Cook Inlet Regional Citizens Advisory Council

Report on Safety of Navigation and Oil Spill Contingency Plans

Final Report

(NOTE: Due to modern changes in typesetting, page numbers in the Table of Contents match the new electronic edition, not the 1992 print edition. All other style characteristics have been observed as much as practicable.)

Date: 15th February, 1992

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17.02.92

Dear Lisa,

Final Report

Safety of Navigation and Oil Spill Contingency Plans

Please find enclosed the final draft of my repot. There are also three extra appendices to add to those in the draft report, please add them to the ones you already have.

I hope you and your committees have found the study of some benefit. Captain Anderson and I are quite convinced that what we have proposed is practical, seaman like, and that the objectives result from fear of the "bottom line" implications from the tanker owners and oil companies. They bear the burden in all other parts of the word and we see no reason why not in Alaska.

We would be most happy to quote you for other marine, oil spill control/ planning, environmental impact studies and hope you will include us on your tender list. In the meantime if there is any further information you require, please do not hesitate to call me.

Yours faithfully,

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Summary of Major Comments and Recommendations

Part: A: Evaluation of Risk Assessment, Contingency Plans and Operations Manuals

1. PLG Risk Assessment for CISPRI

General: Cook Inlet is fortunate to have the oil industry funded CISPRI operating within this area. In general, the updated equipment list is considered sufficient to cope with most spills and the response team would appear to be planning for the inevitable spills with some vigor. The following comments are meant to assist them in this task.

a. The figures expressed in the report would appear to be too optimistic and actual spill incidence rates are more common than those published in the report.

b. The report does not give a cumulative, overall spill figure for all the installations of the CISPRI members.

c. Due to the very rapid spread of spilled oil, more attention should be given to aerial spraying of oil dispersant. It is recommended that the following equipment/ materials be considered for inclusion in the equipment stock. One ADDS pack for a Hercules C-130, 4 helicopter under slung spray units and a stockpile of 25,000 gallons of dispersant at the Kenai airport.

d. The recommendation to acquire a 60,000 barrel barge should be changed to two 30,000 barrel barges. Each unit should be equipped with the following:

1. Storage capacity for 30,000 barrels recovered fluids.

2. On board system to inject demulifier chemicals into the storage tanks in order to break water in oil emulsions and so allow water to be decanted back to sea. The use of seam heating coils in the tanks should also be considered.

3. A minimum of 3 reels, each 1000 ft. of Bay size boom, together with power packs to drive reels and air blowers.

4. A minimum of three weir skimmer sections which can be inserted in the booms required in 3. See section on oil skimmers.

5. A minimum of two Transrec 250 skimmers.

6. Accommodations and basic sleeping accommodations for approx 20 men, two 12 hour shifts.

7. VHF and satellite radio room with FAX/ Telex facility.

8. Each barge to be attended by its own tug in order that it can be moved to encounter and recover the thickest oil.

e. The equipment pile should try to standardize one type of boom for open sea use. It is suggested that the Roulands Bay boom be considered. There is little to be achieved by purchasing the larger sizes. Expanding boom is not recommended for open sea use.

f. Weir booms can recover large amounts of fresh and semi-viscous oil. It is recommended that weir sections be acquired that insert into the Bay boom suggested before.

g. There are new modern alternatives to bladders and dracones. The use of oil bags should be considered to hold recovered oil/ water or to allow tanks to pump oil from the ship to stop the outflow from a damaged tank. See appendix A.

h. It is understood that there are special arrangements made at the KPL dock to allow the discharge of recovered oil/ water to the Tesoro tank farm. These are not mentioned in the risk assessment and should be tested to confirm that the discharge pumps/ line trace heating are suitable for viscous mousse to be efficiently pumped ashore in winter weather conditions.

i. Holding contracts with fixed wing and helicopter operators should be in place to allow the rapid deployment of aircraft to follow the movement of spilled oil. One such helicopter should be fitted with a VHF DF set to track the movement of the Orion tracker buoys.

j. A study should be made to investigate the practicality of r entering into agreements with SERVS and PIRO schemes such that additional equipment/ skilled manpower can be brought in to assist with a major spillage.

2. Tesoro Alaska Oil Discharge Prevention and Contingency Plan

a. There is no sub-section dealing with procedures to be followed when oil is found in the sea, at the dock when a tanker is working alongside. A procedure is suggested in this report.

b. In section 2, the spread of spilled oil on the sea has not been fully appreciated. In 12 hours such a spillage will cover approximately 40,000 acres. This will exceed the proposed booming capability.

c. The recovery rates of spilled oil are overly optimistic. The recovery rate given is 74% whereas, in reality, worldwide experience has shown that 7.4% would be a more accurate figure.

d. Declaration of Inspection. It is recommended that a jetty information book be drawn up which contains all DOI items and other safety requirements. See appendix B.

e. There are no details of tanker ballasting after discharge and crude oil washing. This should be included.

f. The addition of an extra crew member on the *Overseas Washington* is fully supported. All cargo tanks should be hydrostatically loaded, if this is not already the case.

g. Spill Detection. It is recommended that aircraft operators who regularly over fly Cook Inlet be requested to keep a lookout for spilled oil. Any such reports should be made to the USCG via air traffic control.

h. The section on radio communications should be re-examined in the light of the *Exxon Valdez*. The size of the scope of communications is a different area of magnitude in a large spill and should be pre-planned as far as is practicable.

i. Vessel Mooring Winches. The reference to the tension winches should be removed from the section on vessel moorings. Such a practice is not recommended and is forbidden at this and most other tanker terminals.

3. Kenai Pipeline Company, Nikiski Terminal Manual

General: This is a competent document as you might expect from an oil major. The following comments are given as constructive suggestions.

a. The list of pre-arrival information should be expanded to cover the following:

1. Inert gas system operational and all tanks checked to be inert for the last 24 hours.

2. All navigational systems and safety equipment operational, if not details required of deficiencies.

3. Hull and valves oil tight, no leaks.

4. Both anchors available and cleared away.

5. Number and types of moorings, all winches operational. Any deficiencies to be detailed.

6. Approved oil spill contingency plan and certificate of financial responsibility on board.

7. Name of P and I club.

8. Name of Master, ship operator and charterer.

9. Engines will be checked to come astern before boarding the pilot or passing abeam Homer.

b. There are no details of minimum under keel clearance nor maximum loads on the mooring hooks. This should be given.

c. It is recommended that there be minimum ballast requirements for tankers arriving at the dock.

d. The lack of fire-fighting cover at the dock is a major concern to the authors of this report. A study should be made of what is necessary to provide sufficient emergency fire cover and there should be a fire-fighting tug in the near vicinity when there are tankers/ barges alongside.

e. The mooring diagrams given are sufficient to hold the ship alongside with strong winds and current. However, if the ship were to move from the dock at an angle to the tidal stream then the moorings would quickly fail. Ice coming between the ship and the shore would force the tanker off line. It is recommended that tractor type tug(s) be used to assist tankers to remain on the jetty during icing conditions.

4. Cook Inlet Pipe Line Company, Offshore Operating Manual and Contingency Plan, Drift River

a. No details of minimum under keel clearance required and maximum safe loads on the mooring hooks.

b. The tidal current forces on a loaded ship, due to a 15 degree offset of the jetty to the tidal stream direction, indicate mooring forces which could exceed the suggested mooring pattern. Tractor type tug(s) should be used to assist tankers to remain alongside in adverse wind/ icing conditions.

c. A thorough study should be made into mooring arrangements at the loading platform and, if necessary, remedial strengthening of the mooring hooks or additional hooks should be provided. The charter ships should similarly be studied.

d. The use of mixed moorings (rope and wire) to the same dolphin should be strictly forbidden.

e. The ballast reception facilities are non-functional and too small for normal tankers trading to the loading platform. It may be the case that only segregated ballast ships be chartered or older tankers which will retain all ballast on board after loading. This should be made clear in the manual and a suitable ship chosen for the trade, i.e. all segregated ballast and the ship in a good condition of draught/ trim to be effectively handled by the pilot under winter conditions or, a tanker with permanent dirty ballast to achieve the same condition.

f. No fire-fighting capability to assist a ship fire. Additional foam monitor(s) should be fitted which cover the ship's manifold area. A fire-fighting tug should be available in the near vicinity to provide fire cover when a ship is alongside.

g. A system of pre-arrival information should be introduced similar to that suggested for Nikiski dock.

h. A senior member of staff should remain on the loading platform at all times when a tanker is loading crude oil. At present such supervisor returns to Drift River when the pre-loading checks have been completed.

i. There is no mention of checking the oxygen content of the cargo tanks prior to loading. This should be introduced.

j. An emergency shut down button should be available to the tanker crew. The use of VHF radio to achieve such a stop of the cargo is insufficient.

5. General Comment

It is recommended that two tractor type tugs should be available in Cook Inlet to provide the following services:

a. Berthing/ unberthing of large ships.

b. Provide additional push up to moored tankers in adverse wind/ tide/ ice conditions.

c. Provide fire-fighting cover for tankers working cargo alongside Nikiski docks and *Christy Lee* loading platform.

d. Assist spilled oil recovery operations, tow recovery barges, etc.

e. Provide emergency escort services to loaded tankers and barges while traversing restricted waters within Cook Inlet.

f. The Type of such tractor tugs and their design should be the subject of a separate study and will require the input of pilots, dock and oil jetty operators, CISPRI, USCG, Fire Authorities and tug operators.

Part B: - Study and Recommendations on the Safety of Navigation

1. All vessels carrying dangerous or hazardous cargoes to/ from Cook Inlet in winter should be ice strengthened to an appropriate standard.

2. Most of the “Winter Rules” should be incorporated in standard regulations.

3. The originators of the “Winter Rules” should include the existing requirement to place a pilot from the Southwest Association on board tankers at the oil docks during ice conditions.

4. Strain gauges should be installed to all mooring points (hooks) at all tanker berths. Readouts to be centralized in a jetty control room.

5. Protected current meters to be fitted at Drift River and Nikiski docks.

6. Seasonal buoys to be deployed only for the use of seasonal traffic. If such buoys are required all the year round then they should be replaced with fixed navigation aids.

7. Studies be put in hand to examine:

a. Upgrading of visual navaids. This to include the need for RACON and high power landfall lights at entrances to Cook Inlet. Sectored or leading lights to aid approaches to jetties and main channels.

b. Traffic Routing and Designated Anchorages. This to include the requirement to separate ships carrying dangerous cargoes from other shipping to reduce the risk of high impact collisions.

c. Vessel Traffic Services. This to include the requirement for a Traffic Control Center, a VHF relay system throughout Cook Inlet and a traffic way point reporting system.

d. Hydrographic Surveys. This to include an examination of the age and standard of previous surveys of the navigable routes in Cook Inlet and the requirement to update.

8. Suitable tugs should assist in berthing/ unberthing/ escorting of tankers at Nikiski and Christy Lee Loading platform. These tugs will be the tractor type, but the detailed design is to be the subject of an independent study.

9. Clearly defined operating parameters relating to wind, tide, deadweight, etc. to be established.

10. Pilotage licensing to be re-organized under one certifying authority.

11. Only licensed pilots to handle tankers.

12. An independent Harbor Authority/ Administration should be established to manage and regulate all marine aspects and to ensure the safety of navigation in Cook Inlet. This body must be empowered to raise funds to finance its own operations and support the provision and maintenance of naiads/ vessel traffic service/ harbor surveys.

13. All tanker jetties/ structures including fendering should be subject to periodic independent engineering surveys. The results of such surveys should be made available for public scrutiny.

14. The Cook Inlet Pollution Prevention and Safety Program issued by the USCG should be elevated from guideline to regulation.

Section 1

Cook Inlet

Introduction

Draft Report on Vessel Navigation, Pilotage, Terminal Operations, Oil Spill Contingency Plans, Cook Inlet Risk Assessment Report and Related Subjects.

The Cook Inlet Regional Citizens Advisory Council (CIRCAC) engaged Captain J. T. Dickson to examine, comment and compare certain aspects of the operations currently functioning within their area of responsibility. The scope of work of the project includes but is not limited to examination of the following:

1. Contingency Plans
2. Vessel Traffic Management
3. Pilotage and Ship Handling
4. Risk Assessment Report, November 1990
5. Vessel/ Terminal Operating Parameters
6. Moorings and Fendering
7. Vessel Pre-arrival Information and Checks
8. Pollution Prevention Measures
9. Pollution Response Measures
10. Dirty Ballast Facilities
11. Communications
12. Weather Forecasting
13. Navigation Aids
14. Emergency Anchoring Procedures
15. Terminal Operations at the Ship/ Shore Interface
16. Environmental Monitoring

The emphasis of the study is to be directed at the Drift River offshore loading terminal and KPL dock at Nikiski, together with their associated tanker and barge traffic. Where possible, comparisons will be made with the Sullom Voe Oil Terminal and the harbor operations under the jurisdiction of the Shetland Islands Council, the Harbor Authority at Sullom Voe. Where valid comparisons cannot be made, comment will be subjective and based on the authors' experience and research.

Captain Dickson was assisted in this project by Captain James Anderson.

Captain J. T. Dickson

James T. Dickson, M.Sc, B.Sc. (Tech) has worked at Sullom Voe since 1980 as head of the oil pollution control and safety section. His duties are mainly concerned with the prevention and control of oil pollution safety of navigation, ship inspection and air surveillance operations. He is the Council's link with the oil industry and government and other related and interested groups 0on these matters. He sits on the environmental monitoring committee and the oil spill advisory committee connecting with the oversight group, the Sullom Voe Association. Prior to Sullom Voe, he worked for Chevron Petroleum both on and offshore as their Marine Supervisor and prior to that as a tanker officer at sea. He has published papers on his work and has delivered such at conferences and seminars.

Captain J. Anderson

James Anderson, Master Mariner, MNI, M. Inst. Pet., is a Marine Officer and Pilot with the Sullom Voe Harbor Authority since 1984 and was the Senior Deputy Director with that department for two years. He also operates a company which provides marine consultant and contract services which among other ventures, operates a refined product/ crude oil jetty. He is also retained as an advisor to a leading United Kingdom towage company.

Prior to 1984 his career was mainly seagoing and included extensive experience on crude oil and product tankers including seven years in command. He has also provided expertise in marine related litigation and has contributed to papers published on pollution and pilotage. The tanker cargo handling computer driven training simulator in Glasgow College of Nautical Studies was developed by James and a colleague.

In the course of the Cook Inlet study Captain Anderson visited the Cook Inlet area of Alaska from Sunday, 21st of July to Sunday 28th of July. During this period he visited the Port of Anchorage, Nikiski Oil Terminal, Chevron Oil Terminal and dock, Rig Tenders dock, Drift River Terminal, Christy Lee loading platform, the oil tank vessel *Sansinena II* and took passage on the tanker *Overseas Washington* from Nikiski to Homer. He also met with the following persons to obtain background information:

Captain R. Asaro	US Coast Guard, COTP Western Alaska
Captain G. Glenzer	Port Director, Anchorage
Captain J. Cunningham	Pilot, SW Alaska Pilots Association
Captain A. Joslin	Pilot, SW Alaska Pilots Association
Barry Eldridge	CISPRI
Bill Stillings	CISPRI
Master, *Banda Seahorse*	CISPRI
D. Gregor	Manager, Cook Inlet Pipe Line
Larry Duncanson	Supervisor, Cook Inlet Pipe Line
Bill Blessington	City of Anchorage
Jack Brown	City of Anchorage
Damon King	Environment Supervisor, Tesoro
Paul Samora	Tank Farm Coordinator, Tesoro
Gene Jackson	Operations Supervisor, Chevron, KPL
Peter Hellstrom	Mapco Alaska Petroleum
Steve Peterson	Crowley Maritime Corporation
Alex Sweeney	Crowley Maritime Corporation
Blain Elliot	Foss Maritime

William Madigan	Foss Maritime
R. B. Stiles	Diamond Christina Project
Captain O'Brian	Master, *Overseas Washington*
Captain Christiansen	Master, *Sansinena II*
Walt Parker	PWS RCAC, Consultant
Captain Stan Stanley	PWS RCAC, Maritime Specialist
Larry Smith	CIRCAC
Dr. D. Jones	CIRCAC
Cathy Godfrey	CIRCAC
Ken Castner	CIRCAC
Dan Winn	CIRCAC

Cook Inlet Risk Assessment

Prepared for the Cook Inlet Resource Organization

Contractor: PLG Inc., November 1990

This study was commissioned by the Cook Inlet Resource Organization (CIRO), now Cook Inlet Spill Prevention and Response, Inc., (CISPRI).

The scope of the work was as follows:

a. Assess the risk of oil spills into Cook Inlet from CIRO members' facilities.

b. Evaluate the existing capability of the CIRO resources to cope with such spills.

c. Identify action to minimize the risk of spills into the sea.

d. Recommend improvements to oil spill equipment list that would enhance the CISPRI response to oil spill incidents

It is a fairly typical document commissioned by the oil industry to answer the usual questions:

1. What is the maximum spill and the range of spill sizes we are able liable to face?
2. How often will they occur?
3. What equipment do we need to cover our exposure?

4. What are the minimum costs that need to be incurred?
5. How can such costs be allocated to members?
6.

How these figures are calculated and how they can be interpreted is a matter for a statistician. However, anyone can apply a “sanity check” to see how, in reality, the findings and recommendations stand up in the cool light of experience.

A. Spill Size/ Years between Spills:

This report gives the maximum, minimum and typical spill sizes together with frequency between spills as follows:

1. Collision between tanker and another vessel. 51,000 bls. max/ <25 min/ 17,000 typical, with a frequency of 170 years between spills.

2. Collision between tanker and jetty. 6,400 bls. max/ <25 min/ 200 typical, with a frequency of 128 years between spills. It is interesting to note that the report gives as a “mitigating” factor that the berthing is performed without the use of tugs.

3. Grounding of tanker. 46,000 bls. max/ 0 min/ 7,000 typical, with a frequency of 50 years between spills.

4. Fire, explosion or structural failure to/ of tanker. 46,000 bls. max/ 0 min/ 23,000 typical, with frequency of 170 years.

Another report which covers Cook Inlet was that commissioned by the Alaska Oil Spill Commission from Engineering Computer Optecnomics, Inc. (ECO) and was published in December, 1989. Table 11-4 on page 11-52 gives a spill of between 7 and 24,000 barrels every 2.2 years, a spill of between 24,000 and 215,000 barrels every 24 years and between 7 and 215,000 barrels every 2.0 years.

Who is giving the more accurate figure? Perhaps one test might be to compare with what has actually happened in Cook Inlet. The ECO report states that over a ten year period there were 19 known tanker induced oil spills in Cook Inlet. The spill sizes were between 1 and 220,000 gallons (5238 barrels) with the majority being less than 300 gallons. The two largest spills were 207,000 gallons and 220,000 gallons (4928 and 5238 barrels). Both were from tankers which grounded and had a local pilot on board. However, it is believed the presence of the pilots did not contribute to the incidents.

The report of the Alaska Oil Spill Commission goes on to make the very telling point that someone born and living in Cook Inlet in 1977 who survives into 2060 could be expected to endure 4 large oil spills. The beaches would be contaminated with oil for much of their lifetime. This clearly brings into prospective what these statistics are trying to tell the reader. On the other hand, this resident could be “lucky” and experience none.

The figures for the Port of Sullom Voe show that one spill of 7,700 barrels in 1978 which was caused by a tanker collision with the jetty. The next largest spill was 600 barrels in 1985 which was caused by a cargo overflow while loading crude oil. Overall, since 1981 Sullom Voe has experienced 286 incidents in 6430 tanker arrivals at the terminal. It must be stressed that, at Sullom Voe, the reporting of any spill is 100% and the vast majority are mainly sheens of oil where the quantity is very small indeed. The number of spills in excess of one long ton is 27, which gives a mean incidence rate (spill per port call) of 0.0042.

The detailed figures for spillages of crude oil at Sullom Voe are:

27 spills greater than 1 ton, of which	
14 were in the range	1 to 5 tons
4	5 to 10 tons
2	10 to 20 tons
5	20 to 50 tons
2	more than 50 tons, greatest being 90 tons.

The biggest and only significant spillage of fuel oil was 1100 tons. This resulted from a tanker collision with the jetty.

The spill rate per port call for the ECO and PLG reports compared with Sullom Voe are as follows:

PLG, spills between 1/ 7140 tons,	0.0003
ECO, spills between 1/3333 tons,	0.0026
Sullom Voe, spills > 1 ton,	0.0042

Therefore, it is the writers' opinion that the figures expressed in the PLG report are too optimistic and actual spill incidence rates are more common than that published. It could be the case that this has been caused by the report not giving cumulative figures, rather a figure is given for each of the "lead' installations as they are described. If this is the case then it is a major failure of the report not to give the overall spill figures for all the installations of the CISPRI members

The range of spill sizes given in the PLG report is reasonable considering the size of tankers used to carry oil to and from Cook Inlet. When asked how big a spill could be, it is rather like the question, “How long is a bit of string?” If an accident occurs it is only a matter of luck as to how much oil is spilled. The discharge of Oil will depend on where the hull is punctured, over how long a length, and whether the tear is in a cargo tank(s) or ballast tank(s), etc., etc.

B. Containment and Clean-Up Equipment:

It is important to recognize that the very real difficulties facing the oil spill team in Cook Inlet.

a. Tidal Range. Varying from 14.3 feet at Port Chatham to 29 feet at Anchorage.

b. Tidal Current. 2/3 knots at the entrance to Cook Inlet, which increases with distance up the inlet to 5 knots or more near the East and West Foreland. It is thought that 8 knots or more can be experienced during spring tides in this area.

c. Wind. Mainly south westerly during the summer and north easterly in the winter.

d. Ice. Ice is most severe north of the Forelands. Tidal action and current keep the ice in a shattered condition. Nikiski lies in an area that, in the main, is kept free of ice by the prevailing north easterly wind. However, if this wind direction is not present then it too can have ice causing problems to ship movements and to ships working alongside. Close pack ice can be found as far south as Kalgin Island with open to pack ice as far as Kamishak Bay.

e. Floating Debris. Logs and debris are common throughout Cook Inlet and present a problem to booms, skimmers and small craft assisting with oil spill operations.

In the Nikiski area, the average tidal current is approximately 3.8 knots on the flood and 2.6 knots on the ebb, with extreme currents of 6/7 knots. The tidal range is about 20.7 feet at springs. Waves of between 4/ 12 feet can be experienced with between 10/12 fee occurring about 3 times per year. Ice is a problem especially during January and February and more son on the flood than the ebb.

The Spread of Spilled Oil:

With the above natural forces it is quite clear to anyone that the extent of any spilled oil will very quickly overcome the capability of the existing CISPRI equipment to contain and recover the oil. Worldwide experience of large oil spills in open sea conditions has shown that no one has ever recovered more than 10% of the oil spilled and 5% is a typical figure of what is achievable. This fact is caused by the laws of physics which dictate that booms can not hold oil in more than 20 knots of wind or a perpendicular current of 0.7 knot. Wave heights more than 6 feet will drive oil over the larges of ocean booms and render skimmers ineffective. Even in 2 ft. waves skimmers can be less than 50% effective, assuming they are placed in an area of thick non-viscous oil. The recovery figures quoted by manufacturers relate to test tank conditions when a continuing supply of fresh oil is fed into the tank under ideal conditions. In real life, these conditions never exist in open sea recovery conditions.

The basic technology of oil spill containment and recovery has not changed in the last 10 years and whereas the *Exxon Valdez* incident has spurred research, no great improvements are expected. Increases in the effectiveness on large offshore spills are only expected with the use of larger equipment sizes and faster deployment in an emergency. It is therefore important not to restrict reaction to containment alone because for large periods of time they may be impossible to deploy. The person in charge needs to have many strings to his/her bow. No two oil spills are alike; each has to be tacked in a different way. The tools required are as follows:

1. Aerial application of dispersants, where and when allowed.
2. Use of aircraft to observe movement of oil and direct surface craft.
3. Corporate membership of equipment pools of international significance, e.g. SERVS base, PIRO scheme.

4. Standing contracts to all up large numbers of manpower, barges, living accommodations, surface craft and communications equipment.

5. Containment and recovery by means of ocean boom, weir skimmers and large capacity barges.

6. Use of local craft and manpower who have had previous training in oil spill clean-up operations, e.g. fishing fleet.

1. Dispersants:

These chemicals are sprayed on to the oil to break up the oil into small droplets which can sink and disperse into the water column. The use of dispersants is controversial in certain countries, as in the past, these chemicals were more toxic than the oil itself. This is no longer the case and each dispersant which is approved for use at sea has to pass tests that show it meets the requirements of the regulatory authority.

Dispersants are most effective for oil viscosities of less than 2000 cst and ineffective above 10,000 cst. In general terms that gives the on-scene commander about three days to use dispersants as after that period the viscosity will be too great. In severe wind/ sea conditions the formation of water-in-oil emulsions can be very rapid, in as little as 4 hours under certain conditions. Viscosity will then be too high for effective application of dispersants.

Why use dispersants at all? The major reason is to prevent oil from reaching shallow water and stranding on the shoreline. It is thus a delicate balancing act to determine which has the greater overall environmental impact, oil on the land or dispersed oil in the water column. When dispersed, oil in the first few meters under the surface will affect organisms living in that area, but the dilution thereafter is fairly rapid. Thus dispersants are not generally used in shallow waters less than 20 meters deep.

When applying these chemicals, speed is of the essence as they work most effectively on fresh oil. Due to the rapid spread of spilled oil by means of gravity, current and wind, the most effective method of application is the use of aircraft. An aircraft such as a Hercules C-130, fitted with an ADDS pack (airborne dispersant delivery system) can deliver, at full load, approximately 5,000 gallons of dispersant concentrate. Other types of aircraft can be used if they are fitted with spraying equipment. Underslung spray pods for helicopters are also available. These can be used in pairs such that one is being refilled while the other is in use over the scene of the spill. The helicopters can thus be used to full advantage. Application from a boat is also commonly used but it is slow and not time efficient when you consider the three day time bar after which the chemicals are likely to be ineffective.

The effectiveness of dispersants when used with fresh oil is often the question of hot debate among the experts. In 1979 the American Petroleum Institute carried out field trials and the results indicated an effectiveness of between 60 to 78% of the slick being dispersed in the sea. There are opposing views on how this success was calculated, but in the writer's opinion, when compared with Sullom Voe experience, thee figures are reasonable. When the correct dispersant is correctly used on fresh crude oil, the dispersal is almost total. This is true because North Sea crude is very amenable to dispersion and tests have been done to choose the most effective chemical (Enersperse 1583). Research is no continuing into dispersants for use with high viscosities and their use in fresh water. Up to now there is no dispersant that is effective in waters other than salt.

The National Research Council has approved the use of dispersants and recommends they be considered a potential first response option. They are one of the few counter measure that can be applied quickly over a large area.

Work has been done to pre-plan the use of dispersants in Cook Inlet, but whether pre-approval has been obtained is unknown at the time of writing the draft report.

In January 1991 the Alaska Regional Response Dispersant Working Group published a useful document entitled "Oil Dispersant Guidelines for Alaska." This contains useful information and advice and gives details on the effectiveness and toxicity of dispersants.

The dispersant use criteria classify the coastal waters into three use zones. In all cases, the use of these chemicals will be based on the determination that the impact of dispersant or dispersed oil will be less harmful than the non-dispersed oil. The three zones are defined by physical parameters such as bathymetry and surface currents, biological parameters such as fish and wildlife, human use activities and lastly, the time required to respond.

Zone 1 is an area where dispersants can be used where a standing agreement is in force and further consent is not required before use. However, the required authorities should be notified as soon as practicable after spraying has commenced.

These areas are characterized by water conditions that will allow dispersed oil to be rapidly diluted to low concentrations and are far enough away from sensitive resources that dispersant operations are not likely to cause problems. In a Zone 1 area there is likelihood that spilled oil will impact sensitive resources and so an immediate response is required.

Zone 2 is an area where the use of dispersants is conditional and prior consultation is required before spraying is commenced. Such zones are again in deep water but far enough away from sensitive areas that immediate response is not necessary.

Zone 3 is an area where the use of dispersants is not recommended, but there is still the possibility to use them if, on balance, the impact will be less than that of the spilled oil. Again, consultation with EPA and the State of Alaska will be vital before any operations are commenced.

Specific Guidelines for the Use of Dispersants

Cook Inlet

Because of the presence of large numbers of commercially valuable adult salmon, that section of Cook Inlet north of a line drawn along the latitude at Anchor Point north of Kachemak Bay is considered to be Zone 3 during the period from July 1 to August 15. The general rationale is presented below and i8llustrated in Figures 4 and 5.

A. Upper Cook Inlet (North of Point Possession and North Foreland) (See Figure 4.)

Upper Cook Inlet is unique because the extreme upper portion contains two Zone 3 designations (dispersant use not recommended) which are based upon tidal stages. During the first three hours of an ebb tide, the Zone 3 boundary is roughly defined by the five-fathom isobath. For period outside this time window, Zone 3 is defined as the area north of a line between Point Possession and North Foreland.

* The high spill potential;
* The difficulty in mechanically containing spill;
* The extreme tidal fluctuations which rapidly transport spilled oil; and
* Sensitive coastal habitats requiring protection from potential oil contamination.

1. Zone 3 – Ebb Tide

The Ebb Tide Zone 3, <u>which exists only during the first 3 hours of an ebb tide</u>, occurs shoreward of the five-fathom isobath. This shallower isobath is used because: 1) the ebb tide will rapidly transport the dispersed oil to deeper waters; 2) benthic communities in Upper Cook Inlet exhibit relatively low productivity; and 3) increased water depths from the high tide stage will enhance dilution capabilities.

2. Zone 1 – Ebb Tide

The Ebb Tide Zone 1, which exists only during the first 3 hours of an ebb tide, extends outward from the five-fathom isobath. Dispersant use is restricted to an ebb tide period to prevent high concentrations of dispersed oil from being transported to shallow near shore waters.

3. Zone 3 – Flood Tide

The Flood Tide Zone 3 is defined as the area north of a line extending from Point Possession to the North Forelands, for all period outside of the first three hours of an ebb tide. This designation is necessary due to the potential for strong tidal currents to rapidly transport high concentrations of dispersed oil in to important shoreline habitats.

B. Middle Cook Inlet – South of a Line Between Point Possession and North Foreland to East Foreland and West Foreland. (See Figures 4 and 5.)

1. Zone 3

Zone 3 occurs inshore of the five-fathom isobath near the northeast shoreline of this section. The five-fathom isobath is used in this area due to a lack of fish and wildlife resources and the presence of strong currents that run parallel to the shoreline. The Zone 3 designation extends out to the 10-fathom isobath along the southeast shoreline to provide protection to the Swanson River estuary area. Along the west shoreline, the Zone 3 boundary follows the 10-fathom isobath.

2. Zone 1

The remaining waters within this Inlet section are designated as Zone 1. This designation will allow for an immediate dispersant use decision to protect important fish and wildlife resources in Cook Inlet.

C. Lower Cook Inlet – South of East and West Forelands. (See Figure 5.)

1. Zone 3

Zone 3 occurs inshore of the 10-fathom isobath. The 10-fathom isobath provides ample protection to the razor clam beaches and several river estuaries along the east and west shorelines, including Redoubt Bay where large numbers of birds seasonally reside. Around Kalgin Island, a Zone 3 designation is established along the five-fathom isobath. Kachemak and Kamishak Bays are given special protection through an expanded Zone area due to the important fishery resources associated with these bays. The shoreline in the extreme southern portions of Cook Inlet drops off rapidly resulting in the 10-fathom isobath being located very near the shoreline. Consequently, Zone 3 is defined as an area extending one mile out from the shoreline for areas exhibiting such shoreline characteristics. The one-mile buffer distance will allow for dilution of dispersed oil prior to impacting the shoreline or shallow-water areas.

2. Zone 1

Zone 1 is identified as an approximately five-mile wide buffer area extending outside Zone 3. It is believed that the five-mile wide Zone 1 area will provide adequate time to conduct a dispersant response prior to oil entering the sensitive Zone 3 area.

3. Zone 2

The remaining waters within this section of Cook Inlet are designated as Zone 2.

The PLG Report makes very little mention of spraying and this is an omission. It is recommended that access to at least one ADDS pack is guaranteed. In addition, 4 helicopter underslung units should be purchased and stored at the airport for use by helicopters fitted with underslung equipment. The writer is advised that a Hercules C-130 can land at Kenai Airport. Such aircraft normally requires 1722 yards of runway and can carry 4,600 gallons of dispersant.

A stock pile of approximately 25,000 (approximately 5 ADDS loads) gallons of dispersant should be based at the airport to refill such ADDS pack and the helicopter underslung spray units.

2. Booms for use in Open Sea Conditions:

There are many types of oil barrier available on the market today, such as floating booms, netting systems, absorbent booms, bubble barriers and even oil herder chemicals. However, the vast majority of oil containment booms in use throughout the world today consist of the following features:

a. Freeboard (height above water surface) to prevent or reduce oil splashing over due to wave and/ or wind action.

b. Skirt to prevent or reduce escape of oil under the boom.

c. Buoyancy provided by air or some other material.

d. Longitudinal tension member, chain or wire, to withstand the effects of wind, wave and current.

Booms can then be subdivided in to two types, curtain and fence. Curtain booms, as their name implies, have a continuous skirt under the water surface which is supported by a buoyant upper flotation chamber. This chamber is normally filled with air but can be a solid material, e.g. plastic foam. Fence booms are a vertical barrier held I place by solid flotation members and ballasted at the bottom by weights spaced at regular intervals.

Curtain booms have better wave following characteristics and better oil escape velocities than fence booms, which are normally used in calm waters and where tidal current is low.

Forces Exerted on Booms

Environmental forces on booms can be very large indeed and it is important to estimate these before deciding on oil containment operation and choice of assisting craft.

1. Current

Force (kgs) = 26 x subsurface area (sq. mi.) x velocity of current (knots) squared.

Ex: A 300 m. section of boom with a skirt 1 m. deep placed at right angles to a current of .75 knot.

F = 26 x 300 x 0.75 x 0.75 = 4388 kgs.

Note: If the speed of current or tow rate doubles then the force increases four fold due to square of the velocity.

2. Wind Force

F=26 x area above water linex (wind speed/40) squared.

Ex: As above, in 30 knots average wind speed, 1 m. high freeboard.

F = 26 x 300 x (30/40) x (30/40) = 4388 kgs.

These are the maximum forces that could be expected, as in reality, booms curve under external force an thus the exposed area at right angles to the wind/ current is reduced.

As stated earlier in this report booms will not hold oil when:

a. The wind speed is gusting in excess of 20 knots.
b. The wave heights are in excess of 6 feet.
c. The current, at right angles to the boom, exceeds 0.7 knot.

Deployment of these booms can be done in two basic ways. The first, which is designed for rapid deployment, is a continuous upper chamber into which air is pumped while being the boom is pulled off its storage reel. The danger with this type is the probable loss of the boom if the air chamber is punctured by debris or a surface support craft. The design of he second type has the air chamber in sections, usually about 10 feet long, and these are inflated by the insertion of an air lance as the boom is deployed. The loss of one or more of these sections is not critical to the survival of the boom but it is slower to deploy. Another important consideration is the strength of the fabric to withstand rough handling, puncture by floating debris and minimize deterioration while in storage. Booms of all sizes wee used in the *Exxon Valdez* incident, but it is interesting to note that the men on scene considered that booms in the 32 to 42 inch range were just as good at retaining oil as their larger brothers.

In general, booms for use in the open sea will have a draught (depth under the water) of approximately 40 inches and a freeboard of 24 inches. Special powered reels can hold the deflated boom in lengths of between 650 feet and 1000 feet. The quoted inflation time for a sectioned air chamber boom is given at 25 feet per minute using two men. Booms for use in more sheltered waters have a draught of about 28 inches and a freeboard of 20 inches. Those for harbor use are 22 inches draught by 14 inches freeboard.

The Port of Sullom Voe has the following booms in its list of oil spill containment and recovery equipment:

a. Ocean Boom, 8 units, total length 7,550 feet.
b. Bay Boom, 10 units total length 11,420 feet.
c. Self-contained fast boom layer, boom length 1,150 feet.
d. Vikoma seapack, boom length 1,500 feet.

Total length of boom 21,620 feet.

In terms of future development, there is little that can be done to enhance the oil retaining capability of booms. The laws o f physics are a barrier to design, but some advances can be made with speed of inflation/ deployment and in the development of new boom materials that are stronger but yet lightweight.

In Cook Inlet the spread of oil will be very rapid and thus it is reasonable to suggest that the boom will have to be transported to the area of spilled oil. It would be impracticable to tow an inflated boom over a large distance due to the forces described previously and the danger of damage due to floating debris or ice. The use of an offshore rig supply ship is certainly a good transportation system but this should be backed up with booms, housed no powered reels, mounted on an oil recovery barge. Such barge can act as a command center and act as the major collection point or skimmed oil. The PLG report advocates the use of a 60,000 barrel barge and this is to be supported. However, it would be better to have two 30,000 barrel barges as this gives more flexibility and redundancy in the event of non-availability of one unit. Each barge would require conversion to act as described above. In this way will the barges be put to full use. It is recommended that each barge be equipped as follows:

1. Storage capacity for 30,000 barrels recovered fluids.
2. On board system to inject demulsifier chemicals into the storage tanks ni order to break water in oil emulsions and so allow water to be decanted back to sea. The use of steam heating coils in the tanks should also be considered.
3. A minimum of 3 reels, each 1000 feet, of Bay size boom, together with power packs to drive reels and air blowers.
4. A minimum of three weir skimmer sections which can be inserted in the booms required in 3. See section on oil skimmers.
5. A minimum of two Transrec 250 skimmers.
6. Accommodations and basic sleeping accommodations for approximately 20 men, two 12 hour shifts.
7. VHF and satellite radio room with FAX/ Telex facility.
8. Each barge to be attended by its own tug so it can be moved to encounter and recover the thickest oil.

In the PLG report the boom recommendations are as follows:

1. CIRO Resource Group 1. Response vessel to be equipped with 3,000 feet of boom, 1,500 feet of Roulands Bay boom and 1,500 feet of Expandi 4300 boom.

The booms should all be Roulands Bay boom, or similar sized boom of robust construction. Expandi boom, in the writers' opinion, is not suitable for Cook Inlet sea conditions/ ice/ debris/ potential rough handling. Also it is not good practice to mix booms on a vessel if it is unnecessary.

2. CIRO Resource Group 1A. Work boat fitted with 1,000 feet of Expandi 4300.

Again, this should be a powered reel containing 1,000 feet of Roulands Bay Boom. Ocean boom would be too large to handle.

3. CIRO Resource Group 2. Two work boats, 40 feet each, to carry 500 feet of containment boom of approximately 18 inches overall depth.

Roulands Harbor boom is robust, designed for calm water use and 525 feet can be housed on a reel 6 feet by 5 feet, weight 1.5 tons.

4. CIRO Resource Group 3. 1,500 feet of Expandi 4300 boom/ Kepner Reel boom to be deployed from/ near dock to contain or deflect.

Recommend use of Roulands Bay boom.

5. CIRO Resource Group 4. A barge with 1,500 feet of Roulands Bay boom plus 1,500 feet of Expandi 4300 boom.

This recommendation requires substantial reconsideration. The writer would suggest a minimum of 5 reels, each 1,000 feet of Roulands Bay boom would be more appropriate.

6. CIRO Resource Group 6. 10,000 feet of Tide boom, 10 inches minimum freeboard. 2,500 feet of 3M fireboom.

Fireboom should be held as one response capability, if circumstances so allow. Tide boom, it is assumed, is a three compartment, clover leaf design, of which the bottom leaves are water filled and the top chamber air filled. This arrangement acts as a seal against the beach which dries out at low tide. It works quite well as long as there are no under-cut channels in the mud/ sand areas such that the oil will flow under the boom where it spans such a gap. This boom, used correctly, would be a welcome addition to the stockpile of equipment.

3. Oil Skimmers:

The basic design types are as follows:

a. Disk skimmers consist of a number of rotating discs normally made of plastic or aluminum, on to which oil adheres. This oil is then scraped off as the disc enters the body of the skimmer and the oil falls into a pump suction. The pump then transfers the oil to a holding tank. They can operate in moderate sea conditions, but work best on fresh oil. Once the oil forms a mousse or is in excess of 2000 cst viscosity, then disc skimmers should not be used.

Pluses: Good on fresh oil.

Minuses: Oil must flow between the discs in order to be recovered. As viscosity increases with time the disc speed has to be reduced in order to pull the oil inwards. Easily clogged with debris. Use limited to a matter of days after the initial spill, 7 at most.

b. There are four different types of weir skimmer. The simplest consists of the lip of the weir just below the surface of the water allowing the top inch or so to fall into the transfer pump section. The next type allows the recovered fluid to fall into a hopper where it is moved using an Archimedes screw or auger type of pump. The vortex weir type uses paddles to concentrate the oil and then it falls over the weir. The last type is the combination weir/ boom skimmer here one or more weir units are built into a length of oil recovery boom. Weir skimmers tend to have high capacity storage available to match their recovery rates. Otherwise skimming operations will quickly come to a halt due to lack of tankage.

Pluses: Can take very large quantities of fresh oil as long as sufficient oil can be fed to the skimmer by the boom and there is sufficient storage to take the recovered fluid.

Minuses: With viscous oil, units without auger type pumps and debris cutters on the intake quickly become clogged with rubbish. High pressure water jets may have to be employed to push large debris items to one side and force very heavy oil/

c. Suction Skimmers consist of a head which is suspended just beneath the water level and a recovery hose is led to a vacuum pump.

Pluses: Truck mounted units very useful hen road access to a recovery site is available. These have also been mounted on barges with some success.

Minuses: Debris will quickly clog up the intake unless very large hoses (and thus pipes) are used. Six or 8 inch hoses preferred.

d. Belt skimmers consist of a moving conveyor type belt which lifts the oil from the surface up and over a scraper which takes of the oil. The recovered oil is led into holding tanks. The moving belt can be made of materials on to which oil will adhere in preference to water or simply rubber with horizontal metal bands which scoop up the oil. This latter type is used with fuel oils, mousse or other high viscosity fluids.

Pluses: One of the most effective skimmers with heavy oil and mousse. The units with integral holding tanks should be able to allow the recovered water to be run back to sea. The addition of emulsion break chemicals will hasten this process.

Minuses: None worth mentioning. Not designed to work in waves/ swell more than 2/ 3 feet.

e. Rope Mop skimmers consist of polypropylene fiber ropes on to which oil will adhere in preference to water. The ropes pass through metal rollers which squeeze out the oil which is then led to tanks. A special design of these rope skimmers is called the zero velocity skimmer. in which the ropes are passed along between the hulls of a catamaran hull at the same speed as the craft is moving forward. The ropes thus lie effectively motionless in the water and so maximize the adhesion of the oil to the rope. These craft require small booms on either side of the bow to concentrate the spilled oil and direct it to the rope system.

Pluses: Designed to recover heavy oil/ mousse, can pull out oil between floating debris.

Minuses: Slow, if the wringer unit is mounted too high above the water line then oil will run down the ropes. Steam injection on the wringers is required to soften the most viscous oil and keep it liquid to assist pumping to the storage tanks. Some users prefer 6 inch rather than 9 inch ropes as they are stated to hold the thicker oil/ mousse better.

f. Brush skimmers area fairly new development but are basically belt skimmers in concept. The brush is a rotating drum on to which is attached a layer of bristles. The drum rotates down into the water and the bristles hold the oil and the water pressure pushes the oil up into and between the fibers. The drum then passes a scraper removing the oil, which then falls into tankage.

Pluses: Work well in thin oil, less affected by waves.

Minuses: Debris will stop the flow of oil to the brushes. Little practical experience as yet.

Each of the above will have their uses and, as oil will increase in viscosity with time, different skimmers will be called into play. The transrec skimmer system (350, 250 and 100) made in Norway by Frank Mohn, has a skimmer head which can be exchanged for weir, disc skimmer or rope mop depending on oil lay thickness and viscosity. This is a very adaptable piece of equipment but requires mounting on a substantial barge or having a tank vessel available to hold its recovered oil.

Temporary storage of the skimmed oil/ mousse is an important consideration for the logistics staff. Most of the bladders or dracones tend to be of the disposable type. Once filled it is all but impossible to pump them out. The detachable pumps on the Desmi skimmers offer the best chance to pump out such units, but it is a very slow operation. The danger of hydrocarbon gas build up should not be ignored. These rubber tanks will tend to concentrate the gas and this should be expelled by ventilation before pumping is commenced.

The PLG report quite correctly describes the quick drop in efficiency with time due to the increase in viscosity of the oil on the surface of the sea. After 3 days the skimmer is probably only capable of recovering 20% of its rated capacity. Bad weather and lack of daylight also hinder oil containment which is required to keep a supply of oil coming towards the skimmer. This is why the Alaska Department of Environmental Conservation uses the rule of thumb of 30% capacity for three 12 hour periods during the first 72 hours. Oil in water emulsions have 4 parts water to one part oil and so a spill of 5,000 barrels of oil can become 25,000 barrels of mousse (excluding evaporation) should the conditions be such that water and oil are mixed, i.e. bad weather at sea. All these points should be considered when making the choice of skimmers to be included int the equipment list.

The equipment recommended in the PLG report is as follows:

1. CIRO Resource Group 1. Two, Destroil Desmi-250.

These are weir type skimmers with a screw pump to transfer the oil into storage. The Desmi pump is very good indeed and enjoys a good reputation. The skimmer head can have problems in following wave motion but is as good as any in this respect. All things considered, this recommendation is to be supported. The pump used in the 250 is the same as the off loading pump, but the larger power pack must be acquired if it is desired to use the pump as a salvage pump at its maximum capacity of 440 USGPM. This power pack is 47 KW rather than the small KW unit normally supplied with the Desmi 250 skimmer.

However, the writer further recommends that a weir section be obtained to fit into the Roulands Bay boom which is recommended for the response craft. This weir section is inserted into the boom and forms an integral part of the boom. The skimmed oil is then led back to the deploying vessel. This makes the recovery task that much easier in that the skimmer and boom are all in one unit, making it easier to maneuver when catching an recovering oil.

The PLG report also recommends a 4,000 gallons floating container for recovered oil. Recently, Unitor of Norway has introduced an oil recover bag which can hold large quantities of oil yet can be stored in a relatively small container. This bag system is new and untried but it is worth investigating. See Appendix A.

The writer cannot find in the PLG report what is to happen to the recovered oil. Clearly, skimmed oil and mousse needs to be discharged so that vessels can continue skimming operations. It is recommended that this oil should be pumped ashore at the crude oil discharge dock of KPL for storage into tankage at the Tesoro refinery. Special arrangements will have to be made to allow the recovery craft to couple up to the pipeline and also to boost the discharge pressure such that the oil moves the approximately ¾ mile to the shore tanks.

2. CIRO Group 1A. One Destroil 250 skimmer. 4,000 gallon container or bladder.

This skimmer design is acceptable. Suggest use of oil bag rather than bladder.

3. CIRO Resource Group 2. One Desmi 250 skimmer, one Walosep W4 weir skimmer.

The Desmi is acceptable. The writer is unable to find in the PLG the reason why certain specific types of equipment have been recommended to the client. The Walosep is a variation on the weir design called a vortex skimmer and little is known about their track record in large spills. A better alternative would be the inclusion of a Roulands weir skimmer section for the Bay boom already on the craft and the provision for a Unitor oil bag to hold the recovered oil once the on board tanks have been filled.

4. CIRO Resource Group 4. One Transrec 250.

This skimmer has a capacity of 250 cubic meters per hour whereas the larger 350 is quoted at 350 cm/ hr and uses 6 inch hoses rather than 5 inch/. There is little to be gained going for the larger unit and so the choice of the 250 unit is to be recommended. However, two such units should be fitted rather than one. Both of the units should be fixed to the barge in such a manner that they can be lifted off and used on a vessel of opportunity in addition to working from the barge.

5. CIRO Resource Group 5. One lightening system for pumping out recovered oil from skimming craft and tanks.

The writer is unable to find out the pump design used by the system. The recovered oil will be very viscous, mixed with debris and experience has shown the best pump type is the screw design. Also note that the pump on the Desmi 250 skimmer is detachable such that it can be used as a lightening pump. Its capacity (440 USGPM with the large power pack) is less than the APTS but is purpose designed to shift thick viscous mousse. It has been used in real spills with good results. It is thus recommended that this be acquired as it can fulfill a dual role, discharge pump and spare unit for the Desmi skimmers.

Other Recommended Equipment

a. Orion 2100 tracking equipment. This is a VHF transmitting buoy which is tracked with a portable direction finding VHF radio receiver. I can also be fitted into a helicopter. This is no substitute for the mark one eye ball. These buoys, with time, move out of phase with the oil and become inaccurate. They can however, in ice free conditions, give a general indication of direction. Their detection range from a surface craft can e quite limited, often less than 12 miles. This is better with height, i.e. an aircraft and if used then it is recommended that a contract helicopter have the antennae fitted such that the VHF radio can be quickly fitted up. There are now on the marked VHF DF (Direction Finding) sets for use in aircraft and all that is required would be to have their radio frequency installed or made available to this new receiver. The tracking of spilled oil is a vital part of oil spill containment and clean-up. CISPRI should have standing agreements wit fixed wing and helicopter operators such that aircraft can be obtained with the minimum of delay. There need not be any special equipment fitted to the aircraft other than a VHF DF receiver for the buoy tracking aircraft and under slung gear for the helicopters. A trained observer should fly with the pilot to gather information and pass on, via a marine band VHF radio, to the on-scene commander. The observer should carry an S-VHS camcorder to record important events such that he tapes can be shown at the planning meetings. One picture is often worth more than 1000pwords. The aircraft should be flown last thing at night and also at first light such that surface craft are kept informed of the movement of the spilled oil.

Contacts with Other Response Organizations

In the event of a major incident, equipment and perhaps more importantly, trained man power will be required to mount a large oil spill clean-up operation. Probably most attention will be turned towards Alyeska, whose resources are renowned world wide It is recommended that CISPRI investigate the possibility of entering into a contractual agreement with Alyeska where, in return for an annual fee, CISPRI can call upon equipment and supervisory staff. Clearly such a call on resources will be set at a maximum level such that the TAPS operations are not compromised.

Such arrangements already exist within the oil industry, the most well known is the Southampton Oil Spill Service Center where 12 oil majors have formed a service company that has sufficient oil spill equipment to cover two simultaneous spills each of 30,000 tons. This equipment is sent world wide and where necessary, the center sends its skilled staff to supervise operation of the equipment. Another example is the United Kingdom Offshore Operators Association who acts on behalf of all the oil companies with interests in the North Sea. They have stock piles of oil spill equipment along the coast line of Great Britain which can be called on by any member dealing with an oil spill.

Marine Spill Response Corporation is establishing oil spill response depots around the US coast and the American oil industry is setting up the Petroleum Industry Response Organization which will also have stock piles of oil spill clean-up equipment at strategic locations along the US coastline. It is understood that Alaska will not be one of the stock pile locations, presumably because the bulk of the oil moved is of TAPS origin and Alyeska has sufficient equipment already in place in Valdez. However, CISPRI must establish contact with the managements of these stock piles planned for Settle and other locations, and pre-plan the logistics of moving the equipment to Cook Inlet. Equipment should be pre-slung on pallets/ containers for direct loading on heavy transport aircraft such as the Hercules C-130, with heavier items containerized for quick loading on to platform supply craft or similar vessels of opportunity.

Manpower and Accommodations

Having sufficient equipment is only half the battle; manpower is equally important. It is no use having the equipment sitting on the beach if there is no staff to deploy and operate it. Trained supervisors are vital; they can lead teams of relatively unskilled labor picked up from the local population. If labor has to be imported into the area to cope with large spillage, lack of accommodations can be a major restraint on the ability to respond with sufficient manpower.

For the supply of additional skilled supervisors standing agreements should be in place with local and US wide clean-up contractors: Alaska Clean Seas, Alyeska, PIRO (when established), Southampton Oil Spill Service Center, US Coast Guard and other sources of expertise.

For the supply of unskilled labor, the local supply will quickly be exhausted, especially during the summer months. It is thus important to be able to draw from the lower 48 using the States’ employment organizations. Clean-up contractors should be able to assist in this work as they have to hire labor in these circumstances when a large operation is under way.

Contactors who can supply accommodations in the form of barges with living modules on deck and “flo-tels” (semi-submersible rigs fitted out to act as living accommodations for hook-up staff working offshore) should be pre-agreed with the regulatory authorities remembering that sewage discharge could be a problem if only partial treatment facilities are available on the unit. Arrangements for collection and disposal of garbage also need to be addressed.

No mention is made of tanker casualty management plans. This we consider to be an omission as they are required as part of the ship’s oil spill response plans. These plans should address, among other things, the most suitable location to place a damaged tanker or barge in terms of minimum current, minimum environmental impact, suitability of seabed for possible beaching and convenience of logistical support. There is a clear need for close cooperation with the USCG and CIRCAC on agreeing such management plans with reference to operations in Cook Inlet.

Section 3: Tesoro Alaska Oil Discharge Prevention and Contingency Plan

Volume One, March 1991

This contingency plan covers all aspects of the Tesoro operation in Alaska including shipping of crude, discharge, refining, storage, vessel/ barge loading of product and he management of a pipeline to Anchorage. The parts of the plan which the writer is competent to comment on are matters concerning shipping and dock side operations.

Section 1, Emergency Spill Response Plan:

Paragraph 1.1 would appear to cover a major incident such as a collision or explosion where a large quantity of oil has been released and crew members may have even injured or even killed. In such cases the safety of life is paramount and the Master's initial efforts will be directed towards that end. In these circumstances, the US Coast Guard will be his first contact point in order to request assistance and ensure the safety of his crew and tend to the injured. At this point the Master will advise the USCG that oil has been released and it is recommended that in the USCG emergency check list that there is an action to inform the Tesoro incident commander. It is assumed that the USCG will be aware that the vessel is on charter to Tesoro. The next probable action by the Master will be to contact his owners or managers and advise what has happened. They in turn will notify the P and I club, hull underwriters, cargo owners, classification society and probably the Salvage Association. After these contacts, the ship will inform the charterer (Tesoro incident commander) of the situation so it is unrealistic to expect that Tesoro will be the initial contact in these extreme circumstances and thus Tesoro management must ensure that they will be informed by the others detailed above. This is known as "closing the loop."

The check list correctly highlights the requirement to locate the source of the spill and take immediate steps to stop the flow of oil. This will probably require the transfer of oil into empty or slack tanks such that the hydrostatic differential between oil/ seawater is reduced to zero. Clearly, for this to succeed the ship must have sufficient empty space to take the transferred oil, if many tanks have been damaged then this will not bee completely effective. To overcome this lack of available space, Unitor of Norway has developed an oil bag which can be used to hold oil pumped from the manifolds. This bag is released into the sea with one end retained at the pump manifold. The bag can be purchased in sizes between 50 and 20,000 cubic meters and has been approved by DNV, the Norwegian classification society. The first units have been delivered to several European tankers. See Appendix A.

If there is oil on deck, a very rare occurrence while at sea, then it can be pumped to the slop tank and/ or absorbents can be used to soak up the oil.

What is not often realized by the general public is the ship's complete inability to contain and recover oil which has been lost into the sea. It is impossible for the crew of a large tank vessel to shoot booms or skimmers, the freeboard is too high, there are no assist craft to take the end of the boom, spilled oil is taken away from the ship by wind and tide, etc. Any action taken to contain the spilled oil must come from an agency other than the ship.

There would appear to be an omission in this section in that there is no subsection dealing with the discovery of oil at a jetty when a ship/ barge is alongside transferring oil. In such circumstances very clear guidelines need to be laid down or the ship's crew will assume the dock supervisor will report the spill or vice-versa. When sheens and/ or oil are found at the jetty head the source is not immediately obvious, although the odds are it is the ship that is at fault. However, the source could be leaks from the loading arms/ hoses, jetty sump overflow, vent valves partially open, etc., so it is better to have the following reporting system:

1. If first seen by the ship's staff then they should reporter it to the jetty operator who will then advise the senior duty officer at the Tesoro refinery.

2. If it is the jetty operator who first sees the oil, he/she should inform the ship and then the senior duty manager at the refinery.

3. The ship and jetty operator must then immediately investigate the spill and if it is not immediately obvious that the spill is of a very minor nature and has stopped, then cargo pumping must cease until the situation has been resolved to the satisfaction of he Tesoro incident commander. Where it is suspected that the ship has passing sea valves then it may be the case that only a diving inspection will resolve the source. This can only be done at slack water.

Section 2, Spill Response Scenarios:

Section 2.1 outlines a spillage of 50,000 barrels from a tanker off the KPL dock at Nikiski. To say the least, the spill has occurred in ideal weather conditions. The text states that the spilled oil has formed a slick “2-3 inches” thick and is under the influence of the tide. Oil, like everything else, is affected by gravity and will quickly spread to a thin, uniform layer approximately 0.04 inches deep. In 12 hours, given calm wind conditions, the spill will spread to approximately 40,000 acres (6 square miles) and in 24 hours it will cover approximately 60,000 acres (9 square miles). This is hastened by hot oil, on a warm sea, in summer air temperatures. Moderate to high winds will drive the oil to cover more sea area. The sea area polluted by oil will quickly spread to an area far in excess of what the proposed booming capacity can handle. The response craft skippers will be overwhelmed and they will only be able to deploy their equipment in what they perceive to be the thickest oil. This is very difficult unless they are receiving guidance from the air where a trained observer ill be able to guide them to the thickest areas, ignoring the sheens. It will be vital to embark on a major aviation response in addition to the surface craft. Helicopters and even Hercules C-130 aircraft will be needed to spray dispersants in areas outside the scope of the booms. Other aircraft will need to supply a near constant supply of information to the surface craft and the incident commander.

The estimation of the quantity o recovered oil is unrealistically high, 37,000 barrels out of 50,000 barrels, 74%. Experience has shown that actual recovery rates are nearer 7.4%, 3,700 barrels, even under ideal conditions such as those in the scenario. The reason is the spread of oil to cover such a large area. The Independent Tanker Owners Pollution Federation advised that in such a catastrophic spillage as that described, 90% of the oil will be released in the first few hours of the disaster. Clearly, the response to this size of spillage will require more thought.

Section 3, Operation and Spill Prevention:

There can be no doubt that one ounce of prevention is better than on ton of cure, especially n hostile waters such as the Cook Inlet. Subsection 3.1A, correctly states that the ship master is ultimately responsible for the vessel being securely moored. This does not prevent the berth operator from insisting on minimum requirements for the number and type of ropes to be used forward and aft. The reason is that some masters have differing standards as to what can be considered safe. It is almost certain that the KPL dock operator will lay down minimum standards and these and any other requirements should form part of the charter party between the ship and Tesoro. Once a ship has been to the dock for the first time, the ship master and the dock operator should inspect the moorings such that a drawing can be made which shows the optimum mooring arrangement. The Oil Companies International Marine Forum issues guidelines on mooring principles and these should be consulted. The principle is concentrate on breasts and springs wherever possible.

Declaration of Inspection (DOI):

There is no information on what items are inspected and found to be in order before the certificate is signed. Also, there is no mention of paper work where all the agreed items are recorded for both parties to work to as the transfer takes place. It is recommended that a jetty regulations and information book be drawn up such that the variable items are printed on carbonless paper so that one copy can be torn off and given to the ship as record of the pre-transfer conference. It will also contain the items to be checked before the DOI certificate is signed. A copy of such a book is given in Appendix A of this report. This is the booklet used by BP at the Sullom Voe Oil Terminal and it is a good example of an “all in one” check list/ DOI and jetty information pack See Appendix B.

Watch and Shift Arrangement:

No particular merit is seen in having a new transfer conference every time there is a shift change ashore or a watch change on board. It is important that ship and shore have copies of the jetty information book in which is recorded all the required information. Clearly the ship and ashore staff must have an efficient scheme to correctly give all information to on-coming staff. One other recommendation is that tat hourly intervals, the jetty supervisor should board the vessel/ check the waters around ship for oil or sheens/ walk around the vessel checking moorings, hoses or arms, scupper plugs, etc., and if any faults are found the ship’s duty officer should be informed immediately.

As discharge commences and at approximately 4 hourly intervals thereafter, the jetty supervisor should satisfy himself that the quality of the inert gas is within the required specification, i.e. 4% from the engine room. He should check the oxygen content and pressure gauges in the control room and witness a random test of a tank being discharged. This should be less than 8% oxygen content. These checks will only apply to ships which are required by USCG regulations to be equipped with and use inert gas.

Cargo Transfer Procedures:

There is no mention of ballasting the ship. The following guidelines are recommended:

1. Ballasting the segregated ballast tanks should commence soon after cargo discharge has commenced. The principle being to keep the vessel as low as possible in the water to reduce wind loads on the moorings. Reasonable stern trim for draining is acceptable.

2. If dirty ballast has to be taken, i.e. sea water pumped to a dirty cargo tank, then this should not be commenced until the jetty supervisor boards and ensures that the ballast pump is run up before the sea suction valve is opened. He/ she should check that no oil escapes.

Personnel Training:

It has been mentioned elsewhere that the *Overseas Washington* carries an extra crew member in order, presumably, to reduce fatigue on the deck officers. It is not mentioned exactly who this extra crew member is, but it is assumed to be an extra navigating officer. This requirement of the charterer is fully supported as the prime reason for accidents is crew error brought on, more often than not, by fatigue. This is made worse by short voyages which can result in excessive hours. Officers in charge of cargo operations (12 hours per day) then take up 4 hourly navigation watches until the next port is reached when they again revert to 12 hours per day. When mooring and unmooring standby by all hands is added to these already excessive hours, it is little wonder that ship's crew become tired and attention to detail can lapse. The inclusion of an extra officer goes a long way to lessening such excessive hours and is relatively cheap compared with the ship hire charges plus cost of the cargo. It is to be recommended that other large tank vessels on time charter to Cook Inlet making short voyages should also consider the inclusion of an additional deck officer.

Section 4, Spill Detection:

A. Deck Watch on Tank Vessels While Alongside. Mention has already been made on spill detection while alongside. The best method is for the ship to advise the jetty supervisor if the crew sees the oil first. If the jetty sees the oil first then the ship should be advised. The jetty supervisor should then contact the Tesoro duty manager. Cargo should immediately be shut down unless it is obvious that the spill is very minor and is not from the ship. At night oil on the surface is very difficult to see, and both the jetty and on the ship lighting should be directed towards the surface of the sea so that ship and shore staff can check for oil. In high tidal areas if there are known points on the shore where spilled oil will collect, i.e. tidal eddies, these should be checked at regular intervals.

B. In Transit Spill Detection. It is most unusual for the ship’s crew to discover an oil sheen trailing astern. The ship’s wake will mask all but the largest discharge of oil. Even this will be impossible during the hours of darkness. The first reports of oil will come from passing aircraft or fishing vessels working astern of the tank vessel as she passes. The writer has personal experience with oil pollution surveillance flights and every time a sheen of oil has been seen astern and the ship advised, not once were they aware of the problem. It is recommended that scheduled and charter aircraft operators who regularly over fly Cook Inlet be requested to keep a look out for signs of oil on the surface of the sea. If anything is seen, then the pilot should request air traffic control to pass on the sighting to the USCG.

In the event that oil is being released into the sea, the source is almost certain to be passing valves in the pump room/ engine room, or, rarely, damage to the hull in the way of a full cargo or dirty ballast tank. In the event that, despite every effort by the crew, oil continues to escape from the ship, there is little alternative other than to find a sheltered anchorage for the ship. There she can be met by the Banda *Seahorse*, boomed off and temporary repairs commenced. Suitable locations for such work to be done must be identified in advance and approval obtained from the appropriate authorities. These locations are called “safe havens” and in the event of an emergency the USCG should direct the vessel to such a location.

Section 6, Radio Communications:

At every debriefing after a spill or a spill exercise, one problem which is always close to the top of the list is communications. It is the one factor that is always underestimated and log jams develop in logistics and the effectiveness of clean-up operations. To give the reader an idea of the radio communications used in the *Exxon Valdez* incident, the following is part of the equipment list published by Exxon:

1. VHF Systems

   a. 15 base stations
   b. 200 mobile stations
   c. 1150 hand held radios

2. UHF Systems

   a. 50 repeaters
   b. 600 mobile radios
   c. 2040 hand held radios

3. Satellite Systems

   a. 5 earth stations
   b. 15 Inmarsat terminals

Contact should be made with the Federal Communications Division to investigate what assistance can be had in an emergency to allocate frequencies for use during the response operations. The use of VHF channel 10 will be swamped within a matter of minutes of the oil spill incident.

Volume 4 of the CISRPI Technical Manual's "Logistics" has made a start on such considerations, but it is recommended that it be reviewed to consider the communication implications of a major incident.

Section 10, Vessel Information:

It is stated that the *Overseas Washington* is hydrostatically loaded in that the oil level in the cargo is level with or below the sea level. In the event of a grounding oil should not escape to sea unless the vessel's draught is reduced due to riding up on the sea bed obstruction. This action on the part of the charterer is to be supported, but Section 10 does not give details of this method of loading. A description would be of benefit to all concerned. Are all tanks so loaded, or are just the wings or the centers? For hydrostatic loading to be effective, all tanks must be so loaded.

In the section on "Tending Mooring Lines" it is stated that the vessel is equipped with six constant tension mooring winches and only periodic checking of the lines is required. This is contrary to the advice of the oil Companies International Marine Forum who advise in their book on *Effective Mooring*,

"Experience has shown that the use of such (tension) winches whilst the ship is alongside is not a safe practice because the winch restraint is limited to its render load, which is small compared to what it can hold on the brake. It is possible for winches at opposite ends of the ship to work against each other when an external force caused by either wind or current or both is applied to one end so that the ship could "walk" along the jetty. Should the bow winch render a little for whatever reason (i.e. a change in direction or force of wind or current) some wire will pay out, which cannot be heaved onto the drum again because the heaving force of the winch is always less than its render force. It is not possible to heave in until the eternal force which caused it to render is reduced."

Mooring winches should not therefore be left in automatic self tensioning mode once a ship is secured alongside. On completion of mooring the winch should be left with the brake on and out of gear. It is understood that the use of such winches in the tension mode is indeed banned at KPL dock, so it is surprising that they use is mentioned in the text. It is our recommendation that the reference to the use of tension winches be removed from the text of the contingency plan.

Section 4: Kenai Pipeliine Company, Nikiski Terminal Manual

Revision dated, May 1991

This publication issued by Chevron USA, Inc. is intended to inform jetty users of the operating regulations when using the dock, the facilities available and details of the jetty itself. It is written by an oil major with one of the best operated fleet of tankers in the world, and the manual is well written and contains all necessary information. The operating regulations are clear and in keeping with the ISGOT guidelines (International safety Guide for Oil Tankers) published by the Oil Companies International Marine Form (of which Chevron was a founding member) and the International Chamber of Shipping.

The following comments are intended as constructive advice rather than criticism:

a. ETA Requirements:

After the vessel has been approved by the ship vetting department of Chevron Shipping, San Francisco, the list of required information sent by the ship master should be expanded to cover details of:

1. Inert gas system operational and all tanks checked to be inert within the last 24 hours.
2. All navigational systems and safety equipment operational, and if not, details of deficiencies required.
3. Hull and valves oil tight, no leaks.
4. Both anchors available and cleared away.
5. Number and types of moorings, all winches operational. Any deficiencies to be detailed.
6. Approved oil spill contingency plan and certificate of financial responsibility on board.
7. Name of P and I club.

8. Name of Master, ship operator and charterer.
9. Engines will be checked to come astern before boarding the pilot or before passing abeam Homer.

b. Docking:

There are no details of the minimum required under keel clearance. An average figure is about 6 feet, but local conditions may require more if large boulders are known to be taken into the dock area by strong tides.

There are no details of maximum loads on the mooring hooks. This is normally about 100 to 150 tons and ships should be instructed not to allow too many moorings to one hook such that SWL could be exceeded. The winter rules warn the mariner that “in heavy ice conditions it may be necessary to double or triple the normal mooring line requirements.” Care should be taken to ensure that the maximum hook loads are not exceeded.

c. Ballast Requirements:

This area should be strengthened to require vessels to berth with a minimum of 35% of the summer deadweight, including ballast/ bunkers/ fresh water and stores. The propeller tips must be covered and the ship in a suitable trim for maneuvering.

d. Fire Fighting:

This is one area of the manual which causes concern. It is our opinion that there is insufficient effective fire cover at the jetty or from seaward. The manual states there is no fire water at the jetty head and fire fighting equipment is limited. The local fire department will assist with their pumps and there are rig tenders/ CISPRI vessel and monitors. This is not sufficient cover when you consider the products and the quantities there of passing over the dock. Following is a list of how a large crude jetty is normally fitted in the United Kingdom:

1. Two 8" lines, one water and one foam.
2. Fixed monitors on the jetty head to spray water on the whole area plus a water curtain on the gangway to allow persons to escape the area. Four head hydrants every 25 yards down the jetty access road.
3. Two foam monitors, steerable, trained on the manifold area delivering 20,000 GPM produced foam for a minimum of 25 minutes. This can be extended with extra foam making compound. Once again, four head hydrants down the jetty access way. The foam line can be used for water if foam stocks run out.

And all this is backed up by the fire fighting tugs. Each tug is equipped with a top monitor (70 feet above sea) giving 13,500 GPM produced foam for 10 minutes or 1,400 GPM water. Two wheel house top monitors giving a total of 10,000 GPM foam or 1,400 GPM water. All three can be used at the same time. The tugs are versatile in that they can fight fires on tank vessels when away from the berth and so mitigate potential disastrous consequences of a major ship fire.

It is recommended that a tug with the above fire fighting capability should be within reasonable distance to provide emergency fire cover.

e. Oil Spill Incidents:

Oil spills on deck leaks from hoses on the ship or jetty are normally discovered quickly. Passing sea valves or leaks from the hull are more difficult to see and require more diligence to observe. The ship and shore staff should be instructed to look over the side and down tide to check if oil sheens are present. At night, a light should be directed towards the sea on both sides of the ship to enable the staff to check the area within the illumination of the lamp. Where possible, a craft should carry out an oil pollution patrol to see if there are discharges of oil around or down tide. If there is an airport nearby, local pilots should be asked to quickly check the harbor area and report any findings to air traffic control for onward telephone contact to the dock operator.

Many oil spill incidents are of a minor nature and should not require immediate notification to all the parties listed. If the source is known and has been stopped, there is no real need to suspend cargo as long as there are sufficient crew members to deal with the clean-up and carry on cargo operations. If there is any doubt as to the source, then cargo/ ballast operations must be stopped until the source is found. On occasion divers will be required to identify the source and cargo may have to be halted until tidal conditions are suitable.

f. Tanker Moorings:

To check on the adequacy of the moorings the following quick method will indicate the maximum forces and restraining force of the moorings. The computer printouts which follow show the wind/ current forces on the tank vessel *Overseas Washington*, loaded and in ballast.

1.	27 Degrees	7.	8 Degrees
2.	27	8.	8
3.	40	9.	55
4.	90	10.	60
5.	8	11.	35
6.	8	12.	35

Assuming the case of a steady offshore wind of 30 knots blowing at right angles to the ship's side combined with a 5 knot current running parallel to the jetty, the total forces will be as follows:

		Ballasted	Loaded Ship
1.	Forward, across ship	17.2 t	7.8 t
2.	Aft, across ship	25.6 t	14.5 t
3.	Longitudinal,	41.7 t	64.8 t

If the wind were to increase to a three second gust of max 60 knots then the forces would increase as follows:

		Ballasted	Loaded Ship
1.	Forward, across ship	68.6 t	31.3 t
2.	Aft, across ship	102.3 t	57.9 t
3.	Longitudinal	41.7 t	64.8 t

The maximum load on the winch brakes will be not more than 70% of the breaking strain of the wires, 55.6 long tons. The ropes will be on bits thus the maximum strain will be the breaking strain, 73.6 tons. When resolved at right angles considering the angles estimated above, the maximum strain of each line can be resolved as follows, fore and aft/ across ship.

1.	65.5/ 33.1 tons	7.	55.4/ 4.9 tons
2.	65.5/ 33.1	8.	55.4/ 4.9
3.	41.7/ 36.7	9.	31.7/ 45.6
4.	0.0/ 55.6	10.	27.8/ 48.4
5.	55.4/ 4.9	11.	60.3/ 42.0
6.	55.4/ 4.9	12.	60.3/ 42.0

Total Restraint Forward:

Fore and Aft, 283.5 tons — Across Ship, 158.5 tons

Total Restraint Aft:

Fore and Aft, 290.9 tons — Across Ship, 187.8 tons

Thus the proposed mooring pattern is adequate for the anticipated forces as long as the ship maintains parallel to the jetty. From the attached computer printouts you can see the very large forces the current will apply to the ship if, for whatever reason, the ship comes off the jetty at an angle to the current. If ice were to come between the ship and shore and force the ship off, then the moorings could not restrain the ship if the tide was running in excess of about 2.5 knots. It is recommended that assistance to the vessel is given to remain parallel in times of heavy icing that could force the ship off line. This can be achieved by a tractor type tug(s) moored alongside the tanker, parallel to the ships side, and using direction thrust form her propulsion units to push the ship towards the jetty.

Section 5: Cook Inlet Pipe Line Company,
Offshore Operating Manual, Drift River Contingency Plan, October 1990

These documents issued by the Cook Inlet Pipe Line Company contain the jetty information and emergency procedures to be followed by company staff and ships' crews while alongside the Christy Lee offshore loading platform. The documents are competent and informative, well up to acceptable standards. The following observations are put forward to the operators for their consideration.

a. Section 1, General Information:

There is no data on water depths alongside, tidal range, nor the minimum under keel clearance. It is understood that the water depth is quite sufficient for the maximum class of ship expected, however this information should be included in case an unusual happening occurs, i.e. damage to engine room and ship settles by the stern due to ingress of water. The safe working load of the slip hooks (112.5 short tons) should be clearly shown to avoid the danger of overloading during ice conditions when extra moorings are required.

The paragraph on maximum number of lines states that no more than seven lines may be run to any one breasting dolphin. This means that one hook will have two, possibly 1.5" wires. With such wires on a standard winch with brakes rendering at 70% of the wire's breaking load, the load on the hook will be approximately 111 long tons. The hooks are advised to have safe working load of 112.5 short tons which is probably sufficient as long as not more than 2 wires are used and such wires are not greater than 1.5", but there is no room for error. The hooks are on their maximum safe working load.

It has been advised that tidal stream can run in excess of 5 knots on the ebb and 3 knots on the flood in the area of the loading platform and the jetty is aligned some 15 degrees off the direction of the stream. In the attached computer printouts of the tanker *Sansinena II* the forces applied by wind and current are as follows:

		Ballasted	Loaded Ship
1.	Forward, across ship	78.6 t	242.3 t
2.	Aft, across ship	46.7 t	118.8 t
3.	Longitudinal	l.1 t	16.3 t

A quick calculation of the mooring restraint using 4 head/ stern lines and 3 springs each end (a total of 14 mooring lines with an assumed brake render load of 55 tons) gives the following:

Forward, across ship	208 tons
Aft, across ship	208 tons
Longitudinal in one direction	162 tons

The above forces clearly show there is no room for error in the moorings of the ship at the Christy Lee loading platform while in the final stages of loading on a flood tide. Indeed it is surprising that, despite the undoubted vigilance of the ship and platform staff, there have not been more incidents when a ship has come off the berth. It is again recommended that a tractor type tug(s) be used to assist such tankers to remain alongside in times of icing or abnormally high winds and/ or large tidal streams. It is further recommended that a detailed study be made of the berth and ships/ barges that use the facility to ensure that the mooring restrain is sufficient and the mooring equipment is strong enough to take the anticipated loads.

The section outlining the use of mixed moorings is possibly dangerous and could jeopardize safe loading of oil during winter conditions. Mixed moorings should be strictly forbidden and ships that can not comply should not be chartered to come to the facility. The reason is the near impossibility to adjust wires/ ropes such that each bears an equal load at maximum load. The OCIMF guide to moorings stresses this point and advises mixed moorings be forbidden.

The ballast reception facility as described in the operating manual is much too small at 90,000 barrels and it is understood it is not operational at this time. An 80,000 ton tanker will carry approximately 25,000 tons of ballast which is about twice the capacity of the holding tank. It is important that a tanker coming to load be ballasted such that the propeller tips are well immersed and the trim such that the ship can be efficiently maneuvered alongside the platform. This will normally mean about 35% of the summer deadweight including bunkers, fresh water and stores. Ballast is normally a combination of segregated and dirty, depending on the age of the ship. Older ships may not have segregated ballast tanks as defined in the MARPOL convention of the IMO. Segregated ballast is carried in tanks that are only used for such water and there is no piping connection to the cargo system. Dirty ballast is carried in dual purpose tanks which are used for oil on the loaded passage and then for ballast en route back to load. Such water must be sent ashore for processing whether or not the tanks have been washed after discharge. Oil is still present in the ballast and the cargo lines and pumps may well be contaminated with oil. This is the normal practice worldwide and probably at the Drift River offshore loading platform and is a requirement of the MARPOL convention. If the ballast facility is not operational then the ships must sail with the dirty ballast still on board. The discharge of segregated ballast into the sea is permissible, but it is recommended that such ballast be sampled and then tested to confirm the hydrocarbon content is below background level, approximately 3 ppm. This is particularly important for older vessels as the segregated ballast pipe lines run through oil cargo tanks and may be perforated, and so allow the ingress of oil cargo. When discharging at night, a light should be trained on to the sea surface near the ballast outlet to check that no oil is being discharged from a perforated line or joint.

Later in this section a procedure is laid down for the ship to deballast. It should be made quite clear in this section that deballasting will not be permitted before loading. Whereas this may be allowable in certain circumstances, it should e normal practice to require the ship to be in an acceptable condition of draught and trim to allow safe navigation should the vessel have to leave the jetty in an emergency. This will mean that the ship must load/ deballast concurrently or load/ deballast/ load. Deballasting before loading may lead to propeller tips emerging from the water and excess aft trim which hinders maneuvering the ship.

The fire fighting equipment would appear to give adequate protection for the platform itself, but is not sufficient to assist in extinguishing a ship fire or keeping the deck area cool while the ship's crew fights the source of the flames. Details of an acceptable jetty fire fighting installation is given in the section describing the KPL dock and as a minimum requirement it is recommended that a large foam/ water remotely controlled monitor overlooking the ship's manifold area be installed. It is further recommended that an efficient and capable fire fighting tug be in the near vicinity while loading/ deballasting operations are taking place.

There would appear to be no requirement for pre-arrival information from the tanker. This should be put in place with the requirements as given in the comments on the KPL facility. The requirement to accept ship's garbage may be impractical, unless there is an efficient means to transport such waste back to the Drift River terminal. The items which require checking prior to commencement of cargo operations are the minimum laid down in the "Declaration of Inspection" and should be compared with that used at the KPL dock.

The statement that the Terminal Supervisor will leave the platform and return to the terminal after the inspection has been completed is possibly a cause for concern It is recommended that while a crude oil tanker is alongside a senior member of staff should remain on the platform. If the pipe line operator insists that a person of similar status is required ashore, then additional supervisory staff should be sent to the site while a tanker is loading. It is difficult and unfair to expect an operator to force his will on a senior member of ship's staff if the operator is unhappy with a certain operation or situation. It is fully understood that the supervisor can be contacted by radio, but that is not the same as being on site and weighing a potentially dangerous position or situation.

There is no mention of checks on the oxygen content of the cargo tanks. Inert gas is an important safety item and is required by international convention by all crude oil ships. The shore supervisor should take his own oxygen analyzer and check any three tanks at random. If any tank atmosphere contains more than 8% oxygen then the ship should be refused permission to load and asked to vacate the berth until all cargo tanks have been inerted to less than 8% oxygen. The ship's IG plant should also be checked to be operational as inert gas will be required to fill the void space left by out going cargo tank ballast. This is an important requirement. If there is source of ignition present in a tank with hydrocarbon vapors and oxygen within the explosive envelop, then a disaster of major significance will result. It is too important to ignore.

The duties of the platform staff should include:

a. Ensure no craft comes within 50 yards of a tanker alongside. (This may require a safety zone to be declared by the COTP).

b. Ensure no stores are loaded/ discharged during cargo during cargo or ballast operations.

c. Give the tanker hourly figures on cargo loaded to assist ship's staff to prevent cargo overflows.

d. Check that the crewman is on deck at all times and is in radio communication with the platform in the event that an emergency shut down is required if such crewman spots an oil leak or cargo overflow.

The duties of the ship's crew should include:

a. Maintain water pressure on the ship's fire main, bleed off water through hawse pipe washers, if necessary.

b. Rig hoses and foam concentrate near the manifold area.

c. Check scupper plugs are properly in place. Release deck rain water to sea if clean; if dirty, pump to slop tank. If water is allowed to fill the after deck area up to scupper plate level then any spilled oil will go straight over the side.

d. Check ullages at 30 minute intervals, more often if

e. Slow down in good time to top off tanks.

f. Inert gas line to mast riser should be drained prior to commencement to cargo operations.

g. Verify cargo figures as advised by the platform.

Section 3, Emergency Procedures

There is no method for the ship to initiate an emergency shutdown other than by contacting the platform operator on VHF radio. This is a weak point as the platform operator may not hear the radio, the radio may be malfunctioning or the ship's radio may not be available or it may be broken down. Consideration should be given to giving the ship an emergency shut down (ESD) button on a cable near the manifold area. In this position it will be available to the ship's crew member on cargo watch on deck, the person who is most likely to spot an oil spill on the ship or near the area. Such an ESD arrangement is fitted at Sullom Voe.

Comments have already been made on the lack of efficient fire fighting equipment to protect the ship and cargo while working cargo or ballast. There should be a different scale of magnitude of fire protection in the form of equipment capable of laying down large quantities of foam and also the provision of a fire fighting vessel to assist from seaward. One procedure given is to release the moorings if the fire is on the ship is endangering the platform. Whereas it is agreed that this is a possibility, the operator must not do this if the ship is not under command, i.e. engines unavailable or ship control systems non-operational. To do this will result in the ship grounding with all the consequences of hull damage. It also makes the work of the rescue services more difficult and it is thus recommended that moorings only be released if the ship agrees and is able to steam away from the area while the remainder of the crew fight the source of the fire.

The section on spills or leaks which result in oil discharged to sea should include the following:

a. The contract helicopter (which is available at all times at Drift River) should be mobilized to over fly the area and guide the *Banda Seahorse* to the leading edge of the spill.

Section 6: Cook Inlet and Sullom Voe, General Description

Cook Inlet

The Cook Inlet tidal estuary runs north east from the Gulf of Alaska and is about 200 nautical miles long. It varies in width from about 50 nautical miles at the entrance to an average of about 15 nautical miles north of the Forelands. The depth of the navigable waters of the estuary varies from more than 50 fathoms near the entrance at the south west extremity rising to an average of around 20 fathoms in the Nikiski/ Forelands area. North of the Forelands water of 10 fathoms deep or more is available up to Fire Islands Shoals. The approach channels and berths at Anchorage are periodically dredged to maintain 35 depth at MLLW. The depths at the other two principle installations at Drift River and Nikiski are maintained by the natural souring effects of the tidal stream. The Kennedy and Stevenson entrance to Cook Inlet lie respectively north and south of the Barren Islands. Both are relatively unobstructed over a width of about 8 nautical miles. The tidal range in Upper Cook Inlet is one of the largest in the world at more than 30 feet. The tidal streams are commensurate with such tidal ranges and currents can exceed 7 knots at times. The tides are semi-diurnal and can vary from prediction by more than an hour in time and several feet in height due to meteorological effects. Ice hampers shipping operations over the winter months. The degree of disruption to shipping due to ice can vary significantly from year to year.

Sullom Voe:

It must be noted that Sullom Voe and Yell Sound are not comparable to Cook Inlet in many respects. At Sullom Voe the tanker jetties are located 12 nautical miles from the open sea at the north entrance and east entrance to the harbor area. There are relatively few shoals and the water depth varies from 70 meters at the north entrance to over 25 meters off the jetties. The east entrance is limited to vessels of maximum draught 11.6 meters and is not used by crude tankers. The currents in the deep draught route to the north and in the jetty area are unlikely ever to exceed 2 knots even in spring tides. Current rates of up to 7 knots may be experienced in the south eastern area of Yell sound. Siltation is not a problem in Yell Sound/ Sullom Voe. Sullom Voe/ Yell Sound is not affected by ice at any time. The tidal range in Sullom Voe is 2.3 meters at spring tides.

Section 7: Tanker Jetties, General Information

A. Nikiski Dock, Kenai Pipeline Company:

The Tesoro jetty is located at 60º 41’ North, 151º 224’ West on the east side of Cook Inlet. It is a conventional steel piled open “T” tanker jetty with a concrete deck.

Water depth is 40 feet at MLWS and the tidal range at springs can exceed 30 feet. The maximum current at the dock is said to exceed 5 knots on flood spring tides.

Maximum berthing wind is not stated in the operating manual, although it is understood that an upper wind speed of 35 knots is in force for berthing and working cargo.

Berthing Draught/ Trim/ Ballast requirements are not clearly defined.

Number of ships/ barges per annum (1990) 136/ 38.

Maximum size of ships allowed – 70,000 LT displacement for berthing.

The orientation of this berth is similar to the tidal flow.

B. Christy Lee Loading Platform, Cook Inlet Pipe Line Company

The Christy Lee Loading Platform is located on the west side of Cook Inlet adjacent to Drift River at Latitude 60º 33’ North Longitude 152º 08’ West. The Platform is a sea island berth of steel construction on steel piles. The berth is equipped an unusual fendering system which can be moved vertically on wire pulleys to achieve the optimum location with respect to ship’s hull as vessel loads/ deballasts/ and the tide rises/ falls.

The water depth at the berth at MLWS is reported to be 60 feet, the tidal range can be 30 feet at spring tides. The maximum current at the dock is said to exceed 6 knots at spring tides.

Maximum berthing wind – not defined, but helicopter said to be unable to place mooring personnel on platform in winds in excess of 25 knots.

Berthing Draught/ Trim/ Ballast requirements – not defined.

Number of ships per annum – approximately 24.

Maximum size of ship allowed – 50,000 LT displacement for berthing.

The orientation of this berth is not aligned with the tidal flow. It is reported to be some 15º off the berthing line, i.e. berth is 035º/ 215º and current is 050º/ 230º. Berthing tankers particularly on a flood tide (as is the preference of ship masters) without tug assistance will be fraught with difficulty even in moderate wind conditions. In winds directly on or off this berth, a safe, continuously controlled berthing operation without using tugs is questionable.

C. Sullom Voe Jetties

The Sullom Voe tanker jetties are located at the north east end of the sea inlet known as Sullom Voe at Latitude 60º 27’ N Longitude 01º 17’ W. All four jetties are conventional steel piled open “T” tanker jetties with concrete decks.

The water depth at three of the jetties is 24 meters at MLWS and 17 meters at the other jetty at MLWS. The maximum tidal range is 2.3 meters. The current in the jetty area never exceeds 2 knots.

Maximum berthing wind – 30 knots for vessels up to 350.000 tons DWT/ 365 meters Overall Length (vessels longer than this will not routinely berth in winds of over 20 or 25 knots depending on jetty).

Berthing Draught/ Trim/ Ballast requirements – minimum of 35% of summer DWT. Propeller must be immersed. Trim to be "reasonable" but not defined. These conditions apply at all times vessel is at Sullom Voe, including during loading and deballasting operations.

Number of ships per annum – 540 (1989)

Maximum size of ships allowed – No limit except draught of 22.6 meters.

The orientation of the jetties at Sullom Voe is not significant in terms of the small tidal flow. They are aligned such that the prevailing winds, which are the significant factor at this terminal, will tend to force vessels "on" to the jetties.

Section 8: Weather

Records indicate that the wind speeds at Nikiski/ Kenai rarely exceed 28 knots, (less than 1% of the time). At Sullom Voe during 1990 wind speeds exceeded30 knots for 20% of the year. Wind records for the west side of Cook Inlet are not available. The climate in the inlet is significantly moderated by the horse shoe of mountain ranges protecting the inlet. The mountains also create variations in the weather within the inlet at one time and reports from fishermen indicate that large differences in wind speeds can be experienced between the east and west side of Cook Inlet in certain conditions.

The predominant wind direction is north easterly in winter and southerly in summer. Winter storms with winds gusting in excess of 50 knots over open waters have been reported. Reduced visibility due to fog, haze snow, etc., does occur, but records indicate that visibility of less than 2.5 miles occurs less than 1% of the time at Nikiski/ Kenai. There are no other statistics available for delays to shipping caused by weather at either Nikiski or Drift River.

During 1990 Sullom Voe operations suffered a total of 2,106 hours for all disruptions including high wind speeds, high swell and low visibility. For end of year statistics, see Appendix G.

Weather Forecasting

Weather forecasting in Cook Inlet is provided from Anchorage by the US National Weather Service. There are no forecasts or forecasters specifically dedicated to weather conditions at the oil terminal docks at Nikiski or Drift River.

Sullom Voe has a dedicated forecast service funded by the harbor authority and provided under contract by the National Meteorological Office.

It is our view that such a dedicated service for Nikiski and Drift River is not required if all operations are firmly governed by established weather parameters. It is apparent that the weather conditions at Sullom Voe are, in general, much more sever for a prolonged period and much more volatile than Cook Inlet.

We do recommend that clearly defined operating parameters be established and promulgated to all concerned and interested parties. These shall include:

a. Maximum wind for berthing, unberthing and transferring cargo, (this may vary with wind direction).

b. Minimum berthing deadweight.

c. Define suitable trim condition.

d. Require propeller immersion.

e. Set maximum mooring line/ hook loads. See sections 12, 5 an 4.

f. Set tidal windows for berthing and unberthing.

g. Set tug numbers/ utilization requirements.

h. Set minimum and maximum current rates for berthing and unberthing. See section 12.

i. Set minimum under keel clearance at jetty and in approaches.

j. Set minimum operating visibility requirements.

Section 9: Cook Inlet – Navaids

Most of the shipping bound for Cook Inlet enters through the Kennedy Entrance to the north of the Barren Islands. The only significant navigational aids to this entrance for a vessel approaching from seaward are the lights located on East Amatuly Islands and Perry Rock marking the limits of the entrance to the south and north respectively. Both of these lights have a range of seven nautical miles. In terms of landfall lights, these are of very limited range. There are no racons (radar responder beacon) located in the area of the entrance for radar identification purposes.

The range of the principle landfall lights at the north entrance to Yell Sound (Sullom Voe) is 24 nautical miles and a racon is located on an island close by for purposes of positive radar identification. The landfall light at the east entrance to Yell Sound is 19 nautical miles in range. There is similarly a racon located on a rock inside the sound. Those lights located within Cook Inlet, while considered to be well spaced and placed, are also of inadequate power and range.

It is recommended that high definition sectored lights of appropriate range be established to delineate the safe channels in certain areas, e.g., to guide tankers to the deepest water across the shoals off Nikiski Terminal and to provide distance off berth information to pilots on approach to jetties. Leading lights should also be established where it is practical to locate two or more lighting towers.

We are aware that seasonal buoys are deployed in Cook Inlet. It is presumed that such buoys are intended to aid only those craft which operate during the season of deployment, i.e., inshore fishermen, ferries, pleasure craft, etc.

Any seasonal buoys which are found to be useful to shipping which operate year round should be replaced by visual aids which operate at all times, e.g., sectored lights or robust light towers.

A comprehensive independent study of all visual navigational aids, in consultation with all users, is recommended for Cook Inlet. It is considered that much of the Cook Inlet coastline provides for reliable radar information to shipping. The exception is the mud flats in Upper Cook Inlet. There are, however, numerous hazardous rocks and shoals within the Cook Inlet estuary. Customarily, many of these shoals would be marked with buoys to define the danger areas and deep water channels. Winter ice conditions make the deployment of such aids impractical. In view of the absence of such navigation marks it is recommended that in addition to radar, Loran C, and other statutory navigation equipment, vessels loading to or loading in Cook Inlet and carrying hazardous, noxious or polluting cargoes should be fitted with a GPS satellite navigation system.

Section 10: Traffic Routing, Designated Anchorages and VTS

Currently there is no routing of traffic within Cook Inlet. Currently at Sullom Voe, tanker traffic in restricted channels are not permitted to pass any other vessels. There is also a ten mile tanker exclusion zone around the Shetland Islands. Tankers only enter this zone when proceeding to or from the pilot stations. Within the confines of the harbor area ships are under radar surveillance and port control direction, and thee is also a Pilot on board all tanker traffic. Tanker traffic is given priority over other traffic I this area. Neither double hulls nor any form of hydrostatic loading can protect the environment from high impact collision. The risk of high impact collisions can be reduced by routing tankers and other ships carrying hazardous cargoes so that they do not pass close to one another or other shipping. When considering the matter of routing vessels carrying hazardous cargoes, the practicalities of such an instrument during a winter of heavy ice concentration must be examined closely particularly I Upper Cook Inlet. All vessels/ bares carrying hazardous cargoes would have an inbound or outbound designated route and all other traffic would be aware of that route and the movement of shipping within the route and so avoid impeding shipping which is compelled to use these routes.

It is recommended that a study be implemented to examine the routing of all vessels in Cook Inlet.

It is also considered that anchorages should be designated within Cook Inlet for ships which have on board hazardous, noxious or polluting cargoes and again all other shipping would be aware of these areas and would be directed to avoid passing close to them. When considering the matter of designated anchorages, suitable areas which have the least current affect and the best holding bottom should obviously be chosen. Other factors which influence the selection of designated anchorages are the practical aspects such as vessels waiting for pilots, vessels which may have to wait for suitable tidal conditions or a vacant berth, vessels under repair or waiting for the charter loading period to commence. Anchorages for vessels not transporting cargoes of a hazardous, noxious or polluting nature should be located at a safe distance from dangerous anchorages. As an example, a suitable area off the Port of Homer should be examined and designated an anchorage for vessels and barges carrying hazardous cargoes waiting to proceed north into the inner part of Cook Inlet.

It is recommended that the study on traffic routing incorporate designated anchorages.

Vessel Traffic Services

Currently Cook Inlet has no vessel traffic service. Currently Sullom Voe has a vessel traffic service which includes reporting and radar surveillance.

IMO resolution A.578(14) sets out “Guidelines for Vessel Traffic Services”, (VTS).

The guidelines define VTS as, “any service implemented by a competent authority designed to improve safety and efficiency of traffic and the protection of eh environment. It may range from the provision of simple information messages to extensive management of traffic within a port or waterway.”

It is also stated that, “A VTS is particularly appropriate in the approaches to a port, its access channels and in areas having one or more of the following characteristics:

High traffic density
Traffic carrying noxious or dangerous cargoes
Navigational difficulties
Narrow channels
Environmental sensitivity.”

Cook Inlet qualifies for a VTS on several counts. There are noxious and dangerous cargoes moved by barge and ship. There are many navigational difficulties, particularly in the winter months due to ice. The approach channel to Anchorage is restricted and regularly dredged. There is a sensitive environment to be protected from damage by oil pollution.

It is considered that the sea room available in most areas of Cook Inlet and the relatively low ship traffic density does not demand radar surveillance traffic management.

It is, however, recommended that a traffic management control center be established and all vessels over 25 meters in length shall report the vessel's name and position, speed and destination at specified locations within the Inlet. In view of the geographical spread of Cook Inlet and the limited range of the VHF radio, such an arrangement would require the establishment of a series of VHF transmit/ relay stations suitable located around Cook Inlet. Re-broadcasting by the control center of the movements of vessels carrying hazardous, noxious or polluting cargoes would ensure that all shipping, reporting and non-reporting, could be made aware and directed to keep well clear of all shipping of that nature. The geographical location of the traffic control center should ideally be in the area of East Foreland, which gives a degree of visual monitoring of traffic bound to/ from Nikiski and Anchorage, the busiest ports in the inlet.

Reporting should commence at the natural seaward limit of the "Cook Inlet Harbor Area", the Kennedy and Stevenson entrances. Further reporting is recommended one hour from the Homer Pilot Station (if relevant) and in any case at no more than 1 hour intervals when transiting any part of Cook Inlet. Reporting of arrivals and departures will be necessary at all ports and terminals.

There are additional advantages of a vessel movement reporting system in that the awareness of everyone regarding craft within Cook Inlet will be significantly raised and concentrated. Such a system also allows for immediate reporting of breach of any Cook Inlet Regulation or International Collision Regulation to the appropriate authorities so that action may be taken, thus raising concentration levels even more.

Section 11: Moorings

The mooring diagrams contained in the Regulations issued by the Kenai Dock Operator are considered to provide adequate restraint under normal operating conditions. The mooring arrangements at the Christy Lee loading platform leave little margin for error when considering the fifteen degree offset of the tidal current. In severe offshore weather conditions or when severe weather and significant tidal currents are acting in concert – these moorings may not safely secure a vessel to either berth. (See sections 4 and 5 of this report). In winter conditions when ice is also exerting a force on a vessel's hull, mooring lines not infrequently part. Such situations have resulted in pollution incidents in the past. The platform operator does have winter rules in effect which stop loading in ice during the flood tide and also require extra moorings, but even so the danger of break out is present.

Similarly, the mooring arrangements at Sullom Voe only provide restraint under normal conditions and "off berth" winds regularly interrupt loading operations during the winter months. Regulations are in place which require loading arms to be disconnected and tugs to push up on tankers under certain conditions:

The following regulations are in place in Sullom Voe:

"All loading and deballasting operations must cease when the following wind conditions and direction limits are reached.

a. When the wind speed exceeds 44 knots for a 3 second gust in an onshore direction towards the jetty from seaward.

b. When the wind speed exceeds 35 knots for a 3 second gust in an arc covering the inside of the jetty from 10º to seaward on either side of the berthing orientation line of the jetty axis.

Tugs and Pilots

1. At least one tug shall be called out to assist in keeping any vessel alongside when all the following conditions exist:

a. Where the mean freeboard height of the vessel exceeds the mean draught

b. When the wind is of sufficient speed for loading to be suspended, and

c. When the wind is from a direction within the arc extending from 10º seaward of the berthing line through north to 10º seaward of the berthing line.

2. At the time of suspending loading/ deballasting operations because of deteriorating weather conditions, the Terminal Loading Supervisor will advise Port Control immediately of any vessels in the condition stated in (1.a) above.

3. When a tug is called out under the conditions stipulated in (1) above:

a. The Terminal Loading Supervisor will notify the Master of the situation and request that the vessel be brought to a state of immediate readiness.

b. With the exception of the Port Controller, such Pilots as are available will station themselves on board those vessels which are considered to be most vulnerable, and any vessel with a tug alongside must be attended by a Pilot throughout the period a tug is required.

c. The Duty Harbor Master will be notified.

4. Tugs may be necessary to assist in keeping vessels alongside when some of the conditions in (1) above are absent, and may or may not be called for by the vessel. In such circumstances any vessel requiring tug assistance will also be attended by a Pilot who will board the vessel as soon as possible and remain on board throughout the whole period a tug is in attendance. In these circumstances the duty Harbor Master will be informed.

5. Notwithstanding anything contained in 1-4, the duty Port Controller may, before consultation with the Harbor Master, call out such tugs as are required, at any time, if he feels the situation warrants this action. In the case of large vessels in light condition, for example, it may be prudent in certain circumstances to call out the tugs when the wind off the berth is less than that stated in (1.b) above. In such cases the duty Port Controller should exercise his discretion.

6. In all situations where tugs are required to assist a vessel moored alongside, a Pilot will also be stationed on board that vessel as soon as possible after tugs are called out, and will remain on board throughout the whole period the tugs are in use.

There are currently no tugs located in Cook Inlet capable of assisting a tanker during adverse conditions. The general need for tugs in Cook Inlet is addressed elsewhere in this report.

Section 12: Ice

1. Ice conditions in Cook Inlet vary from year to year. In worst case scenario in extremely cold winters, ice in Cook Inlet can disrupt the ability of shipping to navigate, anchor, berth and remain at berths. Hull damage from ice must be a consideration throughout the winter and in the spring when river ice several feet thick can be found in the Inlet. The hulls of ships carrying cargoes capable of causing oil pollution should be ice-strengthened if they are to trade to Cook Inlet throughout the winter ice period. We understand that container vessels currently trading to Anchorage are ice-strengthened, but the crude tankers trading to Nikiski and Drift River are not. This is inconsistent and those tankers which are of single skin construction should be strengthened to trade in Cook Inlet ice conditions. The necessity is self evident. Sullom Voe and Yell Sound are not affected by ice at any time.

2. Winter Rules:

“Winter Rules” apply at both Drift River and Nikiski during the winter months when free ice is present in Cook Inlet. There is very little regulation contained in these “Rules” which should not be in force throughout the year at both Terminals and be maintained as normal practice.

The “Winter Rules” make no mention of placing a licensed Pilot on board ships if conditions demand unberthing or re-mooring, although it is understood that such is the case in reality. This requirement should be formalized and put into these winter rules. The pilot must, it is recommended, be a member of the local association and not the master or chief officer of the ship concerned.

It is recommended that provision for the placement of a Pilot on board tankers at berths during the period when “Winter Rules” apply should be written into these Rules and Jetty Regulations. Since this has an obvious cost implication, the judgment of when this is necessary should be made by an experienced and independent harbor official (Coast Guard)?

It is also recommended that strain gauges be placed on all mooring hooks at both Nikiski and Drift River. The gauges should be capable of being monitored simultaneously from a central control room at each installation. Such a facility removes the guesswork from making a decision to unberth. It is immediately apparent when a jetty mooring point or mooring line has exceeded its acceptable safe working load and is approaching the breaking strain.

The fitting of such instruments would significantly reduce the risk of unexpected ship breakout caused by wind, current and/ or ice. Strain gauges are commonly fitted at docks and buoy installations when conditions demand, to prevent both damage to the installation and pollution of the seas.

Protected current meters, fitted at each berth, would also give positive information on current rates and accurate timing on hen the peak rate is passed. Definitive information on current rates and direction would also be valuable to pilots during berthing/ unberthing operations.

Section 13: Hydrographic Surveys

The age, quality and regularity of the hydrographic surveys covering the Cook Inlet estuary have not been examined in detail in this report. This is an area of obvious relevance to the safety of navigation and should be addressed under the study recommended on routing, designated anchorages, VTS and visual navaids. We understand that much of the Cook Inlet area has not been surveyed to modern standards. It has been suggested that this may be due to a lack of resources allocated to this area by NOAA and thus supports our argument to raise finance through harbor charges whch could supplement the survey work conducted by NOAA. If the above study confirms a lack of up to date surveys, representations from local and state bodies must be made to NOAA to give Cook Inlet greater priority in their budget for future hydrographic surveys.

Section 14: Pilotage

Services provided by Pilots in most ports, including Cook Inlet and Sullom Voe, mainly comprise conducting ships to or from an open harbor approach to or from facilities where cargo is loaded or discharged. The Pilots must have proven familiarity with their district of operation, including channel depts., tidal streams, navigational marks and local regulations. They must also have proven expertise and skills in ship handling in restricted and sometimes busy waters and berthing/ unberthing ships to/ from jetties, utilizing all the available aids at their disposal, including ship's engines, rudders, anchors, thrusters and tugs.

Pilotage in Cook Inlet is provided by Pilots who are members of the South West Alaska Pilots' Association, pilots who may not be members of the South West Pilots' Association, Ship's Masters and Ship's Officers who have pilotage endorsements on their licenses.

Pilotage in Sullom Voe is provided only by licensed Pilots of the Harbor Authority of Sullom Voe. This is a single tier pilotage and Ship's Masters and Ship's Officers are not permitted to pilot tankers into, out of, or within Sullom Voe.

There would appear to be at least three different bodies who demand their own level or style of qualification to pilot ships within Cook Inlet:

1. The U.S. Federal Authorities issue licenses.
2. The State of Alaska issue licenses.
3. The South West Alaska Pilots' Association requires that their members be qualified beyond the requirements of the Federal and State licenses.

Terminal Operators may also demand a level of familiarity with their dock in addition to that required by the State and Federal Authorities.

In view of the different nature of the shipping in Sullom Voe and in Cook Inlet and the variety of shipping and berths in the pilotage district of SW Alaska, we have not sought to make direct comparisons between the licensing requirements either for the State, Federal or Association licenses. We attach for information the licensing requirement of the State Authority, Federal Authority and Sullom Voe. The South West Alaska Pilots' Association requirements are presently under review and we are therefore unable to comment on their current requirements.

It is our view that the existing multi-license arrangement is not a rational system for regulating ship pilotage. Ships from or to a foreign port require state licensed pilots. Ships to or from another US State require Federal licensed Pilots. The port of origin or destination of a ship is not relevant to the pilotage of that ship. It is strongly recommended that pilotage license qualifications, examinations and other standards be brought under the control of a single authority, and standardized at the highest level currently required for the different classes of pilotage licenses. While it is recognized that the vast majority of Association Cook Inlet Pilots hold both licenses plus meet the Association and Terminal standards, it is a glaring anomaly that persons who do not meet these same standards of qualification and experience, may also freely and legally pilot ships within Cook Inlet. It should also be noted that in UK ports the issue of endorsements to a Ship's Master or Officer is usually restricted to vessels not carrying dangerous cargoes. In Sullom Voe, endorsements are not issued to masters or mates of any vessels. When masters and mates are permitted to pilot their own ships, it is unfortunately often the case that in adverse weather conditions they call in the services of the professional pilot. Pilots, in common with other professionals must practice their skills to maintain their familiarity with every facility within their pilotage district. When they are only infrequently invited to handle a ship at a particular berth and in the most difficult conditions, it is not only unfair; it is also unsafe. This practice is common in Cook Inlet. We recommend that only professional pilots holding the appropriate high qualification be permitted to conduct the berthing, unberthing and pilotage of oil tankers in Cook Inlet.

Section 15: Tugs/ Tug Escorting

Currently in Cook Inlet there is no requirement for ships to use tugs at any time. At Sullom Voe all tankers are required to use tugs to berth and unberth. The number of tugs used is dependent on the size of the tanker, but usually 4 for berthing and 2 for sailing. Find attached the tug requirements for the major European ports, Appendix E.

There is one small harbor tug currently available in Cook Inlet providing assistance to ships docking and undocking at Anchorage. It is of conventional design, 1200 horsepower. The tug is lifted from the water when heavy ice conditions prevail in Upper Cook Inlet. No other tugs are routinely available to assist in berthing, unberthing or escorting or in the event of any emergency at the Nikiski docks or the Christy Lee Platform. The *Banda Seahorse* must not be considered a substitute for a harbor tug.

We have made inquiries of other Pilots and Ship Masters and we cannot find another facility within the western world which routinely berths and unberths large crude tankers without tug assistance.

In most ports the berthing of ships is the most critical stage of pilotage and ship handling and demands the utmost care and control by Pilots as there are enormous forces involved when a ship initially comes into contact with a jetty. The magnitude of these forces obviously varies with the size of ship, the speed, the landing face and the fendering on the jetty. If a vessel is landed with greater impact than ship or jetty are designed to accept, damage to one or both will result. If the ship is damaged, pollution of the sea may also occur. It is therefore the case that tankers are generally placed alongside jetties with the greatest of care, invariably assisted by tugs. It should be noted that hydrostatic loading of tankers is mainly affected to minimize pollution in the event of a grounding. Even minor hull damage at or near the water line in a hydrostatically balanced tank will result in a large spillage of oil due to the fact that approximately 20% of the volume of that tank is above the water line. There is clear evidence of severe fender damage at the Nikiski dock and to a lesser extent at Drift River. Repairs to the dock facing at Anchorage are an expensive, ongoing maintenance routine due to damage caused by ship berthings. We are unable to inspect the other docks at Nikiski. Tankers and other large ships are also undocked using tugs for the same reasons of enhancing the safety of operation.

It is understood that westerly and southwesterly winds can generate significant swell heights of up to 12 feet at Nikiski. Vessels at any of the Nikiski docks would have great difficulty, or indeed find it impossible, to unberth in such conditions without the aid of tugs and could easily suffer hull damage when surging against the dock. The wood cladding on one breasting dolphin fender at Nikiski had been almost totally removed as a result of some incident(s) prior to the visit of our consultant. In effect, loaded tankers were berthing steel hull to steel berth; this would not be permitted at any other installation and should not be permitted at Nikiski.

The tidal stream current a Drift River lies at an angle of 15º to the berthing face. Utilization of tugs would make for a much more controlled berthing at this dock. It is our view that berthing a ship with a moderate or strong onshore or offshore wind would be fraught with difficulty and highly risky without the use of tugs. The presence of suitable tugs in Cook Inlet would also provide for emergency assistance to other ships or barges at or near the tanker jetties which may be a danger to shipping carrying hazardous, noxious or polluting cargoes. It should also be noted that the larger gas tankers berthing at the adjacent dock will have a heavy fuel oil bunker capacity exceeding 1000 tons. They must also maneuver in close proximity to the KPL dock and are equally capable of having a main engine failure.

We recommend that suitable tugs assist all tankers berthing/ unberthing at both Drift River and Nikiski.

There are a few ultra modern tankers which routinely berth and unberth with little or no tug assistance. For example, see Appendix J. These vessels are the third generation dynamic positioning vessels designed for offshore loading of crude oil from platforms and buoys. Nevertheless, they are not allowed to berth at Sullom Voe without tugs.

Some European harbor authorities do permit such vessels to berth and unberth without tug assistance, but they do not experience the same severe weather conditions as Sullom Voe. We recommend that such vessels be examined on a case-by-case basis to establish their capabilities and back-up equipment in the event of failure of a major control unit, prop or thruster. Escorting such vessels remains a requirement.

Escorting by Tugs

Tug escorting of tankers can be conducted either with a tug continuously attached to the vessel or with a tug running free close by the vessel. “Line up” escorting is essential in situations where an immediate application of steering or retardation forces may be required in event of a ship’s machinery malfunction or failure in confined waters. The routes from/ to the entrance of Cook Inlet do not, for the most part, fall into this definition. In those stages of the pilotage near the docks at Drift River or Nikiski, when maneuvering is more restricted, the vessel would in any case have tugs attached to assist in berthing and unberthing.

Vessels transiting Cook Inlet which suffer a loss of propulsion, may be able to anchor safely if the water depth is not excessive at the position where power is lost and the ship is in either slack water or stemming the tidal stream at the time of loss of power and an anchor is let go before the vessel runs with the stream. If the vessel is running with the tidal stream when power loss occurs, or is in deep water, it is unlikely that the vessel will be able to anchor without risking loss of gear. This will obviously be at worst case at times of spring tides.

It is therefore recommended that tugs conduct escort duties for all tankers to/ from the entrance to Cook Inlet.

The design of tugs required to operate a service to the tankers trading to Cook Inlet and to other vessels are required and in emergencies throughout the year would have to take into account the many particular features that are specific to Cook Inlet, including the winter ice in terms of damage to the tug's hull, having a tug of sufficient power to be effective in winter ice conditions, protection for the tug propulsion units, the ability of the tug to provide forces to the ship while not presenting its full length to ice or current forces, suitable engine cooling systems, suitable accommodations, etc. The conceptual design and utilization of tugs would be an entirely separate study. Any tug study must also address training of personnel in best use of these purpose built tractor tugs in the Cook Inlet conditions. Pilots should be included in the training program. The tugs would be funded by all users of Cook Inlet, to differing degrees of course, with the tankers and terminals contributing the most.

For information, one oil major UK terminal operator has already put in place a requirement that all crude tankers over 70,000 tons deadweight shall be escorted to and from their installation. The charge to each ship, regardless of size, for this escort service is currently set at $9,300 per port call. It should be noted that the tankers are also escorted in the ballasted condition.

Section 16: Cook Inlet Regulation and Management

Cook Inlet and all other coastal areas of the United States of America come under the control of the United States Coast Guard. The Coast Guard has many duties and responsibilities. We are of the view that Cook Inlet must be looked upon as a whole operation and a general harbor area on its own account, and as such, shall have its own regulating and governing body which should have authority to raise funds and use them to enhance the safety of the Cook Inlet shipping operations.

We firmly believe that the creation of a dedicated "Authority" headed by professional marine staff with a singular undiluted remit directed only at the Cook Inlet operations would be a significant improvement on the status quo. We are convinced that the full time staff of the "Harbor Authority" would have a long term interest and commitment to enhance safety and services as their appointments would not be of a temporary nature. The "Authority" would also be directly accountable to local interests, both commercial and non-commercial.

General Management

As we have noted above, there is currently no regulating or monitoring of traffic within Cook Inlet. The Coast Guard "Cook Inlet Pollution Prevention and Vessel Safety Program" dated 21st March, 1991, is a sound attempt to deal with this matter on a voluntary basis. The point is made very clearly in the covering letter from the Captain of the Coast Guard Western Alaska that the contents of the document are for guidance only. The Coast Guard is confident that compliance will be forthcoming from those involved without recourse to regulation by Government. While we understand that the creation or amendment of such regulation would be a ponderous and lengthy process, we do not share the Coast Guard's confidence and believe that absolute compliance will only be achieved by regulation and would recommend that after a brief period as a guideline and further consultation with parties involved, much of the document should be part of a Cook Inlet Regulation.

It is also appropriate to highlight here other advantages that would follow from the creation of a Cook Inlet Harbor Authority or similar statutory body. Currently the funding of Navaids for Cook Inlet is met from Federal resources. Such a system of funding inevitably means that Cook Inlet must compete with other coastal areas for a share of the allocated monies. Priorities are set by bodies whose perceptions of whose needs are greatest may be different from the citizens and operating companies in the Cook Inlet area. While central government funding may need to remain a factor under the light dues levy system, as it currently exists, a harbor authority would nevertheless concentrate influence and could directly fund navaids when considered essential to safe navigation (as in Sullom Voe).

Currently the funding of the operation of any ship assist tugs which may be required at any facility in Cook Inlet would need to be met by the operators of that installation alone or the ships using that facility. This takes no account o the emergency response role such tug(s) would continuously provide to all shipping transiting Cook Inlet. It is relevant here to mention that the large container ships trading to Anchorage have a bunker capacity of 3,000 tons of heavy fuel oil. The escape of one third of that amount caused massive pollution in Sullom Voe in 1978.

A harbor authority could, for example, set charges on all shipping to support the existence of suitable tugs in Cook Inlet.

For information, the port charges levied on a tanker of 44,907 GRT (*Overseas Washington*) berthing at Nikiski Terminal with the master conducting the pilotage is currently NIL.

The same tanker berthing at Sullom Voe would be charged as follows:

Boarding and Landing pilot	$2,846
Pilotage (2)	2,657
Mooring	1,000
Tugs (4 berthing, 2 leaving)	23,940
Port Charges	27,113
Total Costs for the turnaround	$57,556

Central authority light charges are not included in the above. The *Sansinena II* would pay $51,500 whereas she pays nothing at Drift River.

Sullom Voe charges are by no means excessive in comparison with UK tanker terminals

Section 17: Environmental Monitoring at the Sullom Voe Oil Terminal

The monitoring of the Sullom Voe Oil Terminal is carried on at various levels as follows:

1. Government level. Annual sea bed survey at the end of the waste water pipe which discharges to the sea. Monthly reports required on the quality of the water discharged, automatic sampling used. Camera records of smoke emissions from the main flares.

2. Local Government level. Grab samples of the water prior to discharge down the pipe to sea. This is done about once a month, with no warning given. Noise/ smell, etc., checked as and when required.

3. Independent Monitoring. This is by far the most rigorous monitoring of the environment surrounding the oil terminal. The local government (Shetland Islands Council) has powers to control developments and when agreeing to the building of Sullom Voe terminal they “extracted” agreement that a joint oversight body should watch over the operation of the terminal. This body is called the SVA (Sullom Voe Association) and consists of members of the oil industry and the Shetland Islands Council. The SVA has two committees which report to it. The first is SVOSAC (Sullom Voe Oil Spill Advisory Committee) which reports on oil pollution control, and the second is SOTEAG (Shetland Oil Terminal Environmental Group) which advises on the environment. SOTEAG has a budget of approximately $500,000 per annum which is used to observe what effects the terminal is having on the environment.

4. The scope of work is adequately described in the booklet contained in Appendix C. Should more information be required, this can be done separately or in the final draft of this report.

5. The observed effects, to date, are small and limited to:

a. Elevated hydrocarbon levels within 100 meters of the jetties. This quickly drops to background levels with distance from the docks.

b. Tributyltin (TBT) contamination of certain shell fish within about a mile of the inner harbor. This is caused by the anti-fouling paint on the tankers' hulls. This problem is now being addressed at an international level.

c. Smell of hydrogen sulfide from the ballast water treatment system. This is now being corrected by increasing the time the treated water remains in the biological treatment pond prior to discharge and also by adding oxygen using a cascade.

d. Studies are now being carried out on the effects of chemicals added at the oil fields offshore to promote production levels and inhibit corrosion in the production tubing and line pipe to the shore. Water extracted from the oil contains these chemicals.

Section 18: Emergency Use of Anchors in Tidal Waterways

In the event of power loss on a tanker, one action which can be used to stabilize the situation is to bring the ship to anchor and so allow repairs to be carried out or wait until a tug can tow the tanker to a repair yard (there are no such facilities in CI). This is not a straight forward task in situations where there are strong tidal currents or when attempting to anchor in a river with a strong flow of water.

The following test is taken from *Peril at Sea and Salvage*, published by the International Chamber of Shipping:

Use of Anchors

In water too deep for the anchor to reach bottom, lowering the anchor or anchors to about 60 fathoms will reduce down weather progress. The anchor and cable may have the effect of a drogue and should help to keep the ship's head to the weather. It should be noted that recovering 60 fathoms of cable and anchors should be possible as this amount is within the design capabilities for windlasses.

Once the ship is in a water depth where the anchor can find the bottom, use of anchors to arrest the ship should be attempted. If the bottom is sand or mud, it may be possible for the ship's movement to be slowed down or even arrested by slowly lowering the anchor until it begins dragging along the bottom. For larger vessels, the scope should be short at first and later it should e gradually increased as the ship's speed decreases. This action should bring the ship's head into the weather and slow her speed over the ground. The chance of success of using anchors on a rocky bottom is much lower, but nevertheless it should be attempted if this is the only alternative available.

If disablement is limited to loss of steering, careful use of the engines should enable the ship to carry out this operation with a much better chance of success. Also, the engines can enable the ship to maintain a safe position if the weather causes the anchor(s) to drag.

For large tankers over 150,000 dwt, the anchoring system has the capability of stopping a ship with a maximum speed over the bottom of about 0.5 knots and a length of cable of between 6 and 10 times the water depth with good holding ground. For these vessels, when anchored, the anchor systems can withstand a 60 knot wind, without current or waves using an ordinary stockless anchor, or a 60 knot wind, with a 2-3 knot current and waves of less than 20 feet, with a high holding power anchor.

Anchors should be made ready for use at the earliest opportunity. Deteriorating conditions may preclude or delay action later. It should be noted however that severe sea conditions near the Kennedy entrance may preclude such clearing away of the anchors until the ship reaches more sheltered waters within CI.

Any decision to lower anchors should not be clouded by fear that they may be lost if they cannot be weighed later.

It is difficult for a large ship to come to anchor in moving water due to the momentum of the vessel compared with the sea bed. For an 80,000 ton tanker, if the drift rate exceeds 2 knots over the sea bed, anchoring is all but impossible. There is every danger that the brakes on the windlass will fail to grip resulting in polishing of the brake linings and so reducing friction with the brake drum. The "bitter end" which connects the end of the chain to the chain locker will be torn from the bulkhead and all chain will pass over the windlass. This will almost certainly result in damage to the windlass system. If the sea bed is very soft and the anchor is dragged, acting as a chock absorber, then there is a chance. It will not work, however, if the anchor gets a good grip, i.e. rock/ shingle, etc., as the full load will be applied to the chain and so to the windlass system.

Today the anchor, cable and windlass of a VLCC or large bulk carrier must be regarded as an extremely fragile arrangement. As ships have increased in size, anchors have become proportionately lighter, cables proportionally shorter, and windlasses more vulnerable to shock loads. In consequence, the anchoring process must be conducted with extreme caution; otherwise the gear will be carried away.

The anchors of a 542,000 dwt tanker are proportionately only one-fifth as heavy as those of an 18,000 dwt vessel, and the cables proportionately only half as long.

There is no margin for error and in consequence the notion that the anchors (for such ships) can be deployed in emergency situations, is no longer tenable.

In many ports in the world pilots daily use anchors with great skill, still for too many the anchor does not exist. Lack of familiarity of use by ship handlers often breeds similar qualities among those on the ships responsible for working the anchors, with the result that an unexpected order to "let go" will mean the anchor being allowed to run out to the bitter end in a cloud of dirt and rust. Once the order is given, the noise on the forecastle head is such that belated orders to “hold on and screw up at one shackle” are rarely heard.

The ship master must ensure that the deck officer in charge of anchoring understands what is required and especially how much chain to slack out, before he goes forward to stand by. The importance of having a man forward who can handle the anchor and be relied upon to put out the correct amount of chain- no more, no less- cannot be over stressed.

The effective way to use anchors to stop in an emergency is to let go just sufficient chain to allow the anchor to first grab and then break loose and drag. The anchor must no dig in and hold. Should the anchor hang up or too much chain be allowed to run, the momentum of the moving mass of the ship on the relatively small brake on the windlass will either burn out the brake or part the cable in all but a small or moderate size ship. It is vital that the anchor breaks out of the ground and relieves the strain on the brake or chain.

To use the anchors, the vessel’s under-keel clearance should be at least 20% of the vessel’s maximum loaded draught, in order to prevent underwater damage to the ship. The amount of chain used is the distance from the hawsepipe to the bottom. Provided the anchor is correctly worked, and the depth of water does not exceed 120 feet or 1 ½ shackles of cable, the ship will continue along her track slowly losing headway, and can be brought to a controlled stop. This is particularly useful after a loss of main engine or steering gear.

Naturally, many mariners will be concerned that it might be difficult to stop the chain running after letting go because of the ship’s speed over the bottom or the depth of water. This concern is especially prevalent when handling larger ships. It is partly due to lack of confidence, for, as stated earlier, emergency situations are fortunately rare, and until experienced, the ability of the brake to cope with the demands put upon it are naturally suspect. There has, in fact, been some improvement in the braking mechanisms on

VLCC windlasses, including the use of retrofit disc brakes and the installation of combination disc and band brakes. It should, however, be remembered that static friction is three times greater than dynamic drum. The brake has three times as much holding power when the gypsy is stopped, as when it is turning. The secret is to screw up the brake as soon as the anchor touches bottom and the weight has momentarily come off the cable. The anchor digs in as the chain comes tight and is then pulled free from the bottom before the static friction is overcome, dragging along the bottom as the flukes ball up with mud.

The arbitrary maximum depth of 1 ½ shackles is based upon the deepest water one could expect to drop an anchor in an emergency in a large ship and still be able to retain control of the weight of anchor and cable. It should, therefore, be treated with caution and, where possible, the anchors should be walked back to about 15 feet (4.6 meters) from the seabed under power and then dropped. This can only be done when time allows. Finally, if dragging the anchors cannot stop the ship before grounding and if the bottom is soft and not likely to damage the hull when the ship goes aground, slack more chain when on or two ship's lengths from the shoal, so that the anchors are laid out ready to help pull the ship back off. The timing of this action will depend on the ratio of the ship's length / length of anchor cable.

The following flow diagram has been taken from a publication on pilotage and outlines emergency anchoring procedures.

Part D

Section 1: Use of Tractor Tugs in Ice Conditions

Cook Inlet Pipe Line and West Coast Shipping managers have made several statements to the effect that tractor tugs would be useless in ice conditions. This is an important point and I have contacted European ports where ice is common and they also use tractor tugs. The following points are the results of the investigations:

1. Voith water tractor tugs use cycloidal propulsion which, for the non-mariner, uses two vertical propulsion units not unlike two egg whisks, rotating in different directions. The blades change pitch while rotating and so impart movement to the ship. The units are mounted under the hull some $1/3^{rd}$ of the way from forward and have protective mounting bars around the units as well as a plate underneath which clearly is meant to safeguard the units should the tug touch bottom. The net result is that these tugs can operate in worse ice conditions than can standard tugs or any other ship with normal propulsion system.

2. There are three German ports where heavy icing is common in winter: Bremen, Bremerhaven and Hamurg. The tug operators in these ports are Hapag Lloyd and URG, and they have vast experience with Voith tractor tugs in these ports. They state that the tractors are the only tugs that can operate in severe ice conditions which prevent the use of conventional twin screw tugs

URG states,

"Our Voith equipped tugs provide reliable and problem-free service in heavy ice. In contrast to our tugs with Kort-Nozzle props, neither the propulsion units nor the prop blades experienced the slightest damage. This was proved subsequently during the routine dry docking of our vessels."

Hapag Lloyd states,

"It can be established, in so far as passage making in ice with Voith tugs is concerned, that there are no difficulties. In contrast to screw prop tugs, no propulsion element was damaged."

3. Furthermore, ships fitted with Voith propulsion units are used as ice breakers. The German equivalent of the USG uses such vessels to maintain navigation for merchant shipping.

Mr. Mueller of the engineering department states,

"Icebreaker *Buffel*, fitted with Voith units. With respect to the direction of rotation of the opposite turning coaxial propellers, our experience supports the view that these units are decidedly more effective in shedding ice than propellers turning conventionally. The propulsive values achieved of the Voith units are also better. As far as judgment regarding the maneuverability of these units it can be said that they are incomparable.

Voith icebreaker *Bison* and Voith tug *Nordmark* operate in the upper Elbe regularly in ice breaking.

4. There is no doubt in the minds of these tug operators and the manufacturers of the Voith propulsion units that a tractor tug designed to cope with the specific needs and environmental conditions of Cook Inlet can play an effective role in the area during heavy ice conditions.

5. We would repeat our recommendation that a study be commissioned to further study the type, design and effectiveness of tractor/ conventional tug utilization in Cook Inlet waters.

Section 2: Author’s Response to Received Comments:

Note:

a. Where the author accepts the points made by the contributors, these have been included in the text of the final report.

b. Where a general comment has been made, there is no need for a reply.

c. Where the author disagrees with a received comment, the reasons are given below.

A. Marathon Oil Company, Mr. W. Watson

1. Failure to meet with Phillips/ Marathon with regard to LNG shipments from Cook Inlet.

Our brief from CIRCAC was to confine our study to the crude oil handling facilities within Cook Inlet, as these were seen as the principle threat to the environment. In our experience, and that accepted worldwide, is that LNG and LPG carriers are the safest bulk ships afloat due to the fact that naval architects and cargo systems designers appreciated that they are working with a potentially dangerous cargo and have accordingly built ships to the highest safety standards. The facilities to load the cargo are similarly designed and so we saw no need to press the RCAC to include the LNG shipping operation. The safe navigation of such vessels is no different from any other large vessel navigating in CI.

2. Risk Assessment, Cumulative figures inappropriate

I would have thought that the authors would want to make the overall picture clear to the general public. The average Alaskan wants to know what the total risk is, not just individual parts of the situation. It is my opinion that the lack of cumulative figures is a weakness of the report and, since the reported spill record is quite good up to this point in time, I see no reason why it should be withheld.

3. Cook Inlet/ Sullom Voe Comparisons

It was never the intent of the report to recommend a mirror image of Sullom Voe be inserted into CI. However, many of the safety procedures used are, in the main, used at all other European ports handling crude oil tankers. The authors have used their discretion not to recommend what is done at Sullom Voe where it is considered inappropriate, e.g. radar coverage, weather forecasting, numbers of tugs.

The average cargo shipped from Sullom Voe is only 600,000 barrels although there is the occasional large shipment. Accordingly, most of our tankers are in the 80/ 100,000 ton deadweight range, which is similar to the crude ships trading in CI. There is no doubt, however, that the SV traffic figures are much larger and our harbor area is only approximately 12 miles in length. The problem of scheduling tug operations is an important one in an area such as CI with its numerous facilities over a wide area. However, it is not impossible, and in the major port complexes such as Rotterdam, ship movements are tailored to tug availability. One role of the proposed area traffic center, possibly I the Kenai area, would be to coordinate such ship movements.

4. Environmental Monitoring

The author was asked what monitoring was done at Sullom Voe and this information was given n good faith. It was not the intention it be recommended for CI, but again, the areas of concern will be similar: discharged water quality/ air emissions/ hydrocarbon sedimentation/ anti-fouling paints, etc. To what degree/ how often/ by whom/ what pollutants will of course differ in CI and will need to be addressed. I cannot emphasize too strongly the need for independent monitoring, the results of which are assessed by a competent panel of experts independent of Federal/ State and oil company control. Only in this way will the public be assured of the extent operations are effecting the environment. Be in no doubt that they are, the degree of which is the important matter. At SV the effects are considered acceptable, providing there is no chronic build up of pollutants. For guidance I have included as Appendix L a copy of the 1991 monitoring program and the budgets for future years. This will give readers a feeling for what work and expenditure we consider necessary in Sullom Voe to check on the effects of the terminal on the environment.

B. Offshore Systems – Kenai, Mr. F. Newton

1. Additional layers of bureaucracy are not required

I presume Mr. Newton is referring to recommendation 12 where it is suggested that an independent harbor authority/ administration be set up to ensure the overall safety of navigation n CI. If this turned out to be a manufacturer of red tape with little practical control of shipping, I would agree with Mr. Newton; but it is certainly not the case in the rest of the world where such authorities exist. What we envisage is a transfer of some of the responsibility from the USCG to a harbor administration rather than pile on extra bureaucracy. What we wish to see installed is a skilled group of people commercially managing the whole harbor area to the betterment of safety. The USCG, we are quite sure, as a federal body, would remain the overall authority, but with some transfer of some of their responsibilities. There are two main benefits as I see them. The first is to raise funds through user charges and invest that money in navigational aids, etc. for CI. In this way the tax payer is not subsidizing the oil industry and the addition of/ replacement of equipment is not dependent on outside funds which may have perceived higher priorities elsewhere. Secondly, there is someone at the top holding all the strings with regard to shipping in the inlet. There is coordination among pilotage, towage, navigational aids, traffic routing, local interest groups, etc. I fully appreciate that this will affect the present responsibilities of the USCG, but given the will, there is a way on this matter. It could be the case that the USCG plays a role within the suggested harbor administration.

C. Ocean Marine Services, Captain F. Staplemann

1. Ice damage/ shoal constraints restrict use of tractors

The matter regarding ice damage is addressed at the beginning of this section. I am a bit puzzled at the comment on the draught of the tug as its own draught will be much less than any of the large ships with which it is intended to work. The draught of a Voith tractor tug of length 121 feet, beam 37 feet and bollard pull of 45 tons is 17.75 feet and this is a little more than would be expected of a conventional tug due to the protective plate under the Voith propulsion units. However, unless working with a large barge in shallow water, I can see no restraints on normal ship operations.

2. Spread of oil on moving water

Captain Staplemann is quite correct when he advises that the oil will of course moved down current. However, it also spreads out in exactly the same way as oil on still water. In other words, the angle X quickly becomes large with some distance from the spill source. The weir skimmers will have to be placed quite close to the spill in order that oil does not pass the outer end of the collection booms. If this can be done safely, all is well, but if there is some danger to life by approaching the spill at close quarters, then oil could bypass the extremities of the booms.

D. Cook Inlet Pipe Line Company, Mr. D. Gregor

1. Mixed Moorings

The section on mixed moorings on page I-3 states that mixed moorings should be avoided but if used, the crew must try and achieve equal tensions, etc. It is my opinion that this is quite impractical and dangerous to all concerned. You cannot tell the tension on a wire due to its very low elasticity (approximately 4% at break). OCIMF guidelines give no latitude on these matters and it again stressed that such practices should be strictly forbidden.

2. Ballast Reception Facility

Captain Anderson, during his visit to CI, was advised that the ballast facility was non-operational. If it is now the case that the system is up and running then, of course, we will accept Mr. Gregor’s statement. The point on ballast discharge before loading remains valid; as well as imprudent deballasting while in the early stages of loading. The ship must, at all times, have propeller tips immersed and the ship in a suitable trim for safe departure from the berth in an emergency.

With reference to the capacity of the ballast reception system, the CFR 33, part 158 states that the terminal must be able to accept:

a. 11 tons of sludge from fuel/ lube oil purifiers.

b. 11 tons of oil bilge water

c. 30% of the deadweight tonnage of the largest ocean going crude oil tankers loading at the terminal. If an 80,000 ton ship is used, 30% is equivalent to 130,000 barrels and so it is still thought that the 90,000 tank is too small.

3. Platform Fire Fighting Equipment, Ship Fires

There is simply not enough capacity and number of monitors to effectively cope with a ship fire affecting the deck area. It is more than probable that the ship, as a result of explosion, will be unable to fight the fire herself due to no motive power for the pumps or the crew are helping injured colleagues. The present platform equipment is not in the right area of magnitude to cope with a major fire until other help arrives on scene.

6. Terminal Supervisor to remain on platform

The suggestion is that the platform operators be directly supervised by a senior member of staff. This may well be someone other than the Terminal Supervisor, but whoever it may be he must be fully acquainted with tanker operations to such a level that he/ she can converse with the tanker master at peer level. Only in this way can tanker mal-practice be recognized and corrected. The OCIMF guidelines did not envisage such a situation where the operators were cut off from their supervisor by a hostile stretch of open sea.

7. Removal of ship from berth

The OCIMF guidelines do indeed provide for such an eventuality, but the point still is, don't cut the ship loose unless she can safely navigate away from the berth and tackle the situation herself. Imagine the situation on board where the crew is fire fighting or searching for injured staff when they look up to see themselves drifting down current towards the shore. The ship has to be contacted to ensure she is ready to vacate the berth.

8. Minimum berthing deadweight

I don not understand the figure of 50 tons given by Mr. Gregor. What w mean is that there should be a minimum percentage of summer deadweight made up of ballast/ fuel/ fresh water and stores which will ensure propeller tips will be immersed and the ship in a suitable trim for safe navigation. A figure of 35% is recommended which means for a ship of summer deadweight of say, 100,000 tons, should carry not less than 35,000 tons of ballast/ fuel/ fresh water and stores. Displacement tonnage could also be used and indeed it is becoming more common to do so.

9. Pilots

We do not suggest that because an individual becomes a member of a professional body which provides pilotage service he is automatically somehow more gifted at ship handling than someone who is not. What we do firmly believe is that it is important that whoever is licensed to pilot must meet the highest standards of training that is mentioned in this report and gain a wide experience and then be thoroughly examined by a body which must include his peers, senior pilots for the area in question. He/ she must then regularly and frequently exercise these skills he/ she gained and indeed, hopefully improve on them. It is most unlikely that a ship master could satisfy these requirements and continue to ply his trade as a ship's master. It is also a fact, that by the very nature of their operation and individual relationships, pilot members of an association continuously monitor their colleagues. This is another good reason why ships carrying high risk cargoes would be piloted by dedicated pilots. Ship masters with pilotage endorsements conducting their own pilotage do not serve under the same peer scrutiny from job to job and any particular failing they might hae would not be brought to their attention by a peer.

E. West Coast Shipping Company, Mr. E. S. Mealins

1. Ballast discharge

The comment on the ballast capacity ashore has already been covered before. Mr. Mealins suggests that in the summer time his ship may discharge ballast ashore before loading, and again it is my opinion that this should be forbidden for exactly the reasons Mr. Mealins gives for winter time loading.

2. Fire fighting

All ships are approved by their flag states to comply with SOLAS (Safety of Life at Sea) convention which covers, among other things, fire fighting. While in deep sea, the crew has only themselves and their equipment to cope with a fire and so the list of equipment is indeed extensive. In the case of tankers, a serious fire can have severe consequences to ship and crew and this risk is much increased while loading or discharging. There is thus a requirement for the shore facility to assist/ stabilize the fire until all the emergency services can assist. It is the case that the ship may be helpless to fight the fire if there has been a serious incident and the terminal should be equipped accordingly. Fire fighting tugs are common in Europe and they have massive capacity as I have detailed before. They are without doubt effective tools and can lay down large amounts of foam on the deck or anywhere on the outside of the ship.

It is not the intention to have the tug remain alongside the ship while loading. This is against OCIMF guidelines and the tug, if required at Drift River, would have to remain well clear of the ship. Only when cargo/ ballast operations were suspended would the ship assist to push up/ fire fight/ unberth, etc.

3. Garbage disposal

These must be available to the ship master by international convention. Arrangements should be in place in case they are required.

4. Docking without tugs

It is a pity Mr. Mealins has to resort to sarcasm to make his point. I am glad to report that at Sullom Voe we have never dented anyone's hull as the pilot always checks with the master the ship's pushing area on the hull. These are usually marked, by the prudent ship owner, with a vertical white line. The concept that tugs provide no assistance or measure of safe navigation while berthing is, quite honestly, ridiculous and I am sure Mr. Mealin's comments are driven more by awareness of tug costs rather than the overall safety of the operation. The question must be asked, what would happen if the ship lost power at a critical moment? This is not an uncommon occurrence. They use tugs on the Mississippi River where the currents are predictable, so why not in Cook Inlet?

5. Operating parameters

If they are already in place then why are they not mentioned in the operations manual? It is recommended they be so included. The point on minimum berthing deadweight is understood. Displacement is the better parameter, but is often not available in shipping detail lists such as Clarkson's or Lloyds. Ships do change their deadweight tonnage, but tankers rarely do and, anyway, the figure of 35% is arbitrary and can be changed if the ship fails to meet the trim/ minimum draft requirements.

6. Navaids/ Traffic schemes

The USA is one of the very few countries where the local tax payer funds the safety of navigation of merchant shipping. In most other countries user fees on the ships pay for such equipment and services; this is reflected in the charter rates the ship owner is able to extract from the cargo owners. Where Federal or State funding is the sole source of funding, money is uncertain and can be delayed or transferred to other spending. It is the ships that use the service, why should everyone else have to pay? This method is an indirect subsidy to the shipping and oil industries and would not be tolerated in other countries.

The routing of ships comes under the International Maritime Organization and they publish a manual on the different schemes and how they are implemented. Publication NO. 977 84.03E, I attach a general description of such schemes that are available as copied from the publication. The only scheme where fishing is not permitted is the full blown traffic separation scheme which normally only exists in heavy traffic density areas such as the English Channel or similar sea ways. Other traffic routes allow the normal collision avoidance rules to be observed and this is what is recommended for CI, although more in depth study is required. The benefit is that the small boat owners know if they are in or near a route for large shipping, then they will have to be very careful what they are doing and keep a good lookout for such ships. Unless I am otherwise persuaded, a two traffic separation scheme with a prohibition on fishing, etc., in the area is not warranted for CI.

7. Pilots

The point should be made who is/ are the pilots Mr. Mealins is talking about. It is the master/ chief officer of the ship concerned and not normally a member of the Southwest Association. The policy of only calling in an association pilot if and when conditions are poor is a bad one. Pilots need constant practice at berthing at a jetty to keep up the level of their skills. The ship owner will only take such an outside pilot when there is no alternative as he sees it as a cost affecting his bottom line profitability. The rules should be simple, when there is ice an association pilot should remain on board at all times. The point about decisions being taken by port officials not "having a stake in what is being done" could be taken as a point of benefit. In other words, they are free from commercial influences which could cloud decision making on matters of safety.

These comments appear to have been written on the premise that only one dedicated ship, the *Sansinena II*, operated by one company, West Coast Shipping, with a master and mates that will never change will ever be permitted to uplift cargo from the Christy Lee platform. If that were indeed the case and the master and mates are trained, examined and experienced to the highest standard we recommend on page 86 of our report, we would agree that the Christy Lee platform is unique in terms of pilotage and could be treated as such, but only if all of these considerations are applied without deviation. We think it most unlikely that any operator would accept the kind of restrictions that these requirements would demand.

Mr. Mealins also covers in the first paragraph of his section 12 comments that there are platform and shipping company policies requiring 2 pilots to be on board during ice conditions. We were not aware there were written procedures for both the ship and the platform specifying the requirement of Christy Lee. However, the policy may be somewhat confused as the second paragraph would indicate the provision of a second pilot should be determined by a person making a subjective judgment and "doing the right thing when it has to be done." We remain of the view that procedures should be established to trigger off an experienced, licensed pilot. For the sake of clarity I will have to provide that age old legal definition of a pilot. "Pilot means a person, not belonging to the ship, who has the conduct thereof."

Mr. Mealins' comments on numbers of ships which load at Christy Lee and which may be conducted by Cook Inlet pilots, are somewhat confusing. There are about 24 ship visits, i.e. 48 acts of pilotage per annum. Anyone licensed to pilot ships to or from this berth must be suitably trained and experienced, then examined by a body which must include, but not exclusively, senior licensed pilots for the area. The ship handling skill gained must be frequently and regularly exercised. Additionally, familiarity with a particular berth must be maintained. It is our view that such a regime can only be unswervingly adhered to by an organized and regulated body of dedicated pilots. The existing regime is only acceptable if all the considerations mentioned earlier in these comments are satisfied, and this is most unlikely. We consider this unlikely because we are confident that changes of characters and ship's personnel must take place from time to time.

We can make no comment on Mr. Mealins' penultimate paragraph on our section 14, but obviously, when warranted, appropriate disciplinary action must be taken by the authority responsible for the safe movement of shipping through Cook Inlet. The statement made in the final paragraph of section 14 comments indicates a complete reversal of roles to the usual ship master/ pilot relationship. What is concerning here is if that experienced Captain is on leave or resigns, who is then the "expert"? This reinforces our view that these ships must be piloted by a local group with a large enough member group having experience and the required training.

In conclusion, Mr. Mealins' comments, not surprisingly, either support or do not address the parts of this report which will not incur costs to his company. We have not cited the detailed training requirements and experience requirements and level of ability demanded by the marine committee prior to licensing someone to pilot to/ from the Christy Lee.

8. Tugs

In addition to what is given in part D, section 1, of this report the use of current is not the same as using a tug. A tug can give thrust in what direction the pilot so requires, especially if it is one of the tractor types. In the event of a ship malfunction the tugs can assist the pilot in recovering the situation or hold the ship until return of control is achieved. Tugs can also rectify a situation where there has been a misjudgment on the part of the pilot or a squall catches the ship while in the final stages of approach. Why take my word for it? We can think of no other crude oil loading berths worldwide where large crude carriers berth without tugs, current or no current.

9. Fendering

We fully agree with Mr. Mealins' comments on fendering; they come from bitter experience, I have no doubt.

10. Escorting

The point of commencement of escort would not necessarily be in the area of Cape Elizabeth. The pick up/ escort from point would be decided after detailed studies take place. This would normally be just before the ship enters an area where any loss of power or steerage could result in a grounding or collision with other harbor users/ jetties. If you take PWS as an example, it is my opinion that tug escorting after passing Bligh Reef outward is unnecessary as the ship is in open water.

With regards to anchoring, yes of course it can be done, providing the ship's speed over the bottom is within limits as described in this report.

11. Regulation and Management

The USCG has no powers, as far as I know, to raise revenue to finance the safety of navigation in CI. Accordingly, it is recommended that the USCG delegate some of their powers to such a harbor administration. It is not, nor has it ever been, the recommendation of this report that another layer of regulation be placed on shipping companies within Cook Inlet. The rules would be much the same as present plus some extra ones to assist the overall level of safety. For example, the Sullom Voe harbor authority does not have its own rules, it merely enforces those of central government, international conventions and the industry guidelines lain down by OCIMF and other similar authorities. The point is that the harbor master is the central controlling figure and is not influenced by outside pressure groups.

Guidelines are not mandatory, and if an incident occurs after they have been ignored it will only result in the remark, "I am not obliged to follow guidelines" and any disciplinary action will most likely fail. Perhaps this is another reason the USCG only made them "guidelines". I have a higher regard for fishermen than does Mr. Mealins, but I agree that it is important to report breaches of any regulations to the fishermen's association who must be represented on the harbor advisory committee which is set up to advise on regulation and feedback information to/ from the harbor users. Despite whatever such a committee may advise, the decision of the harbor master is final.

12. Funding

If funding is available why has it not been spent on extra navigational aids and other studies on the safety of navigation? Everyone seems to agree that more work is necessary and extra equipment is required. The Federal budgets are very tight at the moment and there is great demand for what money is available. It is recommended that the CIRCAC fund a study to ascertain what legislation would be required to establish such a port administration.

F. Tesoro Alaska, Mr. J. Meitner, Spill Prevention Coordinator

1. Spill at the dock

I have no doubt that the jetty staff are very aware, but this should be included in order to “cover all the bases” in the C-Plan. It is not a case of adding a redundant section; it is an important area and its inclusion will only enhance the cover/ reputation and effectiveness of the plan.

2. Summer weather/ sea conditions

I am sure the weather and sea conditions are very close to that of Shetland. The water temperature in Sullom Voe, in summer, is between 50º -54º with similar air temperatures. What we never have is ice, thanks to the Gulf Stream. Long may it last.

3. Jetty Supervisor

I cannot imagine why the supervisor should be forbidden from carrying out spot checks on the ship. If that is the case the checks could be carried out by the jetty operators, given suitable training. The jetty operators at Sullom Voe do such checks and sample inert gas and ballast quality.

4. Ballasting

This section, on page 50, deals with ballasting of the ship, not with deballasting ashore. I think there is a misunderstanding on Mr. Meitner’s part.

5. Tension Winches

This prohibition on the use of such winches is not mentioned in the section on tending mooring lines, so it is not the text of this report that requires correction. I will add that, "it is understood that such winches are not allowed, etc…."

G. Kenai Pipe Line Company, Mr. O.E. Jackson

1. Docking details

These should not be advised to ships only after chartering has been agreed with Chevron, San Francisco. These parameters should be published to all mariners as there is no reason why they should not be widely known. Under-keel clearance, etc. are important data items for potential users.

2. Wind parameters

The figure of 35 knots should be included in the text of the operations manual; I cannot understand why it is not given. What I would add is that considering the size of ships that can be handled at this jetty without tugs, 35 knots is, in our opinion, too high a wind speed for a safe approach to the jetty.

3. Pilots

Mr. Jackson does not say to what extent the pilots did or did not contribute to the incidents he relates. That is rather like saying 99% of people who die do so in bed, therefore you are advised to sleep on the floor. There is no doubt that a large proportion of incidents in near shore waters occur with a pilot on board, but it must be said that the pilot is the servant of the ship master and many incidents are outside the control of the pilot. The fact that there was a pilot on board made no contribution to many shipping accidents.

4. Tugs

Credit was given for the skill of pilots in the report. But to say that the currents are predictable and therefore a vessel can safely berth is stretching credibility a little far. I have already mentioned the role of tugs to assist during a ship control failure while docking. My point is that berthing without the use of tugs is taking, in my opinion, an unacceptable risk and would not be permitted at any other crude oil installation, current or no current.

H. Ms. Mary Jacobs, PROPS Chair, Dispersants/ Burning

A FAX from the above has just been received with the request that its questions be included in the report.

1. In-Situ Burning

This method of removing oil from the surface of the sea has never been popular in Europe and indeed I am unaware that it has ever been used during an actual spill. It has been tested, however, in test tanks. The main arguments given against such a course given are:

a. “All you are doing is transferring pollution of the sea to pollution of the air.” This is not quite the case, as the heat does destroy a large portion (75%) of the oil but none-the-less the smoke is quite horrific and the pres will have a field day.

b. “In order to burn the oil, you have to boom it anyway, so why not try to recover the oil instead of burning it?” This is indeed the case and is a powerful argument. If the weather is good enough to keep the oil inside the boom, then it should be good enough to skim the oil into tankage.

c. It is often very difficult indeed to set the oil alight as, in a short space of time it loses most of its light ends due to evaporation. The use of heli-torches, etc., normally used in fighting forest fires, is often insufficient to set the fire going. If it does light, then often it will extinguish itself due to the cooling effect of the sea and wind.

d. The operation requires the use of special booms to corral the oil and yet be fire proof when burning commences.

e. Not all the oil burns, and you are left with a thick sticky mess which can only be recovered by belt skimmers/ weir skimmers or grabs. Approximately 25% of the oil will remain n this condition.

f. Great care is required to ensure that the burning oil is not a hazard to shipping or that it drifts ashore and starts a fire in the woodlands, etc. It is quite out of the question to allow such burning in a harbor area where there is even the remotest risk that the fire could spread to tanker jetties or any other harbor installations, for that matter. To this extent Cook Inlet is similar to Sullom Voe where burning does not, nor ever will, appear on the option list. I cannot advise too strongly that this oil removal option be discounted.

2. Dispersants

The writer has now had some 20 years' experience with dispersants used both offshore and in harbor areas. Over the last 10 years great advances in chemistry and application methods have been made and the latest systems available are now in use in Sullom Voe. Used correctly, they are a valuable tool in the armory of the oil spill control team.