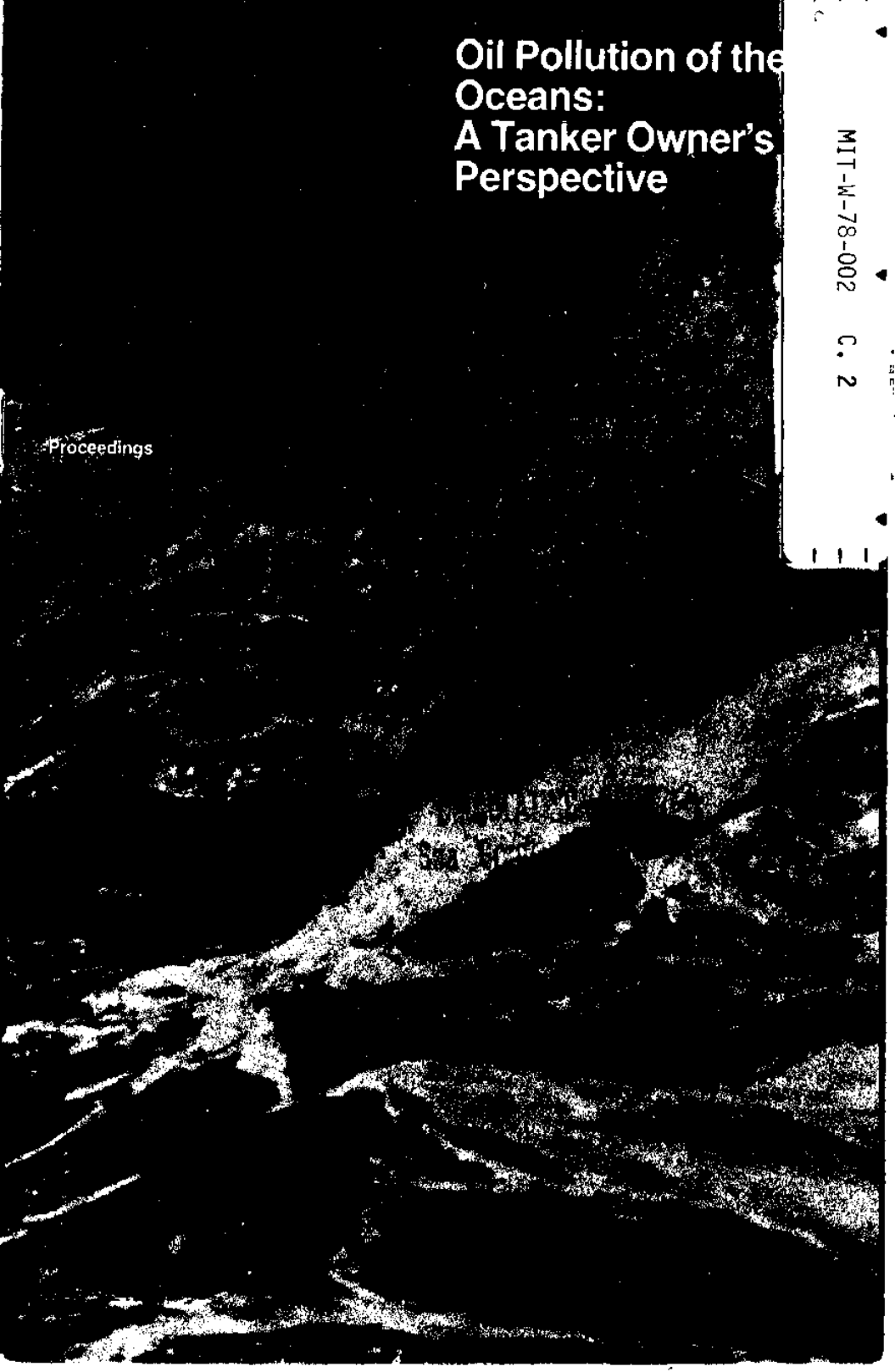
Oil Pollution of the Oceans: A Tanker Owner's Perspective

Proceedings



Oil Pollution of the Oceans: A Tanker Owner's Perspective

Proceedings

The 7th Annual Sea Grant Lecture and Symposium

Tuesday, 24 October 1978
3 pm

Kresge Little Theatre
Massachusetts Institute of Technology

Report No. MITSG 79-1

Index No. 79-601-Wep

Lecturer:

Erling D. Naess
Chairman
International Association of
Independent Tanker Owners
(Intertanko)

Panelists:

William M. Benkert
Rear Admiral
U.S. Coast Guard

James A. Cole, Jr.
General Manager
Marine Department, Texaco Incorporated

Jerome H. Milgram
Professor of Naval Architecture
Department of Ocean
Engineering, MIT

Evelyn F. Murphy
Secretary of Environmental Affairs
Commonwealth of Massachusetts

Moderator:

Dean A. Horn
Director
MIT Sea Grant College Program

Sponsored by the MIT Sea Grant
College Program

Erling D. Naess

Erling D. Naess is Chairman of INTERTANKO, The International Association of Independent Tanker Owners, a position he assumed in 1976. INTERTANKO members control about 180 million deadweight tons (dwt) of tankers, about 80 percent of the world's privately owned tanker fleet.

Mr. Naess reached this position of eminence following a determined career in whaling, fishing, and shipping industries, a career that spanned five decades of revolutionary changes in these ancient trades.

Mr. Naess was born in Bergen, Norway, an old and traditional shipping city, in 1901. At 14, he entered the Gymnasium at Halling School, and was dedicated to the study of economics. He received his master's degree in economics at Oslo University in 1920, and for four years continued his studies at Oslo University and at the London School of Economics.

In London, while preparing a doctoral thesis, Mr. Naess decided to leave academia to become involved in a whaling venture. At that time, the floating whale oil factory ships were gaining dominance over land stations, and by age 27 Erling Naess was promoter and director of Viking Whaling Company Ltd., the first whaling company whose shares were dealt on the London Stock Exchange.

In 1929, Mr. Naess participated in the contracting of his first oil tanker, 10,000 dwt, amidst growing concern that the stock of whales in the Antarctic would be depleted to the point where whaling operations would become unprofitable. Over the years, Viking responded to the favorable tanker market, and began to acquire more tankers.

Mr. Naess continued his association with the Viking Whaling Company and Viking Tanker Company Ltd. until 1943, when he severed the connection to avoid a conflict of interest with his position in New York as Deputy Director of Nortraship, which he had assumed in 1942. Nortraship, the abbreviated name for the Norwegian Shipping and Trade Mission, was created by the Norwegian Government to manage and operate about 1,200 ships in the Norwegian merchant fleet that were outside Norway when the Germans invaded the country in 1940.

In 1946, Mr. Naess left Nortraship and continued his ship owning and ship management activities by forming two Panamanian companies, Nortuna Shipping Company, Inc., and Nomess Shipping Company, Inc. In 1947, Nomess purchased a Liberty ship of 10,850 dwt from the U.S. Maritime Commission. Following this acquisition, Mr. Naess went on to build one of the largest shipping companies in the world by contracting for the type and the largest size tankers he thought oil companies would require in the next few years. By 1973, Nomess owned a fleet of more than 50 tankers and bulk carriers.

Mr. Naess was one of the first shipping men to recognize the advantages of the economies of scale in bulk shipping, particularly in the coal and ore trade with Japan and the first foreign owner to place orders in Japanese shipyards after World War II. He pioneered the development of the combination carrier for dry and liquid cargo.

He also coined the term "flag of convenience" and was one of the original users of the controversial shipping registry system.

In his association with Intertanko, Mr. Naess not only represents the interests of his fellow tanker owners, but is steadfast in his efforts to help overcome the causes of oil pollution of our oceans, especially intentional discharge into the oceans of slops and tank residues, as well as accidental oil spills.

Mr. Naess is author of "Erling D. Naess, Autobiography of a Shipping Man."

William M. Benkert

Rear Admiral Benkert graduated from the United States Coast Guard Academy at New London, Connecticut, in June 1943 as an Ensign, USCG, with a B.S. in Marine Engineering. While serving combat duty in the Pacific Area through the remainder of World War II, he assumed several vessel commands.

Over the next twenty years his sea duty assignments included command of five Coast Guard vessels operating worldwide engaged in search and rescue work, aids to navigation, ocean station weather patrol and polar icebreaking. While ashore, he commanded USCG marine inspection offices at San Diego and New York and the Coast Guard's Marine Inspection Indoctrination School. His first assignment at Coast Guard Headquarters in Washington was as Assistant Chief of the Merchant Vessel Inspection Division.

In 1971, then Captain Benkert was promoted to the rank of Rear Admiral and served until 1974 as Chief, Office of Marine Environment and Systems, with responsibility for aids to navigation, bridge administration, ports and waterways safety, and marine environmental protection. In 1974, he assumed his assignment as Rear Admiral and in his capacity as Chief of the Office of Merchant Marine Safety, RADM Benkert was responsible for the development and implementation of the regulatory programs of the Coast Guard dealing with commercial vessel safety. In this capacity he represented the Coast Guard in extensive dealings with labor, management, congressional committees, other federal and local governmental agencies, environmental groups, and the public at large.

RADM Benkert has had extensive experience (in conjunction with his merchant marine safety and environmental protection duties) in dealing with wide areas of the merchant marine field both nationally and internationally. He has been involved in international negotiations representing the United States in the IMCO (Inter-governmental Maritime Consultative Organization) forum relative to worldwide ship safety, design, construction and operational matters. He was responsible for the U.S. delegation and its predominant role in the negotiation of the International Convention for the Prevention of Pollution of the Seas in 1973 and was the U.S. Representative to the Maritime Safety Committee of IMCO.

RADM Benkert retired from active duty in the Coast Guard as of 1 August 1978. He now serves as President of the American Institute of Merchant Shipping.

James A. Cole, Jr.

James A. Cole, Jr. is General Manager of the Marine Department for Texaco Inc. In this position which he assumed in 1971, he operates Texaco's worldwide fleet of 160 tankers, the world's third largest tanker fleet, as well as an associated fleet of petroleum tugs and barges that carry petroleum.

Mr. Cole, born in Floral Park, New York, in 1922, graduated from the U.S. Merchant Marine Academy in 1943. He spent the war years as a licensed deck officer on tankers, and when he returned to the United States, worked on ships at night and attended New York University School of Commerce during the day. He received his B.A. in accounting from NYU in 1949, and continued to pursue his career in marine management.

In 1949, he joined Texaco's affiliate, Caltex Petroleum Corporation, and subsequently held several positions in marine operations and chartering at New York, London, and Bordeaux.

In 1967, Mr. Cole was appointed Manager of Chartering and Traffic in Texaco's Marine Department in New York. He was named Deputy Managing Director of Texaco Overseas Tankship Limited in London in 1969.

Mr. Cole is Chairman of the American Petroleum Institute's Central Committee on Transportation by Water. In this capacity, he is involved in Congressional activities related to all tanker-related issues, including vessel construction, design, and pollution control measures.

Jerome H. Milgram

Jerome H. Milgram, Professor of Naval Architecture in MIT's Department of Ocean Engineering, is recognized for his research in hydrodynamics, ocean engineering, and oil pollution control.

He received his S.B. in Naval Architecture and Marine Engineering and in Electrical Engineering from MIT in 1961, his S.M. in Naval Architecture and Marine Engineering from MIT in 1962, and his Ph.D. in Hydrodynamics in 1965, also from MIT.

In recent years, Professor Milgram has been active in investigating ways to improve oil slick control in the offshore environment, and has studied the mass transport of water and floating oil by waves, and the dispersion of oil slicks by ocean waves and turbulence. He has also studied the effects of wave forces on ocean structures.

In 1976, when the tanker Argo Merchant grounded off Nantucket, Professor Milgram went to the stranded vessel to observe the spill and its interaction with breaking waves. He took the first slick samples, and also, by lowering a one-liter bottle to an Atlantic Strike Team member on board the vessel, was able to obtain the only sample of unweathered cargo taken during the entire incident.

He subsequently wrote a Sea Grant report, "Being Prepared for Future Argo Merchants," outlining his observations and recommendations for structural changes in tankers that might help prevent future calamitous spills that could damage coastlines. The report, widely read by legislators, government officials and engineers, provided the basis for Professor Milgram's testimony before the House Subcommittee on Energy and the Environment.

In addition to Professor Milgram's teaching and research activities at MIT, he has studied computer-aided design and construction of sails, and has been a member of the Society of Naval Architects and Mechanical Engineers (SNAME) panels on Sailing Vessels and Ship Waves. He was Technical Advisor to the Center for Law and Social Policy on oil pollution aspects of the (then) proposed trans-Alaska oil pipeline, and was a member of the panel on Data Buoy Technology of the Marine Board of the National Academy of Engineering.

Professor Milgram was also a member of the National Academy of Science panel for Review of the National Oceanic and Atmospheric Administration.

Evelyn F. Murphy

As Secretary of Environmental Affairs for the Commonwealth of Massachusetts, Dr. Evelyn F. Murphy is the state's chief environmental policy maker, reporting directly to Governor Michael Dukakis.

Programs under her authority include the supply of water, sewage disposal for metropolitan Boston communities, operation of state forests and parks, beaches, and recreation facilities, the management of fish and wildlife resources, enforcement of environmental regulatory statutes, and land use planning of coastal as well as inland environmental resources.

Secretary Murphy's top priorities for the past year have included setting the Dukakis administration's offshore energy policy and heading up the northeastern governors' efforts in developing a national water policy. She has also been a prime sponsor along with the Governor for using recreation monies for youth and the elderly in densely populated areas.

Before Dr. Murphy assumed her present position in January 1975, she was a partner in Llewelyn-Davies Associates, New York, an international town planning firm. Dr. Murphy was in charge of social and health planning practices, and was involved in a comprehensive plan for a city in upstate New York, and a plan for location and design of multiservice centers in Tucson, Arizona.

From 1971 until the company became an affiliate of Llewelyn-Davies Associates in 1974, Dr. Murphy was president of Ancon Associates, a Boston firm she founded and managed that advised nonprofit firms on management and operations.

Dr. Murphy, a resident of Lexington, Massachusetts, graduated from Duke University in 1961 with a major in mathematics, earned a master of arts degree in monetary economics in 1963 from Columbia University, and holds a Ph.D. in fiscal economics, Duke, 1965.

She was general manager of the Organization for Social and Technical Innovations, Cambridge, Massachusetts, where she worked from 1966 to 1971.

She taught a course at Brandeis University on housing policy, and lectured at the Massachusetts Institute of Technology, at Duke University, and at the London School of Economics, University College.

Recently appointed by President Jimmy Carter to be Vice Chairman of the National Advisory Committee on Oceans and Atmosphere, a standing committee before the President and the Congress, Secretary Murphy is a driving force behind the government's efforts to use and preserve our oceans, rivers, and wildlife areas.

Mr. Pariser:
Good afternoon ladies and gentlemen, and welcome to the Seventh Annual Sea Grant Lecture. I am Ray Pariser, Associate Director of the MIT Sea Grant College Program, and your host for this afternoon.

The national Sea Grant Program, established by a congressional mandate 12 years ago as a university-based, partially government-funded program, accelerates advisory and educational activities for developing marine-related resources through research. Shortly after the MIT Sea Grant Program was established in 1970 under the leadership of Dr. Alfred Keil and Dr. Ira Dyer, we sought to create a special annual event that would be a milestone in the marine field, an opportunity for experts to review current issues and to present perspectives on future marine development.

When we heard Mr. Naess speak at last year's Sea Grant Lecture in response to Congresswoman Burke's address, it was clear that he would be a superlative choice for this year's event. And so, with the approval of our Sea Grant Faculty Council and Sea Grant Policy Committee, we invited Mr. Naess to return to MIT as our lecturer.

Erling Naess is eminently qualified to address the topic: "Oil Pollution of the Oceans: A Tanker Owner's Perspective." As chairman of INTERTANKO, he heads the huge company whose members control more than three-quarters of the world's privately owned tanker fleet. He is fully aware of, and sincerely concerned with, the oil pollution problem. As a realist, he recognizes that on the one hand oil pollution of the oceans is the unavoidable consequence of mankind's dependence on an oil-based energy pattern – just as the end products of any human or biological processes are unavoidable and viewed as either desirable or polluting. On the other hand, unavoidable does not necessarily mean irreducible – Mr. Naess has been active in devising international instruments to reduce pollution, and I think it is only fitting to say we owe him a debt of gratitude for his efforts. Mr. Naess emerged from truly tumultuous decades of personal experience in the shipping business as a wise, articulate, literate and courageous world leader in the affairs of man and oceans. We are honored and most grateful that you came Mr. Naess, despite all the competing commitments and responsibilities you must have Mr Naess.

Mr. Naess:
Mr. Pariser, ladies and gentlemen. It is quite right, as Mr Pariser said, that I was on the panel last year, and I enjoyed it very much. It is questionable whether I should enjoy as much to be the lecturer, in view of the formidable panel with which I am confronted this afternoon.

I am going to speak to you about oil pollution of the oceans and beaches.

Much has been written and said about this topic in the news media and elsewhere. So much so, that the voice of the tanker owners themselves has received little attention. To hit the tanker owners when pollution occurs is as popular as apple pie. If the tanker happens to be owned by an independent ship owner or by a large oil company, and it happens to fly the Liberian flag, the popularity is even greater – say like apple pie with ice cream.

I accepted the assignment to be today's lecturer not to excuse the pollution of the oceans, coastlines and beaches. When it happens, it upsets me as much as anybody – perhaps more because I have been in the tanker business most of my life and I am also the owner of a beach hotel in Bermuda. But, as is often the way of events that attract the wide-eyed atten-

tion of the general public, a sense of proportion is lost. The dramatic unfolding of the horrible picture of a black tide of floating oil killing marine life and ruining the beaches is very upsetting, and the accusing finger is pointed menacingly at the tanker owner. I have been trying to the best of my ability to explain that this is not fair. Emotionally inspired brickbats should not be thrown at the tanker owners. By getting together today to discuss this problem, perhaps each of us will learn something.

I am standing here in one of the foremost centers of science and marine engineering. We in the tanker industry depend on marine engineers to develop new ideas. If what I have to say can generate some new thoughts, my effort will have been extremely worthwhile.

First of all we must acquire a sense of proportion. The amount of crude oil and petroleum products transported by tankers has reached close to 2 billion tons per annum. The accidental spillage of about 220,000 tons of oil as in the case of the AMOCO CADIZ is only about 1/10,000 of the annual volume transported by sea. If the AMOCO CADIZ remains the only major accidental oil spill in 1978, it means that about 1,999,780,000 tons will have been transported safely, with only 220,000 tons lost. Allowing for vessels presently in lay up, I estimate there are about 3,500 tankers actually trading. If we reckon that they make an average of six voyages per year each, we arrive at a figure of 21,000 tanker voyages per annum. Even if there were two major accidental oil spills per annum, it would still only be 1/10,000 of the number of safe voyages completed.

If this lecture can be sufficiently provocative to cause people to judge accidental pollution from tankers with this background, it will have served one of its purposes. The accidental discharge of about 220,000 tons of oil into the ocean receives an overwhelming degree of publicity, but the safe transportation of 1,999,780,000 tons goes unheeded. This does not mean that I do not deeply regret the pollution of the Brittany coast by the black tide of floating oil, and the destruction of wildlife caused by the AMOCO CADIZ disaster.

To use the AMOCO CADIZ accident as an excuse for attacks on "flags of convenience," which has been done by the general press, demonstrates not only ignorance but political and ideological prejudices as well. The accident was totally unrelated to the vessel's Liberian registry. The vessel, built in 1974, was operated in accordance with the highest standard and was manned by a crew of 40, all Italian nationals. All officers were licensed by both Libena and Italy and were graduates of Italian nautical academies. To attack "flags of convenience" because of the AMOCO CADIZ disaster makes no sense.

On January 1, 1978, the world's tanker fleet, including combined carriers, consisted of 4,137 vessels over 6,000 dwt each, with a total deadweight of 380,448,000. In other words, the average size was 91,962 dwt, a very large ship indeed. In some people's minds the development of the supertanker, the so-called VLCC, and the ultimate in size, the ULCC, is in itself a source of pollution danger.

To this my answer is that if there had not been a rush towards increased size of tankers and the world's fleet had remained at the T2 level (about 15,400 dwt) so popular at the end of the last war, there would have been 24,789 tankers in existence today instead of 4,137. With six times as many vessels approaching coastlines and entering and leaving ports, there can be hardly any doubt that many more collisions and other accidents would have occurred. I feel that I am making a modest guess when I say there

would have been at least 10 times as many. The popular argument that the growth in the average tanker size represents an increased risk of pollution does not hold water. On the contrary.

At this stage it would also seem appropriate to remind ourselves of what the economy of scale means in saving transportation cost. If the world's oil transportation needs had depended on T2 tankers, the cost would have been astronomical. The operating cost of a T2 tanker is at least 4 or 5 times higher per ton of oil than that of a ULCC.

And while on the subject of vessels moving in and out of harbors, I'd like to mention that much publicity has been given to the need for the highest standards of competence for bridge personnel and for navigational aids and equipment onboard ships. Very little if any publicity has been given to the equally important need for shore navigational aids and vessel traffic services to be of the highest possible technical excellence. It is the ship which is moving, and if something happens the accusing finger always points first in that direction. This is often unfair.

Another point receiving scant attention is that despite the beating marine life takes from accidental oil spills like those of TORREY CANYON, ARGO MERCHANT, Bravo blowout and AMOCO CADIZ, the end result shows that marine species somehow survive and repopulate. Biologists believe the bird population has largely recovered from the TORREY CANYON accident, the Cornish oyster fisheries were largely unharmed, the damage to fishing grounds from the ARGO MERCHANT was finally judged to be negligible, and the damage to marine life from the Bravo blowout was admitted to be close to zero. While these accidents were given screaming headlines, the conclusion that the ultimate damage was not so serious had little news value. In 1977 the U.S. General Accounting Office issued a report stating that ecological and economical damages resulting from 250,000 gallons of fuel oil spilled by a barge off Smith Point in the Chesapeake Bay were far more severe than those resulting from the ARGO MERCHANT's 7,500,000 gallons spilled off Nantucket. The environment appears better able to cope with oil spills from large tankers in the comparatively deep water of the open ocean than small and much less publicized spills by barges in shallow estuaries. If the spill from the large tanker takes place in rough seas, which is often the case, the waves will accelerate the natural evaporation and help the oil to disperse. It has been estimated that out of the 220,000 tons spilled by the AMOCO CADIZ, around 100,000 tons were evaporated by the heavy seas.

It is regrettable that the AMOCO CADIZ steering gear breakdown happened so close to the Brittany Coast. But in defense of the vessel, it should be pointed out that it was sailing in the northbound tanker lane prescribed by international rules. The tanker had to comply with the international rules or risk collision with southbound traffic. Ironically, when agreement was reached on establishment of "oceanic roads" with left- and right-hand lanes, it was hailed as a great stride towards tanker safety. Nearly 100 separation schemes around the world have undoubtedly been all to the good. It was not the ship's fault that the rules on this particular journey compelled it to sail so close to shore. At the proposal of France, the Inter-Governmental Maritime Consulting Organization (IMCO) has since revised the routing arrangements in the Ushant and Casquets traffic separation schemes designed to keep laden tankers further seaward. Apart from pointing this out, I will not endeavor to express any opinion regarding blame for the grounding until official enquiries are complete, which they were not when this was written.

While the lasting damage to the environment

has proven not to be as serious as feared, the immediate impact of the black tide of floating oil hitting coastlines often necessitates spending great amounts of money for clean-up and compensation. The tanker industry recognizes that liability for clean-up cost should be borne by both the tanker owner and oil company that owned the cargo. On January 7, 1969 the world's oil companies signed the Tanker Owners Voluntary Agreement concerning Liability for Oil Pollution Damage, known as TOVALOP, which became effective October 6, 1969. TOVALOP ensures that when there is an oil spill, the cost of fighting the spill and cleaning up the damage can be recovered up to $100 for each gross ton of the tanker's tonnage or U.S. $10 million, whichever is less. TOVALOP provides the tanker owner with insurance to cover his liability. Practically all of the world's tanker tonnage today is covered by TOVALOP.

Recognizing that TOVALOP might not provide adequate compensation for pollution, a further voluntary agreement was reached among the oil companies on January 14 1971 that greatly increased the total amount of compensation available in case of an accident. This agreement is known as the Contract Regarding Interim Supplement to Tanker Liability for Oil Pollution (CRISTAL). It increases the overall amount available for each accident to $30 million. CRISTAL became effective on April 1,1971. Over 90 percent of the oil transported by sea is covered by CRISTAL.

It is important to place the highly visible and much publicized oil spill accidents in perspective in two other respects. Firstly, only a very minor fraction of worldwide oil pollution is caused by the photogenic kinds of accidents you read so much about in the newspapers. Estimates vary between 3 and 5 percent. Operational discharges from tankers account for another 25 percent, making the total tanker pollution about 28 to 30 percent. The remaining 70 or 72 percent comes from other sources such as atmospheric fallout, discharges from ships other than tankers, natural seepage from the sea bottom and from land sources reaching the sea from rivers and coastlines. The latter is estimated at about 40 percent of the total.

Even if the tanker industry is one of the lesser culprits, we in the industry regard it as an essential aim to reduce and even totally eliminate our part of the pollution. We are still the largest single source of oil discharge into the oceans from ships.

Estimates of the volume of the operational kind of pollution from tankers vary between 1.5 million and 10 million tons per annum. What are tanker owners doing to eliminate or at least reduce this type of pollution? However much a tanker owner would like to do so, it is impossible for him to act alone. This is a world problem so it needs a world solution. He cannot reduce the carrying capacity of his tanker by installation of Segregated Ballast Tanks (SBTs) or take other steps that will cause him to lose freight and make his tanker uncompetitive. With an acutely competitive market like that of the tanker industry, this would be a sure way to go broke. No tanker company, and even no country, can resolve this problem by themselves. Nations cannot protect the health of the oceans unless they negotiate rules in the interest of all nations. They must ratify the international conventions in order to bring into force uniform standards and techniques aimed at eliminating pollution, with which vessels of all nations can comply. International action is imperative. That is where the problem lies. The history of the tanker owners' efforts to combat oil pollution of the operational kind is one of repeated conventions and resolutions ratified only after many years of delay. And even after their ratification little action was taken. It is the pitiful story of the

inability of international bureaucracies to take vital and necessary steps reasonably promptly.

I have been asked: Why shouldn't the industry "police" itself? Why should it be necessary to bring international bureaucracies into the picture? As I shall explain a little later, the industry is to a great extent "policing" itself through voluntary restraints developed by the International Chamber of Shipping. But with 40 or 50 nations involved it is a hopeless task to develop a "police" mechanism on a voluntary basis. United States antitrust laws lay limitations on the degree of cooperation permissible by companies in the same industry. The claim that the cooperation has environmental objections would probably not be accepted by your Department of Justice.

The first International Convention aimed at the Prevention of Pollution of the Sea by Oil was passed in 1954. In 1962 an International Conference on the Prevention of the Pollution of the Sea by Oil convened under the auspices of IMCO, which is the United Nations body concerned with maritime affairs. This Conference repeated some of the resolutions passed in 1954, among them the provision of facilities for reception of oil residues at oil loading terminals. An amendment passed in 1969 to the 1954 Convention again called for reception facilities. Another international conference held in October and November 1973 was attended by more than 600 representatives from 79 nations. The main objective of that conference as expressed in the IMCO Assembly Resolution is: "the achievement by 1975, if possible, but certainly by the end of the decade, of the complete elimination of the willful and intentional pollution of the seas by oil and noxious substances other than oil, and the minimization of accidental spills."

Looking at the situation today, we find that the 1954 Oil Pollution Convention and the 1962 and 1969 Amendments were ratified by the necessary number of nations, but I have a hard time discovering whether much action has been taken to live up to the commitments. The ratification of the Conventions does not seem to mean that prompt action will be taken to provide reception facilities, ashore or afloat, which the Conventions describe as essential. The provision of the reception facilities requires a considerable investment of capital, which may or may not be profitable. In addition, it is hard to estimate what capacities of reception facilities are required in the different loading and repair ports. And in the meantime, pollution of the oceans continues.

Who have been the foot-draggers in this situation? IMCO cannot be criticized. It has consistently organized conferences of its more than 100 member nations. The tanker industry? Definitely not. The record of measures taken by the tanker industry is impressive.

In April 1976 self-imposed restraints, which had been developed over the years by the industry, were codified in what became known as the International Chamber of Shipping's Pollution Prevention Code. In the introduction to this Code, the ICS referred to IMCO's Convention of 1973 and stated: "Pending the coming into force of the Convention the tanker industry should promote the general objectives aiming at the elimination of the discharge of oily wastes into the oceans." The Code was in no way promoted as a substitute for the 1973 Convention. It was intended to fill the gap until the Convention could be brought into force.

To assist the tanker owners in observing this strict "self-control" in regard to discharge of dirty ballast, slops, etcetera. Clause 7 of the Code provides that charterers shall agree to pay freight on oil residues and also on the water associated with them within certain reasonable

limits, thus enabling the tanker owner to practice "load on top" without the risk of losing freight money.

The Code is particularly interesting because it recognizes that the independent tanker owner cannot fight pollution alone. The collaboration of the charterers, usually oil companies, is a must. There is still room for this collaboration to be improved.

Take for example a tanker which trades between Venezuela and the U.S. East Coast. When the tanker has discharged its cargo, for instance, in Philadelphia, she is ordered to return to Venezuela to load her next cargo. The captain is ordered to arrive in the Venezuelan loading port with clean tanks because the next cargo of crude oil will be of a different kind than the previous one. He wirelesses to the loading port asking whether it has reception facilities so he can pump ashore the residues of the previous cargo and the dirty wash water. If the answer is no he has no choice. He has to pump the dirty slops and ballast water into the ocean. This is a simplified example. He can practice what is known as "load on top," which is a method of reducing pollution not always possible. But it does help a great deal when practical.

The procedure known as "load on top" works in the following manner:

1. After discharging its cargo the tanker fills some of its empty cargo tanks with ballast water. How much depends on the master's judgment of how much ballast the vessel needs for a safe voyage. This depends on the type of sea and weather the vessel is expected to encounter.

2. The cargo tanks not filled with ballast water are washed and the oily washings pumped into a holding tank known as the slop tank. The tanks which have been washed can now be filled with clean seawater ballast.

3. By this time it is hoped that in the original ballast tanks the oil left in the bottom and sides of the tanks has separated from the water and floated to the surface. The relatively clean water below the surface is then pumped overboard, and the slops into the slop tank. The vessel should then be ballasted with clean seawater, which can be discharged overboard upon arrival at the next port.

4. The oil and water in the slop tank should now also have separated to some degree so that the lower part of the tank containing clean water can be emptied at the next port. If the next port is an oil loading port, new cargo is pumped into the partly filled slop tank on top of the remaining residue.

There are several weaknesses to the "load on top" procedure. It takes several days for the oil to separate completely from seawater and float to the surface. During the tank washing operation some of the water pumped overboard is oily to a degree unless the ballast voyage is of at least five days' duration and the sea fairly calm. The procedure is useless in the case of voyages shorter than five days and, if the sea is rough, even longer voyages. Secondly, the effectiveness of the procedure depends on the skill and good judgment of the crew. Desire to get the tank cleaning operation completed may cause the officer in charge to be less than strict in regard to water pumped overboard. The introduction of inerting the tanks during and after cargo discharge not only made it possible to wash the tanks with water in a safer atmosphere, but it led to a new development: the use of crude oil as a tank washing medium.

Several major tanker companies experimented with using crude oil for washing and found, surprisingly, that the solvent action of the crude oil was greater than that of steam and water. By washing the tanks with the crude oil

cargo itself during cargo discharge, the time and effort spent on water washing during the ballast voyage were reduced. The extra time needed for cargo discharge was moderate. When it was discovered that oil clingage to the tank's vertical surfaces was practically eliminated and much less sludge and scale collected in the bottom of the tank, the introduction of crude oil washing was hailed as a new step forward. It was another example of the inventiveness of private industry in its efforts to reduce or eliminate the pollution of the oceans.

Let me halt here for a moment to summarize the position at which I have now arrived. The pollution of the oceans from tankers is less than one-third of the total pollution suffered by the oceans. Of the pollution from tankers only a tiny fraction is the result of the much dramatized accidents. The rest of the tanker pollution is of the operational kind. To eliminate or at least reduce this operational kind, international action is required. Repeated resolutions passed by IMCO have either not been ratified by the necessary number of nations, or in the cases where they were ratified, very little action has been taken. In the meantime, the tanker industry has imposed upon itself restraints pending ratification of the IMCO Resolutions. While these self-imposed restraints have certainly reduced the oil pollution, they have not eliminated it.

At this point, I am glad to say, something happened that built a fire under the boiler.

In the winter of 1976/77, as you probably all remember, there was a sequence of tanker casualties off the coast of the United States. They received publicity with screaming headlines. Shortly after assuming office in January, 1977 President Carter on March 18 announced with much fanfare a series of proposals to increase tanker safety and reduce the risk of pollution. He asked that these be given prompt consideration by IMCO.

There was a distinct risk that the United States would introduce unilateral measures that would bring chaos to international tanker regulation. To avoid this IMCO took prompt action. Meetings were organized not only by IMCO, but by the shipping associations of the major maritime countries, the Oil Companies International Marine Forum, and the International Chamber of Shipping. These meetings culminated with the International Conference on Tanker Safety and Pollution Prevention attended in London between February 6 and 17, 1978 by 62 IMCO members as well as observer countries and several nongovernmental organizations.

The main feature of the United States' proposal was that all existing and new tankers of 20,000 dwt and over be equipped with Segregated Ballast Tanks (SBTs) as well as with an inert gas system. The segregated ballast concept for existing tankers involves setting aside a sufficient amount of a tanker's carrying capacity exclusively for ballast so that the tanker need not use any cargo tanks for ballast. This eliminates dirty ballast and reduces tank washing. It also reduces the cargo carrying capacity by about 15 to 20 percent. While the U.S. proposal had pollution control as its main motive, a number of countries, particularly those with large tanker surpluses such as Norway, Sweden and Greece, supported the United States' position on SBT because they recognized that, if approved, it would reduce these surpluses by 15 percent. Other countries, led by the U.K., believed that the new technique of crude oil washing (COW) would have the same environmental benefit and would secure a better cargo outturn at a fraction of the cost.

Estimates of the cost of SBT retrofitting varied

a great deal. A U.S. calculation made available during the Conference gave a figure of between $1.9 billion and $2.9 billion, depending on the extent of extra tank coating. The Organization for Economic Cooperation and Development's (OECD) estimate was twice as high, but it assumed full coating of ballast tanks in vessels under 10 years old. Being in the throes of a severe depression, the tanker industry could not conceivably mobilize funds of this magnitude without outside help. Retrofitting of SBTs would also give rise to major commercial problems associated with existing charter party agreements.

Many of the developing countries strongly opposed SBT because they feared the expensive retrofit provisions were bound to result in higher cost of oil products. India assumed the leadership of the developing countries which, after informal meetings, came out in support of COW. The Arab countries, while undecided in the early stages of the conference, also decided to support COW. Finally, Liberia entered the COW camp.

After long and involved negotiations a compromise was reached and at a final plenary meeting was passed by 39 votes to nil – with 15 abstentions. Among the abstentions were the major countries that had supported SBT including Norway, Sweden, Denmark and Greece. Few of the countries were entirely happy with the compromise package, but they recognized that it was the best that could have been developed under the circumstances.

The compromise package has become known as the London Protocols to the 1973 Marine Pollution Convention. They will enter into force twelve months after ratification by fifteen states that represent not less than 50 percent of the world merchant tonnage, but not later than June 1981. The latter date is for all intents and purposes recommendatory and not mandatory, but I have the feeling that the U.S. may regard it as of the latter nature, and I would agree with the U.S.

Briefly, the compromise package requires:

Existing Tankers

Crude carriers over 40,000 dwt must have either COW or SBT (or for a limited period something else known as Clean Ballast Tanks (CBT), which implies that certain cargo tanks will, without structural changes, be set aside for ballast) commencing the moment the London Protocols come into force. Four years after the London Protocols come into force CBT alone will no longer be acceptable. Crude carriers over 70,000 dwt must have either COW or SBT commencing two years after their enforcement. An inert gas system becomes obligatory for all tankers over 70,000 dwt existing two years after the Protocols come into force; for those over 20,000 it becomes obligatory in four years.

New Tankers

Crude carriers over 20,000 dwt must have SBT in a protective location to minimize the risk of oil spills following collision or stranding, in addition to COW and an inert gas system. These demanding requirements apply to all vessels contracted after June 1979 and delivered after June 1982.

Under the terms of the compromise package it was agreed that existing tankers in specified trades would be allowed to operate without SBT, CBT or COW as long as the loading ports are adequately equipped with slop and dirty ballast reception facilities. As Chairman of INTERTANKO I have for several years argued that the establishment of reception facilities in both loading and repair ports would be the cheapest way of eliminating operational pollution. But I have not made much progress, in spite of the enforce-

ment of the 1954 Oil Pollution Convention and the 1962 and 1969 Amendments. It was interesting to me that at the IMCO Conference the U.S.S.R. suggested the use of reception facilities was perhaps the most efficient solution and exclusive trades equipped with these facilities should be encouraged. This idea was endorsed, and IMCO promoted studies of specific trades in which reception facilities can be applied.

The February 1978 IMCO Conference culminated many years of international meetings and discussions aimed at reducing or eliminating operational pollution and at increased tanker safety. If not for the shot in the arm given by the United States, the Conference would probably not have been held. That it was held and that a compromise was reached despite great complexities was indeed a significant achievement. It represented international collaboration at its best. No particular nation or group of nations obtained what they wanted – there was give and take on everybody's part. Those who were hoping to see SBT cutting into the tanker surplus were disappointed, as were those who argued in favor of the tough requirements put forward by the United States, which included double bottoms.

The IMCO Secretariat displayed great professional skill in organizing the Conference and ensuring that it ran remarkably smoothly.

Unfortunately, as the name implies, IMCO wields no power beyond that of recommending and advising its members to take a certain action. It is up to each flag nation to endorse or ratify what IMCO recommends. That IMCO is an agency of the United Nations lends an obvious weight to its recommendations, but provides no punitive authority. The record over the last 30 years shows this is obviously a weakness. Year after year IMCO's resolutions have remained just resolutions

The tanker industry has done its bit by exercising voluntary restraints for many years and by resolving all differences in working out and agreeing upon the Protocols of 1978. It now remains for them to be ratified by 15 nations whose combined fleets total at least 50 percent of the world's gross tonnage of merchant shipping, and for adequate enforcement procedures to be established. An incidental result will be the ridding of substandard ships from the seas, since they cannot afford to comply with the rules and, I hope, strengthened port state inspection will catch them. When that happens and the Protocols are enforced, the world will see the end of the operational oil pollution of the oceans. There will be no reason for any slops or dirty ballast water to be discharged into the seas anymore. Let us hope that the nations will sweep away bureaucratic cobwebs, break down the walls of Jericho and ratify the Protocols without the usual delay. When that happens it will be the dawn of a new day for the oceans. The oceans will continue to live and so will we.

Thank you for your patience.

Mr. Pariser:
Thank you Mr. Naess for this truly exciting and informative paper. We shall now assemble our panel of experts under the leadership of our moderator, Mr. Horn, who will lead the dialogue between the panel and our distinguished guest, Mr. Naess.

Allow me to introduce our guests.

First, Dr. Evelyn Murphy, Secretary of Environmental Affairs for the Commonwealth of Massachusetts, who is the state's chief environmental policy-maker reporting directly to Governor Michael Dukakis. We are very honored, Secretary Murphy, that you are with us.

Our next panelist is Rear Admiral William Benkert. For twenty years his sea duty assignments included command of five Coast Guard vessels operating worldwide engaged in search and rescue work, aids to navigation, ocean station weather patrol and polar ice-breaking. He retired from active duty as of August 1, 1978, and is now President of the American Institute of Merchant Shipping. We are very pleased, Admiral, to have you with us.

Next to him is Mr. James Cole, General Manager of the Marine Department for Texaco, Inc., who operates Texaco's worldwide fleet of 160 tankers, the world's third largest tanker fleet, as well as an associated fleet of tugs and barges that carry petroleum. Mr. Cole serves as Chairman of the American Petroleum Institute's Central Committee on Transportation by Water. In this capacity, he is involved in Congressional activities concerned with all tanker-related issues, including vessel construction, design, and pollution control measures. Thank you for coming.

Professor James Milgram, who teaches naval architecture in MIT's Department of Ocean Engineering, is recognized for his extensive research in hydrodynamics and ocean engineering. In recent years, Professor Milgram has been active in investigating ways to improve oil slick control in the offshore environment, and has studied the mass transport of water and floating oil by waves, and the dispersion of oil slicks by ocean waves and turbulence. Thank you for being with us

Finally, it gives me great honor to introduce the moderator, my friend, Mr. Dean Horn, Director of the MIT Sea Grant College Program. Last year, MIT was nominated a Sea Grant College, the first private institution to receive this honor. Together with Dr. Alfred Keil and Dr. Ira Dyer, Mr. Horn, with his long association with both MIT and the Navy, started and ran the MIT Sea Grant Program. He is now also a senior lecturer in MIT's Department of Ocean Engineering. Mr. Horn.

Mr. Horn:
Thank you very much. I think we should ask the panel members to respond to our fine lecturer, starting with Dr. Murphy.

Dr. Murphy:
Thank you. It is indeed a pleasure and an honor to be here on the panel today since these annual seminars have become quite noted for the quality of the exchange of views on important issues. Mr. Naess' depiction of the tanker owner's view of oil pollution in the oceans and the industry's view is disturbing. The tanker industry would have us believe that the recent public criticism, given the spate of oil spills, is unwarranted. They would also have us believe that they have already undertaken the necessary reforms to reduce spillage. There has been progress, of late. Of that there is no doubt. But there is much more to be done, as I will explain shortly.

But before I do, I want to comment on the quality of the dialogue about this problem that we must attain. It does little good to lament which interest group has been unfairly criticized in the media. We are all tender on that point. And it does little good to lull ourselves into the complacency that we have done enough. Oil pollution in our oceans will continue to be with us for a long time to come, happening for different reasons and under different circumstances as technologies become more sophisticated and our transport of oil changes courses and destinations.

I would urge us all first to look thoughtfully and singlemindedly at the facts before us and

from these facts derive what can and must be done to reduce and minimize ocean pollution caused by oil spills. Then, once we know what needs to be done, let us look just as thoughtfully at who – industry, government, private citizens – must bear the responsibility for such reforms.

Together we can accomplish a great deal. But we are needlessly misplacing our energies at this time, if we continue only to criticize each other. In a constructive and collaborative mode, then, let me present some different interpretations of data we ought to consider.

My comments today focus on four especially vexing problems – pollution from tanker operations, dollar costs of biological damages, manning, and equipment maintenance.

First, let me consider what percentage of marine petroleum hydrocarbons has been contributed by tankers. Mr. Naess has correctly quoted National Academy of Science figures: The best estimates are that some 3-5 percent of marine hydrocarbons come from "photogenic" tanker spills, and another 28-30 percent from day to day operations. The operational causes of tanker pollution – the 28-30 percent – deserve some additional thought. Looking at the figures another way, 80 percent of all tanker oil pollution is caused by faulty engineering, routine tank washing procedures, and errors at tank terminals.

One very important implication of these facts is that tanker pollution, for the most part, is not caused by "acts of God," but rather by the failure of tanker owners to incorporate higher standards into their operations. Let me use an example of a problem facing us here in the North Atlantic – oil pollution resulting from tank washings. Again, using the National Academy of Science figures, tank washings constitute some 43 percent of all tanker pollution or contribute 13 percent to all marine hydrocarbons. Segregated ballasts would practically eliminate this problem. Estimates by the Department of the Interior predict that segregated ballasts would reduce Georges Bank oil pollution resulting from outer continental shelf activities, including large tanker spills, by an outstanding 77 percent. The important thing is to recognize that over 630 million gallons of oil, the equivalent of 100 ARGO MERCHANT spills, is being discharged into marine environments annually, and most of that results from day to day tank operations. No one knows what the long term implications for the marine environment are, but everyone knows that there are ways to eliminate 80 percent of the tanker pollution problem.

One issue Mr. Naess did not raise is the problems from the few large tanker spills occurring each year. Three important points should be made. First, four-fifths of all tanker spills occur in coastal waters, the most highly productive and accessible of all marine environments. Second, the cost of those spills is not just oil-soaked birds and slick-covered rocks, but amounts to decades of lost income to the commercial fishing and tourist trades. Third, and finally, the jury is not yet out on the long term implications of ocean oil spills.

One of the world's best documented studies on the short- and long-term effects of coastal spills has been conducted in this state by the prestigious Woods Hole Oceanographic Institute. In 1969 a relatively small spill of 4,000 barrels from the barge FLORIDA contaminated several miles of coastline, which included salt marsh and shellfish flats, in West Falmouth, Massachusetts. While the oil was visible on the surface for only a short time, sediment contamination has kept shellfish flats closed for nearly 10 years. In fact, new areas have been contaminated as oil and the subtidal sediments

have spread seaward over the years. The direct economic cost of this spill in terms of shellfish alone has amounted to some $400,000 in foregone production over the last 9 years. Considering the large economic multipliers associated with this shellfish industry, the total impact on the Massachusetts economy is closer to $4,000,000.

This Woods Hole research on the incorporation and persistence of hydrocarbons in the bottom sediments has only recently begun in offshore waters, the location of commercial finfish grounds. Not enough is known about oil in the benthos once it is forced down from the surface by turbulence, nor do we understand the effects of the slow release of hydrocarbons over the years. The benthos is a vital part of our marine ecosystem where finfish spawn and shellfish, such as scallops and ocean quahogs, live. Oil in the benthos contaminates these niches, possibly reducing fish populations vital to commercial fisheries. Again, quoting Interior's figures for one section of the Georges Bank: a 1.5 million gallon spill (one seventh the size of the ARGO MERCHANT) could contaminate 52 percent of the benthos with resultant potential losses of $23.6 million to the commercial industry each year, if bottom contamination prevented fishing in the affected area. If we assume conservatively that hydrocarbons persist offshore about the same amount of time as the West Falmouth spill, the losses amount to a total of about a quarter of a billion dollars. None of these figures include damaged fishing gear fouled by slicks and sunken blobs of oil while attempting a catch.

I would now like to quickly examine two main problems both in maintaining and manning tankers so that oil spills might be prevented. After investigating the ARGO MERCHANT accident, the Liberian government concluded that the owners of the ARGO MERCHANT were irresponsible, if not negligent, in the maintenance and operation of the vessel. Three times in the last three years of operation the vessel had been totally disabled at sea because of a failed propulsion system. The vessel had incurred numerous violations in the United States and foreign countries for minor oil spill incidents. Despite requirements for yearly inspections, the vessel had not been inspected for 18 months. Upon boarding the vessel after stranding, the Coast Guard found extensive rusting and unsanitary conditions. Many valves and portholes would not function properly and the pump and engine rooms were not properly sealed off from each other. The vessel had no Loran navigational equipment and had 6-year-old charts, a faulty gyrocompass, an inoperative course recorder and a malfunctioning radio direction finder. The owners had provided an insufficient number of crew despite the captain's request, and many of the personnel were inexperienced or unqualified for their positions. Finally, once the vessel was aground, the owners waited 36 crucial hours before making arrangements for salvage operations. We would not have had the ARGO MERCHANT accident if the owners had maintained their vessel and provided an ample and qualified crew.

The difficulty for any group, whether it is the industry or government, and I must emphasize any group in this regard, is to ensure effective maintenance and manning. This difficulty can be seen vividly in the following. The AMOCO CADIZ was owned by an American company, registered in Liberia with its head office in Bermuda, run from Chicago, operated with an Italian crew, carried oil owned by a Dutch company, failed to be rescued by a West German tug and ended up running aground in France. That is, at the very least, an international and

terribly complicated problem.

The failure to internalize the costs of oil spills into everyday operations has forced governments to take action. The United States has been in the forefront, recently establishing compensation funds for costs of third party damages, losses to natural resources and clean-up in connection with outer continental shelf activities. The new amendments to the Ports and Waterways Safety Act for the most part implement the IMCO resolutions, enacting provisions to correct many causes of operational discharges. Massachusetts has filed a rule-making petition with the Coast Guard to go beyond the IMCO conferences and establish standards for small tankers and barges along the Massachusetts coast.

These remedies are not enough to solve the tanker pollution problem. Government regulated compensation for lost natural resources is not available to Georges Bank fishermen nor for non-outer continental shelf oil tanker spills. TOVALOP and CRISTAL, while admirable and critical initiatives on the part of industry, do not provide adequate coverage for the photogenic spills. The funds total $30 million – that is but a third of the estimated $100 million damage and clean-up costs from the AMOCO CADIZ spill. And as Mr. Naess has noted, one nation's ratification of the IMCO conventions does not even come close to ensuring the health of the oceans worldwide.

What more can be done to close these gaps? Government ratification of the IMCO Protocols worldwide is essential. The United States and Norwegian governments have taken the lead in this regard, but it's up to the private citizen to apply pressures on recalcitrant nations.

While international cooperation is necessary, nothing is more important than concrete demonstrations of the willingness of tanker owners to take the initiative to solve tanker pollution problems. Tanker owners can enlarge funds covering oil spill clean-up and begin to address third party damages. They can face up to responsibilities in the event of accidents by shirking straw corporations, flags-of-convenience, and limits on liability. They can enact the IMCO Protocols and get ahead of government regulations. They must accept their responsibilities to maintain vessels and provide well-trained crews.

The rapid growth of oil transportation threatens the viability of our oceans, inflicting inequitable costs on coastal residents and others. I would challenge us all to live up to a sense of duty to reduce and eliminate marine oil pollution with a commitment to some housekeeping within the tanker industry itself and a commitment to more rigorous government standards. Thank you.

Mr. Horn:
Thank you very much Dr. Murphy. We'll proceed now with Admiral Benkert's comments.

Admiral Benkert:
Thank you very much, Mr. Horn, for inviting me here to participate in this lecture, even though Dr. Murphy is usually a tough act to follow – I've had some conversations with her before. Ladies and gentlemen, I have a very brief prepared response to some of the topics Mr. Naess covered in his excellent lecture. And if this is the appropriate time, I'd also like to make a comment or two about Dr. Murphy's response.

I should preface my remarks by explaining that between 1971 and 1978, I was the U.S. Coast Guard Officer who probably had the greatest direct responsibility for all actions the Coast Guard took (or didn't take), nationally and internationally, relative to ocean pollution from vessels by oil and other substances, and

commercial vessel safety. I think it's important to put that into perspective when you listen to my brief comments.

First, I would like to strongly emphasize Mr. Naess' premise that the diverse, complex, and highly technical problems pointed out by the AMOCO CADIZ casualty – and the TORREY CANYON, METULA, VENOIL/VENPET, ARGO MERCHANT, and SANSINENA – cannot be solved by emotional tirades generated by the news media, or fanned by publicity seekers and perhaps well meaning but uninformed "sideline shooters." By no means am I implying that all comments, proposals, or suggestions from sources outside the industry are unwarranted. I am saying that what is needed, as Mr. Naess and Dr. Murphy have enumerated, is a solid, professional approach on a national and international basis to the safety and pollution problems inherent in the transport of oil by tankers.

In this vein, a few words regarding IMCO and the actions or inactions of its individual members are in order. Mr. Naess has given us a rather thorough summary of some of these in recent years, as developed and implemented by tanker operators voluntarily through IMCO on an international basis. He has emphasized the need for international action, and to this latter, I can only say "Amen." President Carter's initiatives of March 1977 most assuredly gave a tremendous shot-in-the-arm to the governmental international maritime community efforts.

Since that time we have watched the development, under IMCO auspices, of a revised and updated 1973 Pollution Convention. Mr. Naess described this very briefly. We've had an extensive and stringent Protocol to the 1974 Safety of Life at Sea Convention, and the International Convention on Standards of Training, Certification and Watchkeeping for Seafarers. Each convention has its own area of coverage and, in that area, each has attacked pieces of existing and possible future vessel safety and pollution problems in a responsible, efficient and professional manner. I say efficient because where else in any international deliberative forum has so much been achieved in so short a time?

I would like to add, however, that not a single one of these highly admirable and extremely desirable internationally arrived-at agreements are in force today, nor are a number of their predecessor agreements. Many of their specific provisions are being implemented by maritime nations nationally on a flag-state basis.

The United States, despite not having ratified these, or in fact several earlier agreements, has implemented through national statute and federal regulation many portions of these agreements, applying certain provisions to both U.S. flag vessels and to foreign-flag vessels entering U.S. ports. This rather piecemeal approach, although it exerts a strong effect because of the tremendous volume of oil imported into the United States in foreign-flag vessels, is certainly not an international solution to an international problem.

I happen to be a firm and vocal supporter of IMCO. For a number of years I have represented the Coast Guard and the United States in that forum, both abroad and to our Congress. I think it has been and still is today, despite increasing political pressures so apparent within the United Nations, an organization with active participation by maritime professionals who have produced highly beneficial, technically sound international agreements.

More is needed, however, and I would certainly agree with Dr. Murphy and Mr. Naess in their emphasis on international agreement. The U.S. Senate should ratify these agreements in a timely manner. The Department of State should

exert the diplomatic influence and muscle that our country possesses to hasten acceptance of these agreements by our international partners in maritime commerce. Too often, I believe, our country has strongly pressed for international agreements and action and then itself been a laggard in following through fully.

At this point, I would like to shift my thought to an area Mr. Naess has not specifically discussed today, though I know he understands this area and happens to be in agreement with me. I'm speaking of vessel statute and regulation compliance, maintenance, repair and operation under the responsibility and direction of the vessel owner. This particular aspect of the problem tends to get lost either because of the emphasis placed upon governmental action or lack thereof, or because it gets muddied-up with the "flags-of-convenience" issue. Despite international agreements, national legislation and regulation, steadily expanding and more stringent flag and port state inspection and control, and Coast Guard inspectors all over – in our country and in other countries – the major deterrent to unsafe and pollution-prone vessel conditions and operation, and, I believe, the most important aspect of this entire problem, is responsible vessel ownership and management augmented by qualified, competent shipboard personnel similarly motivated. We must eliminate substandard vessels, and substandard vessel operators. Governmental action can help in this regard, but basic responsibility still rests with the vessel owner and the people who run the vessel. I think that we are seeing major gains in this area.

As a final quick comment, I'd like to offer my compliments to Mr. Naess on what I thought was a truly excellent lecture. I think he's most cohesively put his finger on and voiced many points that knowledgeable, thinking people in and out of the marine industry have made in one format or another over these past few years. I would like to congratulate him on his presentation.

If you'll bear with me, Mr. Horn, one comment for Dr. Murphy. I'd like to go back to the ARGO MERCHANT. I think most of us would like to forget the ARGO MERCHANT. But you know the guts of the ARGO MERCHANT issue. It would not have made any difference if that vessel had been the best equipped in the world and in marvelous shape. If the skipper makes an error on a ship, does not navigate properly and runs aground, you are going to have problems. It's as simple as that. Thank you very much.

Mr. Horn:
Thank you Admiral Benkert. We will now turn to Professor Milgram and ask him for his comments.

Professor Milgram:
Mr. Naess has stated that public reaction against tanker owners following polluting accidents is not fair. I will put forth some arguments indicating that this response is, in many instances, fairer than Mr. Naess would wish us to believe. On occasion, it is essentially impossible to determine who the owners of a polluting tanker are shortly after an accident. The owners are sometimes able to "hide" from public view for a considerable period of time. To an extent, our laws encourage such action along with business and legal arrangements that allow tanker owners to protect themselves from the full cost of the damage they have caused. Mr. Naess has noted the financial responsibility required of tanker owners by TOVALOP. However, the $10 million limit is often much less than the cost of the damage. Even the increased financial coverage provided by CRISTAL of $30 million

can be inadequate. As we were told by Dr. Murphy, reports of the funds spent in cleaning up the oil spill from the AMOCO CADIZ exceeded $83 million. There were other damages not included in this cost. Clearly, the $30 million imposed by CRISTAL did not cover the costs. Even so, I would ask Mr. Naess to report to us in his latter comments whether even the $30 million has been paid to date.

Mr. Naess has sought assistance for tanker owners from those outside the industry. In particular he has cited the need to interest us here at MIT to work on tanker problems, and the need for shore navigational aid and traffic vessel services to be provided. Each of these needs requires financial support. As a faculty member in the MIT Department of Ocean Engineering, I can unequivocally state that tanker owners have not provided financial support for our research at a level appropriate for us to be able to make substantive contributions to the problems involved. Similarly, I will again ask Mr. Naess to make a latter comment on how much of a direct financial contribution the tanker owners have made for the development of shore navigational aids and vessel traffic services. He would like us to believe that, after an accident, the accusing finger should more often be pointed at a lack of adequate shore aids and traffic services and less often at the tanker owner. Let us not forget that shore aids and traffic services are conveniences, but a tanker accident almost always results from negligence in the ship's design, operation or maintenance, whether or not shore aids are being used.

Mr. Naess has down-played a number of oil shipping accidents by stating that if there were two major accidental oil spills per year, it would represent, on the average, only one spill in 10,000 voyages. However, there are many more than two major spills per year. For example, records indicate 45 worldwide major polluting tanker accidents in 1975 and 29 in 1976. Thus Mr. Naess' figure of one in 10,000 becomes more like one in 500. I would also like to point out that in 1976, reported worldwide tanker casualties resulted in 226 deaths and 87 injuries.

Our speaker has stated that to use the AMOCO CADIZ disaster as an example for attacking "flags-of-convenience" makes no sense. He has stated that the reasons for this are that the vessel was operated in accordance with high standards and its crew was made up of Italian nationals licensed by Liberia and Italy. I know of no compelling reason why a crew should be considered especially proficient just because they are Italian nationals. The TORREY CANYON was driven up on Seven Stones Reef by an Italian Captain. Furthermore, I have not yet seen the evidence indicating that the AMOCO CADIZ was operated according to the highest standards or that the inspections required by Liberian Registry were sufficiently thorough to discover developing difficulties in the steering system. United States registered vessels undergo an annual inspection by the Coast Guard. Every two years, the inspection is so thorough that it must be made with the vessel in drydock. The whole ship is inspected inside and out. Between inspections, a complete internal inspection is made. There is every reason to believe that the steering gear is thoroughly inspected in both types of American inspection. What type of steering gear inspection is made for vessels in Liberian Registry and how often is this done? It would be instructive for us to see the last Liberian inspection report for the AMOCO CADIZ to determine the extent to which the steering gear was examined and when this occurred. Until we have this information, we cannot state that the disaster was not related to

the Liberian Registry of the vessel.

After taking issue with many of our speaker's comments, I would like to conclude by giving my support to two of the matters he raised. These are recognition of the difficulties in achieving international cooperation required to make effective voluntary plans for reducing pollution, and recognizing that some of our laws actually oppose the most effective procedures for preventing pollution. These issues indicate our laws related to ships and shipping should be reviewed and in some cases revised; and unilateral action may be necessary to provide our nation with the level of safety against pollution we would like to have.

Mr. Horn:
Thank you very much, Professor Milgram. Now we'll ask our final panelist, Mr. Cole, to give us his remarks.

Mr. Cole:
Thank you, Mr. Horn. Having listened to the preceding panelists, I'm beginning to wonder whether a prepared commentary on my part is the answer. I think Mr. Naess is going to have some very interesting questions and responses.

I would like to respond to Professor Milgram regarding the "flags-of-convenience" question. From my experience, accidents don't know any nationality. For instance, shortly before the ARGO MERCHANT mishap the flagship of the U.S. tanker fleet, a 250- or 260,000-ton tanker, ran aground in the Bahamas, fully loaded, in daylight, at 8:30 in the morning, 5 miles off a lighthouse. I understand that she ruptured one or more of her forward cargo tanks, and it was only because of a split bulkhead that equalized the oil that we avoided massive pollution in the southeast Atlantic area. In regard to the performance of foreign crews, I would like to point out that many other nations, including Italy, provide post-certification training that I believe is better than that given to American flag officers – and I say this as a licensed U.S. deck officer. I think it's something we should all look at objectively without regard to a Liberian ship with a Dutch cargo and an Italian crew on her.

Mr. Naess, I've known you for some time. You gave today what I thought was a presentation of the high quality that one might expect from you. I won't take substantive issue with what you've said today, but I would like to talk on efforts underway in oil pollution damage and liability compensation schemes, a subject that has been discussed today by you as well as Dr. Murphy and Professor Milgram.

Dramatic changes are occurring, and it may be useful to review the development and positive direction these schemes are taking internationally, as well as to focus on the lack of domestic direction in structuring viable liability and compensation legislation. As Mr. Naess pointed out, in 1967 the TORREY CANYON incident drew worldwide attention to the potential consequences of a major tanker casualty. As a result governments, including the United States, expressed through IMCO the need for a legal regime in tanker liability for oil pollution damage.

This concern ultimately resulted in two international treaties: Firstly, the International Convention of Civil Liability for Oil Pollution Damage (CLC) of 1969, which imposed on tanker owners primary insurable liability for oil pollution damage to a ratifying nation's coast and territorial seas; and secondly, the International Convention on the Establishment of an International Fund for Oil Pollution Damage (Fund Convention) of 1971, which provided for a supplemental fund to be created by assessments against oil cargo owners. The conventions are

complementary and provide compensation regimes of up to $36 million, which could be expanded to $72 million if necessary for recovery of costs and/or damages associated with marine oil pollution. Speaking of the indicated high dollar value of potential claims and lawsuits related to the AMOCO CADIZ incident, I might add that the question of proven damages is debatable.

The CLC entered into force on June 19, 1975, and currently 35 nations have ratified its provisions. This numerically represents about one-third of the nations required for worldwide coverage to become effective.

The Fund Convention, with the minimum required 14 signatories, entered into force on October 16. As a matter of interest the United States, which was a driving force in the creation of these two treaties, has not yet ratified either one, along with some others that they played a significant role in formulating.

During the late 1960's industry, correctly predicting a lengthy ratification process, embarked on a voluntary undertaking to ensure the availability of compensation for oil pollution damages. Working closely with governments and with many independent tanker owners – I believe Mr. Naess was one of those – several oil companies created TOVALOP and CRISTAL. These two plans in many respects paralleled the conventions then under preparation. TOVALOP provides commercially-insured tanker coverage and CRISTAL provides a fund established and maintained by contributions from member oil companies. As Mr. Naess pointed out, TOVALOP today embraces 96 percent of the world tanker tonnage and current estimates indicate CRISTAL covers 92 percent of all crude and fuel oil shipped by sea

TOVALOP and CRISTAL were structured as interim agreements designed to expire when the CLC and Fund Convention became universally effective. This, as noted earlier, has not occurred and there are substantial geographic gaps in the coverage. Again I stress that both the CLC and the Fund Convention are *area*-specific and only provide protection to signatory nations. TOVALOP and CRISTAL, on the other hand, are *vessel*-oriented and applicable to a spill anywhere as long as the owner is a TOVALOP participant and the oil cargo belongs to a participating oil company. In this respect, I believe the Coast Guard was compensated for their pollution prevention efforts in the ARGO MERCHANT case by the insuring company covering that tanker under TOVALOP.

Some inconsistencies existed between industry schemes and the conventions' provisions. However, in June of this year, which was when the dollar monetary amounts changed, both TOVALOP and CRISTAL were amended to essentially mirror, and in certain respects exceed, the provisions of the conventions. Briefly, TOVALOP, like the CLC, now establishes a tanker owner's liability at $160 per ton, not to exceed $16.8 million per incident, and provides compensation for damages to private persons as well as governments and tanker owners for clean-up expenses. CRISTAL, like the Fund Convention (CRISTAL mirrors the Fund Convention and TOVALOP mirrors CLC), guarantees the difference between TOVALOP (CLC) liability and $36 million. CRISTAL, as in the Fund Convention, also provides a "roll-back" feature whereby tanker owners are reimbursed for clean-up expenses in excess of $120 per ton, but not exceeding $160 per ton. Essentially, this will roll back the tanker owner's liability under CRISTAL and the Fund Convention to about $10 million. Both the revised CRISTAL and the Fund Convention have provisions to increase the aggregate total to $72 million

These briefly are the steps taken by governments and industry in the international sector. Predictably, industry in meeting its responsibilities will continue TOVALOP and CRISTAL as long as necessary. Protection under either regime is comprehensive, uniform and equitable.

Nationally, the picture is somewhat different. Within the United States a patchwork of oil liability and compensation laws exists on the federal and state levels. Each was enacted in an apparently emotional response to a particular incident or to protect a specific geographic area. There are bare spots, overlaps, and some conflicts in the coverage provided. The existing system does not protect the citizen damaged by oil spills. It works hardships upon owners and operators of tankers and oil terminals and, because of multiplicity, increases the cost of oil to the consumer.

For four years, the tanker and petroleum industries have supported legislation that would create a single large national oil spill compensation fund, or "Superfund," as it is commonly called. The objective of federal oil spill liability legislation, we believe, should be to establish one fund at the federal level for prompt compensation of proven oil spill damages, establish one set of oil spill liability laws for the nation to cover all types of oil spills from all sources, remove both the overlaps and bare spots of the present patchwork system, and minimize bureaucracy.

To accomplish these objectives, the laws enacted must set appropriate levels of uniform liability for all sources of oil spills of any kind, establish an ample oil spill compensation fund, preempt the existing patchwork system of oil spill liability laws and compensation funds at the state level, repeal existing federal oil spill liability laws and compensation funds, place first responsibility for oil spill clean-up and claim settlement upon the spiller, make the fund responsive for quick settlement, and utilize existing governmental agencies to administer it. The 95th Congress adjourned recently without passing Superfund. The principal point of conflict was federal preemption of state laws and funds.

Industry insists that any legislation contain strong language that totally preempts individual states from establishing differing levels of liability or taxing petroleum to create separate clean-up funds or equipment pools. I am sure you will agree with me that duplication at the state level in this regard is a waste of money and creates another level of bureaucracy, the cost of which is ultimately borne by the consumer and the taxpayer.

Dean, thank you very much for the opportunity to appear this afternoon. I'm sure that the question and answer session will, after the lecturer's comments, elicit some lively discussion. Thank you.

Mr. Horn:
Thank you very much Mr. Cole. Before we open for questions, I would like to offer Mr. Naess the opportunity to respond to some of these comments.

Mr. Naess:
Thank you. I will deal first with the charming Dr. Murphy. She suggests that the tanker owners are at fault. Well, if there were a tanker owner by the name of Evelyn F. Murphy, I think she would think otherwise. How can one single tanker owner reduce the carrying capacity of his tanker by 20-25 percent? He would go broke. This is an issue that has to be solved internationally by the 1978 Protocols. When that is done, we will be far on our way to a solution.

You seem to talk as if there were something

suspect about running an international tanker business. I used to build ships myself in Holland, man them with Italians, charter them to an American company, and trade to the Philippines. That was a perfectly normal international tanker business. Must it be national only? I think not.

Second, to my friend Admiral Benkert – I can only say that I admire the U.S. Coast Guard more than almost any institution in the shipping world. It is the finest service of its kind, and it has wonderful personnel. Admiral Benkert is one of them. He and I agree completely on the subject of substandard ships. We must get rid of them. How? Here again, if the 1978 Protocols are ratified we will get rid of about 50 million tons of old ships. The fact that they are old doesn't necessarily mean they are substandard. It all depends on how that owner maintains his ship. But when you look at statistics you find, of course, more substandard old ships than new. When, however, the Protocols are ratified, many substandard ships will be eliminated.

Then I come to Professor Milgram, a very difficult adversary. I agree that there should be more protection against spill damage. I am hoping to see an international Superfund created. No individual tanker owner can take on himself the costs of cleaning up a serious oil spill. So everything must be insured, and the tanker industry has absolutely no objection to paying the higher insurance premium that would be involved with establishing an international Superfund. The United States is thinking of establishing a Superfund. I would like to make it an international one.

He also referred to my figure of one in ten thousand. I didn't mean to be taken so literally. He himself mentioned that there were 40 oil spills. I haven't figured out exactly how many there were, but what I meant was that we are going to have accidents. If this planet of ours is going to be run on oil for energy and if millions and millions of tons of oil are going to be transported across the oceans, we are going to have some accidents. Let's face it.

Then he had a shot at the Italians. Italy has very high class naval academies, and when a captain or an officer graduates from an Italian naval academy, I am confident that he is well educated. I cannot agree with any slur on the Italians – they're just as good as Norwegians. Thank you very much for listening to me.

Mr. Horn:
At this point, I'll take some questions from the audience.

Question:
For the gentleman from Texaco: What percentage of the ultimate cost of petroleum products is represented by the cost of transportation? And, if you were to do everything that industry critics suggest, how much would that increase the cost of shipping?

Mr. Cole:
I don't have the numbers with me, but I can tell you that currently, at $12 a barrel oil and a VLCC at cost, it would cost about $1 per barrel for transportation.

The VLCC is actually pretty well off under the new convention and will not require significant modifications. Regarding smaller tankers on long hauls – there will be some cost, but not the billions of dollars Mr. Naess spoke of earlier.

I'd like to speak to the question of retrofitting smaller ships. Industry opposed it. A brand new ship can be designed and constructed with defensively located segregated ballast, but I believe that retrofitting an existing ship is basi-

cally wrong. I think that Mr. Naess' numbers might be low on the loss of cargo carrying capacity in ships that have either retrofit segregated ballast or retrofit clean ballast – the loss may be as much as 30 percent. You burn a higher percentage of fuel oil to move the equivalent barrels in a ship operating at only 70 percent of capacity, again a diseconomy and a waste of energy.

For a country like this, with our estuaries and oil movements up and down the rivers, I would like to see five years from now a comparison of oil pollution figures arising from collisions, groundings, etcetera, prior to and as a result of the new Protocols. Perhaps four ships of necessity will be traversing the Delaware and Mississippi in lieu of the current three. With respect to cost per unit, varying estimates have been made, and I'm not in a position now to state what they are. They have to be passed on to the consumer in due course – if that's the price we want to pay.

Question:
Mr. Naess, I'm Dr. Dyer. In my opinion, the crucial issue is that accidents will always occur. I cannot conceive of a world in which we can or would willingly pay the cost of an error-free operation for a service as vital as oil transport. We want to reduce accidents to a small number – we can't afford zero, but we don't know the right number. What we aren't doing well enough in this country is marshalling our intelligence and forces to properly contend with those spills. We don't have standby capabilities. We don't know what to do except to flail around when an accident occurs. If we were serious about oil spills, we would devote more effort to ameliorate the effects.

Mr. Naess:
Excellent comments. I agree with you entirely. We could build small ships to carry small amounts of oil, and I'll guarantee there will be no accidents. But we can't afford it, so we have to compromise as best we can.

Question:
Admiral Benkert. I would like your comments on implementing a traffic control scheme of the sort used for aircraft to continually control coastal traffic in high-risk spill areas. Has there been much research on this?

Admiral Benkert:
I think you are referring to a major control concept for all vessels in coastal waters. There has been a great deal of research effort and some money spent on specific cases of vessel traffic system installation in the United States. There are some systems in our ports right now. The Coast Guard, among others, is engaged in certain R&D-type appraisals to possibly expand this along our coast. Certain Congressmen and one of our eminent senators wanted us to control traffic out to 200 miles along all our coastline – the Atlantic, Pacific, and Gulf. Physically and practically, this is obviously an impossibility. But there are a number of thinking people who feel you can control traffic where necessary, such as at approaches to ports where traffic converges. The Coast Guard is required to do this under the Ports and Waterways Safety Act. I don't think coastal (offshore) accidents warrant this – you are talking about a fantastic number of vessels. You could control just the big ships, thinking they're the ones that give you problems. But you forget that small ships can run into them. The idea of an air patrol-type "control" on the whole coast is economically and

practically a tremendous task. And I don't think you would get the benefits.

Question:
Admiral Benkert: What is your perspective of the coastal fleet of tugs and barges, its level of equipment, and the standard of manning and regulations?

Admiral Benkert:
This is something most people in this country don't understand. Barges in our inland and harbor waters safely transport millions and millions of tons of cargo, including oil, coal, grain, chemicals, and hazardous materials of all kinds. They have the safest transportation record in the United States per ton mile or any other criteria you want to use in the country, whether you compare it with automobiles, trucks, or airplanes.

But you have a pollution problem with small vessels such as barges. A big ship like the ULCC sees no docks at all en route. But barges go from one dock to another, and through locks on the Mississippi and Ohio river systems. One of the biggest causes of oil pollution in our waters – and Dr. Murphy is well aware of this – is the collision of barges with docks.

The Coast Guard is looking now toward providing regulation proposals for double hulls on this type of barge. Thousands and thousands of barges already exist. You can't just throw them away. They're a tremendous economic investment, and they're needed for our country. You must devise some kind of scheme, and the Coast Guard may look into this, toward gradually scrapping existing single-skin barges and implementing new double-hull barges.

But don't let anyone tell you barges are "hazardous" as such. They are the safest method of transportation today for bulk cargo transport.

Question:
The largest number of tanker incidents have been within 15 miles of shore. In most cases reports indicate ships were run by unqualified people. In addition we're finding, as was reported with the TORREY CANYON, the skipper will try to beat the tide to save a few hours in unloading the ship. I would like your comments on this, Mr. Naess.

Mr. Naess:
I think you have a point. Many charter parties contain a guarantee of speed under all weather conditions. I have pointed out time and again that this is very dangerous, because the master of the ship will try to maintain the guaranteed speed, whatever the weather is. The Italian master of the TORREY CANYON tried to catch the tide. He was trying to do well for his owner. He made a mistake, and those mistakes will occur, I'm afraid.

Mr. Cole:
I'd like to speak to Mr. Naess' comments, as both a charterer and an owner, regarding the guaranteed speed clause. The oil companies, in years of negotiating and evaluating the competitive cost of charters with the independent owners, would have them represent a ship as being capable of a certain speed under certain weather conditions, only to find that the speed had been overstated by the owner and the charter, therefore, turned out to be more costly. But in no way do we, either as charterer or owner, endorse speed under unwarranted or risky conditions. The master is aware that safety of the personnel, vessel and cargo are paramount. I can well remember the closing words in our voyage orders to ships' masters for many years: "Take no undue chances. The final decision is your prerogative and responsibility."

This is still true. And this comes back to the responsible shipowner of the world.

Question:
Do you think a mandatory state inspection program would be one way to solve the substandard ship problem?

Mr. Cole:
Yes, if we're speaking of port state inspection. The flag state is that which the ship carries: Liberia, Panama, United Kingdom, Norway. Port state would be a Panamanian or Liberian ship visiting the United States, with the United States being the port state. I think every responsible owner in the world supports port state inspection. There are probably 300 rust buckets – and I'm speaking of oil tankers – that are causing everybody headaches, perhaps due to the unnecessary measures that have been either legislated or agreed upon because of them. So we, the industry in general, endorse – and I think Mr. Naess would also – singling out these substandard ships and giving the port states the right to stop them.

Question:
I realize the difference in terminology here. I would like an answer, however, as to what we could do on a state level.

Admiral Benkert:
Not for the United States, but, for example, Massachusetts. You feel that something special needs to be done for the environmental or safety concerns in your geographical area. My feeling and that of the Coast Guard and responsible tanker people is that this should be done by the federal government. It's the Coast Guard's statutory responsiblity to do this. One item in the Tanker Safety Act of 1978, just passed by Congress, is the concept of annual Coast Guard inspections of foreign flag tankers entering U.S. ports. The Coast Guard started that program sometime before the ARGO MERCHANT happened. But this inspection should be standardized for all ports and carried out by one outfit to avoid confusion.

Mr. Cole:
I'd like to respond to that. The Coast Guard's in-port inspection program has significantly benefited the country. But the one problem industry people face is that the Coast Guard cannot publicize the list of ships with noted deficiencies. Oil companies themselves are enjoined by the Justice Department from sharing similar information. Release of the Coast Guard data would benefit several persons; not only major oil companies that maintain a surveillance scheme, but small independent cargo lot purchasers, and the cargo brokers who have no way of tracking these ships.

Mr. Horn:
I'm sorry we are rapidly running out of time. I'm going to exercise my right as moderator to ask Mr. Naess to repeat a comment he made earlier to me. In his talk he mentioned slop disposition – tank washings when there are no reception facilities – and the importance of establishing reception facilities in ports throughout the country. These tank washings represent, according to the National Oceanic and Atmospheric Administration study, about 12 percent of the oil that is introduced into the oceans worldwide, the second largest single source of oil pollution into the oceans. Mr. Naess, in his autobiography, recommended that old ships existing in this country be used as reception facilities. Mr. Naess, do you still think this is a viable solution, and which country leads the world in develop-

ment of reception facilities?

Mr. Naess:
The country that is leading the world in reception facilities is the Soviet Union, which irritates me. I have argued that reception facilities would be the best solution, and I haven't gotten anywhere because it costs so much money. I'm still arguing, but the industry has taken upon itself to say, "Well, that's all very well, Mr. Naess, but we think we have methods that are going to be just as good or better and will cost much less." The methods refer to crude oil washing and segregated ballast tanks, and if they solve the problem, fine. Then we wouldn't need the reception facilities.

Mr. Horn:
Thank you very much. Ladies and gentlemen, before you leave I will try to summarize the outstanding lecture, panel comments, and audience discussion. I think we all realize the great complexity of the oil pollution problem affecting the oceans today. There is no panacea, no single culprit, no easy solution. It's going to require the combined efforts of every interested group of people to correct and control these conditions. It's taken us a long time to get to where we are today in dirtying the oceans, since there has been natural seepage for millions of years and man has been adding to it in increasing rates over the last half century. It's going to take us a long time to correct it. But we've started, and we've got to keep going. I want to thank the audience for their participation and lively questioning, the expert panel for presenting their views and responding so effectively, and, especially, Mr. Naess for this outstanding lecture and a new perspective full of challenging ideas.

The MIT Sea Grant College Program

We of the MIT Sea Grant College Program dedicate this occasion to the identification and study of inventive approaches to major national and international opportunities in the oceans, and to all persons whose vocations or interests are served by the seas.

The Annual MIT Sea Grant Lecture

The MIT Sea Grant College Program presents the annual Sea Grant Lecture to provide a forum for discussion of perspectives and opportunities for our current and future uses of the seas. The Lecture also explores and heightens awareness of the roles of engineering, science, and the social sciences in developing marine resources, reflecting the Institute's commitment to environmentally balanced development of the oceans and coasts.