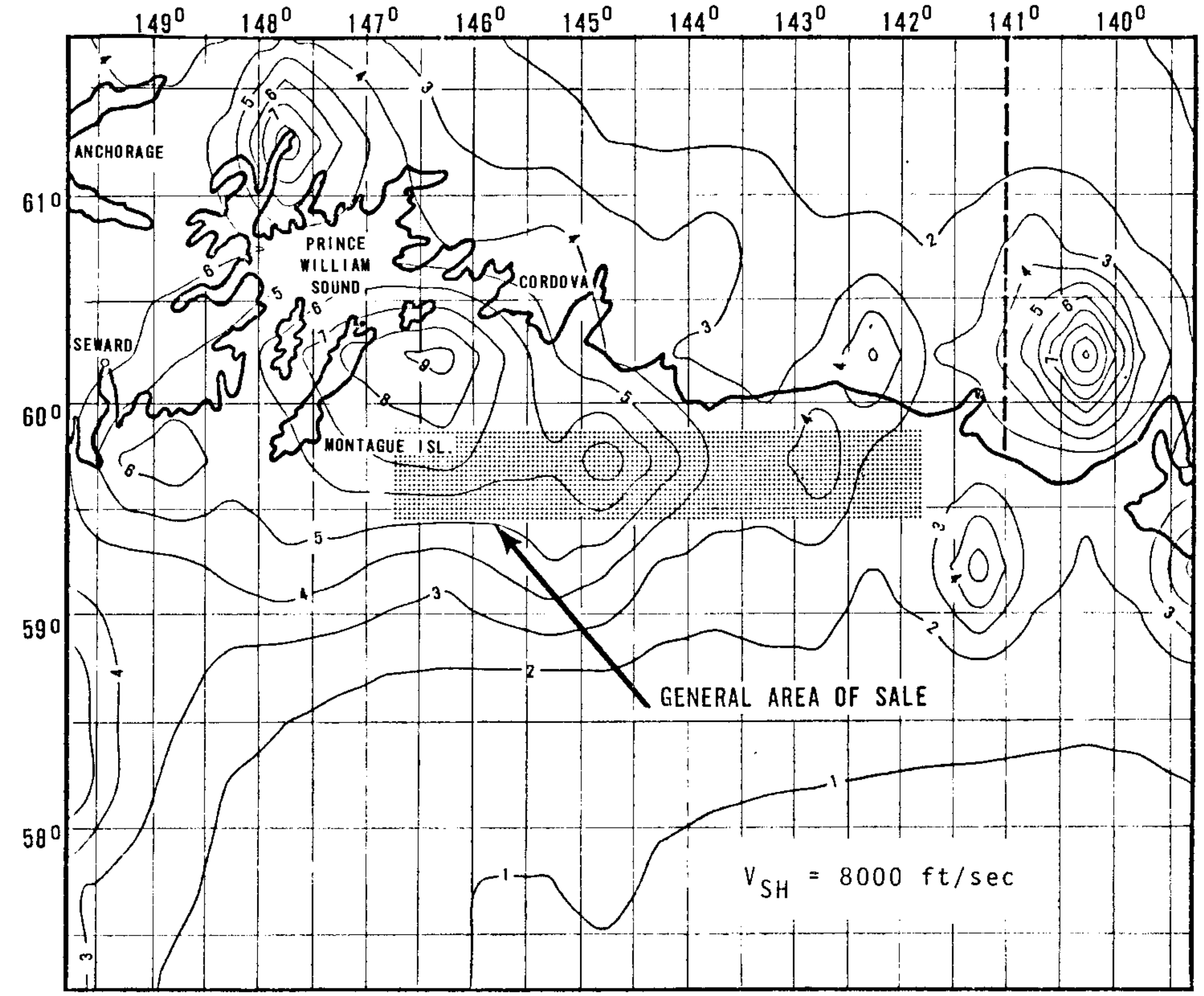
AFTERSHOCK ZONES OF EARTHQUAKES OF MAGNITUDE 7.3 OR GREATER SINCE 1938



1. Dashed where extent of zone is uncertain.
2. Dates and magnitudes given.
3. After Page.

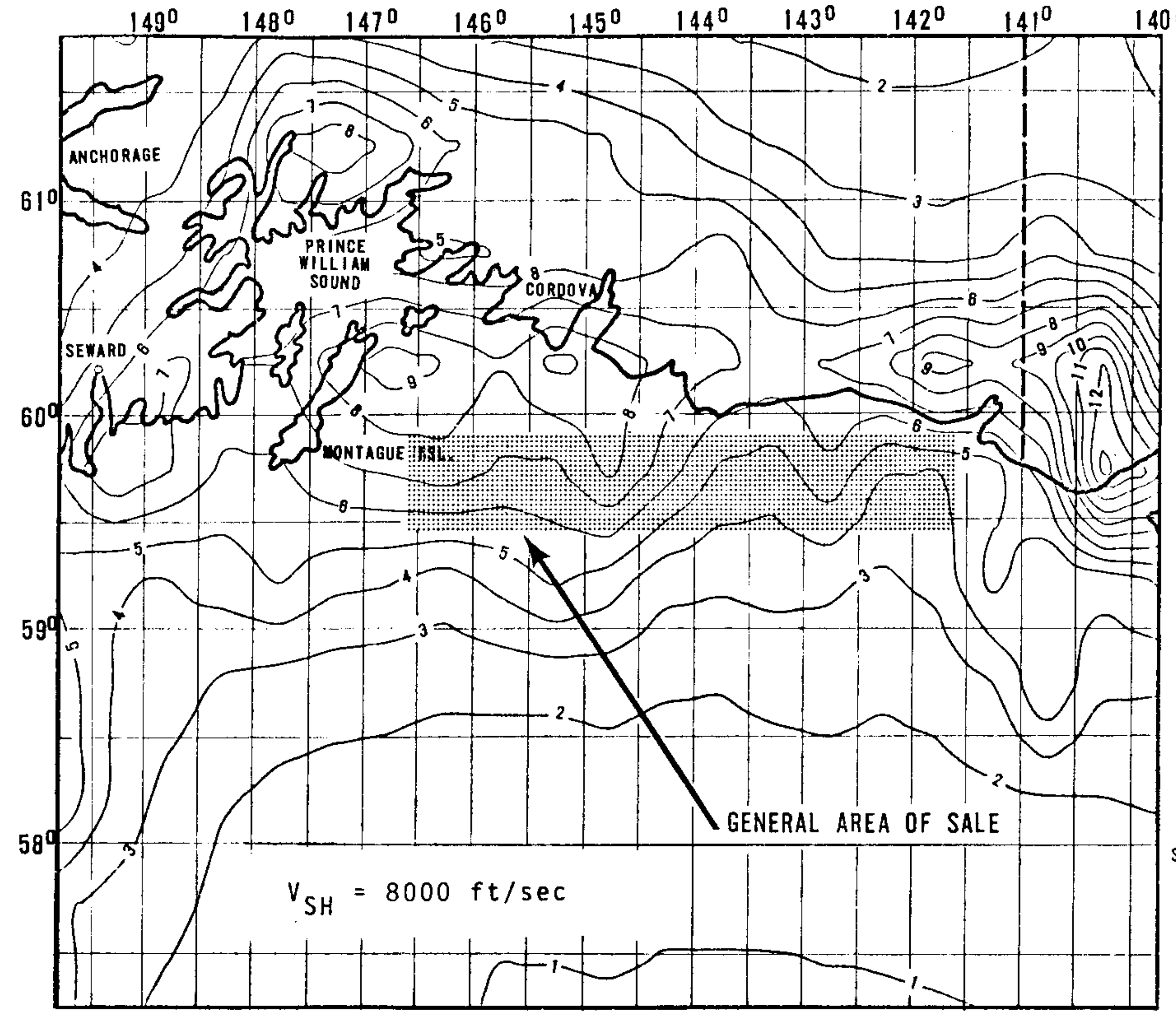
SLIDE 21

HARDROCK VELOCITY (IN/SEC), GULF OF ALASKA, RETURN PERIOD = 100 YEARS
(NO FAULT LINE ENERGY DISTRIBUTION)



SLIDE 22

HARDROCK VELOCITY (IN/SEC), GULF OF ALASKA, RETURN PERIOD = 100 YEARS (WITH FAULT LINE ENERGY DISTRIBUTION)

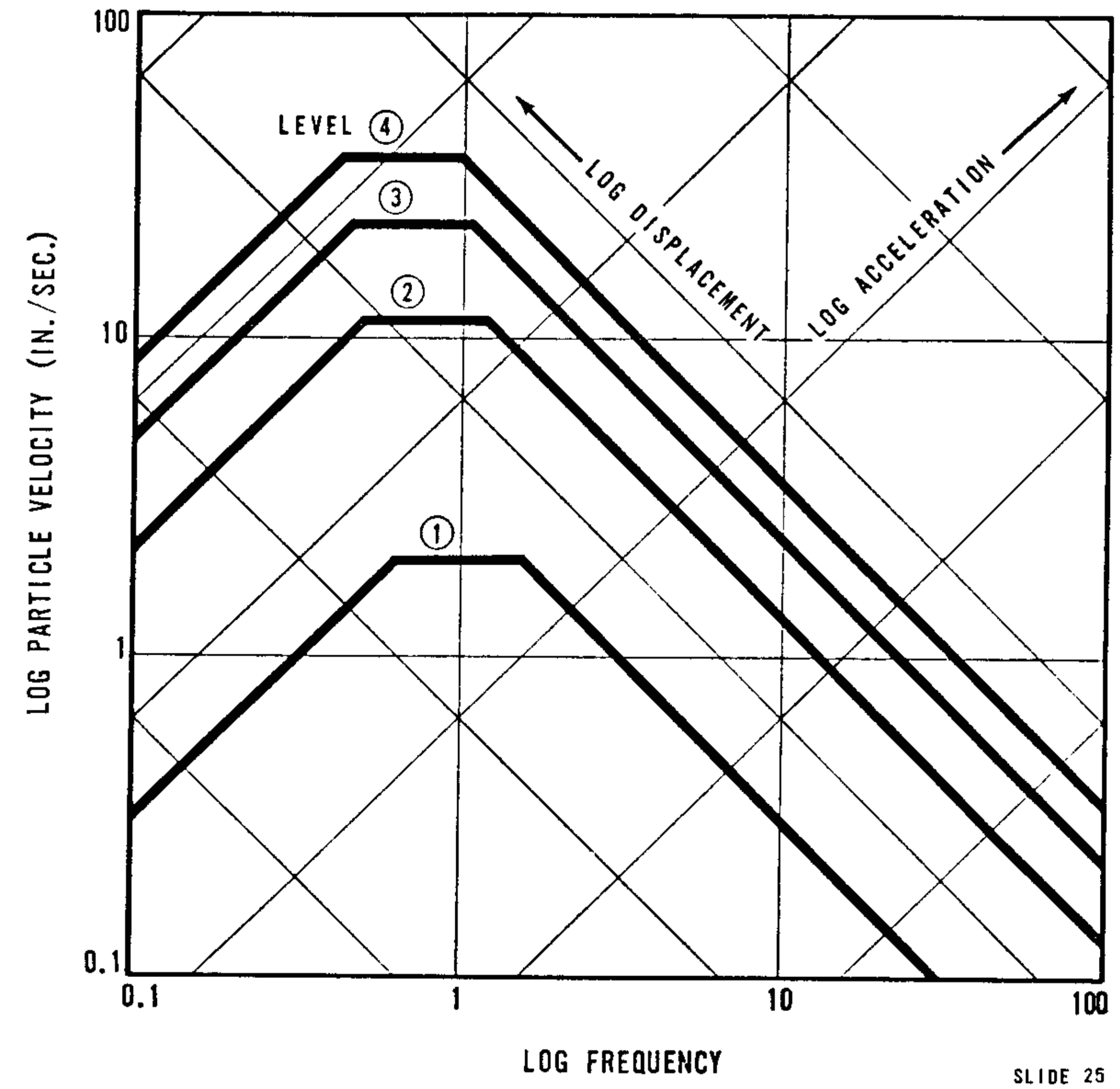


SLIDE 23

ANALYSIS CRITERIA

	BUILDING LIFE	PROBABILITY OF EQUALING OR EXCEEDING
UNIFORM BUILDING CODE	50 YRS	22%
USGS RISK MAPS	50 YRS	10%

HARDROCK PARTICLE VELOCITY SPECTRA (V_{SH} = 3800 FT/SEC)



SLIDE 25

EARTHQUAKE PROBABILITIES FOR SEISMIC ENVIRONMENTS IN GOA

FOR MONTAGUE ISLAND AREA

LEVEL NUMBER	P_0(%)
1	99.9
2	31.9
3	12.8
4	5.6

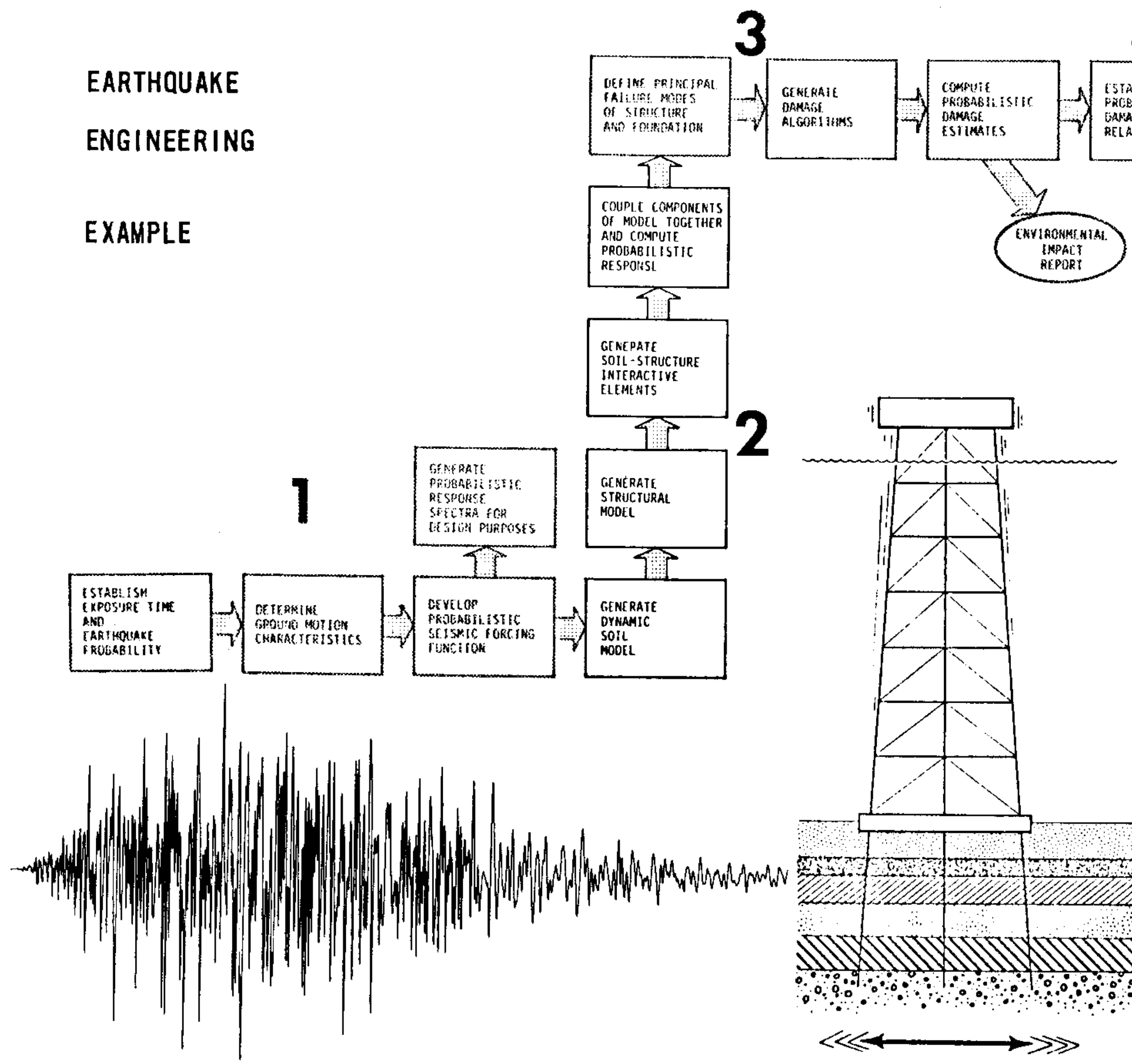
FOR YAKUTAT AREA

LEVEL NUMBER	P_0(%)
1	97.2
2	18.4
3	6.0
4	3.1

EARTHQUAKE

ENGINEERING

EXAMPLE



1 SEISMIC ENVIRONMENT

2 STRUCTURAL ANALYSIS AND RESPONSE

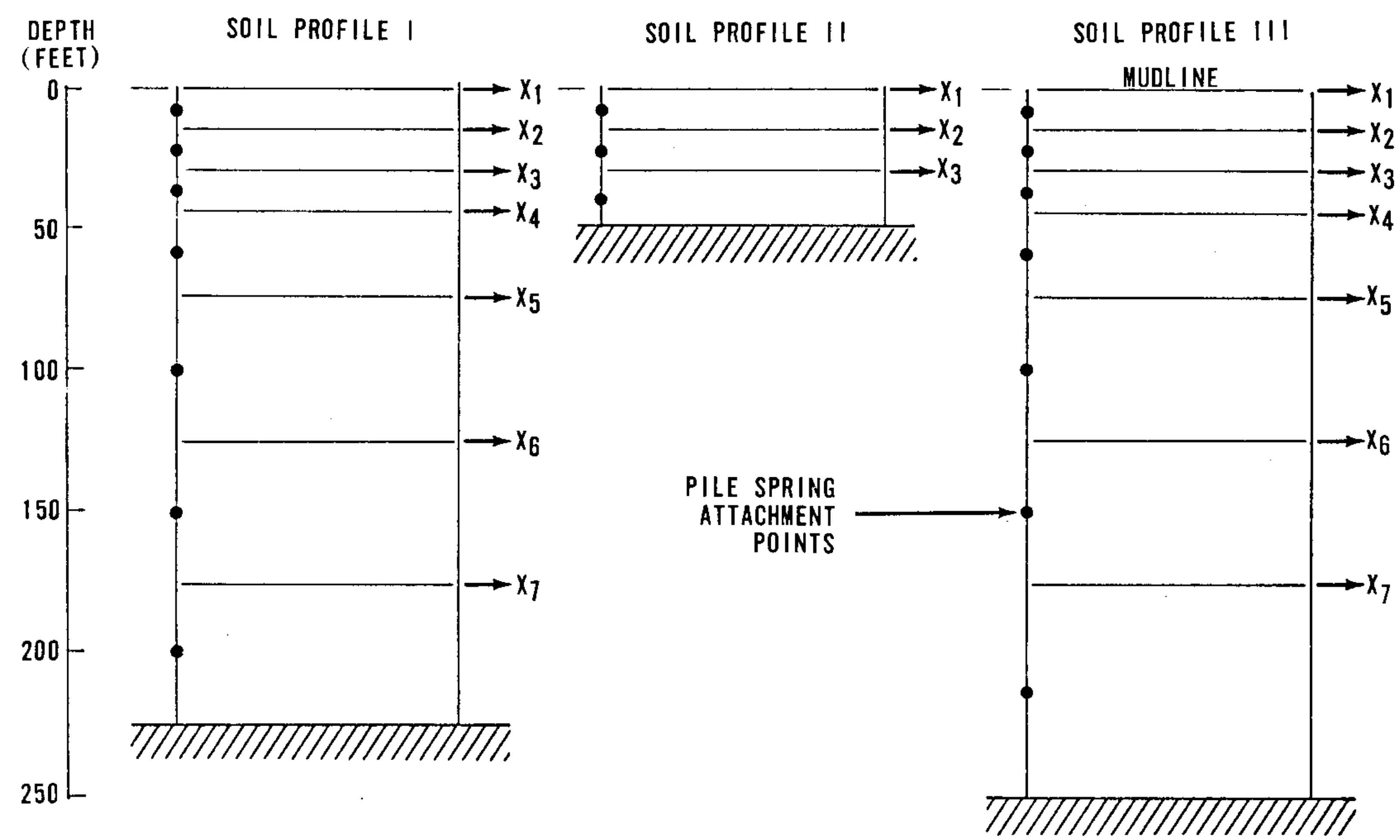
3 FAILURE MODE ANALYSIS

4 RISK ANALYSIS

j.h.wiggins company

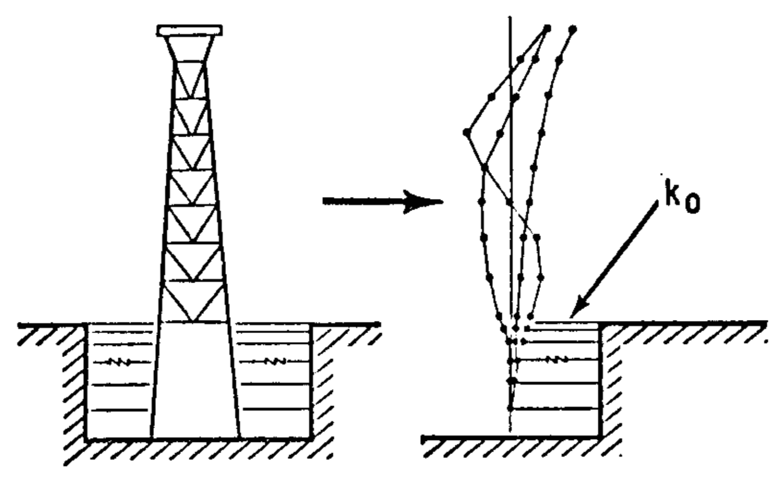
SLIDE 27

FINITE ELEMENT MODELS FOR THREE SOIL PROFILES

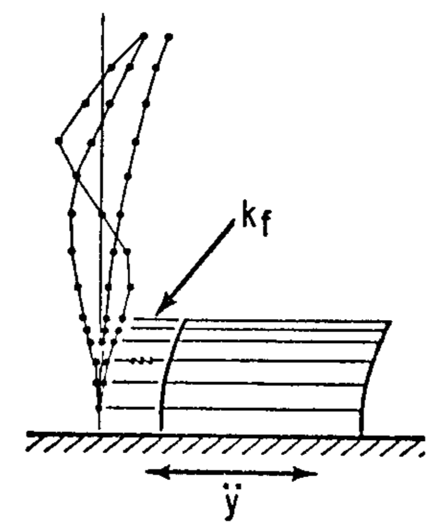


SLIDE 28

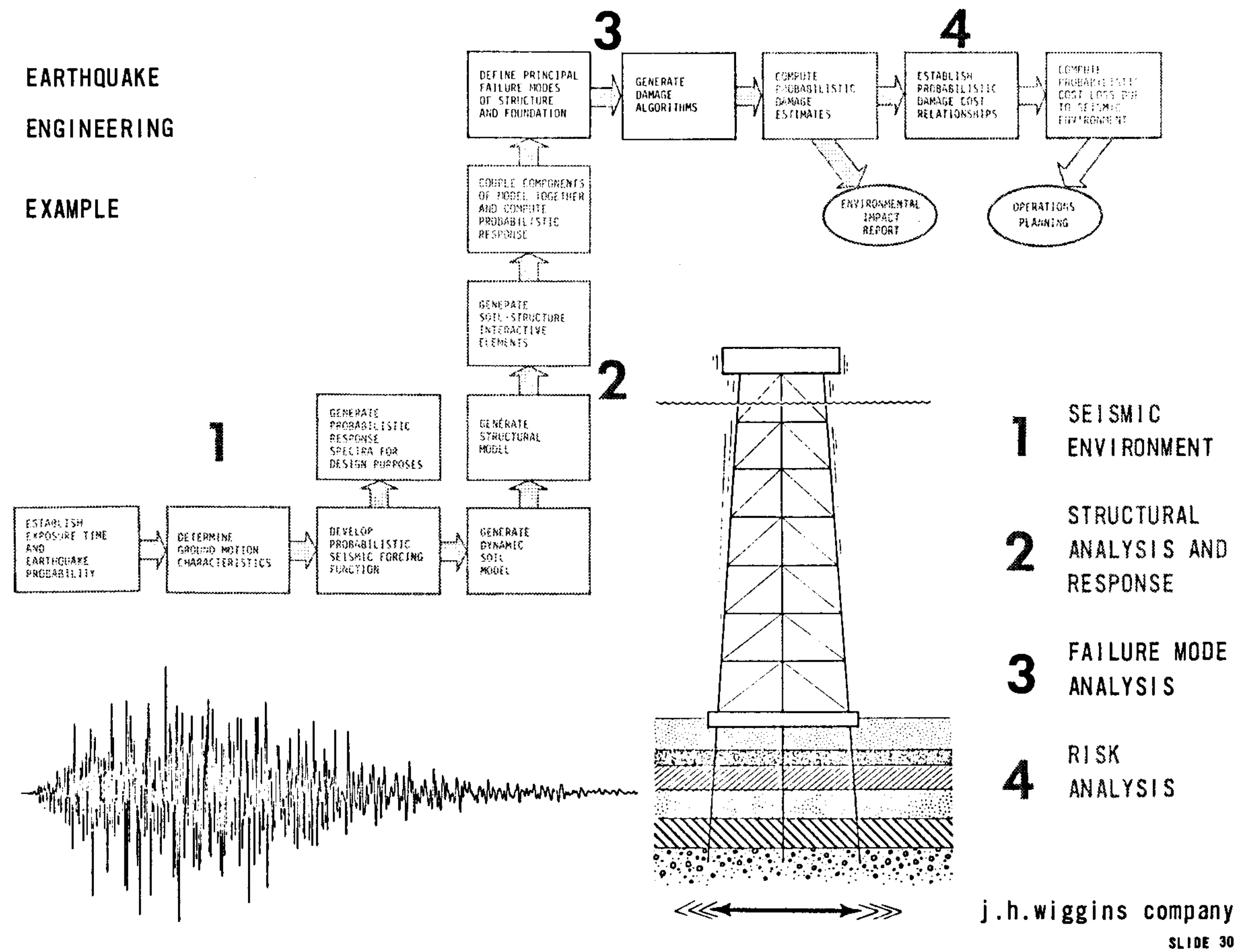
MODAL REPRESENTATION
OF A COMPLEX STRUCTURE



COUPLED RESPONSE OF
SOIL STRUCTURE SYSTEM



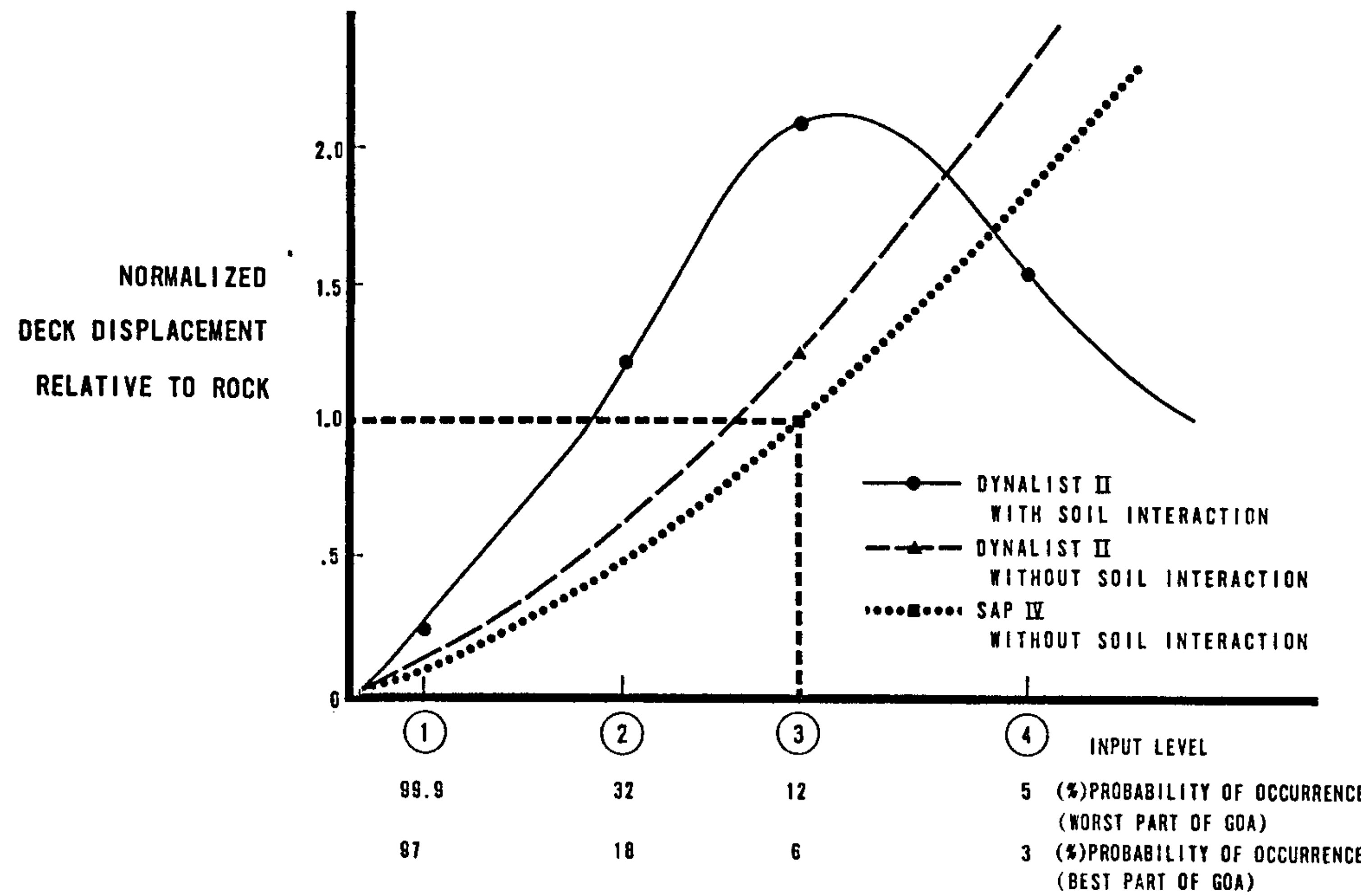
SLIDE 29


EARTHQUAKE
ENGINEERING
EXAMPLE
1
ESTABLISH EXPOSURE TIME AND EARTHQUAKE PROBABILITY
DETERMINE GROUND MOTION CHARACTERISTICS
DEVELOP PROBABILISTIC SEISMIC FORCING FUNCTION
GENERATE PROBABILISTIC RESPONSE SPECTRA FOR DESIGN PURPOSES
GENERATE DYNAMIC SOIL MODEL
GENERATE STRUCTURAL MODEL
2
GENERATE SOIL-STRUCTURE INTERACTIVE ELEMENTS
COUPLE COMPONENTS OF MODEL TOGETHER AND COMPUTE PROBABILISTIC RESPONSE
DEFINE PRINCIPAL FAILURE MODES OF STRUCTURE AND FOUNDATION
3
GENERATE DAMAGE ALGORITHMS
COMPUTE PROBABILISTIC DAMAGE ESTIMATES
ENVIRONMENTAL IMPACT REPORT
4
ESTABLISH PROBABILISTIC DAMAGE COST RELATIONSHIPS
OPERATIONS PLANNING
1 SEISMIC ENVIRONMENT
2 STRUCTURAL ANALYSIS AND RESPONSE
3 FAILURE MODE ANALYSIS
4 RISK ANALYSIS
j.h.wiggins company
SLIDE 30

FAILURE MODES CONSIDERED

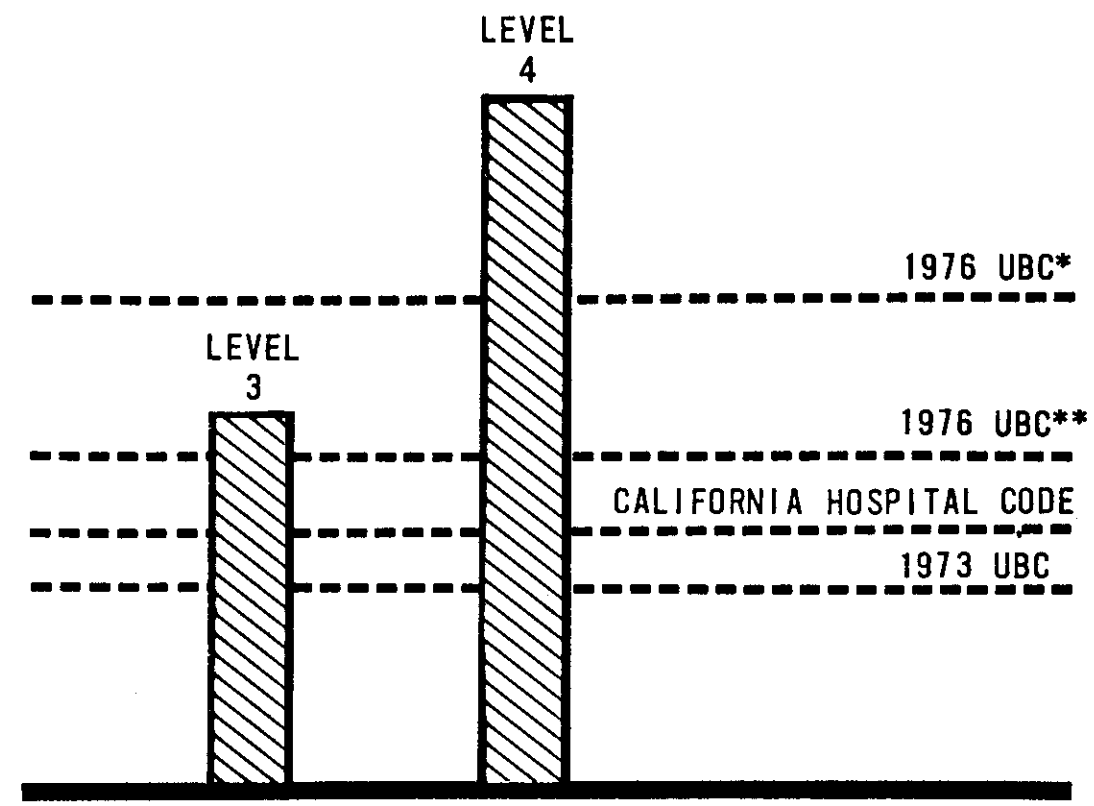
1. DECK STRUCTURE
2. TEMPLATE
3. PILES IN COMPRESSION
4. PILES IN TENSION
5. CONDUCTOR PIPE

COMPARISON OF RESPONSE METHODS



SLIDE 32

COMPARISON OF LEVELS OF ANALYSIS PERFORMED ON PRELIMINARY GOA STRUCTURES WITH EXISTING U.S. CODES



* Worst Soil, Most Important Structure.
** Best Soil, Most Important Structure.

SLIDE 33

SEISMIC RISK - PROBABILITY OF OCCURRENCE

- PROBABILITY OF EARTHQUAKE = P_E
- PROBABILITY OF LOCATION = P_L
- PROBABILITY OF RESPONSE = $P_E \times P_L \times P_R$
- PROBABILITY OF DAMAGE = $P_E \times P_L \times P_R \times P_D$
- PROBABILITY OF LOSS ($) = $\underbrace{P_E \times P_L \times P_R \times P_D \times P_\$}_{\text{CONDITIONAL PROBABILITIES}}$

STATEMENT

OF

LELAND E. WILSON

BEFORE

THE U.S. DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT HEARING

ON THE

PROPOSED OUTER CONTINENTAL SHELF
OIL AND GAS LEASE SALE

GULF OF ALASKA

________, 1975

ANCHORAGE, ALASKA

Mr. Chairman, my name is Leland E. Wilson. I am a 1950 graduate of Tulsa University in Petroleum Engineering. Since 1950 I have worked with Atlantic Richfield Company, primarily in drilling and production activities. I am a registered Petroleum Engineer in the State of Alaska and have authored several technical papers on drilling and production. My experience includes eight years in the offshore areas of the Gulf of Mexico, four years in the Cook Inlet area and three years on the North Slope. For the past three years I have been associated with my company's operations in the North Sea. While the North Sea is not the Gulf of Alaska, there are many physical similarities between these two areas and certain of the operating conditions found in the North Sea will be present in the Gulf. For that reason, the experience of the industry in the North Sea is relevant to this hearing.

In my opinion the North Sea effort has clearly demonstrated industry's proven capability to explore and develop in a severe environment. However, it should be borne in mind that we will be entering the Gulf of Alaska very substantially better prepared, equipped and supported than we were when operations commenced in the North Sea. We will have more and better data on basic environmental conditions and structural design for the Gulf. This results from our industry programs relating to meteorology, oceanography, current data, weather forecasting, wave hindcast evaluation, superstructure icing and, most importantly, on our evaluation of the significance of this data. We will be entering the Gulf of Alaska with capable, trained personnel and will be able to draw from a well developed and experienced oil industry related infrastructure of capable contractors.

(1) Index Map of the North Sea Area.

It was in 1964 that the governments of the various countries surrounding the North Sea began awarding exploration licenses. Early drilling was confined to the southern portion of the North Sea in water depths of less than two hundred feet. Large gas fields, including Leman Field, one of the largest offshore gas fields in the world with reserves of about ten trillion cubic feet of gas, were quickly discovered. Gradually drilling operations moved northward, and the first major oil field Ekofisk, was discovered in Norwegian waters in 1969. Other new oil fields were discovered at Forties, Josephine, Auk, and Brent, and new gas fields were found at Heimdal and Frigg. The northernmost drilling site of 62^{0} North latitude in the North Sea compares with a latitude of about 60^{0} North for the northern Gulf of Alaska.

(2) Slide of Fields

A total of 975 wells have been drilled in the North Sea since the beginning of leasing in 1964. Of these 975 wells, 725 have been exploratory holes. Of these exploratory wells, 520 were dry holes, 120 discovered gas and 85 discovered oil. Seventeen commercial gas fields and twenty-four commercial oil fields have been discovered.

The North Sea was quite different from other major operating areas where the industry had previously worked. The Gulf of Mexico, although certainly severe at times, did not generate the continual storm environment of the winters in the North Sea. There we have not only sea states of 65 to 85 ft. maximum waves, but we had added the conditions of extremely cold water, heavy swells from the mid-Atlantic and rapid development of storm conditions both from the North and West. Fog conditions were frequent and radio/communications/navigation systems were not as well developed in the North Sea as in the Gulf of Mexico. It is not unusual to have extended periods of downtime due to this wide spectrum of offshore problems, for example: one drill ship which we contracted for was essentially idle from November 15th to February 15th with almost no progress. The semi-submersibles which are better equipped to maintain operations under storm conditions have also been shutdown for weeks at a time due to one or more of the variety of conditions which can cause downtime. The Gulf of Mexico seldom shuts down rigs for such long periods although individual hurricane storms can be just as severe for short periods.

To search for and produce oil under adverse conditions new equipment had to be designed and built. One of the major tasks was to develop drilling and production platforms capable of withstanding the harsh sea and weather conditions. The early drilling in shallow water depths in the southern North Sea was accomplished from existing jack-up rigs. As drilling moved North into more severe weather conditions and greater water depths, semi-submersible rigs such as are shown on these viewgraphs were used:

(3) SEDCO 135

(4) BLUE WATER III

(5) TRANSWORLD 61

These rigs were utilized in water depths up to six hundred feet and, in summer months, as far north as the Shetland Islands (refer to Viewgraph 1). Generally, these rigs returned to more southern drilling sites in winter months to allow for more efficient operations. However, as demand increased for year-round exploration, as well as for exploration in the far north (up to 62^{o} North Latitude), more sophisticated, heavy,semi-submersibles were built to cope with the sea and weather conditions:

(6) WAAGE II

(7) PENTAGONE DESIGN

(8) SEDCO 700

(9) AKER H-3

(10) PENROD 71

These rigs, some displacing upwards of 30,000 tons, can work safely in gale force winds and high sea states. They are capable of survival in one hundred foot seas and are able to continue efficient operations in twenty to twenty-five foot seas in water depths of over one thousand feet. Most are self propelled, use all-chain anchor systems, and have crews of seventy to ninety men. Many of these rigs have sustained maximum wave heights of seventy feet and mean wind velocities of over sixty-five miles per hour. In the event of severe storms, a rig of this type can disconnect from the sea floor and ride out the storm, primarily because of its design which offers much less resistance to waves than does a ship shape. Most of this new generation of semi-submersibles are ocean going craft that can, and have, crossed the Atlantic under their own power or with only an accompanying tug.

(11) Illustration of Transparent Design

As of July 1, 1975 there are thirty-five semi-submersible rigs working in the North Sea from about Latitude 56^{o} North to 62^{o} North. It might be noted that all rigs and hull designs are carefully checked by qualified marine surveyors such as Det Norske Veritas, Lloyds, and the American Bureau of Shipping.

In addition to advanced drilling platforms, development of associated equipment has aided in operations in the North Sea and contributed to the fine safety record of these new rigs. For example, major advancements have been made in the design of Blowout Preventers and subsea equipment. Operators regularly use 10,000 psi working pressure equipment although little high pressure has been encountered. The newer equipment allows releasing from the sea floor safely, reconnecting and completely circulating the well prior to opening BOP's. Fail-safe valves, shear rams, redundancy on all safety systems and frequent tests have greatly improved the reliability of all this equipment.

Another major development greatly aiding operations in the North Sea has been better weather forecasting utilizing computers and satellites. These forecasts give us more lead time to prepare for storms and allow a prediction of their duration. Many operators use the London Weather Centre and independent contracting firms to give them twice a day forecasts or even more frequent if storm conditions are worsening. For example, our own Company uses a procedure whereby if weather forecasts are for twenty-five foot seas and/or forty-five mile per hour winds we discontinue drilling new hole, but may continue with other operations which are considered safe such as: logging or running casing. If wave heights are forecast to be greater than thirty-five feet we suspend all operations at the drill floor, pull and lay down sufficient drill pipe to allow the drill string to be hung off on the lower pipe rams with the bit inside the casing. If wave heights are expected to exceed forty-five feet or there is a vertical motion of the drill floor equal to or greater than fifteen feet we pull and lay down the riser pipe with the drill pipe still in the hole at the base of the last string of casing. In this position we are able to ride out the remainder of the storm or if we were moved off location by an anchor slippage it would not be too difficult or expensive to get back on to location again. It is very rare for the personnel to be removed from the rig since the vessel is seaworthy and designed to withstand up to one hundred foot waves.

In order to offset the long distances from operating bases it was necessary to greatly improve support transportation. Long range helicopters with large load capacities have significantly helped to alleviate the distance problem. These helicopters can quickly deliver emergency supplies and technical assistance when needed. Specially designed supply ships with 1,000 ton cargo capacity are now common. In addition to moving large amounts of supplies in one trip, these ships can serve as anchor handling vessels, supply vessels, towing vessels and safety vessels.

(12) Viewgraph of Supply Boat

Increased storage areas on rigs also help to resolve the supply problem. The larger rigs can store up to 2,000 tons or more of variable loads of muds, cement, water and fuel, as well as items for human consumption. This increased storage capacity helps to prevent in-hole problems as enough materials can be kept on board to cope with emergencies until more supplies can be obtained.

Rigs in the North Sea are manned by much more than a driller and a few roughnecks. Highly trained technical personnel in numerous fields stay on board. On a typical rig in the North Sea will be found superintendents, both for contractor and company, geologists, drilling engineers, electricians, mechanics, sub-sea engineers, mud engineers, cementers, welders, weather observers, a complete marine crew, and a team of expert divers.

There is no doubt that those operating in the Gulf of Alaska will benefit greatly from industry's experience in the North Sea, including the mistakes that were made. For example, certain rig deficiencies noted in the early stages of the North Sea activity have resulted in significant improvements in structural design, instrumentation, and inspection techniques which will provide much more reliable Units for the Gulf of Alaska than were available for the initial operations in the North Sea. Several rigs which were of inadequate design have failed to perform properly and one jack-up rig and one semi-submersible has been lost in storms. Inadequately designed rigs are now relegated to the Mediterranean and other milder areas. In addition one gas well went out of control and a relief well had to be drilled to control it, however no environmental damage was done during this blow out. Many of the lessons we have learned in drilling in the North Sea will be of benefit to the Gulf of Alaska operation, such as proper marine riser tension, use of motion compensators, proper storm draft, and improved anchor handling techniques.

The success of the North Sea operation reflects the proven ability of the oil industry to explore and develop in a hostile environment similar to that which will be encountered in the Gulf of Alaska. I believe it is reasonable to expect an even better personnel and equipment safety record in the Gulf of Alaska as a result of improvements initiated in the North Sea. Wells are now routinely being drilled East of the Shetland Islands at distances of 200-250 miles from the Aberdeen shore base which require 2½-3 hours helicopter flying time and 24-30 hours boat time each way. Sea temperatures are very similar to that of the Gulf of Alaska at between eight and nine degrees centigrade during the winter months. From what I have seen of the storm data of the Gulf of Alaska it appears that the same frequency of storms and similar sea states can be expected during the winter months.

It is a credit to the governments of the countries surrounding the North Sea and the industry that despite all of this activity no major oil spills or serious environmental damage has occurred. This outstanding record has been achieved even though the area was entered and initially explored with a lack of experience in operating in such an environment and without some of the more sophisticated technology and logistical support which will be available in the Gulf of Alaska.

In conclusion, let me point out that the North Sea is estimated to contain 30 billion barrels of oil reserves and 85 trillion cubic feet of gas reserves. Production should peak at about 2.8MM barrels per day of oil and 10 billion cubic feet per day of gas by 1980, thus making Norway and the United Kingdom self-sufficient. Hopefully, operations in the Gulf of Alaska will help move our country in the same direction. Based on my experience, I see no reason why the industry cannot operate safely and efficiently in the Gulf of Alaska.

STATEMENT OF

KENNETH A. BLENKARN, Ph.D.
AMOCO PRODUCTION COMPANY

before the

U. S. DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT

HEARING

on

PROPOSED OIL AND GAS LEASING

on the

OUTER CONTINENTAL SHELF

NORTHERN GULF OF ALASKA

ANCHORAGE, ALASKA
AUGUST 12-13, 1975

OFFSHORE DEVELOPMENT AND PRODCTION

Statement of Kenneth A. Blenkarn, Ph.D., Amoco Production Company

OFFSHORE SALE ENVIRONMENTAL HEARING

Anchorage, Alaska

Good morning, ladies and gentlemen. My name is Kenneth Blenkarn. I am a Special Research Group Supervisor for Amoco Production Company, and I direct the development and application of offshore and arctic technology for Amoco and its corporate affiliates. My engineering Ph.D. degree emphasizes training and research in theoretical and applied mechanics. For more than 20 years I have been developing basic technology related to petroleum production, particularly environmental force criteria for offshore structures. I have been responsible for the design of many offshore platforms, including many of the early permanent structures installed in Cook Inlet.

Slide 1

My first purpose is to describe for you the equipment and methods employed in the production of offshore petroleum resources. I then wish to address the special aspects of engineering for applications in the Gulf of Alaska.

Only after exploratory drilling has discovered petroleum deposits, and various testing and confirmation has established adequate reserves, does actual development of production begin. The key feature of most offshore production is the construction of fixed platforms or towers. These platforms, founded on the sea bottom, support working decks clear of wave action and from which well drilling and production activities are conducted. Most offshore platforms are comprised of three basic elements: jacket, piling, and deck.

Slide 2
Slide 3
Slide 4

The trussed or braced jacket is fabricated at a shore location. It is then barged or floated to the offshore site where it is tipped or otherwise maneuvered into position resting on the ocean floor.

Piling are then guided and driven through members of the jacket to fix the structure firmly into the foundation soils. This work is generally performed by special offshore construction derrick barges.

Slide 5

Slide 6

Once piling installation is complete, deck sections, together with operating equipment, are hoisted up and placed atop the structure by the derrick barge.

Effective design of offshore platforms requires careful evaluation of the environmental forces to be anticipated during the structure lifetime. This is especially true of forces caused by storm waves. Over the years, the offshore industry has devoted significant effort to the scientific investigation of ocean waves, their occurrence probabilities, and the forces resulting from waves. Such efforts have contributed to the success of the industry in building reliable offshore platforms.

After construction of a platform is completed, well drilling is initiated generally through specially driven structural well conductor pipes. Several wells are directionally drilled from a single platform to reach an array of locations at the productive horizons. Production from the completed wells is directed into separation and other treating equipment to prepare it for entry into the transportation system.

Slide 7

All of the equipment and tanks on a platform are fitted with automatic safety devices which shut in the producing wells and stop flow through the system in the event of any equipment malfunction. Shut-off valves on the platform deck are supplemented by safety shut-in devices down inside well casings, below the ocean bottom. These are controlled to be activated by abnormalities in the production equipment or in the platform structure itself. The likelihood of oil discharge, even in the improbable event of platform structural failure, is significantly reduced by use of downhole safety valves. These valves have undergone rapid improvement in recent years and will be able to provide a high degree of reliability.

Slide 8

Generally, the preferred and safest way to transport offshore production away from a platform is to pump it through a subsea pipeline to shore facilities. The construction of subsea pipelines employs special pipe-lay barges. As successive lengths of pipe are joined on the barge, additional lengths of pipeline are lowered onto the ocean bottom.

Slide 9

Depending upon the water depth, the pipeline is either guided to the ocean bottom by a structural stinger or suspended under controlled tension to preclude bending damage to the pipe. Subsea pipelines are weighted to rest on bottom without movement under changing current or wave conditions. In areas where the pipe is likely to be subject to excessive environmental forces, or to mechanical damage by anchors and fishing gear, the pipe is buried beneath the sea floor. The pipe bury operation is accomplished with unique dredging equipment which cuts a trench into which the pipe is deposited and subsequently to be covered.

Pipelines are coated to protect against corrosion, and construction joints are carefully inspected to avoid mechanical or metallurgical defects. Nevertheless, like platform production equipment, subsea pipelines can be equipped with automatic sensing devices which shut down the throughput stream. These devices serve to minimize the discharge of oil in the case of any leak which might occur in spite of quality control measures in construction.

While pipelining to shore has long been the predominant disposition of offshore production, alternates are being developed. Offshore storage

Slide 10

and offshore tanker loading have become increasingly common. The latest developments are engineered to permit continuation of operations even under stormy sea conditions.

Additional detail regarding various potential development systems for the Gulf of Alaska is to be found in a supplemental document which I submit for the record.

The basic methods for production from offshore locations are well established and proven. The question at issue in these hearings is whether such technology is suitable for application in the Gulf of Alaska. More specifically, the concern is with our ability to adapt this proven technology adequately to account for the particular physical environment of the area. I intend to show that such an adaptation can be made. I will discuss the two important implications of the environment of the Gulf of Alaska. The physical oceanographic conditions and earthquakes.

The Gulf of Alaska is recognized as a stormy region, and one must address the influence of weather and waves upon the safety of offshore facilities. At the heart of the matter is the effect of storm waves on the structural integrity of offshore platforms or other structures.

Testimony by Mr. Horrer describes studies of the physical oceanography of the Gulf of Alaska and our knowledge of expected conditions in this region. For the present concern, the main result is a comparison of

Slide 11 extreme Gulf of Alaska wave conditions with those determined for the North Sea. This comparison is shown on slide 11. There is no real definable difference in the severity of extremes in the two areas. This is important because a number of offshore platforms have been designed to withstand North Sea extremes. Several of these have already been installed. There is no question of our ability to design platforms to resist Gulf of Alaska extreme waves.

Slide 12 Some of the recently designed North Sea platforms represent a marked departure from traditional modes of offshore platform construction. Specific attention is drawn to the concrete, gravity-foundation platforms. It is, however, to be recognized that this particular development is a reflection of (a) construction schedules and economics, (b) foundation soil conditions, and (c) premium placed on storage capacity. The choice of a concrete gravity platform as opposed to a more conventional steel structure is not a consequence of the particular design wave requirements. There may emerge special platform designs for Gulf of Alaska operations, but such designs will not be dictated because wave conditions are more severe than encountered elsewhere.

The generally stormy weather of the North Sea has led to the construc-

Slide 13 tion of larger, more seaworthy construction ships and barges, for example, very large derrick ships and semi-submersible pipelay vessels. These advances have been motivated by the need to improve the effective working time of construction equipment. It is to be expected that much of this construction experience will carry over directly to application in the Gulf of Alaska.

The Gulf of Alaska region is, of course, recognized as being prone to earthquake activity. Hence, as in the case of design against waves, the industry must build structures to resist anticipated earthquakes with a high degree of reliability. This is required for reasons of both economics and personnel safety. Nevertheless, we must balance risks against the costs to society of reducing such risks. It is not in the best

Slide 14

interests of society to squander capital, material, and human resources in needless overdesign of offshore structures. In seeking the proper balance of design, the industry looks to the professional community, as well as its own scientists and engineers.

The technology of earthquake design has been developing for many years. As Dr. Wiggins explains, it combines inferrences of seismically induced base rock and ground motions together with analyses of resulting structure and foundation behavior. I think that it is important to emphasize that this is not just a matter of interpreting seismic measurements by mathematical manipulations. Methods and practices of earthquake design have been adjusted and calibrated from observations of actual structures in earthquakes; some fail, while others experience earthquake shaking without damage.

The focus of earthquake design is to provide a structure adequate to withstand statistically projected seismic conditions anticipated at the construction site. Dr. Wiggins testimony outlines the basis for this technology. Of course, there is no such thing as a structure which can be guaranteed against failure, regardless of cataclysmic events which nature might someday bring to pass. This is not to say that such imponderables are to be simply ignored. Serious conjecture about such events can provide useful input to the overall design process. These ideas may, for example, suggest design refinements which give a structure the potential to sustain extensive damage without collapse, but which do not subvert the basic design indicated by established earthquake engineering practice. Once again, it is to be noted that in the unlikely event of structure damage or even collapse, the likelihood of pollution by uncontrolled well flow will be further reduced by the functioning of downhole safety shut-off valves.

On balance, there is little doubt but that we can design offshore platforms with appropriate levels of earthquake resistance. It is important

Slide 15

to observe that offshore structures, unlike most conventional buildings, are predominantly designed against lateral loads. And there is an extensive experience in such designs. The wave loading on a platform may well be of the same magnitude as design earthquake forces. Moreover, in-service experience shows that offshore platforms display a substantial margin between design forces and those actually required to cause collapse.

Ocean bottom soils are particularly important in considering design against possible consequences of earthquakes. Local soil conditions affect the intensity of local seismic loading and the foundation integrity for structures. The soil of the ocean bottom also determines the susceptibility of pipelines to seafloor slides triggered by earthquakes.

Slide 16

The industry has already initiated investigations of the Gulf of Alaska sea bottom through use of soil borings and soil seismic surveys. Testimony by Mr. McKeever describes such activity in some detail, and places it within an overall geologic perspective. Extensive and detailed investigations will take place during exploratory drilling and in preparation for development of permanent facilities. The purpose will be to identify suitable sites for offshore structures and proper routing for pipelines, all to reduce earthquake damage hazards. Surveys with soil sampling and seismic methods also serve to avoid the placing of installations where there is likelihood of disruption by surface faulting or soil movement.

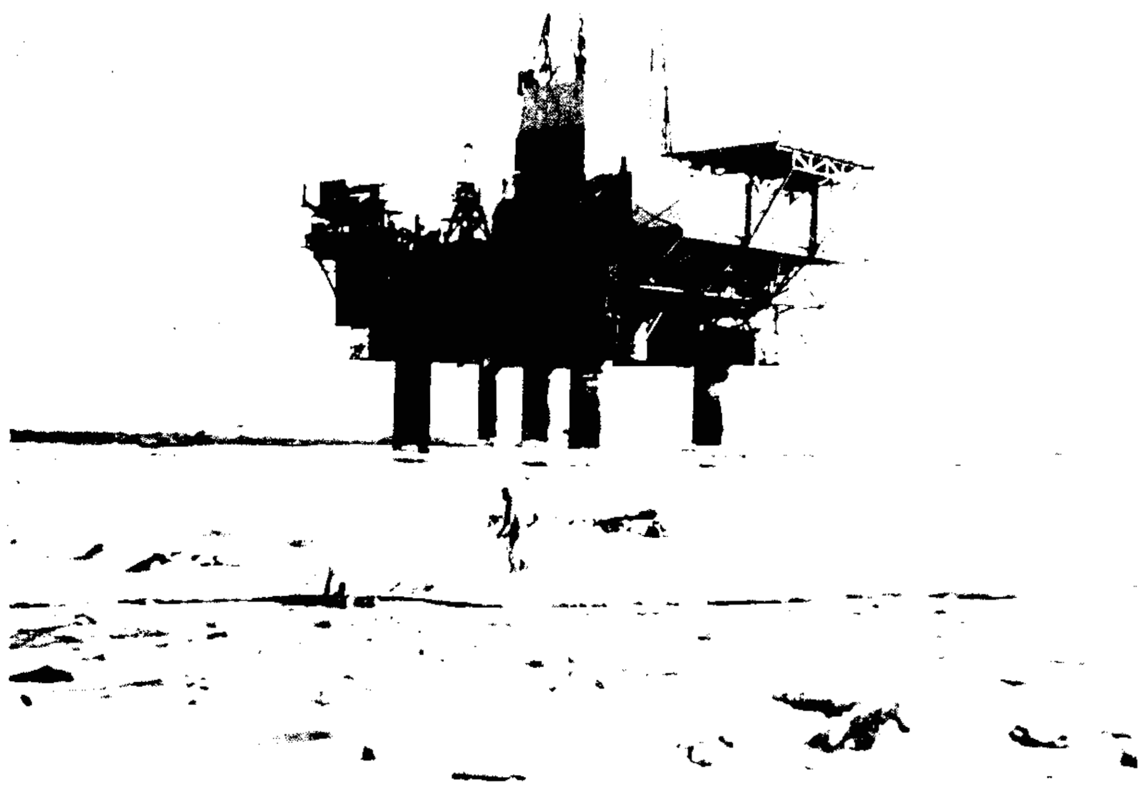
One might perhaps be concerned over direct disruption of oil wells by fault movement during earthquakes. However, there is a body of experience to indicate that this is not a significant problem. Extensive drilling and producing operations have been conducted in the seismically active area of Southern California. While a few wells have suffered casing damaged by fault movement, such damage has not occasioned release of well fluids to pose a pollution threat.

Consideration of the foregoing leads me to the following conclusions regarding technology for offshore production in the Gulf of Alaska:

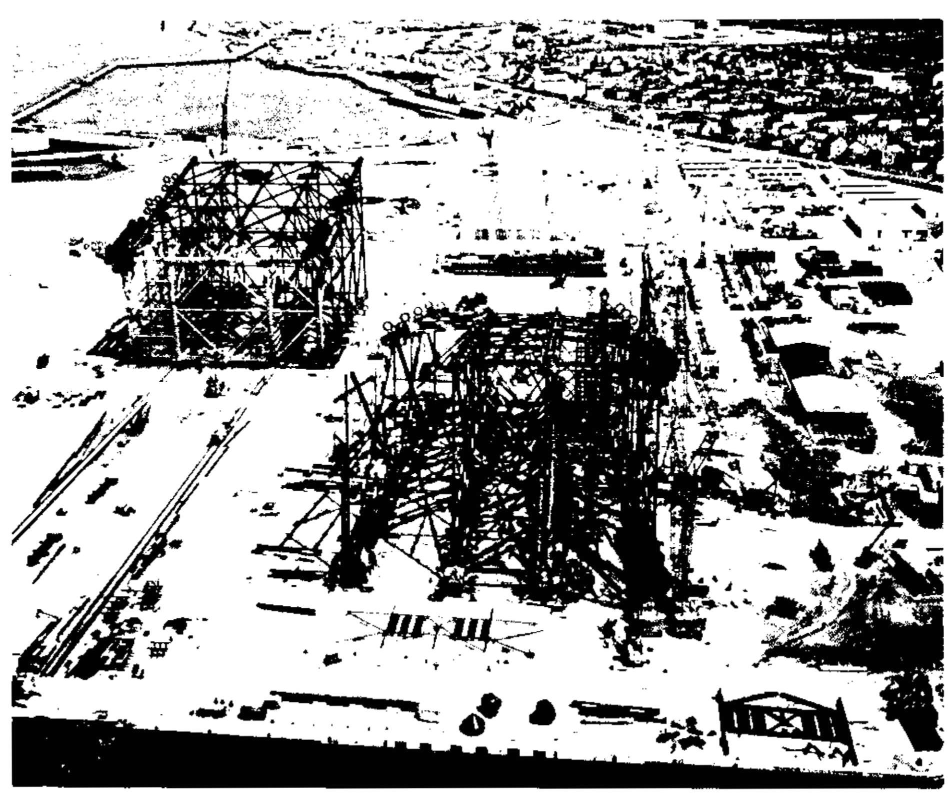
1. Most of the established production technology previously described here is directly applicable to operation in the Gulf of Alaska.

2. Wave conditions in the area against which facilities must be designed are not any more severe than already overcome by the industry.

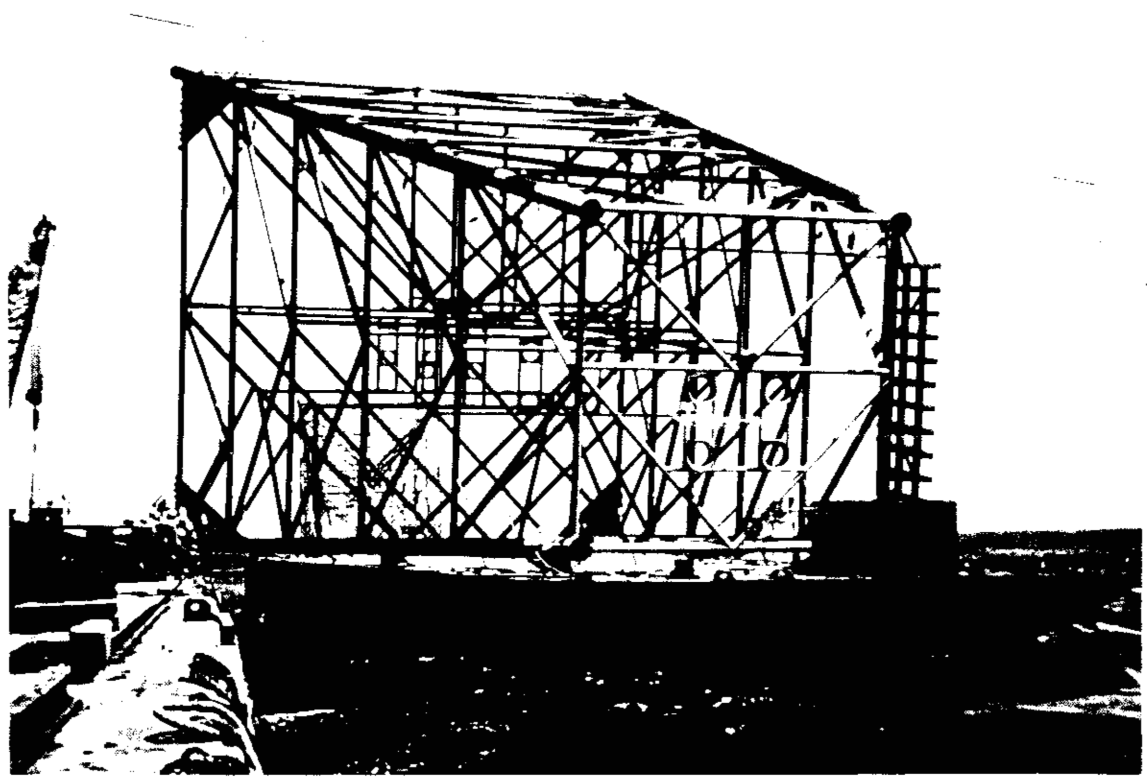
3. Available earthquake technology provides means for construction of platforms and other facilities with adequate structural reliability.



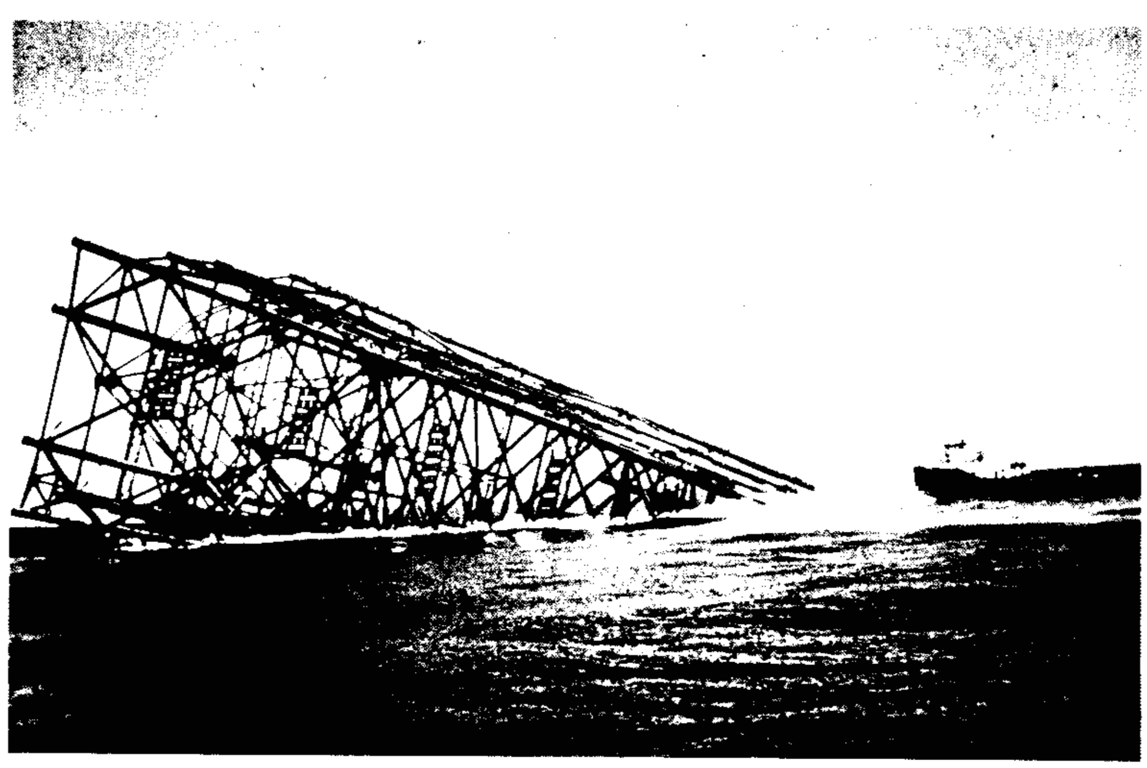
SLIDE 1 COOK INLET PLATFORM



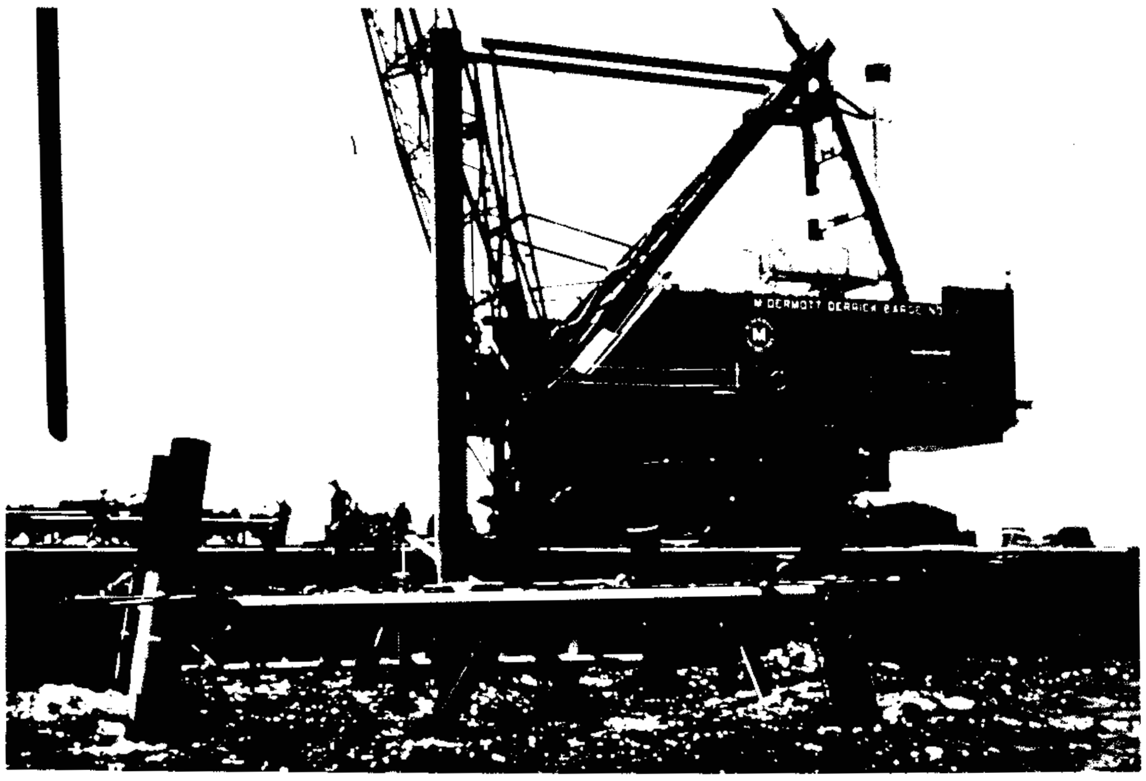
SLIDE 2 PLATFORM JACKET IN FABRICATION



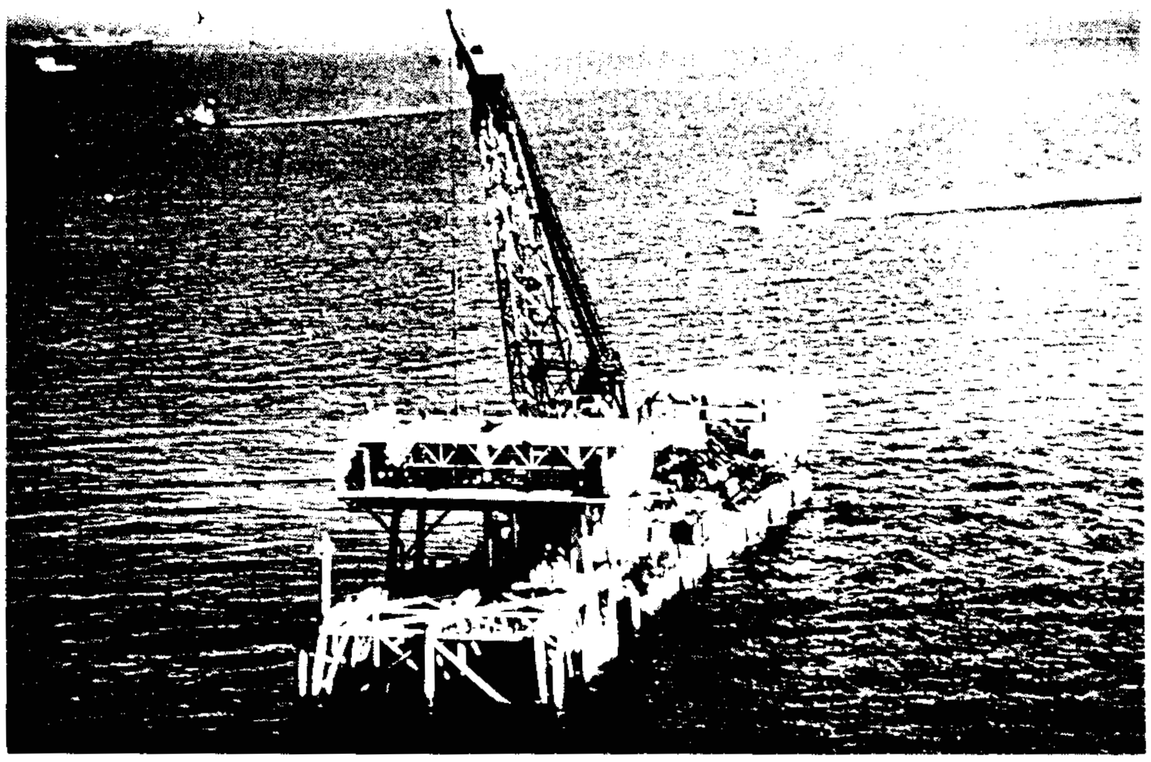
SLIDE 3 JACKET BEING TRANSPORTED



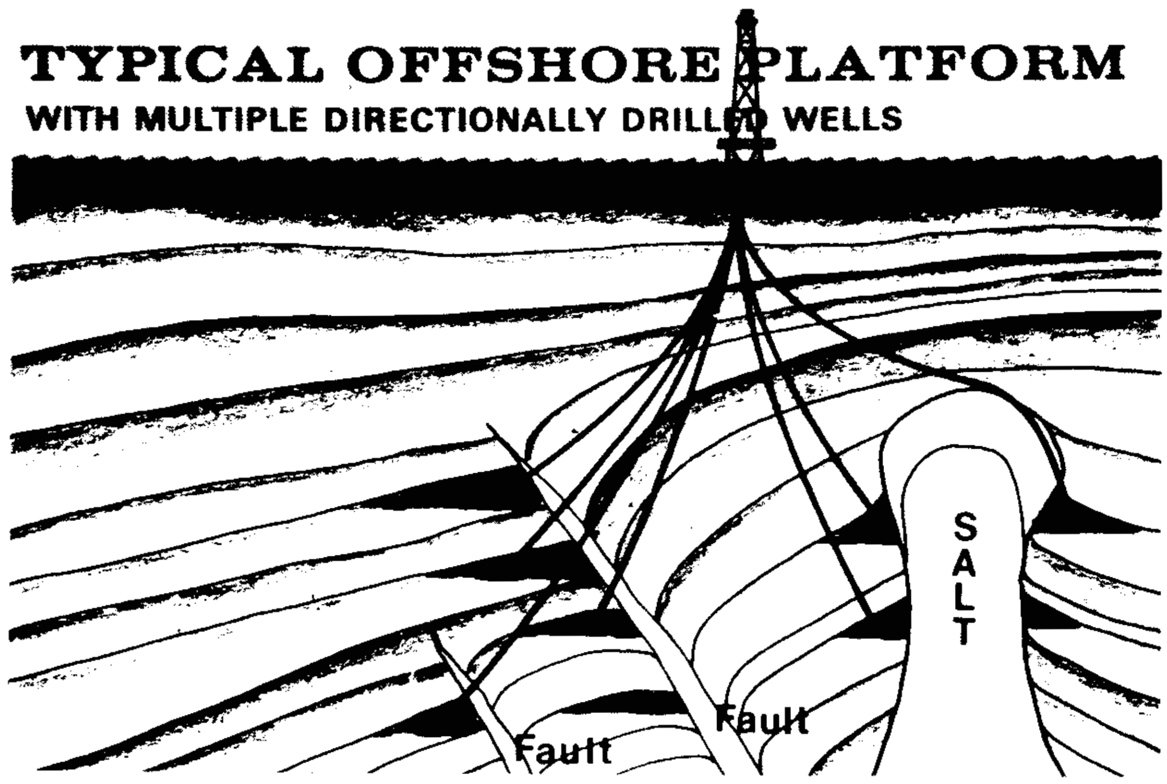
SLIDE 4 JACKET BEING LAUNCHED



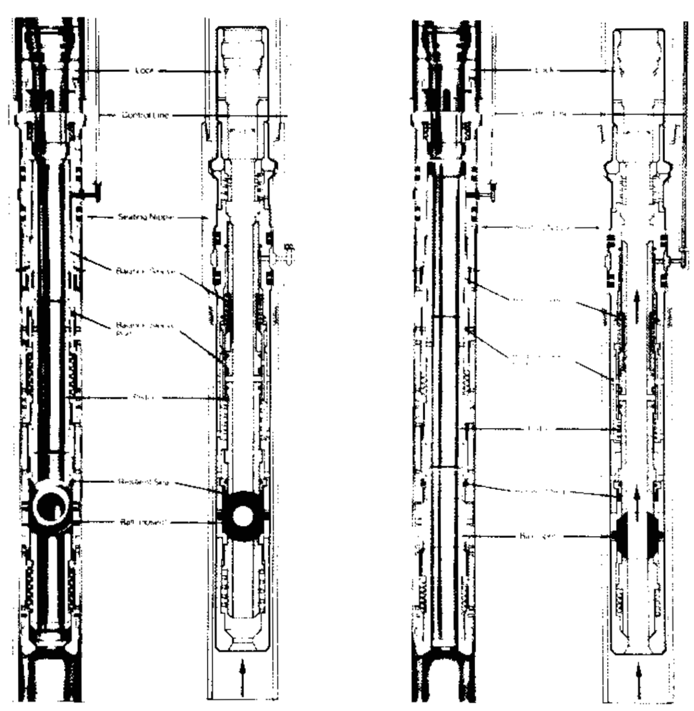
SLIDE 5 PILE DRIVING



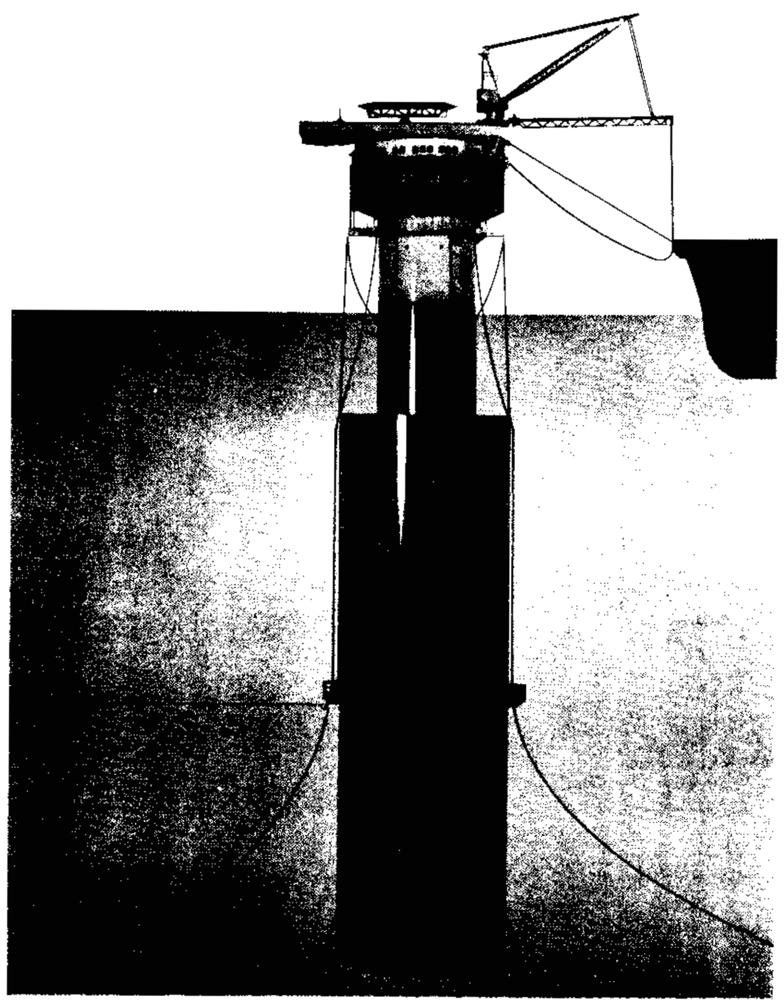
SLIDE 6 DECK LIFT



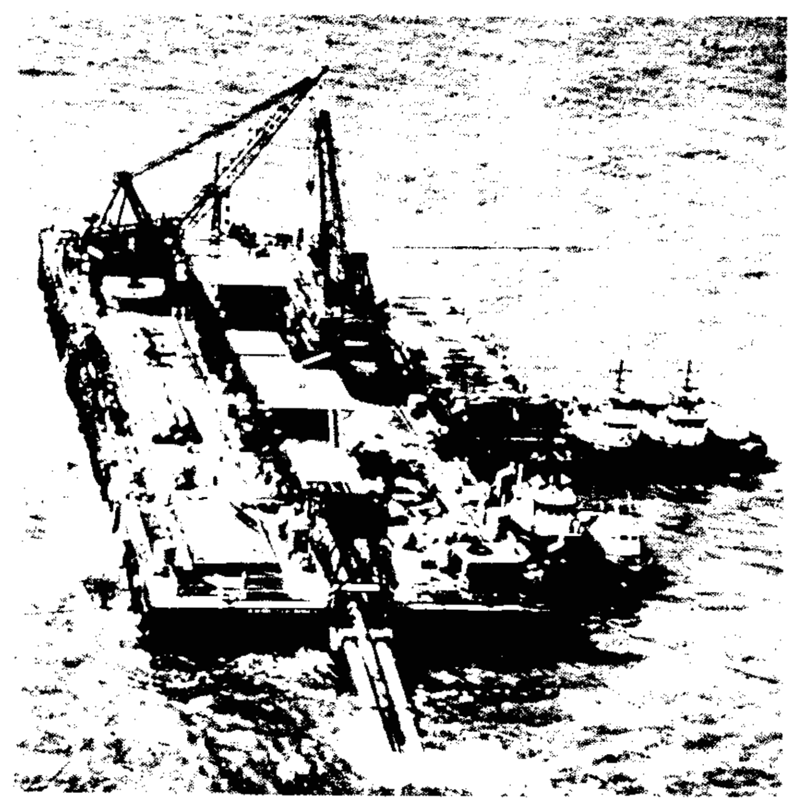
SLIDE 7 SCHEMATIC OF DIRECTIONAL DRILLING



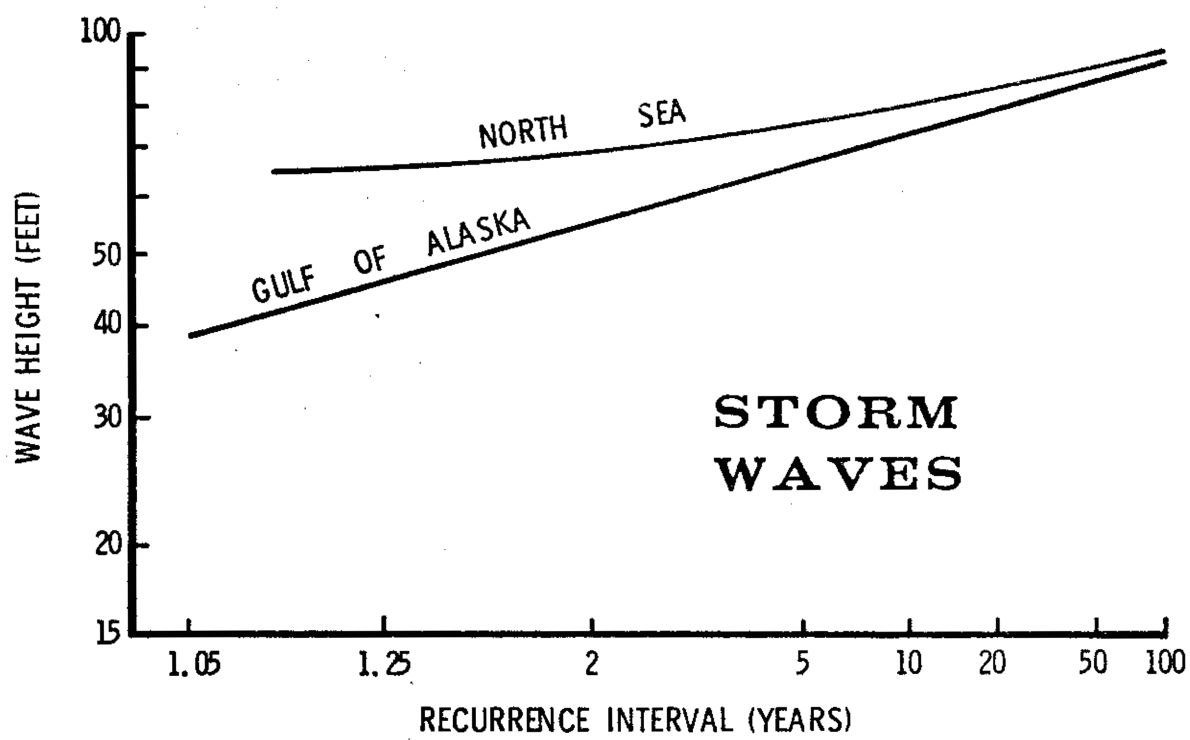
SLIDE 8 DOWN-HOLE SAFETY VALVE



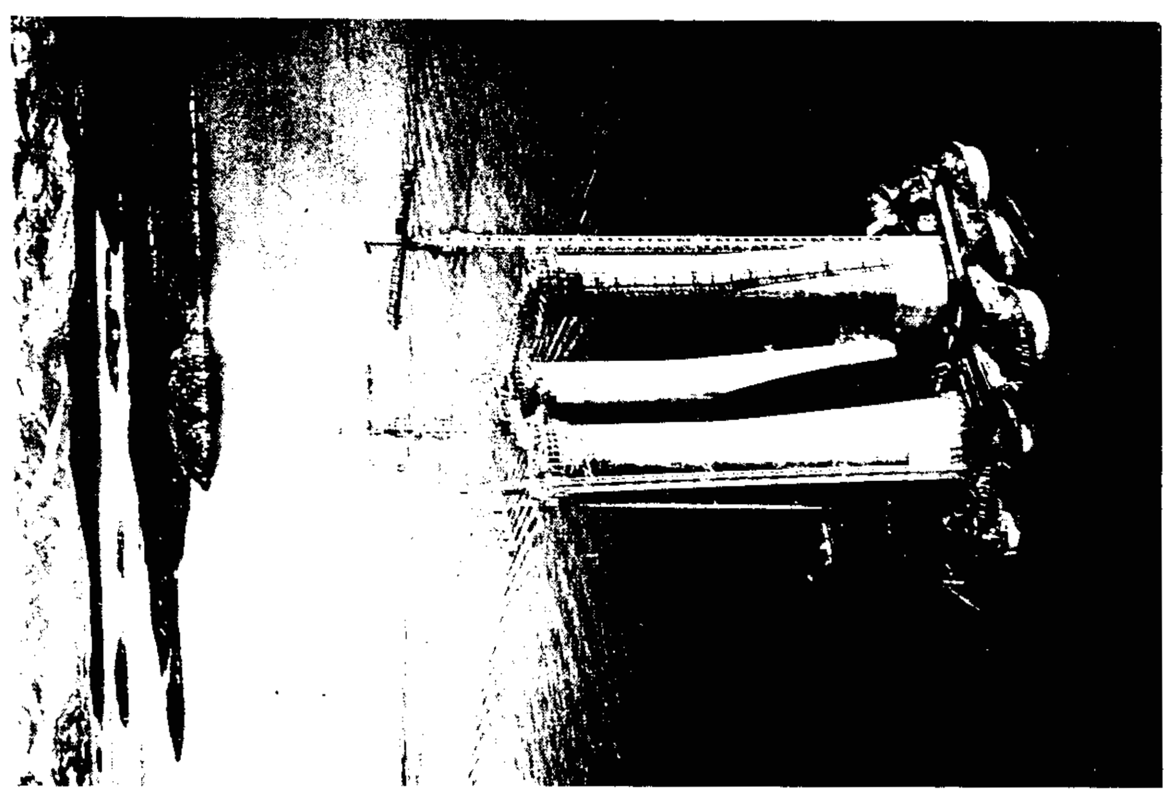
SLIDE 10 OFFSHORE STORAGE AND TANKER LOADING



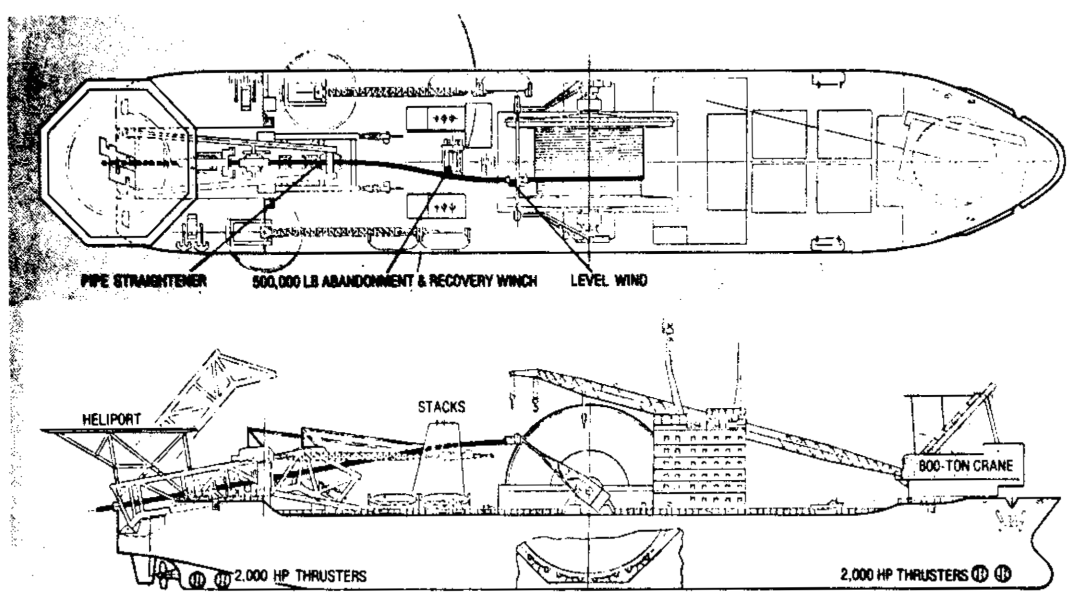
SLIDE 9 PIPELAY BARGE



SLIDE 11 GULF OF ALASKA AND NORTH SEA STORM WAVES

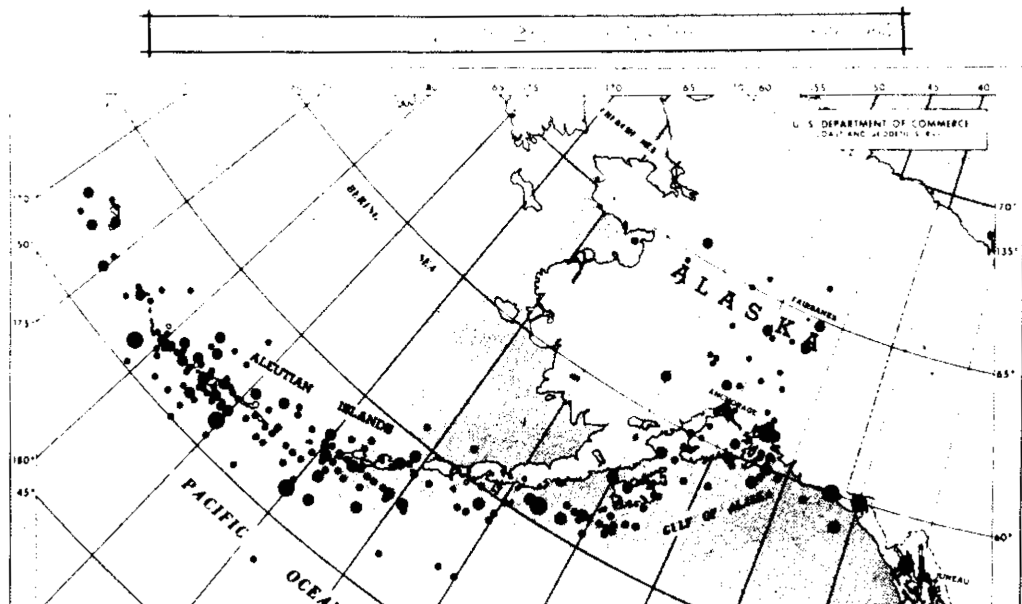


SLIDE 12 CONCRETE, GRAVITY PLATFORM

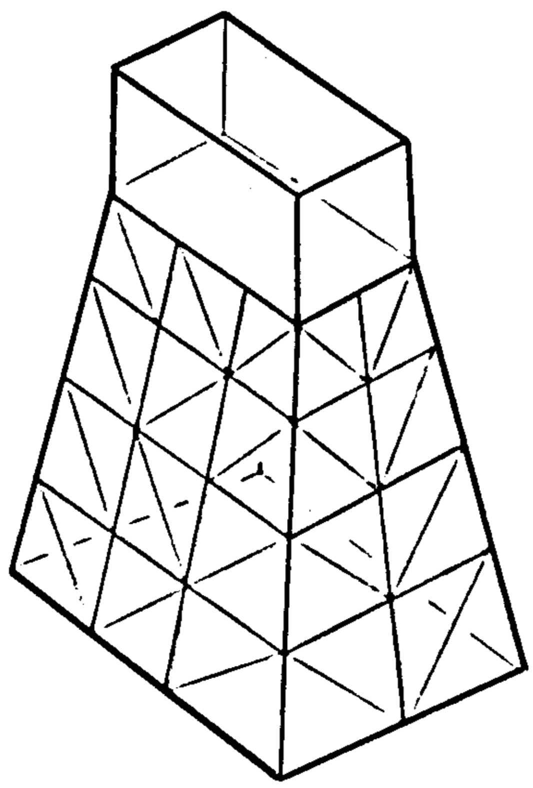


SCHEMATIC OF THE PIPE LAY SHIP A level wind feeds wraps of pipe on and off the reel. As it is wound around the reel, the pipe acquires an ovality of 1.5%, but after it is straightened, an ovality springback reduces this to about 0.1%. Shown here the pipe is entering the water at a shallow angle. The truss can be elevated to increase this angle to 55%.

SLIDE 13 NORTH SEA CONSTRUCTION VESSEL



SLIDE 14 GULF OF ALASKA EARTHQUAKE LOCATIONS

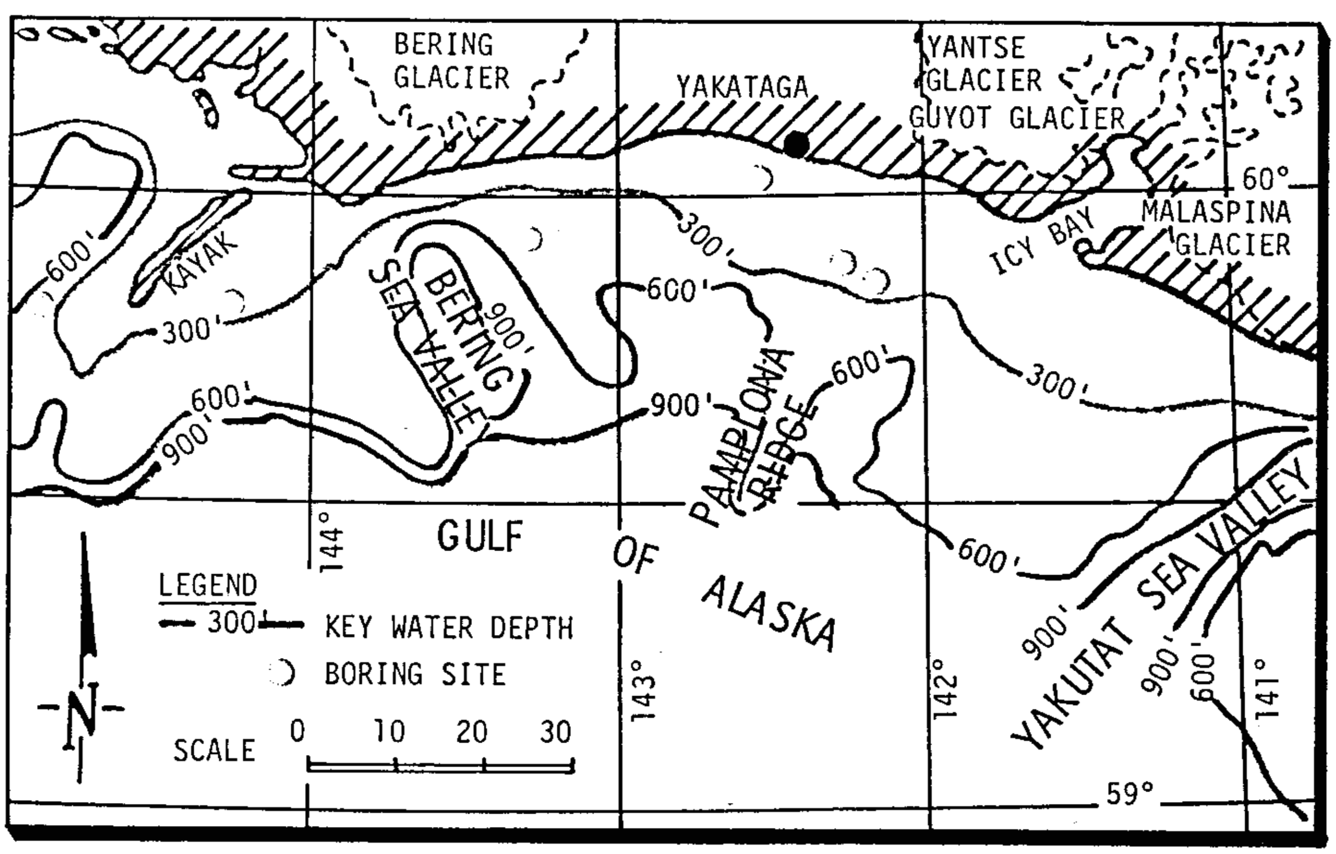


WAVE vs. EARTHQUAKE LOADING

EXAMPLE PLATFORM
IN 300 FOOT WATER DEPTH

FOUNDATION SHEAR	FOUNDATION OVERTURNING
6,000 TONS	1,200,000 TON-FEET
7,300 TONS	1,800,000 TON-FEET

SLIDE 15 COMPARISON OF WAVE AND EARTHQUAKE LOADING



SLIDE 16 SOIL BORING LOCATIONS

PROFESSIONAL SUMMARY

KENNETH A. BLENKARN

Present Position:

Special Research Group Supervisor
Marine and Arctic Operations
Tulsa Research Center
Amoco Production Company

Degrees:

1951 B.A., Rice University
1952 B.S. Mechanical Engineering, Rice University
1954 M.S. Mechanical Engineering, Rice University
1960 PhD Mechanical Engineering, Rice University

Professional Societies:

American Institute of Mining, Metallurgical and Petroleum Engineers

Publications (9):

Petroleum technology, theoretical mechanics, structures

Principal Field of Research:

Oil well drilling, offshore structures, drilling vessels, marine environmental design conditions

Years of Industrial Experience: 20

STATEMENT OF

A. D. MOOKHOEK
EXXON COMPANY, U.S.A.

before the

U. S. DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT

HEARING

on

PROPOSED OIL AND GAS LEASING

on the

OUTER CONTINENTAL SHELF

NORTHERN GULF OF ALASKA

ANCHORAGE, ALASKA
AUGUST 12-13, 1975

PRESENTATION FOR ENVIRONMENTAL HEARING
GULF OF ALASKA OFFSHORE SALE
A. D. Mookhoek

My name is Bram Mookhoek. I am the Ocean Operations Manager for the Marine Department, Exxon Company, U.S.A., and during my 27 years in the company have been associated with all areas of marine transportation including the technical, economic and operational aspects. I might mention at this time that I am also chairman of the Marine Services Subcommittee of Alyeska, which is a group representing the Owner companies in marine matters. In this capacity, I work closely with the U. S. Coast Guard on routing of tankers to and from Valdez, navigation aids, anchorage areas in Prince William Sound, vessel traffic system, etc. Some or all of these aspects will also apply to the Gulf of Alaska marine operations.

In my discussion today, I will cover two subjects: (1) marine transportation, and (2) terminals.

In the marine transportation area, we will first look at the ships. For obvious reasons, we are, at this time, in no position to determine the size tanker to be used since this is a function of the crude production and the location of the terminal. However, to place this in better perspective, we have prepared this slide which shows, for various ship sizes and at different production levels, the number of port calls which would occur. This tabulation shows that a 45,000-ton tanker with a draft of 39 feet and a carrying capacity of 325,000 barrels of crude at a production level of 120,000 barrels per day will be arriving at the terminal about once every 3 days, while a 120,000-ton vessel having a draft of 52 feet and carrying about 860,000 barrels will arrive once every 7 days. Of course, if the production is greater than 120,000 barrels per day, port calls will increase correspondingly, as indicated by the number to the right of the third column.

It should be pointed out that the ship sizes shown here are arbitrarily selected and do not imply the actual size to be used. However, I believe it can generally be accepted that vessel size increases as production levels become higher.

Some of the sizes shown here are for existing vessels in the U. S. fleet, while others are new construction. Assuming that crude will be shipped to the U. S. West Coast, only vessels built in the U. S. and manned by U. S. crews will be permitted, because the Jones Act prohibits use of foreign flag vessels in U. S. domestic trades. U. S. ships are built to standards established by the American Bureau of Shipping and maintained under the rigid inspection and maintenance requirements of the ABS and the U. S. Coast Guard. The vessels are equipped with reliable and advanced communication and navigation equipment.

On this next slide, we are indicating some of the typical design and operating data. The sea speed of all these vessels is about the same and varies between 16 and 17 knots.

One of the items in this slide shows the quantity of segregated and dirty ballast capacity. Under normal weather conditions, northbound vessels carry about 30 to 35 percent of the ship's deadweight tonnage in ballast, while in heavy weather this may amount to 40 to 50 percent. As you know, segregated ballast is carried in tanks which are dedicated to clean seawater ballast and are not connected to the cargo tanks. Accordingly, this ballast water is not in contact with oil and can be discharged to the sea. The dirty ballast is carried in tanks previously containing crude and is contaminated with oil. Therefore, this ballast will be transferred to a shore receiving facility where oil and water will be separated. How this is done will be briefly covered later in this presentation in the environmental impact statement.

On this next slide we show some of the special design and equipment features. Most of these items relate to safety, communication and pollution prevention and are designed to prevent accidents.

In this respect, you may be aware that a traffic separation system is presently under development by the U. S. Coast Guard for all ships traveling between Valdez and the West Coast. This new system will establish separate routes for north and southbound vessels and is designed to minimize crossing situations, thus reducing the chances of collision. It is likely that vessels scheduled to load at a Gulf of Alaska terminal will be required to use these same routes for part of the voyage. In addition, a vessel traffic system similar to Prince William Sound will probably be developed for the approaches to the terminal.

You may also be aware that the Coast Guard is installing a Loran "C" system which will cover the area from Southern California to Alaska. This navigation system, which, according to the U. S. Coast Guard, is accurate to 1/4th of a mile at the edge of the station's operating envelope and improves to 50 feet accuracy closer to the station, is scheduled to be in service prior to the start-up of the Trans Alaska pipeline and provides accurate vessel position fixing and, combined with the radars and bridge-to-bridge communications, will augment the ship's navigation system to insure the possibility of collisions and groundings are reduced to as low a level as possible. Vessels to and from the Gulf of Alaska will use this system also.

Turning now to the second subject, a marine terminal or terminals will be necessary to receive crude oil delivered from the wells, store the oil and then load into tankers for delivery to market destinations in the lower 48. These terminals may serve a single company or, in most cases, may be operated as multiple use facilities. A typical terminal installation located ashore is shown in this slide. Terminal storage requirements depend directly upon thruput volumes and tanker sizes and schedules. Storage facilities must be adequate to allow continuous operation of the offshore pipelines, thus minimal storage requirements are usually several times the daily thruput volumes. To place this in better perspective, for a production level of 120,000 barrels per day, a terminal site of about 40 acres with about 1 million barrels of tankage would be required. Because of these large storage requirements, for operational reasons it is generally more advantageous to locate the tanker loading facilities adjacent to or near the shore. However, offshore loading berths cannot be discounted at this time for the Gulf of Alaska until fields are discovered and the feasibility of suitable onshore terminals has been developed.

There are a number of site locations in the Gulf of Alaska, as indicated on this slide, which would be suitable for tanker terminals. In view of the present uncertainty as to where oil will be discovered, no detailed analysis has been prepared for these locations. In the selection of a location, we take into account length of submarine pipelines, water depth, protection from the weather by terrain features, suitable land to build a tank farm, etc. Some of the more favorable sites for terminals near the proposed lease area are:

Yakutat Bay - This location with water depths of 180 feet can accommodate the largest tankers and is currently used for infrequent tanker deliveries and has a dock facility. However, this facility is very limited in size and not suitable for crude tankers anticipated. Several protected waterfront sites exist within the bay which are suitable for a marine terminal. Water depth is adequate near shore to accommodate fixed loading docks while terrain is sufficiently high to protect the shore facilities from high tides and waves.

Icy Bay - The bay with a water depth of up to 60 feet provides shelter from the east and has several potential terminal sites with deep water near the shore. The bar at the entrance to the bay has about 40 feet of water, with the bottom consisting of sand and gravel. Dredging to a depth of about 50 feet suitable for 80,000-ton tankers for a distance of about two miles could be considered. The contiguous land areas are flat with sufficient high ground to accommodate an onshore terminal.

Kayak Island - This area is exposed to the Gulf of Alaska on the east but affords some protection for large vessels on the west side. Deep water areas, 180 to 300 feet 4 miles offshore, have no limitations for large tankers, while the approaches are not restricted by depth or land masses. Due to the exposed location, sea berths would probably be more practical than fixed berths. There is ample relatively flat land for installing tanks and other terminal facilities.

Middleton Island - The west side provides protection from easterly winds and seas, but due to the depth of water, about 80 feet, tankers would have to moor approximately one and one-half miles offshore. Adequate high ground is available on the island for storage tanks and related terminal facilities.

Montague Island - This area has several protected areas with deep water, about 600 feet, to the coast which would be suitable. Onshore land is available for terminal facilities.

The crude oil terminals will be planned and operated in accordance with advanced technology to ensure a safe, pollution free performance with the principal features to be developed to suit the specific sites. Design considerations and operational provisions will be made for rapid response to emergencies such as extreme weather, warning of a tsumani or other contingencies. Of course, the actual location and design of any terminals will require compatible solutions to land use, wildlife habitat and seismic considerations.

Crude oil will be received from the submarine pipelines in all welded steel tankage which will be designed to meet the local conditions, i.e. high snowfall and anticipated seismic forces. Tanks will be provided with automatic gauging equipment with manual back-up, together with high level alarms to guard against overfilling. A containment dike with a capacity of 110% of the total tankage including adequate allowance for surface water impounded within the dike area will be installed. A fire detection and extinguishing system will be incorporated in the design.

Turning now to the dock facilities, a sufficient number of docks will be provided to accommodate the required number and size of tankers. These docks will be equipped with a fendering system and designed to withstand seismic and wave forces as well as docking impact forces. The dock structure to be used will vary with the prevailing slope and soil conditions of the seabed. For flat or gently sloping seabed conditions, the dock will be constructed from steel jacket or reinforced concrete structures which will be anchored to the sea bottom.

In the case of a steeply sloping sea bottom, a floating dock might be constructed which will have the ability to move in a vertical direction to accommodate tidal movement or wave action. Lateral or longitudinal movement will be restrained by means of rigid struts hinged at the dock and anchor points ashore.

Mooring dolphins for each type of berth will be constructed of steel jacket structures anchored to bedrock or firm soil. Each mooring dolphin will be equipped with quick release mooring hooks for securing the mooring lines from the tankers.

Qualified pilots will be used for all tankers entering or leaving the terminal while tugs and mooring launches will be available to assist in mooring the vessels. In addition to berthing and unberthing tankers, these tugs will be fitted with fire fighting systems capable of delivering foam or water onto the deck of the largest tankers when in light condition.

Loading of the tankers will be by gravity flow if tanks are installed at a sufficient elevation, which is dependent on the topography of the onshore site. In the event elevation is insufficient, loading pumps will be used.

Steel loading arms will be provided on each dock to connect to the ship's piping. These will be operated from a control center on the dock. Shut-off valves will be provided on the docks and onshore in each loading line to permit either local or remote operation from the control center. This valve arrangement will allow emergency shutdown to be initiated at various points. To prevent excessive surge pressures in emergency conditions, relief valves will be included in the design. These emergency features will prevent internal pressure buildup by more than 10% at any point in the piping system.

To maintain the high water quality standards and scenic beauty of the area, strict operating procedures to guard against the possibility of accidental oil spills and the adoption of design criteria to minimize the risk of oil spills resulting from equipment failure or due to earthquakes will be developed. In addition, a sewage treatment facility and incineration of combustible waste will be provided.

A ballast treatment plant to handle all oil contaminated ballast water and wash water used to clean cargo tanks will be installed. Although advancing technology may result in further improvements, the type of system will probably consist of a three-step process of gravity separation followed by chemical flocculation and dissolved air flotation. The treated water will conform to the applicable water quality standards. In this system, oil contaminated water is pumped into steel storage tanks where, after settling, floating oil is skimmed off and pumped to the oil treating section. After the gravity separation, chemicals will be added to the ballast which will then enter the chemical flocculation and air flotation chambers. The ballast is retained for a specified time in the flocculation chamber where it is subjected to continuous gentle agitation for floc development. This floc has a strong affinity for oil, and the remaining oil in the ballast is captured by the floc particles.

From the flocculation chamber, the ballast flows to the mixing zone, where air is introduced and air bubbles attach themselves to the floc and the mixture flows to the flotation zone. In the flotation zone, the air suspended material rises to the surface where skimming equipment removes the floating matter. The clarified ballast is tested continually for oil content and leaves the treating facility into an outfall line through a diffuser discharging into the port at a point well below sea level.

Oil skimmed in the gravity separation step and that recovered in the flocculation/air flotation process is pumped to the terminal crude storage tanks for loading aboard tankers.

The foregoing description of dock facilities mainly applies to onshore type installations. However, offshore sea berths cannot be discounted until oil fields are discovered and the feasibility of suitable onshore terminals has been developed. Ballast handling facilities for offshore loading berths will be designed to perform a similar function as for the onshore berth. Either the dirty ballast will be pumped ashore for treatment or retained aboard the vessel for subsequent discharge at a shore treatment plant.

These offshore berths could be of several types, including fixed type docks, island type docks, single point moorings or conventional multipoint moorings. In general, the seabed anchoring characteristics, water depth and sea conditions will dictate the most economical and practical type structure.

Offshore loading facilities are relatively common, but until recently they were all located in protected water. However, with improved technology, offshore loading terminals in exposed locations are relatively common, i.e. Kharg Island in the Persian Gulf, Dubai Terminal 60 miles offshore in the Arabian Gulf, Mobil's Nigerian Terminal, Phillips' Ekofisk Terminal in the North Sea, etc. In addition, single point mooring installations are in the advanced engineering stage for offshore locations in the Gulf of Mexico off Louisiana and Texas.

The Louisiana facility will be located about 18 miles off Bayou Lafourche, while the Texas installation will be 30 miles off Freeport. Both facilities will be in a water depth of about 100 feet. Although the difficulties may be accentuated in the Gulf of Alaska, these installations which include tanker safety zones and traffic regulations demonstrate the feasibility of constructing and operating offshore terminals in exposed locations safely and with minimum hazard to the environment.

ADM:mjb

8-5-75

MARINE TRANSPORTATION

AND

TANKER TERMINALS

FOR THE

GULF OF ALASKA OPERATORS COMMITTEE

MARINE TRANSPORTATION AND TANKER TERMINALS

Revised August 1975

MARINE TRANSPORTATION SYSTEM

GULF OF ALASKA TERMINALS TO DISCHARGE PORTS

I INTRODUCTION

The marine transportation link of the system designed to move Gulf of Alaska oil to the demand areas will begin at a terminal, or terminals, in Alaska and end at various ports. The ships will load at the terminal site, sail into the Gulf of Alaska to the Pacific Ocean and on to discharge ports.

The term "Owner Company or Affiliated Company" as used in the following text refers to companies successful in lease acquisition in the Gulf of Alaska as well as those developing production on leases acquired.

II ENVIRONMENTAL PROTECTION OBJECTIVES

The entire marine system selected for transporting oil from the Gulf of Alaska will be designed and operated to minimize the risk of any spills of oil and to avoid any other pollution resulting from the marine operations.

III DESCRIPTION OF THE MARINE TRANSPORTATION SYSTEM

Until a timetable and production rates for the Gulf of Alaska fields have been established, it is not possible to accurately estimate the number and size, or to list specific details of, ships which will be engaged in the Gulf of Alaska service. Likewise, until a terminal site has been established it is not possible to discuss the navigational features of approaches to and from the terminal. The purpose of this paper is to describe in general the marine system and its environmental impact and to list specific operational and design requirements which will be imposed on vessels making use of the terminals to minimize oil spills.

(a) Tanker Fleet

The number and sizes of tankers engaged in the Gulf of Alaska trade will vary depending upon the volumes and distribution of the oil which in turn will vary with production start-up, growth, and terminal completion time. It is possible that large crude carriers could be used in the Gulf of Alaska trade.

(b) Design & Operating Data on Ships

Typical design and operating data on some of the ships that may call at the terminals for loading are presented in Table 1. Variations in specific design, ship size, and operating data can be expected since the various ship owners will have different design specifications and shipping requirements.

The fleet for the Gulf of Alaska trade may initially be drawn from ships currently in operation or from ships either being built or on order. For the most part these ships will either be owned or on long-term charter by the owner companies or their affiliates.

Each U.S. ship destined for the Gulf of Alaska-West Coast trade will be built to the high standards of the American Bureau of Shipping and maintained under the rigid inspection and maintenance requirements of the American Bureau of Shipping and U.S. Coast Guard. The ships will be manned by U.S. crews, which have been trained in tanker operating methods. Furthermore, the vessels will be equipped with reliable and advanced communications and navigation equipment, including standby units.

Some of the existing vessels to be used and a substantial number of the vessels to be built for Gulf of Alaska-West Coast trade will be equipped with special design features that contribute to better control over loading and discharging operations, improved ship operation at loading and discharge ports, and efficient navigation. Some of these design features are listed in Table 2.

(1) Navigation

Generally speaking, the U.S. Coast Guard provides the best navigational aids and systems in the world. Representatives of the Coast Guard and the owner companies will be involved in the planning of a system that will provide the best possible navigational aids in the Gulf of Alaska trade as is common practice today.

The ships will be equipped with up-to-date charts which will define the shipping routes into and out of the various harbors along the western coast of the United States. These will have charted all land masses, sea depths, navigational aids, reef, and obstructions along the lanes to be used. Whenever vessel traffic routes have been established by the U.S. Coast Guard for vessels trading in Valdez, tankers proceeding to or from terminals in the Gulf of Alaska will utilize these routes to the maximum extent practicable. The ships will be furnished with electronic navigational systems for position fixing at sea and a 10 C.M. Radar and a 3 C.M Radar to fix the ship's position in relation to navigational aids, land and floating masses. More conventional equipment aboard will include Chronometers, Sextants, Gyro-Compasses, Radio Direction Finders, Fathometers, and Gyro-Pilots.

Personnel trained in the use and maintenance of navigational equipment will be aboard each ship. The systems will be designed for continuous application, and equipment such as Radar, will be operated on a continuous basis. With well-defined shipping lanes and charts, proper application and maintenance of the navigational equipment available, and the advanced navigation aids, the probability of collisions or groundings should be reduced to essentially zero.

Loran can locate the ship's position on the sea with an accuracy of about 1/2 mile if the vessel is near the limit of the stations operating radius with accuracy increasing if distance from the station is decreased, while radar can locate the ship relative to a target within approximately 2 percent of scale (20 mile scale, 0.4 miles). Radio direction finders can establish a ship's position within 3.0 miles from a distance of 100 miles. Celestial navigation can produce an accuracy of two miles while terrestrial navigation can produce an accuracy of .1 mile with a 10-mile target.

(2) Communications

All ships scheduled to load at terminals in the Gulf of Alaska will be fitted with modern communication equipment, including radio telephone for voice communication and radio telegraph for radiograms. The VHF radio telephone will permit extensive in-port communications. Single side band will provide the ships with excellent long range communication while using only a narrow portion of the frequency band.

Owner company or affiliated company ships will have installed radio systems for bridge-to-bridge communications, in accordance with legal requirements.

Through voice communications, directions will be provided for all ship movements to and from the Gulf of Alaska Terminals. Clearances, weather, navigational, and traffic information will also be provided. No ship scheduled to load at a Gulf of Alaska crude oil terminal will be permitted to proceed past the designated anchorage area without proper clearance, even though the ship may have satisfied all other entrance requirements.

The application of sophisticated communication systems, together with the traffic control, will further minimize the possibility of ship groundings and/or collisions.

(3) Manning

Modern communication and navigation equipment aboard ship and properly designed ships do not assure safety at sea or in port. The ship and its equipment must be properly used and maintained. This means attention of the people to operate equipment.

U.S. ships will be manned by trained U.S. crews, licensed or certified by the U.S. Coast Guard to perform the duties to which they are assigned. Crew members will receive specific training on the operating and safety rules applicable to their individual assignments, including appropriate sections of the International Oil Tanker & Terminal Safety Guide (I.O.T.T.S.G.).

Masters and relieving masters will be thoroughly trained in handling the vessels under their command, either by actual experience aboard similar ships or at suitable training facilities ashore. Two shore training facilities are currently available, one at Delft in the Netherlands, where masters are trained on ship handling simulators much like those used in airplane pilot training programs, and the model facility at Grenoble, France providing ship handling training in scaled down versions of large vessels. All U.S. ship manning will conform to the manning requirements of the U.S. Coast Guard. Each officer aboard the ships is required to keep his license current and approved.

(4) Ship Maintenance

Under certification and licensing procedures, each man assigned to the ship must be familiar with the operation and maintenance of the equipment used in his assignment. For the more critical equipment, such as radar, back-up systems will be provided. Ship maintenance will be a continuing requirement of the crew and men skilled in machinery and equipment repair will be made available at either the loading and discharge ports or both. Critical repair parts will be carried in ship stores, as well as base stock, along with materials for fabricating parts in the machine shop aboard each ship.

Each year every U.S. ship will undergo a Coast Guard inspection, and needed repair and ship maintenance will be accomplished. Every two years each ship will undergo an inspection in drydock which involves a complete inspection of the ships hull and overhaul of all major equipment. Every four years a special American Bureau of Shipping Survey will be conducted which requires detailed internal and external inspection of the hull and its appurtenances together with opening all major machinery components.

Repair facilities are available in the San Francisco area for ships up to 125,000 DWT. Smaller vessels can be dry-docked at San Pedro and Seattle. Suitable construction and repair facilities for larger ships are not presently available on the West Coast. However, the four major ship concerns - Bethlehem, Todd, Lockheed, and National Steel - have expansion plans to meet the ship building and repair market. It is anticipated that when the market for larger vessels develops, facilities will be available.

(c) Loading Operations - Gulf of Alaska Terminal

Protection afforded by land masses and deep water approaches will be a major consideration in the selection of a terminal site to provide a harbor for any size vessel on a year-round operation; however, an offshore terminal may be used. Other features which will be important in a terminal site selection are accessibility, absence of navigation hazards, sheltered location, low current velocities, availability of ample maneuvering room, deep water, and freedom from ice. Mooring and unmooring operations at the terminal will take place with a pilot or docking master aboard.

Owner company and their affiliated companies' experience with large tankers in similar harbors indicates that 70-100 tons of bollard pull is adequate for docking vessels of the VLCC class. Adequate tugs will be provided for handling vessels at fixed type mooring berths. Careful attention will be paid to the maintenance of the tugs, their towing gear, and the qualifications of their personnel.

Any tugs needed will have fire fighting capabilities including water/foam nozzles. The system will be of such capacity to deliver water or foam onto the deck of the large tankers in light condition. The tug's crew will be properly trained to operate all of the tug's fire fighting equipment.

Adequate mooring launches will be furnished to assist in the mooring of all vessels. These launches will carry the ship's lines to the appropriate mooring points.

Simultaneous with the mooring, operation procedures will be initiated applicable to vessel and oil transfer facilities as prescribed in the U.S. Coast Guard "Rules and Regulations" Subchapter Ø Parts 154-156 and vessel safety as prescribed in Subchapter D, Subpart 35.35, which are attached as Addendum No. 1.

To meet these Coast Guard requirements, the person in charge of a vessel must confer with the person in charge of the facility and complete a Declaration of Inspection which requires close checking of all aspects of the transfer operation to be executed. The Declaration of Inspection covers both Safety and Pollution Prevention requirements.

Once the Declaration of Inspection has been completed and all connections have been made, loading and ballast discharge operations will commence. A watch will be maintained on deck and in the engine room throughout the loading and discharge operations. The manifolds, ullage gauges, and the water adjacent to the ships will be under constant surveillance. Throughout loading and ballast discharge operations, Coast Guard rules and regulations (Addendum No. 1) will be strictly adhered to.

It is not expected that facilities for bunkering will be provided at the Terminal and accordingly all ships must arrive with sufficient fuel for the return trip to the discharge port.

(d) Oil Spill Contingency Plan - Gulf of Alaska

All of the facilities available at the terminal will be available to assist ships in distress close to Alaska, within the framework of the "Seattle Coastal Region, Oil and Hazardous Materials, Pollution Contingency Plan" issued by the United States Coast Guard, 13th District, a copy of which is attached as Addendum No. 2.

The tugs and mooring launches, which will normally be used for terminal operations, will be available to assist any vessel in distress near the Gulf of Alaska terminal site.

A separate portion of this environmental statement describes in general terms the terminal oil spill contingency plan and the actions which would be taken and the materials and equipment which would be available if the terminal were to be put into operation now. These plans will be revised and updated to take into account new techniques and equipment which may become available when the terminal becomes operational.

(e) Voyage Description

Applicable Pilotage endorsements for waters leading to the terminal will be mandatory for the master of all enrolled vessels as required by existing federal legislation. In accordance with Alaskan state laws, all vessels under registry will have on board a state licensed pilot.

Once a terminal site has been selected, a detailed analysis of the tanker route from the terminal to the then existing tanker routes of the Gulf of Alaska will be made. Inbound and outbound lanes with appropriate separation zones will be established or, where channel width prohibits separation, traffic control rules permitting one way only traffic will apply.

The adequacy of existing navigational aids, and the quality of natural radar targets and suitable anchorage locations in the approaches to the terminal will be established. If needed, recommendations for additional navigation aids to insure safe passage of deep draft tankers and recommended anchorage locations will be developed and presented to the U.S. Coast Guard for review and implementation.

South of Middleton Island in the Gulf of Alaska enroute to the U.S. West Coast no navigational obstructions exist offshore. During this part of the voyage, normal celestial navigation supplemented by electronic position fixing and radar positioning will be carried out while Radio Direction Finder beacons on the coast are also available to assist in determining vessel's position. Before arrival at the West Coast port the local regulatory requirements pertaining to the use of licensed pilots, navigation of entrance channels, safety rules, use of tug boats, etc. will be strictly observed to avoid the possibility of accidents.

In the Gulf of Alaska, all ships will maintain navigation instruments in operation and continually scan with radar. Ships will be in communication with shore installations which provide weather and traffic information. All masters will be experienced in handling ships in stormy weather. Tanker shipments from Alaska to the West Coast of the United States have been made for many years. The record of safety and pollution control, though subject to continuing improvements, is good. It is expected that this trend will continue during the life of the Gulf of Alaska oil shipments.

All ships will be required to strictly comply with all of the state and national laws and the 1969 Intergovernmental Maritime Consultive Organization proposed international amendments related to discharges at sea. Each ship master will be required to sign an affidavit to the effect that he has complied with these requirements prior to loading at the Gulf of Alaska terminal.

(f) Discharge Port Operations on U.S. West Coast

Los Angeles - Long Beach: Los Angeles has presently a 47 foot depth in the deep draft channel to the Union Dock. Ships in the 100,000 DWT category presently navigate this channel. Twenty tanker berths are available in the inner harbor which have a 35 foot draft at mean low water, thus limiting fully loaded tankers to about 30,000 DWT. Two berths are available in the outer harbor where a 51 foot mean low water draft exists.

The Long Beach channel has 59 feet at the entrance, 61 feet in the channel and 65 feet at the anchorage. There are four tanker berths available operated by private companies, in addition to seven municipal berths now in operation. The berths have a mean low water draft of 55 to 37 feet. The ARCO dock on Terminal Island is presently handling 120,000 DWT tankers.

San Francisco: The current maximum depth over the Golden Gate Bar is 50 feet and the Pinole Shoal Channel leading to the Benicia-Martinez area has a 35 foot depth. Future plans call for deepening the Bar entrance to 55 feet and the Pinole Channel to 45 feet. The 45 foot depth would allow use of at least 80,000 DWT tankers. Dockside berthing is the predominant berthing system in the San Francisco area, with maximum drafts at the docks between 35 feet and 38 feet. Tankers arriving with a greater draft are lightered at the anchorage before proceeding to the docks.

Puget Sound: The Straits of Juan de Fuca, Rosario Strait, Puget Sound and some tanker receiving facilities have capabilities for large vessels. Dockside berthing is used and both steel loading arms and hoses are used in transferring cargo. The ARCO refinery terminal at Cherry Point is equipped with steel loading arms.

(g) Discharge Port Contingency Plans for Spill Clean-Up

Los-Angeles - Long Beach: An oil spill cooperative called "Clean Coastal Waters Inc." consisting of major area industries has been formed for the Los Angeles - Long Beach Harbor and essentially all of the potential owner companies or their affiliates currently shipping into this area are members of this Co-Op. A copy of this plan is attached as Addendum No. 3. The plan is updated as developments in the art of oil cleanup are made and as additional equipment is added.

San Francisco: A non-profit corporation called "Clean Bay Inc." has been formed by oil companies in the Bay Area. This corporation maintains all necessary emergency spill clean-up apparatus to supplement the capabilities of local terminal organizations and arranges for suitable sub-contractors as the individual case may require. A copy of the response plan is attached as Addendum No. 4. The plan is updated as developments in the art of oil spill clean-up are made and as additional equipment is added.

Puget Sound: Under the auspices of the Western Oil and Gas Association (WOGA) all of the major oil companies in the Washington area have formed "Clean Sound", an organization to provide industry cooperation and common use of owned supplies and equipment to meet oil spill emergency requirements. Details of this oil spill contingency plan are attached as Addendum No. 5. The industry plan is updated as developments in the art of oil spill cleanup are made and as additional equipment is added.

Santa Barbara: A cleanup cooperative called "Clean Seas Incorporated", has been formed for the Santa Barbara Channel by over a dozen oil companies with operations or interests in the area. The CSI oil spill clean-up manual is attached as Addendum No. 6.

These plans provide for both equipment and manpower to cope with usual spills and for mobilization of men, equipment and materials for unusually large spills (over 100,000 gallons).

(h) Discharge Port Navigation and Traffic Control

Los Angeles - Long Beach: The Los Angeles harbor area is basically under the control of the Los Angeles Pilot Association, a Civil Service group. All vessels under registry and also enrolled vessels which do not carry a qualified officer with Los Angeles pilotage, are required to have a Los Angeles pilot on board prior to entrance of the harbor. The Los Angeles Harbor Pilot station is equipped with radar and all pilots carry VHF radio units and maintain contact with each other and the shore based pilot advisory station. In addition, the vast majority of enrolled vessels with pilotage capabilities converse with the pilot association regarding vessel movements, etc.

The Long Beach area pilot group, Jacobson Pilots, Inc., is a private concern but, in other respects, it is similar to the Los Angeles group. Jacobson is equipped with radar and maintains contact will all of their pilots as well as the Naval Base concerning combatant ship movements, etc.

Both Los Angeles and Long Beach Pilot Associations (which both, in fact, control vessel movement) are ideally situated for their assumed monitoring responsibilities. Both are within visible contact of the harbor entrance and normal navigation hazards. When fog or other abnormal restrictions occur both groups impose restrictions on entrance or exit passages as they feel is required.

The U.S. Coast Guard reports that the Los Angeles and Long Beach area pilot groups, with radar, are doing an adequate and worthy job of policing harbor movements. No traffic controls or other similar regulations are deemed required at this time in the Harbor area. The U.S. Coast Guard has, however, established offshore approach lanes and associated radar surveillance is necessary before effective ship control in the general Los Angeles - Long Beach area is achieved. Means of VHF communication with all ships, particularly Naval vessels, should be established. It is highly recommended by the pilot groups, and is endorsed by the owner companies along with mandatory use of the harbor pilot radar services.

San Francisco: At the present time, two complementary advisory agencies exist which monitor vessel movements and provide information to vessels through VHF communications on a voluntary basis. The Harbor Advisory Radar System (HAR) is an experimental radar system operated by the U.S. Coast Guard which monitors traffic in the area covered by its radar system (see Addendum No. 7), and provides information to vessels upon request. Areas outside of the HAR system (notably the Upper Bay and Stockton Channel Area) are monitored by the Marine Exchange which relies on vessel radio reports to keep track of various vessels' positions and movements in specific channel and harbor areas. Use of the HAR and/or the Marine Exchange System is now compulsory. With the exception of enrolled vessels which have on board an officer with appropriate pilotage, all ships entering San Francisco Bay must take on board a "Bar Pilot" to pilot the ship to its berth or appropriate anchorage. The "Bar Pilots" are equipped with VHF portable radios by which they keep in contact with HAR or the Marine Exchange as the case may require. In addition, many of the enrolled vessels with on-board pilots are equipped with VHF and contact HAR as a matter of course. Details of the HAR and Marine Exchange operations are included in the "Operations Manual" which is attached as Addendum No. 7. The major problems presently experienced by these groups are the numerous small vessels in the area, confusion over proper communication channels or lack of proper equipment, and the absence of authority to actually regulate or direct vessel movements.

Following a tanker collision in San Francisco Bay, the Marine Exchange and the Association of Bay Area Governments prepared a list of recommendations for improved harbor control which they entitled REPORT OF REGIONAL COMMITTEE ON NAVIGATION AND THE ENVIRONMENT (ROSE), a copy of which is attached as Addendum No. 8. These recommendations were endorsed and include:

1) VHF equipment should be required on all deep draft vessels and must be used on designated frequencies.

2) The use of formalized harbor safety and advisory services (HAR and Marine Exchange) should be mandatory.

3) The U.S. Coast Guard should provide additional aids to navigation to separate inbound and outbound lanes. (Notably radar beacons of the continuous wave type on the Golden Gate Bridge.)

4) New rules and advisory services should be applied uniformly to all vessles. No specific rules for vessels with various cargo (other than explosives) are recommended.

Puget Sound: At the present time regulations covering pilot requirements are similar to those in Los Angeles and San Francisco, i.e., all vessels under registry and enrolled vessels without an officer with the proper pilotage endorsement must take on a Puget Sound pilot off Port Angeles in the Juan de Fuca Straits. These pilots communicate with one another by means of portable VHF radio units.

The U.S. Coast Guard and other agencies in the Puget Sound area presently have a Harbor Advisory Radar Service similar to San Francisco in operation.

The U.S. Coast Guard is presently installing a considerable number of navigation aids in the Rosario Straits to insure safe passage of 65' draft vessels.

IV ENVIRONMENTAL IMPACT OF MARINE SYSTEMS

Ships, whether they be dry cargo or tankers, do not themselves cause harm to either water fowl or marine life in their passage through the sea and inland waters. Oil spills, particularly those that are large (100,000 gallons) do have some effects even though they may be short in duration. Addendum 9 discusses these effects in greater detail. The following discussions will be directed to both intentional and accidental tanker discharges as they may relate to the Gulf of Alaska marine transportation system.

(a) Causes of Spills in Ship Operations

The causes of oil pollution can be categorized as those spills resulting from ship groundings, collisions (ship to ship casualty), rammings (ship to object casualty), ship breakup at sea, oil contaminated discharge at sea, and finally spills occurring while in-port loading, discharging and bunkering operations are under way. Each of the categories will be described, along with the related operational plans for minimizing the probabilities of a spill occurring in the Alaska-West Coast tanker operations.

(b) Groundings

Groundings result from poor navigational aids, uncharted rocks and/or reefs, bad weather, poor operational practices and errors on the part of ship's crews and/or pilots. Based on history, poor navigational practices appear to be the major cause of groundings. Oil may or may not be spilled when a ship runs aground, depending on whether or not the ship is loaded, the ship's speed, and whether or not the grounding is in rock or soft material. If the ship is loaded and the hull is ruptured in the area of the cargo tanks, a spill may occur.

Table 3 presents tanker grounding data for the world tankers fleet released in November, 1974 by the U.S. Coast Guard for the 1969-1972 period. A total of 709 groundings occurred, of which 538, or 76 percent, resulted in no pollution. The U.S. Coastal Waters are well charted; however, the East and Gulf Coasts are generally shallow near the shore and channels to ports are dredged. As indicated on Table 3 the majority of the groundings and the related pollution incidents occurred while navigating in harbors, entrances or in shallow coastal areas.

Maneuvering near shore, through narrow channels and in shallow water is not expected to be a problem in a Gulf of Alaska terminal area for any of the locations likely to be selected as a terminal site. With the navigational equipment and aids planned, groundings would be virtually eliminated unless a breakdown of the propulsion plant occurred and strong cross-winds and/

or currents prevailed in which case anchoring could take place. Any tugs stationed at the terminal would be quickly available to assist vessels in the unlikely event that power was completely lost. Water depths will exceed 80 feet in all areas where tankers will normally navigate except possibly in Icy Bay and Yakutat. Probability of groundings under the conditions expected to prevail at a properly selected terminal site in the Gulf of Alaska area can be anticipated to be near zero considering the plans for traffic control, more sophisticated communication and navigation equipment together with the trained ship personnel.

The Port of Los Angeles - Long Beach has several channels to navigate. Channel dimensions vary from 300 feet in width and 2,400 feet in length to 700 feet wide and 2.3 miles long. These channels are inside the breakwater and have mud bottoms with some sand. Within these areas ships move at slow speeds and any groundings that may occur will be the low energy type. This, together with the fact that the bottom and sides of the channels are soft, will reduce the probabilities of cargo tank rupture to essentially zero. According to Captain W. H. Putman, whose report is attached as Addendum No. 10, there were no spills resulting from a grounding from 1962-1969. It is not expected that such a spill will occur considering the awareness of operators to the problem and the future plans for traffic control communications.

The Port of San Francisco has an over-the-bar channel that is 2,000 feet wide and 2.75 miles in length with a sand bottom.

The Southampton Shoal Channel is 600 feet wide and about one mile in length. The bottom is primarily sand. Pinole Shoal Channel is 600 feet wide and five miles long. This channel has predominately a mud bottom with some hard spots. It is possible that a tanker may run aground in either the Southampton Shoal Channel and/or the Pinole Channel; however, the probabilities of a spill become remote since low energy groundings would occur in soft channel bottoms. The probabilities of a tanker grounding in the bar channel are essentailly zero because of its width. Furthermore, with traffic controls, defined shipping lanes, improved communications, and navigation equipment and procedures becoming the order of the day, the probabilities of groundings are minimized.

Puget Sound: The only significant area containing a number of navigation hazards and a restricted channel is the Rosario Strait leading from the Juan de Fuca Strait to the Straits of Georgia (see Addendum 11, page 3). The refineries at Cherry Point, Ferndale, and Anacortes are reached by means of this Strait. The Strait is roughly 3/4 - 1 mile wide at the narrowest point and extends for about 18 miles. Due to its narrow width, a single lane was established to limit movement of large vessels to one direction at a time. That, along with the following regulations issued by the U.S. Coast Guard VTS should eliminate the possibility of collisions or groundings in this area. A vessel may not enter Rosario Strait unless:

1) A report is made by the master of a vessel at least fifteen minutes before it enters the Strait, giving the vessel's ETA at, and point of entry in Rosario Strait to the Vessel Traffic Center by radiotelephone;

2) The radio equipment on the vessel that is used to transmit the reports required is in operation;

3) During the periods of visibility of two miles or less, the radar on a vessel equipped with radar is in operation and manned; and

4) The vessel is free of any conditions that may impair its navigation such as fire, defective propulsion machinery, or defective steering equipment.

The Puget Sound area leading to Seattle and Tacoma is roughly two miles wide with depths well over 100 feet. No restricted channels exist and navigation aids including a mid-channel buoy system is presently adequate.

(c) Ship Collisions & Rammings

Operating practices that contribute to ship collisions and rammings include poor planning, training, and equipment maintenance, improper use of navigation equipment, and poor communications. Collisions and rammings of ships generally occur in areas of heavy traffic concentrations and are generally the result of poor operating practices and master and/or pilot error. In broad expanses of water and the open sea, ship collisions are less likely to occur and history bears this out as documented in Tables 4 and 5.

If ships collide and the cargo tanks are holed, the spill could be severe. In extreme cases the entire contents of the holed tanks could be spilled. However, for reasons set forth in prior sections and below, including the planned navigational equipment and aids, planned traffic separations systems, crew requirements and ship construction, combined with the relatively low traffic density, the Gulf of Alaska-West Coast run should be one of the safest in the world with collision possibilities reduced to near zero.

Table 4 presents data from the American Bureau of Shipping for the ten-year period of 1959-1969 on tanker collisions and rammings. These data are based on an average of 488 tankers in ABS class that were 30,000 DWT, and larger. Table 5 presents more recently compiled and released data from the U.S. Coast Guard on collisions for the period 1969-72 without respect to tanker size. Both tables point to the fact that collisions are more apt to occur within harbors and it can generally be stated that because of regulations and operating practices, these are low energy impacts and more often that not will not result in pollution. This is substantiated by Tables 4 and 5 which show that only a small percentage of collisions and rammings result in pollution incidents. Table 5 indicates that of 1219 collisions or rammings within harbor entrance only 18 percent resulted in any pollution. While data on the amount of oil spilled for each of the polluting collision/ramming incidents is not available it is expected that the oil out flow was minor in all but a few such incidents.

Collisions of tank vessels entering harbors rank third to all types of collisions with data from Table 4 indicating an average of about .013 such collisions per ship operating year. In the case of the West Coast Harbors under anticipated conditions in 1975 and thereafter, ship collisions should be minimized by improved navigational aids, harbor traffic controls, ship to ship and ship to shore communications, and the establishment of traffic lanes, into and out of the harbor.

Shipping lanes into the Gulf of Alaska terminal would provide for the complete separation of tanker traffic. Considering the relatively low traffic density, the navigational and communication system planned, the traffic control system and its coordination and interface with the proposed Valdez tanker terminal, together with trained ship personnel, the probability of a collision of tankers approaching or leaving such a terminal is near zero.

Sea routes to and from a Gulf of Alaska Terminal from the West Coast will be in the wide open waters of the Gulf of Alaska and the Pacific Ocean. Considering the low frequency of collisions at sea of about .013 per ship operating year (ABS data), which is highly weighted by high density traffic in the approaches to the U.S. East Coast ports and similar worldwide ports, together with planned communication and navigational systems, it is apparent that open sea collisions will approach zero.

(d) Ship Breakup at Sea

Ship breakup has occurred during the heavy storms in open sea and because of onboard explosion. Breakup in storms can be attributed to poor operations, or other errors on the part of the ship's master or crew, or to inadequate design margins. American tankers are designed, when properly loaded, to withstand any known forces generated in the sea by wave and swell action. Oil spills resulting from ship breakup at sea can be severe if the ship is loaded. Measures to be taken to prevent ship breakup will include sophisticated loading calculators to insure that stresses in the hull will be kept at acceptable levels while tank cleaning procedures will follow the safety guidelines laid down by the International Chamber of Shipping.

Fire at sea, in the absence of collision, is often thought of as a cause for ship breakup. All U.S. ships must comply with Coast Guard regulations and will be equipped and operated to minimize this possibility.

(e) Ship Casualty Trends - U.S. & Foreign

(1) Total Losses
(Including vessels deemed to be constructive total losses)

While the total number of ships lost each year from the World Merchant Fleet (Table 6) is significant (e.g., 195 vessels out of a total 31,486 in 1974), and provides no cause for complacency, the loss trend is not alarming either. Statistical tables based on the annual report of The Liverpool Underwriters Association and Lloyd's Register of Shipping - Statistical Tables, are attached (Table 7 and 7-A). These tables show that on the average less than four U.S. Flag ships have been lost per year over the last 10 years. Less than one U.S. flag tanker per year has been lost on an average over the same period.

(2) Partial Losses

This category, presented in Table 8, includes all reported casualties exclusive of total losses suffered by vessels in the World Fleet. Details are not available to permit an analysis by flag or vessel category; however, the Liverpool Underwriters Association Reports do classify the casualties by cause and this is shown on Table 9. The ratio of casualties to total vessels is high - an average of 28.4 percent over the last eight years. In 1971 and 1972 there was a tremendous improvement - 19.6 percent and 19.3 percent, respectively.

(f) Harbor Oil Spills

Harbor spills are more frequent than spills at sea; however, they generally are limited to very small quantities. They occur as a result of human errors and/or equipment failure. Common causes are the inadvertent opening of a valve, failure of a ship-shore connection, sea valves left open, tanks over-filled, starting pumps before connection is completed, leaky joints or valves, and equipment failure, or poor operational procedures during bunkering.

Based on Captain W. H. Putman's data, which is attached as Addendum 10, and covers Los Angeles Harbor for the period 1962-1969, U.S. and Foreign tankers have the same number of spills in port (75 U.S. - 74 Foreign), while in the freighter category foreign ship spills exceed the U.S. ship spills by 122 to 88. Captain Putman states in his paper that ship spill experiences vary directly as the number of ship calls. The statement is verified, somewhat, by 1969 and 1970 data accumulated on spills in the San Francisco Harbor since 5,136 and 4,931 ships called in 1969 and 1970 respectively, and these ships experienced 74 and 68 spills respectively.

Table 10 represents the seven year data on the cause of oil spills from tankers in Los Angeles - Long Beach Harbor, presented by Captain W. H. Putman, and is believed to be representative of spills in all of the concerned harbor areas. In addition, the measures to be taken in a Gulf of Alaska-West Coast shipping system that will minimize the probability of oil spills within a Gulf of Alaska terminal and the discharge ports are indicated. This is not to say that occasional spills will not occur; however, it should demonstrate that the incidence of tanker spills at a terminal will be considerably less than experienced in the past. For instance, in the past the major cause of oil spills on cargo discharge operations were incorrect valve alignment (24). The USCG regulations requiring completion of a checklist, and the fact that a large number of the vessels engaged in Gulf of Alaska-West Coast trade will be equipped with centrally controlled cargo systems and power operated valves, should reduce such spills.

Bunkering spills (total of 27), resulted primarily from over-filled tanks. Most vessels used in the Gulf of Alaska-West Coast System will have direct reading gauges and high level alarms and, thus, the frequency of spills from these two causes alone should be substantially reduced.

(g) Intentional Oil Contaminated Discharge at Sea

In order to put the matter of causes of tanker pollution in perspective it is noted that the 1975 National Academy of Sciences publication "Petroleum in the Marine Environment" indicates that casualties such as rammings, groundings and collisions account for only 12 1/2 percent of total tanker-induced pollution. Bilge pumping, bunkering, and terminal operations account for another 3.8 percent; the remaining source of pollution from tankers is tank cleaning and ballasting operations which accounted for some 83.7 percent of the total. Discharge of oil contaminated water at sea results from bilge pumping, cargo tank cleaning and de-ballasting operations.

Owner company and affiliated company owned vessels will pump oily bilge water into their slop tanks for later discharge into shoreside facilities. Several tankers will have segregated ballast tanks so that only clean, uncontaminated ballast water is discharged. Others will, however, need to use ballast receiving facilities in the Gulf of Alaska. With the oil contaminated ballast receiving facilities planned for the Gulf of Alaska terminal (discussed in the next section) the need for tank cleaning will be greatly reduced for vessels in the Gulf of Alaska-West Coast service.

Prior to loading, each ship's master must certify that in traveling to the terminal his ship has complied with all International, National, and State laws and regulations governing the discharge of ballast and bilge water. The port will provide the necessary forms for certification by the ship's master. Any ships known not to have complied with applicable laws or regulations will be reported to the appropriate authorities.

(h) Ballast Handling

With the exception of the small portion of the ballast voyages when the minimum necessary tank cleaning is done, the vessels enroute to a Gulf of Alaska terminal will normally take on salt water ballast in both their cargo tanks and segregated ballast spaces at, or on departure from, the discharge port. All oil contaminated ballast (contaminated ballast in cargo tanks) will be discharged to the terminal. Ballast treatment facilities at the terminal will be designed to handle the maximum anticipated oil contaminated ballast required for heavy weather ballast passages for the largest vessels intended for this service.

(i) Impact of Ship & Ship Operations on Fishing Grounds in the Gulf of Alaska

The operation of the ships in the Gulf of Alaska will not affect the fishing grounds. The operation of the ships may, to some degree, impose additional requirements on the part of fishing boat and pleasure boat operators which may be operating near the terminal area. With proper navigational and communications equipment and procedures and with equal care by other marine users it is not likely that a collision will occur.

When a proposed anchorage area is located it could be within the area in which commercial fisherman catch crab and shrimp, and in which they seine. The ships' presence within the anchorage area will in no way affect the marine life in the fishing grounds. The ships at anchor and underway in the anchorage area should not interfere with boat activities or destroy trap settings. Bad weather or unavailability of a dock will be the prime reason for ships going to the anchorage area.

In other areas of the U.S. the fishing industry, sports fishing, and the shipping industry have lived together in harmony with each respecting the rights of the other. In the Gulf of Mexico, for instance, large areas are dedicated to anchorage areas and to shipping lanes.

There has been no major conflict between any of the Gulf industries, including the oil-producing industry and the dedication of ship anchorage area and shipping lanes. One requirement is an attitude of flexibility so that areas set aside can be changed to the mutual interest of those developing and harvesting the resources in the seas and under the seas.

Normally, there will be no occasion for a ship to go to anchorage loaded with an oil cargo. Most ships in the area will be in ballast. There will be no exposure to pollution, oily ballast will not be discharged; the water is deep, thus the risk of grounding is very remote; and with the excellent navigational equipment and aids, the voice communications planned, ship collision exposure will be minimal.

Except for the interaction of ships with fishing boats and ships with crab traps, no effects on the fishing grounds or fishermen are anticipated in the terminal area. The entire marine system will be operationally and technically designed to minimize the possibility of destructive oil spills.

(j) West Coast Port Traffic

The U.S. flag tanker system transporting oil from the Gulf of Alaska terminal to the West Coast would displace foreign tankers carrying imports and, hence, would not affect the traffic density at the three major ports of Los Angeles, San Francisco and Seattle.

In contrast to the low traffic density of the loading and discharge ports of a Gulf of Alaska-West Coast Marine System is the New York Harbor where 75,000 DWT ships navigate a 600 foot channel and where

28.3 ships of all categories call each day. Also in direct contrast are the Houston Ship Channel and the Port of Philadelphia. Tankers of the 75,000 DWT class go up the Houston Ship Channel which is 400 feet wide and through which an average of 11 ships call each day - three of which are tankers. In Philadelphia, with a width of 800 - 1,000 feet, and a channel length of 90 miles, there is an average of 16 calls per day, of which six are tankers. In addition, there are numerous barges and tugs operating in these areas.

V GENERAL INFORMATION

(a) Offshore Terminal Alternative

Offshore terminal sites cannot be eliminated from consideration for the Gulf of Alaska fields until the fields are located and details of the feasibility and availability of a suitable onshore terminal have been developed. Offshore terminals can be designed to provide environmental protection equivalent to an onshore site; however, economic considerations indicate the latter alternative may be a better choice. One of the greatest deterrents for an offshore oil loading terminal is the need to provide a large storage capacity adjacent to the loading facilities.

(b) Supplementary Traffic Data

Loaded tanker traffic along the East and Gulf Coast of the U.S. in 1970 averaged approximately 33 ship calls per day, while the average number of loaded tankers calling on the West Coast that same year was eight ships per day. These tankers were both U.S. and foreign flag.

In view of the extreme precautions being planned for the Gulf of Alaska-West Coast tanker operations, the claim of inevitable environmental damage to the Canadian coastline expressed by some British Columbia residents is not justified. In fact, ships carrying South Alaska crude from Cook Inlet to Puget Sound have been operating off the Canadian coastline for several years without accident.

VI REQUIREMENTS FOR TERMINALS AND SHIPS LOADING AT A GULF OF ALASKA TERMINAL

In the course of this paper a number of requirements for the terminals and ships calling at an Alaska terminal have been stated. These requirements are for the purpose of materially enhancing safe navigation and improving tanker loading and discharge operations which will substantially reduce the danger of pollution from oil spills. The requirements are summarized as follows:

1. All ships calling at a Gulf of Alaska terminal are required by law to furnish proof of their financial responsibility to the limits specified in the 1970 Water Quality Act. In addition, owners of all ships calling at the terminal will be encouraged to have membership in TOVALOP* and all cargo owners will be encouraged to have membership in CRISTAL.**

* TOVALOP - Tanker Owners Voluntary Agreement Concerning the Liability for Oil Pollution (Over 99% of World Tanker Fleet belong).

** CRISTAL - Contract Regarding an Interim Supplement to Tanker Liability for Oil Pollution (Includes Owners of over 90% of Seaborne Oil).

2. Oil Spill Clean-Up Co-Operatives presently exist in Puget Sound, San Francisco, Los Angeles/Long Beach and Santa Barbara. Owner Companies or their affiliates are either currently members of these Oil Spill Clean-Up Co-Operatives or will become members. In addition, an extensive oil spill contingency plan has been laid out for Port Valdez. This capability will be available if needed in the Gulf of Alaska. When owner companies have traffic in the various ports in areas where such Co-Operatives do not exist, they will actively pursue their formation or else arrange for a suitable alternative.

3. The terminal will provide oil spill clean-up equipment and manpower for spills occurring in or near the terminal area.

4. Strict compliance with all U.S. Coast Guard regulations concerning preparation for cargo transfer, officer responsibility, Declaration of Inspection, emergency shutdowns, drip pans, etc., will be required and any violation of these regulations will be promptly reported to the U.S. Coast Guard.

5. All enrolled vessels will either be under the command of masters who have a U.S. Coast Guard pilotage endorsement for Alaskan waters leading to the terminal or, if masters are not so licensed they and vessels under registry will take aboard a state pilot as required by Alaskan law.

6. Sufficient tugs will be stationed at fixed structure terminals for the specific purpose of servicing ships destined for the terminal, in the terminal and/or leaving the terminal.

7. All overboard discharge valves from the cargo tanks not connected to the segregated ballast discharge system will be sealed or lashed prior to loading in accordance with U.S. Coast Guard regulations. These valves will remain sealed until the cargo is discharged.

8. Masters will be completely experienced in the handling of the vessels to which they are assigned. In the larger ships they will be given training at either model basins or aboard ships of the same class or larger.

9. In accordance with Coast Guard regulations, arrangements will be made for communications in a common language between vessel and terminal personnel.

10. At fixed installations when conditions permit, ships will either be boomed prior to loading, or a boat will be positioned to provide for rapid placement of sufficient oil containment booms to control any oil spilled.

11. Direction will be given ships arriving and departing the terminal. Such direction will be through radio communications. Clearances, weather, navigational and traffic information will be provided. No ship will be permitted to proceed past the anchorage area without proper clearances.

12. Any spills at sea will be handled in such fashion as the incident demands with the prime objective being to keep the spills from coming ashore. The U.S. Coast Guard contingency plan for Washington and Alaska will be the basis for planning.

13. Each ship will be required to carry standard six inch hose sufficient to make up a 50-foot length and the necessary adaptors to connect to their manifold for lightering purposes in emergencies at sea.

14. All ships loaded at any Gulf of Alaska terminal must be equipped with a fathomater, Radio Direction Finder, electronic position fixing device, and two radar systems. Also, all ships must have VHF and single side band radio, telephone and telegraph.

15. Personnel trained in the use and maintenance of navigational equipment will be aboard each ship. Systems designed for continuous use, such as radar, will be operated on a continuous basis.

16. The assignments of anchoring locations for ships dispatched to the anchorage area will be coordinated to minimize congestion and risks of collision.

17. The terminal will receive all contaminated ballast and wash water from cargo tanks to a site for treating and disposal.

18. All ships will be equipped with trim and stress calculators, together with a loading plan and discharging plan that will provide acceptable trim and stress tolerances while loading, discharging, and/or bunkering.

19. Tank topping off operations will be under the direct supervision of the senior deck officer on watch. Loading procedures and rates will be incorporated into each ship's loading plan. Coordination between terminal and ship will include communications relative to loading rate changes. Tanks will be constantly tended during the topping off operations.

20. Fire fighting equipment will be maintained at the terminal, aboard ships and on any terminal tugs.

21. Known violations of the Federal and State rules and regulations will be reported to the designated authority.

22. Crew members will receive specific training on the operating and safety rules applicable to their individual assignments, including the appropriate sections of U.S. Coast Guard regulations.

23. Continuous direct communications between the terminal and vessels entering the terminal area will be required on a 24-hour basis. Inbound and outbound traffic lanes will be established. Traffic control rules prohibiting two way tanker traffic through any narrow channel leading to any selected terminal site will be established.

24. Each ship master will be required to sign certification to the effect that he has made no unlawful discharges at sea prior to loading at the Gulf of Alaska facilities.

TABLE NO. 1

TYPICAL DESIGN AND OPERATING DATA

NOMINAL DEADWEIGHT (MLT)	60	70	75	80	120	250
Length Overall	731'	810'	810'	811'	883'	1,143'
Beam	105'	105'	125'	125'	138'	170'
Summer Draft	43.2'	43.5'	41.5'	43.2'	51.8'	65.5'
Gross Tonnage	32,000	41,000	38,140	38,000	62,000	114,000
Net Tonnage	23,000	25,000	32,425	27,200	42,000	94,370
Propulsion	Steam Turbine	Steam Turbine	Steam Turbine	Steam Turbine	Steam Turbine	Steam Turbine
Horsepower	20,000	20,000	19,000	24,000	26,000	31,500
Average Sea Speed (Knots)	16.5	16.0	17.0	17.25	16.0	15.6
Number of Wing Tanks	8	12	10	8	10	10
Approx. Wing Tank Capacity (Bbl.)	27,500	24,600	36,000	37,500	55,000	115,000
Number of Center Tanks	5	6	5	5	5	5
Approx. Center Tank Capacity (Bbl.)	46,000	42,000	57,000	62,000	98,000	180,000
Cargo Compartment Cubic - 98% Bbls.*	440,000	552,000	564,500	598,000	921,200	1,805,000
Segregated Ballast (Bbls.)	85,000	78,500	142,100	130,000	157,000	385,000
Dirty Ballast - Average (Bbls.)	40,000	80,000	67,000	50,000	156,000	190,000
Dirty Ballast - Heavy Weather (Bbls.)	100,000	140,000	102,000	125,000	250,000	370,000
Cargo Loading Rate, Max. B.P.H.	80,000	60,000	72,000	100,000	100,000	100,000
Cargo Discharge Rate - B.P.H.	30,000	37,500	40,000	50,000	91,400	75,400
Cargo Pumps - Number and B.P.H.	2 @15,000	3 @12,500	4 @10,000	2 @25,000	4 @22,850	4 @18,850
Segregated Ballast Disch.Rate-B.P.H.	12,000	7,250	4,300	14,000	10,700	18,850
Maneuvering Data:						
Turning Circle DIA - Ft.	2,300'	2,300'	1,800'	2,800'	2,500'	2,540'
Crash Stop - Reach - Ft.	4,300'	9,000'	5,225'	5,000'	10,000'	13,500'
Crash Stop - Dead in Water - Min.	7'	12.0	8.5	9	13.5	16.0
Maximum Transfer - Ft.	930'	1,400'	--	1,050	1,500'	--

* Segregated Ballast and Cargo Cubic Numbers are based on carrying 27 degree API crude and modifying piping to convert excess cargo compartments to ballast spaces.

AJS:hs

TABLE NO. 2

DESIGN AND EQUIPMENT FEATURES OF SOME U.S. SHIPS IN GULF OF ALASKA TRADE

1) Bow Thrusters
2) High level alarms on cargo tanks
3) Centrally controlled loading and discharge systems
4) Remote reading ullage gauges
5) Power operated valves on loading and discharge systems (remote)
6) Wire rope mooring winches
7) Bridge aft
8) Radar
9) Loran
10) Remote shut-down switches for loading and discharge pumps
11) VHF, UHF, SSB and radio telephone for ship-to-ship and ship-to-shore communications

TABLE NO. 3

U.S. COAST GUARD TANKER GROUNDINGS STATISTICS 1969-1972

GROUNDING LOCATION	TOTAL INCIDENTS	INCIDENTS RESULTING IN POLLUTION
Piers	7	0
Harbors	244	47
Entrances	247	51
Coastal	178	71
At Sea	1	0
Miscellaneous	32	2
	709	171

Source:

J. J. Henry Co.
"An Analysis of Oil Outflows Due to
Tanker Accidents" - Figures 4 and 9
Presented to U.S. Coast Guard
November 1973

RBK/mlr
3/6/75

TABLE NO. 4

ABS REPORT TO IMCO FOR TANKER COLLISION
Years 1959 - 1969

Tankers in ABS Class	488 30 MDWT & Above
Total Collision	553
Strike Submerged Object	17
Ice Damage	3
	573
Collision in Port	417
Collision at Sea	65
Entering Harbors	56
Unknown	15
	553
Damages in Cargo Area	
Indented Plating	510
Fracture Plating	37
Extensive Holed Area	3
Damages to Machinery Area	10
Possible Pollution	43
Definite Pollution	3
Longitudinal Bulkhead Holed	1
Longitudinal Bulkhead Indented	5
Machinery Space Holed	1
Machinery Space Indented	9

(From Mr. Marshall June 4, 1971)

TABLE NO. 5

TANKER COLLISIONS AND RAMMING
U.S. COAST GUARD STATISTICS 1969-1972

LOCATION	TOTAL INCIDENTS	INCIDENTS RESULTING IN POLLUTION
Piers	243	31
Harbors	527	71
Entrances	167	45
Coastal	204	66
At Sea	33	9
Miscellaneous	45	2
	1,219	224

Source:

J. J. Henry Co.
"An Analysis of Oil Outflows Due to Tanker Accidents" - Figures 4, 6, and 10
Presented to U.S. Coast Guard
November 1973

RBK/mlr
3/6/75

TABLE NO. 6

MERCHANT FLEET OF THE WORLD (Over 500 GRT)

Year	Total				Tankers				All Other Vessels	
	World		U.S.		World		U.S.		World	
	#	GRT M	#	GRT M	#	GRT M	#	GRT M	#	GRT M
1964	24,028	148,635	2,823	22,267	3,843	50,201	398	4,499	20,185	98,434
1965	24,495	155,873	2,680	21,360	3,975	54,666	377	4,511	20,520	101,207
1966	25,224	166,465	2,564	20,624	4,095	59,804	362	4,413	21,129	106,661
1967	25,893	177,250	2,490	20,147	4,158	63,794	369	4,539	21,735	113,456
1968	26,651	188,730	2,397	19,478	4,268	68,804	362	4,482	22,383	119,926
1969	27,468	205,781	2,329	19,365	4,436	76,959	357	4,554	23,032	128,822
1970	28,378	221,323	2,148	18,275	4,623	85,687	345	4,684	23,755	135,636
1971	29,520	240,750	1,823	15,965	4,835	95,692	331	4,641	24,685	145,058
1972	30,312	261,540	1,630	14,632	4,993	104,674	313	4,585	25,319	156,866
1973	31,036	282,790	1,535	14,443	5,133	114,903	306	4,717	25,903	167,887
1974	31,486	303,896	1,410	13,935	5,332	129,029	300	4,878	26,154	174,867

Source: Lloyd's Register of Shipping
Statistical Tables

RBK/mlr
3/7/75

TABLE NO. 6-A

MERCHANT FLEET OF THE U.S. (Over 500 GRT)

Year	Total #	Total GRT M	Tankers #	Tankers GRT M	All Other Vessels #	All Other Vessels GRT M
1964	2,823	22,267	398	4,499	2,425	17,768
1965	2,680	21,360	377	4,511	2,303	16,849
1966	2,564	20,624	362	4,413	2,202	16,211
1967	2,490	20,147	369	4,539	2,121	15,608
1968	2,397	19,478	362	4,482	2,035	14,996
1969	2,329	19,365	357	4,554	1.972	14,811
1970	2,148	18,275	345	4,684	1,803	13,591
1971	1,823	15,965	331	4,641	1,492	11,324
1972	1,630	14,632	313	4,585	1,317	10,047
1973	1,535	14,443	306	4,717	1,229	9,726
1974	1,410	13,935	300	4,878	1,110	9,057

Source: Lloyd's Register of Shipping
Statistical Tables

RBK/mlr
4/1/75

TABLE NO. 7

WORLD TOTAL LOSSES* (Vessels over 500 GRT)

	Totals				Tankers				Other Vessels	
	World		U.S.		World		U.S.		World	
Year	#	GRT M	#	GRT M	#	GRT M	#	GRT M	#	GRT M
1964	117	477	3	26	7	58	2	21	110	419
1965	154	692	3	17	13	142	0	0	141	550
1966	159	837	3	21	17	227	2	13	142	610
1967	163	747	6	31	18	187	1	12	145	560
1968	157	675	5	31	20	198	0	0	137	477
1969	147	820	3	22	19	347	0	0	128	473
1970	151	709	4	13	22	241	1	1	129	468
1971	175	944	2	28	21	341	N.A.	N.A.	154	603
1972	188	1,057	5	21	26	464	1	13	162	593
1973	179	1,078	3	26	20	359	0	0	159	720
1974	195	1,026	3	25	25	215	1	12	170	810

*Includes Constructive Total Losses

Source: Liverpool Underwriters' Association, Annual Reports
Lloyd's Register of Shipping - Casualty Reports

RBK/mlr
3/7/75

TABLE NO 7-A

U.S. FLAG TOTAL LOSSES* (Vessels over 500 GRT)

Year	Total #	Total GRT M	Tankers #	Tankers GRT M	Other Vessels #	Other Vessels GRT M
1964	3	26	2	21	1	5
1965	3	17	0	0	3	17
1966	3	21	2	13	1	8
1967	6	31	1	12	5	19
1968	5	31	0	0	5	31
1969	3	22	0	0	3	22
1970	4	13	1	1	3	12
1971	2	28	N.A.	N.A.	N.A.	N.A.
1972	5	21	1	13	4	8
1973	3	26	0	0	3	26
1974	3	25	1	12	2	13

*Includes Constructive Total Losses

Source: Liverpool Underwriters' Association, Annual Reports
Lloyd's Register of Shipping - Casualty Reports

RBK/mlr
4/15/75

TABLE NO. 8

WORLD PARTIAL LOSSES (Over 500 GRT)

Year	World Fleet	Casualties	Ratio (%)
1964	24,028	8,317	34.6
1965	24,495	8,884	36.3
1966	25,224	9,088	36.0
1967	25,893	8,333	32.2
1968	26,651	8,672	32.5
1969	27,468	8,024	29.2
1970	28,378	7,170	25.3
1971	29,520	5,787	19.6
1972	30,312	5,858	19.3
1964/72 Average			29.4

Source: Liverpool Underwriters' Association

RBK/mlr
3/10/75

TABLE NO. 9

WORLD PARTIAL LOSSES 1965/72
(500 Gross Tons and Upwards)

Nature of Casualty	1965	1966	1967	1968	1969	1970	1971	1972	1965/72 Average
Weather Damage	1,079	1,198	985	1,059	861	739	401	406	841
Strandings	1,038	1,013	848	909	854	800	656	678	850
Collisions	1,945	1,768	1,566	1,595	1,624	1,471	1,200	1,278	1,556
Fires and Explosions	445	462	422	444	433	417	340	374	417
Damage to Machinery, Shafts & Propellers	1,737	1,965	1,896	1,993	2,031	1,817	1,667	1,585	1,836
Contact Damage	1,583	1,646	1,674	1,647	1,359	1,136	766	731	1,318
Other Casualties	1,057	1,036	942	1,025	862	790	757	806	909
Total Partial Losses Reported	8,884	9,088	8,333	8,672	8,024	7,170	5,787	5,858	7,727
World Fleet (Number of Vessels)	24,495	25,224	25,893	26,651	27,468	28,378	29,520	30,312	27,243
Ratio % of Casualties to Total Vessels in World Fleet	36·27	36·03	32·18	32·54	29·21	25·27	19·60	19·33	28·36

Source: 1972 Annual Report - Liverpool Underwriters' Association

RBK/mlr
3/10/75

TABLE NO. 10

HARBOR SPILL CAUSES & PLANNED PREVENTION

146 HARBOR SPILLS - TANKERS - LOS ANGELES - LONG BEACH HARBORS 1962 - 1969 DATA

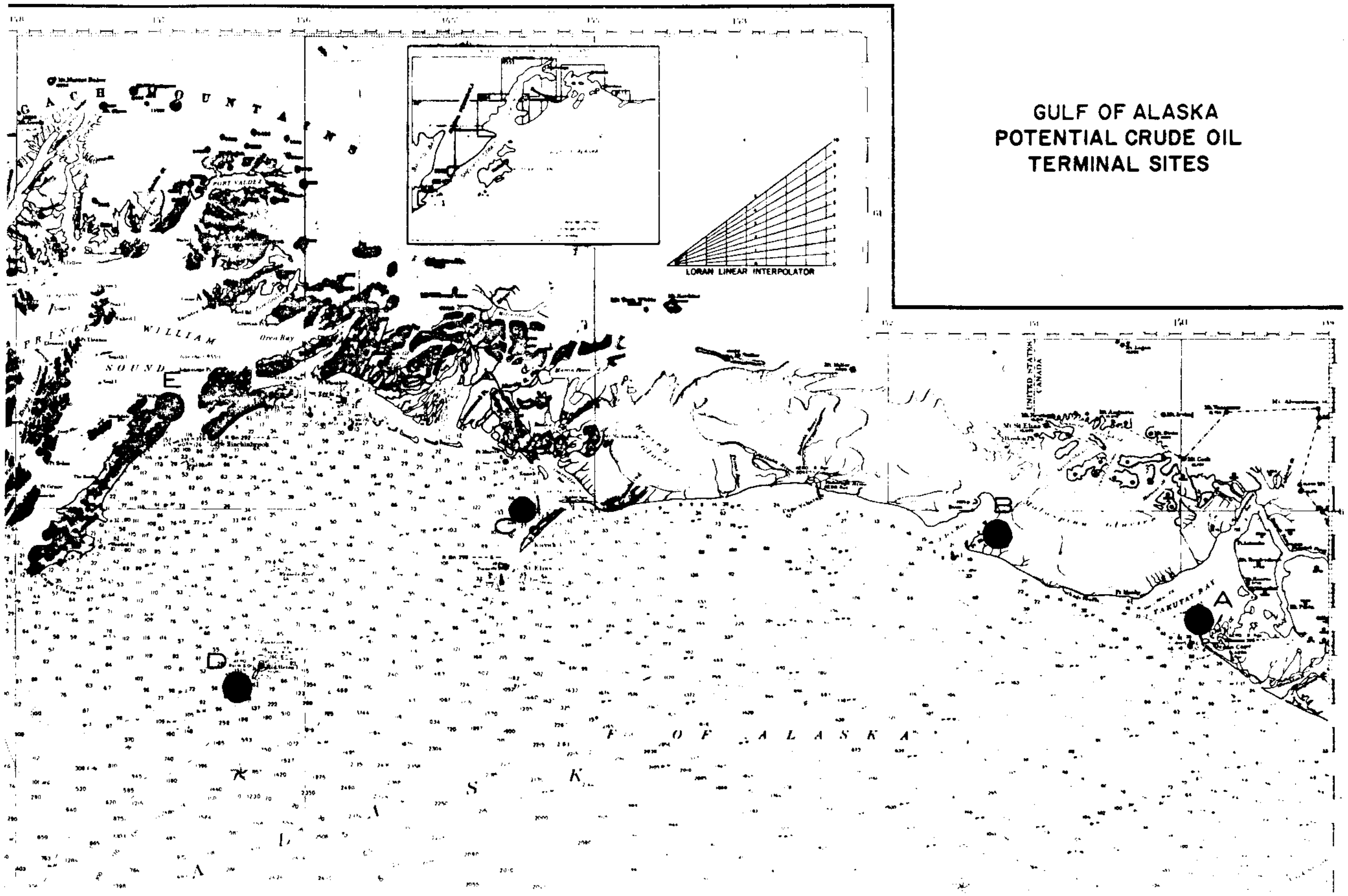
Operation	Causes	Gulf of Alaska	Southern Ports
Load Cargo (48 Spills)	Overfilled Tanks	High level alarms - Training, Ship-shore coordination & Comm. Terminal rate of flow meters & volume meters.	
	Soundings infrequent or none	Direct reading Ullage Gauges, rate of flow meters & volume meters.	Deballast only.
	Incorrect valve alignment	Check list between ship & terminal.	
	Hull leaks	Certification & visual observation - booms when required.	
	Ruptured cargo hoses	No hoses.	
	Broken Chicksans	All steel construction - inspection & testing.	
	Did not consider list or drag	All ships equipped with trim & stress calculator, high level alarms & direct reading ullage gauges. Constant loading pattern for all devoted vessels.	
	Thermal expansion	No cubic limits - tonnage limited.	
	Skin valve open	Checklist between ship & terminal. Sealing of sea valves before start of loading.	
Discharge Cargo (34 spills)	Incorrect valve alignment		Ship & shore check list - ship to shore communications.
	Hull leaks		Visual inspection, booms & ship maintenance.
	Overfilled tanks	Ballast only.	Ship to shore communications (shore tank).
	Ruptured cargo hoses		Visual inspection on use, monthly hydrostatic.
	Broken checksans		Steel construction, visual inspection & full maintenance.

Operation	Causes	Gulf of Alaska	Southern Ports
Discharge Cargo (Continued)	Did not consider list or drag		All ships equipped with trim stress calculator, high level alarms & direct reading ullage gauges.
	Broken Reach Rod		Inspection & testing - double valve protection.
Bunkering (27 spills)	Overfilled Tanks	No Gulf of Alaska bunkering.	High level alarms, direct reading ullage gauge.
	Incorrect valve alignment		Ship to bunkers check list.
	Soundings infrequent or none		Ship to bunkers check list.
	Top off excessive rate		Operations training, ship to bunkers communication & level alarms.
	Did not consider list or drag		Operations training & stress & trim calculations.
	Communication problem		Ship to bunkers communications.
Deballasting spills (9 spills)	Knowingly pump oily ballast overboard	All ballast & slops to shore.	
	Excessive discharge rate in deballasting	Design for max. size ship & max. discharge rate.	
	Incorrect valve alignment	Check list between ship & shore.	
Ballasting (7 spills)	Ballasting without prior suction.		Ship check list.
	Incorrect valve alignments		Ship check list.
	Overfilled tank		High level alarm.

Table 10 - continued

Operation	Causes	Gulf of Alaska	Southern Ports
Fuel Transfer (4 spills)	Overfilled tanks	High level alarms.	High level alarms.
	Top off at excessive rates	Operational training.	Operational training, high level alarms.
	Soundings infrequent or none	Direct reading ullage gauges.	Direct reading ullage gauges.
	Incorrect valve alignment	Ship check list requirement.	Ship check list requirement.
	Skin valve open	Ship check list requirement.	Ship check list requirement.
Cargo transfer (2 spills)	Overfilled tanks	Single cargo - emergency only.	None anticipated - single cargo - single port.
	Soundings infrequent or none	High level alarms.	High level alarms.
	Incorrect valve alignment	Ship check list.	Ship check list.
Hydro test (1 spill)	Riser ruptured	Steel construction.	Steel construction, visual inspection, testing hydrostatic monthly.
Light off boiler (1 spill)	Light off improperly	Manufacturers operating instructions will be strictly followed. Personnel training.	Manufacturers operating instructions will be followed.
Maneuvering (1 spill)	Collision	Traffic control in harbor, pilotage & tug assist. Communication requirement and improved navigation aids.	Use of traffic advisory services, harbor pilotage & tug boat assist. Support of recommendations for improved navigation and communication systems.
Bilge spills (assume 1/2 of total merchant) 87	Oily bilge water	All bilge discharged to slop tank.	All bilge discharged to slop tank.

GULF OF ALASKA POTENTIAL CRUDE OIL TERMINAL SITES



GULF OF ALASKA PETROLEUM OPERATIONS

TERMINALS

I. INTRODUCTION

A marine tanker loading terminal or terminals will be required to receive crude oil delivered by offshore submarine pipelines, store the oil, and then load tank ships for marine transportation to market destinations.

Terminal storage requirements depend directly upon throughput volumes and tanker sizes and schedules. Storage facilities must be adequate to allow continuous operation of the offshore pipelines thus minimal storage requirements are usually several times the daily system throughput volumes. Because of the large storage requirements, from an operational viewpoint, it is generally more advantageous to locate the tanker loading berths adjacent to or near shore; however, offshore loading berths cannot be discounted for use as Gulf of Alaska terminals until fields are discovered and the feasibility of suitable onshore terminals have been developed.

The comments below are based upon the best current technology. Improvements in equipment and technology will occur as time progresses. The operations described herein will be modified to incorporate those improvements as they become feasible.

II. GEOGRAPHIC LOCATION

There are a number of site locations within the Gulf of Alaska which provide sufficient water depth for tanker terminals. Locations provide complete or partial protection by terrain features and all are essentially ice free year around.

Existing ports within Prince William Sound would be most suitable for tanker terminals. However, these ports, namely Whittier, Valdez, and Cordova, are quite remote from the OCS lease sale area; and, for this reason, they do not appear favorable for long-range offshore Gulf of Alaska operations. It is possible that temporary operations could be conducted from these ports by bringing crude oil from offshore producing areas to the existing ports by barge or small tankers for transshipment in larger tankers until such time that terminal facilities could be constructed near the producing fields.

Some of the more favorable sites for terminals near the proposed OCS lease area are briefly described below:

Yakutat Bay

Yakutat Bay, see A on attached chart, is currently used by shipping and has some docking facilities. Several protected waterfront areas exist in Yakutat Bay which are suitable for marine terminals. Water depth is adequate near shore to accommodate fixed loading docks. Onshore terrain is relatively flat but sufficiently high to protect the facilities from high tides and waves.

Icy Bay

Icy Bay, B on chart, affords several possible terminal sites. Deep water areas within the bay are available near shore. The entrance to the bay is relatively shallow, however, with about 40-foot clearance over the bar at mean low water level and a sea bottom of soft sand and gravel; dredging could therefore be considered. Minimal dredging would be required to deepen a channel to 50-55 feet for a distance of approximately two miles in order to accommodate vessels of up to 80,000 DWT. The contiguous land areas are flat; however, there is sufficient high ground for onshore terminal facilities. Although the surface of the bay does not freeze over to restrict marine traffic, there is floating broken glacier ice which must be watched for possible hazard to small boats. The bay provides shelter from the east. High ground to the north provides shelter from winds from this quadrant.

Kayak Island

Kayak Island, C on chart, is a long strip of land separated by a narrow strait from the mainland. It is fully exposed to the Gulf of Alaska on the east, but affords some protection to large vessels on the western side. Deep water areas are close to shore and approaches from the Gulf are not restricted by depth or other land masses. Due to the exposed location, sea berths would probably be more practical than fixed berths. There is no protected harbor on the island for small craft. It would therefore be necessary to construct a protected small boat harbor for the terminal auxiliary craft. There is ample relatively flat ground for installing tanks and other terminal facilities.

Middleton Island

The west side of Middleton Island, see D on chart, provides protection from easterly winds and seas; however, tankers would have to moor approximately one and one-half miles offshore. A breakwater or small boat harbor would be required on the west side for auxiliary vessels associated with the sea berth operations. Adequate high ground is available on the island for storage tanks and related terminal facilities.

Montague Island

Zaikof Bay, E on chart, provides a natural marine terminal site which has deep water close to shore that is protected by land on three sides. The approaches are unrestricted along established navigation routes to other ports within Prince William Sound and to the open Gulf. Onshore land is adequate and possibly of sufficient elevation to provide gravity loading to fixed type loading berths.

III. OPERATIONAL CONCEPT

The crude oil terminal will be planned and operated in consonance with the most advanced technology to insure the safest, most pollution free performance. The following outline presents the principal features of the terminal systems as now conceived. These are subject to development to suit a specific site and to improvements resulting from technological advances.

Crude oil will be received from the submarine pipeline or pipelines into terminal storage facilities. Crude oil deliveries to the terminal and deliveries to tankers will be measured by means of meters or automatic tank gauging. Remote tank readings will be displayed and recorded in the terminal operations control center.

Facilities will be available so all oil contaminated ballast water can be discharged through a separate piping system to ballast treatment facility. Day to day quality control will be maintained.

Every precaution will be taken to minimize accidental oil spills. Should a spill occur, the contingency plan described in Section V of this report would be put into effect immediately. Oil spill containment and cleanup equipment and procedures are also described in Part VI herein and in the attachments to the Marine Transportation section.

An adequate fire detection and extinguishing system will be installed for the onshore facilities and loading berths.

Terminal personnel will receive specific training on the operating and safety rules applicable to their individual assignments, including appropriate sections of the International Oil Tanker and Terminal Safety Guide (I.O.T.T.S.G.) and U.S. Coast Guard Regulations.

Pilot services will be provided for all tankers entering or leaving a terminal. It is anticipated that an outside pilotage service will be developed to meet this need; however, the practicability of such depends upon the number of vessels, location of terminals, navigation hazards and other factors. Tugs will be used for docking all tankers at fixed type mooring berths. Mooring launches and crews will be provided to assist in handling tankers' mooring lines during berthing at both fixed berths and sea berths. Quick release mooring hooks and loading line connectors will be provided.

IV. MAINTENANCE CONCEPTS

Inspection and routine maintenance of all terminal facilities will be carried out by a regular terminal staff. Major maintenance and overhauls will be handled on a contract basis. A rigid policy will be adopted to insure that regular inspection and preventive maintenance programs are followed in order to minimize accidents and downtime due to equipment malfunctions.

V. FACILITIES DESIGN CONSIDERATIONS

Special Features

Special features will be incorporated into the terminal design as dictated by climatic conditions, topography, and environmental requirements.

Climatic conditions necessitate enclosing all mechanical equipment to prevent snow and ice from causing malfunction or hindering manual operations and inspection. Electrical equipment must be protected against condensation and all piping containing water must be protected to prevent freezing.

Onshore topography varies considerably throughout the Gulf of Alaska. In some instances, extensive excavation or formation of embankments will be required to render a terminal site suitable for the large structures involved. Special consideration must also be given to selecting soil conditions that are least susceptible to earthquake activity.

Environmental requirements dictate that the natural scenic beauty of the area and the high water quality standards which result in sport and commercial fishing and tourism be maintained. A strict operating procedure to guard against the possibility of accidental oil spills and the adoption of design criteria to guard against the risk of oil spills resulting from equipment failure due to earthquakes will be employed. Containment dikes will be constructed around all oil storage tanks capable of retaining the total contents of the tanks. Sewage treatment facilities will be provided and all combustible waste will be burned in an incinerator designed to keep emissions to a minimum.

Standards

The terminal facilities will be designed and constructed in accordance with industry standards and in full compliance with applicable local, state and federal regulations.

Site Development

In selecting terminal sites, special efforts will be made to select those with soil conditions which provide better protection against seismic effects. Also, sufficient elevation will be provided to insure that onshore facilities are out of range of possible tidal wave action. A complete soils investigation, including laboratory analysis of recovered samples will be made on the onshore and offshore area involved in order to establish adequate design criteria.

Once a terminal site is selected, soundings will be made in the approaches, turning areas, potential anchoring areas, and the general dock areas to insure that existing hydrographic charts are accurate, and that the area is free from obstructions. Current studies will also be conducted if factual historical data are unavailable.

Crude Storage and Ballast Water Tankage

All tankage will be welded steel construction. Special low temperature steel will be considered where climate conditions warrant. In areas where high snowfall is experienced, the tanks will be furnished with roofs designed to withstand this loading. A containment dike will be provided to enclose groups of crude oil tanks, with a capacity equal to 110% of the total volume of the tankage plus adequate allowances for surface water impounded within the area. Ballast water storage tankage will be contained within a common enclosure. Because of the very low percentage of volatile material in the ballast water, the dike area will be sized to contain the capacity of one tank plus an allowance for surface water impounded within the area.

All tanks will be equipped with automatic gauging devices with provisions for manual gauging as backup. Level alarms will be provided on all tanks to guard against overfilling.

Each tank will be designed to withstand the anticipated seismic forces after careful study of the seismic characteristics of the area. Construction of the tanks shall be such that a design earthquake can occur without damage resulting in loss of oil.

Dock Facilities

A sufficient number of docks will be provided to accommodate the required size and number of tankers. An individual dock may be designed to handle a range of tanker sizes from 16,000 DWT to 250,000 DWT, water depth permitting.

The type of dock structure will vary with the prevailing slope and soil conditions of the seabed. For flat or gentle sloping seabed conditions, the dock would be constructed from steel jacket structures, or concrete steel reinforced structures, which will be anchored to bed-rock or firm holding soil. In the case of steeply sloping sea bottom conditions, a floating dock could be constructed that would be free to move in a vertical direction to accommodate tidal movement and wave action, but would be restrained from lateral or longitudinal movement. This restraint would be provided by means of rigid struts hinged at the dock and hinged to anchor points onshore.

Mooring dolphins for each type of berth will be constructed of steel jacket structures anchored to bedrock or firm soil. Each mooring dolphin will be equipped with quick release mooring hooks for securing the mooring lines. The quick release hooks will be provided with remote controls operated from the dock operators building. Alternatively, the hooks may be released manually.

A fendering system will be provided on the seaward side of the docks.

All dock structures will be designed to withstand seismic and tidal wave forces as well as docking impact forces.

Loading Facilities

Loading from the storage tanks onto the tankers will be by gravity flow or by loading pumps depending upon the topography of the onshore site. Steel loading arms will be provided on each dock. The loading arms will be equipped with a quick, no-drip, disconnecting coupling to allow the tankers to leave the dock quickly in the event of an emergency. The tankage will be manifolded so as to provide maximum flexibility between tanks and the docks.

Shut-off valves will be provided on the docks and onshore on each berth loading line to allow either local operation or remote operation from the dock control center and the operating control center. Valves will also be installed at each tank. This valve scheme will allow emergency shutdown operation to be initiated at various points within the terminal complex.

Adequate relief valve and protective equipment will be installed to protect the terminal piping system from momentary surge pressures resulting from emergency shutdown procedures. These devices will be properly sized to insure that the level of pressure rise due to surge or any other variations from normal operations will not exceed the internal design pressure by more than ten percent at any point in the piping system.

Offshore Loading Terminals

The above description of dock facilities applies to onshore type installations. In the event offshore sea berths are to be installed, they could be of several types including fixed type docks, island type docks, single buoy moorings or conventional fixed multi-point moorings. Seabed anchoring characteristics and sea conditions will generally dictate the most economical and practical type structure to use for this method of berthing. Should terminal site selections necessitate offshore berths, then the design would be prepared accordingly for this type of installation. Onshore facilities would generally be the same for either offshore or onshore berths.

Offshore loading facilities are becoming relatively common. Until recently, however, they were all located in protected waters. An exception is a multipoint sea berth which was in use for several years at Cyrus Field near Kharg Island in the Persian Gulf. This has recently been replaced by a single point mooring system. Other loading terminals in exposed locations include the Dubai terminal, 60 miles offshore in the Arabian Gulf, Mobil's Nigerian Terminal, and the Phillips Ekofisk terminal in the North Sea. In addition, single point mooring installations are in the advance planning stage for the Gulf of Mexico offshore Louisiana and Texas (see Addendum No. 12). Although the difficulties may be accentuated in a Gulf of Alaska location, these existing installations demonstrate the feasibility of constructing and operating offshore terminals in exposed locations safely and with minimum hazard to the environment.

Certain design and construction features have been found essential to safe pollution-free operation. Central in these is proper selection and design of hoses and their appurtenances. Remotely operated shut-off valves should be installed at both the sea floor manifold and on the buoy. Careful monitoring of pressures and adherences to proper shutdown procedures will prevent over-pressuring the hoses. Proper design of moorings and hose configurations, including consideration of the dynamic effects of the tanker and the buoy, will minimize hose and mooring failures. Finally, a rigid system of periodic inspection, maintenance, repair, and replacement will assure safe, trouble-free operation within the limits of practicability.

Ballast Treating Facility

Ballast treating facilities will be installed to handle all oil contaminated ballast and wash water used to clean cargo tanks. The system described below is an example of the type of system now envisioned, although advancing technology may result in improved systems. The proposed system consists of gravity settling followed by chemical flocculation and dissolved air flotation. Treated water will be of a quality acceptable to the State of Alaska water quality standards.

Gravity settling will be accomplished in steel storage tanks. The ballast tankage will be sized to accommodate the simultaneous discharge of tankers if more than one dock is installed. Equipment will be provided to skim the storage tanks to remove floating oil to the oil treating section of the facility. Following gravity settling the ballast will be gravitated or pumped to the chemical flocculation and air flotation chambers. Before entering the flocculation chamber chemical additives will be added to the ballast. The ballast is then retained for a specified period in the flocculation chamber where it is subjected to continuous gentle agitation for floc development. The floc has a strong affinity for oil and the remaining oil in the ballast is captured by the floc particles in this chamber.

From the flocculation chamber the ballast flows to the mixing zone where it is mixed with an air charged stream. The air charged stream is recycled polished effluent. In the mixing zone minute air bubbles attach themselves to the floc and the mixture flows into the flotation zone.

The flotation zone provides the flow conditions and detention time for the air suspended matter to rise to the surface where skimming devices remove the floating matter. The clarified ballast flows out of the treating facility into an outfall line with diffuser which discharges into the port at a point below sea level. The diffuser will promote mixing of the treated ballast into the port waters. The polished effluent will be tested continouusly to insure that it meets all requirements of the water quality standards established by the State of Alaska.

Oil skimmed in the gravity settling tanks and that recovered in the flocculation-air flotation process will be treated to remove the last traces of water. The recovered oil will be pumped to the terminal crude storage tanks for loading aboard tankers. Water removed at this point will be recycled to the ballast tanks for reprocessing. The ballast treatment unit will be operated by an operator who will have complete control of all treatment operations.

Fire Fighting System

The terminal will be equipped with a high pressure fire main system. Hydrants will be installed along the line throughout the tankage area and in the building areas and on the docks. Water for the fire fighting system will be taken from the port and pumped into the mains by diesel engine-driven fire pumps.

A central foam system will be provided for the crude oil storage tanks. In addition, monitor towers for foam/water cannons will be provided for each berth. Each berth will be provided with foam from supply tanks located onshore, adjacent to each berth.

In addition to the foam/water cannons on monitor towers at each berth, a separate foam flood system will be provided for a curbed area around the loading arms. Foam and water hose reels will be installed on the operating platform at each berth.

All tugs serving the terminal will also have fire fighting capabilities including water/foam nozzles. The system will be of such capacity to deliver water or foam onto the deck of the tankers in light condition. The tug's crew will be properly trained to operate all the tug's fire fighting equipment.

The pump room of the ballast treating facility and any other pump buildings such as tanker loading pumps will be protected by fire and smoke detection devices. Other buildings will be protected by water from hydrants on the fire main and portable hand extinguishers located through the buildings.

Control System

All oil handling operations throughout the terminal will be controlled from the terminal operations control center. Remote reading automatic tank gauges, registering in the control center will be used to measure the quantity of oil delivered by the submarine pipelines, the quantities in idle tanks, and the quantities loaded onto tankers. High level tank alarms will register in the control center to warn against the possibility of overfilling tanks. A dock operator having continuous communication with the control center will be in attendance on each dock during all times when a tanker is alongside.

Service Vessels

Tugs will be available at all times to assist in berthing and unberthing at fixed docks. Tugs will have sufficient power to handle safely the largest tankers using the terminal. Each tug will be fitted with fire fighting equipment capable of delivering foam or water onto the deck of the largest tankers being received, when in light condition.

Mooring launches will also be provided to assist in handling tanker mooring lines. Small, but high-powered, vessels, perhaps in the vicinity of 40 feet in length, would be suitable around fixed berths in protected waters, while larger very seaworthy craft of perhaps 60 to 80 feet would be required at sea berths.

Utilities

Diesel engine or turbine driven generating units will be provided to supply the power requirements at the terminal. Redundancy will be designed into the utility system so that for essential operations, there will be continuous source of power.

Personnel Accommodations

The terminal complex will include living quarters for terminal operating personnel, along with necessary kitchen, dining, and laundry facilities.

Communications

The terminal control center will be equipped with radiotelephone for voice communication. Communications will be maintained with all ships arriving and leaving the terminal. Communications will also be maintained by either radio or microwave with all production platforms delivering crude oil to the terminal.

Heliport and Airstrip

An airstrip is desirable for normal operation, supply and emergency needs. Therefore, concentrated efforts will be made to provide at least a minimal airstrip for fixed wing aircraft.

The landing strip will, terrain allowing, be of sufficient length to accommodate Hercules type aircraft. If the terrain is inadequate or impractical for constructing a landing strip, then a heliport will be provided.

VI. TERMINAL OIL CONTAINMENT/CLEANUP EQUIPMENT

The extent of oil containment and cleanup equipment to be located at the terminal site will depend largely upon the total offshore operations involved and the proximity of cooperative type equipment within the general area. The following equipment is considered minimal for terminal operations.

Floating Boom

A floating boom will be available at the dock sites. The dock and supporting tendering vessels will be equipped with necessary deployment gear. Terminal and vessel crews will be properly trained to insure precise and prompt deployment of the boom.

Floating Skimmer

A self-propelled belt-on boom skimmer capable of working in six-foot waves will be provided. Also, a vacuum unit will be installed on the dock or on the deck of a boat or work barge. This type of mechanical cleanup equipment is particularly suitable for small spills where the spill is contained within a small area, thereby allowing the vacuum line to be played across the surface of the water manually.

In addition to the above, absorbents either of natural origin or synthetic material will be available for use on spills where oil has been effectively contained on water within a small confined area.