THE DEVELOPMENT OF INSTRUCTIONAL MATERIAL TO FACILITATE LONG-TERM RETENTION OF OPERATING PROCEDURES FOR OILSPILL COUNTERMEASURES EQUIPMENT

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by

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ABSTRACT

The development of instructional material for operators of marine oilspill countermeasures equipment is decribed. The purpose of the material was to facilitate the recall of procedural tasks initially learned in courses offered by the Oilspill Countermeasures Training Unit in St. John's, Newfoundland.

Once the need for new material was demonstrated, the audience characteristics and tasks were analyzed. A printed manual was selected as the most appropriate medium. A Preliminary Version was produced, which was evaluated by content and audience specialists, and a sample of the target audience. It was also reviewed by the manufacturers of the equipment. Subsequently a final 1981 Edition was produced.

A panel of experts rated the final version good to excellent. Pilot testing indicated that after extended periods of no practice or exposure to the specialized equipment, target audience representatives could successfully answer questions on operating procedures through reference to the manual. The continued use of the manual was recommended.

ACKNOWLEDGEMENTS

I should like to express my gratitude to the Eastcoast Spill Response Association, which funded the development of the Oilspill Countermeasures Training Unit courses and the manual, and in particular to Mr. Alan Cormack, its first chairman. I am also deeply grateful to Don Balsom, David Grenville, Bill Ryan, and Jack Strong of the OCTU group.

To Dr. Garfield Fizzard and Dr. Ted Braffet I should like to express my sincere thanks for their guidance, supervision, and perseverance. Finally, I commend Mr. Michael Claire for his artistic contribution to the design of the final manual.

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CHAPTER ONE: INTRODUCTION

General Background

In the fall of 1978, a number of major oil companies were preparing for exploratory drilling in the offshore waters of Newfoundland, Labrador, and Nova Scotia. Sporadic offshore drilling activity had occurred in the region during the previous ten years, but 1979 was expected to see a concerted effort. This promised, if successful, to bring a considerable boost to the economies of these provinces, but it also raised the possibility of serious oil spills on the valuable fishing grounds which exist in the same area.

At the same time as east coast exploration activity was increasing, the oil companies exploring in the Beaufort Sea were developing plans to ship oil from that area to markets in Eastern Canada and the United States of America. The oil would be carried in special tankers, using a route through the Northwest Passage to Davis Strait, then southward along the Labrador coast and past insular Newfoundland to their destinations. Such tankers would also be a source of risk of oil spills in the region.

In 1978, St. John's was already a centre of Canadian expertise in oilspill countermeasures. The Marine Emergencies arm of the Canadian Coast Guard (CCG) maintained a considerable depot of equipment, and stationed a small cadre of trained personnel in the city. It was also in the process of acquiring some of the newest European equipment for combatting offshore oil spills.

In September of that year, the Centre for Cold Ocean Resources Engineering (C-CORE) at Memorial University of Newfoundland (MUN) received a request for information on training programs for oilspill countermeasures equipment operators. The request came from a company in the North-west Territories which was providing a reponse team in that area. Coincident with that request, the oil companies operating on the east coast were planning how best to fulfill their obligation to federal and provincial governments to be able to deal effectively with any spill resulting from their activities. An industry co-operative was being discussed, which would buy equipment and maintain a reponse capability. This group would also need to train equipment operators (Grenville and Strong, 1981).

Discussions took place involving four local agencies: CCG Marine Emergencies, the College of Fisheries, Navigation, Marine Engineering, and Electronics (the College), and two groups within MUN, the Extension Service and C-CORE. These discussions resulted in the submission of a proposal by C-CORE to the Eastcoast Petroleum Operators' Association (EPOA), for funds to develop a training program for oilspill equipment operators. This program would be implemented through an initially informal group, made up of members of the four organizations, to be known as the Oilspill Countermeasures Training Unit - OCTU.

One particular aspect of the proposal was the creation of reference material for the trainees, for use both during the course and, more importantly, to assist them in later recalling the operating procedures. In November, the author was engaged by MUN Extension Service to develop the material.

The OCTU Courses

The first course to be developed was designed to teach the basic operation of a variety of pieces of equipment used to combat an oil spill. Existing equipment is usually

considered to be for use either offshore, that is in open water subject to ocean waves, or inshore, in sheltered waters such as bays and harbours. The concentration of the first course, "Offshore One" was on the offshore equipment, but the inshore equipment was discussed briefly. A complementary "Inshore One" course was foreseen, which would have the opposite emphasis. An "Offshore Two" course was also envisaged, which would deal with the offshore equipment in greater detail.

The Offshore One course was one week in length and heavily oriented toward practical, "hands-on" instruction on the actual equipment. Instruction was to be done by staff of the College and CCG. Representatives of other organizations were to be invited to give instruction in general matters concerning oil spills, but the relative time allotment was very small compared to the main activity of teaching the operation of the equipment.

Broad Specification for the Material

The initial requirements for the material were drawn up by the OCTU group (Balsom, 1978, Note 1). In summary, these were:

Content: offshore and inshore oilspill countermeasures-equipment operation, and some background on oilspills and environmental aspects, in line with the courses being developed;

Purpose: to provide reference material for use by trainees during and especially after their course; and

Schedule: a useable preliminary version to be available for the first course in early summer, 1979.

The author was to develop the material from scratch with minimal supervision other than of a project management nature. The OCTU group's major concerns were that the material should be of high quality and available in good time and within budget.

The concept of "a manual" was inherent in the original OCTU proposal. Nevertheless, it was felt that this conclusion should be rewiewed in a systematic fashion, to ensure that this was the most appropriate solution to the basic problem: the necessity to provide a means to facilitate the retention of the operation of oilspill countermeasures equipment, learned during a course of instruction but without follow-up practice.

CHAPTER TWO: THE NEED FOR MATERIAL DEVELOPMENT

The Need for Material

The purpose of the initial OCTU course was to train a group of persons which would then be available, in the event of an oil spill in the region, to operate the variety of equipment required for an effective countermeasures operation. They would work under the supervision of oil company or CCG personnel. The trainees would have five days of training on the equipment, after which they would return to their usual employment (Grenville and Strong, 1981).

A number of sources of trainees were discussed in the early stages of the project. These are explained in detail in Chapter Three, but it is relevant to note that although many trainees were expected to have some experience of the sea or the marine industry, none were expected to have any access to the oilspill equipment, other than through the course and any refresher training that might be arranged. Thus the primary requirement for the material was to facilitate retention and recall of the course content, which would normally be rapidly forgotten.

There are two concepts of the mechanism by which forgetting occurs: interference and trace decay (Adams, 1967; Schmidt, 1975). Very briefly, interference theory holds that learning a task other than the one primarily under consideration causes forgetting of that primary task. If the secondary learning precedes learning the primary task, interference is <u>proactive</u>; if it follows, interference is <u>retroactive</u>. Trace decay theory states that forgetting is a purely time-dependent function.

The tasks which the material would be covering were primarily motor skill procedures. Most of the research on long-term retention of motor skills has focussed on the parameters of retention, rather than the the mechanisms of forgetting, and therefore there is no concensus as to which of the two theories is the primary cause. In a major review of research on the retention of motor skills, Schendel, Shields and Katz (1978) concluded that there was no real evidence for trace decay, and that interference is unlikely to be significant unless the other learning is closely related. Nevertheless, people do forget, as research invariably shows (Schmidt, 1975), and indeed as common knowledge indicates.

Research has indicated that there are considerable differences between the retention of continuous task skills and of procedural tasks. A continuous task (also called a perceptual-motor task) is defined as a task which involves repetition of movement patterns which have no discernible start or finish, such as steering an automobile (Adams, 1967). A procedural task was defined by Schendel et al (1978) as a fixed sequence of discrete tasks, which themselves have defineable start and end points, and are of short duration. Changing automobile gears with a manual shift system was their example. Another example would be preparing and starting a piece of machinery.

In general, research has shown that continuous task skills are retained very well over considerable periods (up to two years) in several types of tasks, such as tracking (Ammons, Farr, Bloch, Neumann, Dey, Marion, and Ammons, 1958) and balancing (Roehrig, 1964). Adams and Hufford (1962) found that a ten month interval of no-practice did not degrade continuous flight-control responses.

Conversely, procedural task skills appear to be forgotten very quickly. Ammons et al reported proficiency losses of up to fifteen per cent over one day, and fifty to

seventy-five per cent over periods of six months to a year. An interval of two years resulted in losses of sixty to ninety per cent, depending on the original level of mastery. These types of results were borne out in a number other studies (e.g. Mengelkoch, Adams, and Gainer, 1971; Grimsley, 1969). Schendel et al reported a number of US military studies which support the same generalization.

A preliminary review of the skills to be trained in the OCTU course revealed that they were mostly of a procedural nature. There were very few continuous motor tasks. Furthermore, the discrete elements of the procedural tasks were not complicated in themselves. Thus the goal for the material was seen to be the facilitation of the retention of (or, in view of the findings on the degree to which skills are forgotten, virtually re-instruct) the procedural tasks involved in operating the equipment.

Alternative Solutions

Three alternatives were identified as being theoretically capable of achieving the goal: retraining, practice on the equipment, or self-study of instructional material.

Retraining. This was identified as being possible through a follow-up course, Offshore Two. However, this course was not foreseen as being for all those who took the first course. Actual refresher training was seen by OCTU as an impractical solution, for reasons of cost and work-load on instructors, since the frequency would need to be quite high if the skills were to be maintained at an acceptable level.

Practice Sessions. Since the equipment concerned is large and heavy, special arrangements would be required to make it available for practice. Such arrangements were considered impractical, chiefly on cost grounds.

Self-Study Materials. It appeared that, if self-study materials could provide the necessary instruction, they would be the most practical solution.

Richardson (1967) concluded that mental practice of procedures could significantly enhance the retention of procedural motor tasks. Other research (McAllister, 1953; Holding, 1965) has shown that verbal cues can also improve the maintenance of procedural task skills. Finally, Grimsley (1969) found that training personnel in a 92-step procedure

was equally effective using the real equipment or a drawing with a high degree of functional similarity. Thus it appeared that self-study material which contained verbal/textural cues and visual representations ought to be effffective at maintaining the skills taught in the OCTU course when used to promote mental practice of the procedures. This supported the OCTU group's original concept, and so the solution of providing the trainees with self-study materials was adopted.

Alternative Sources of Materials

Since the cost of developing new materials is inevitably higher than either using existing material unchanged or adapting material from other sources, the suitability of available materials was assessed for the purpose at hand. Three sources of material were identified: published literature, other courses, and the equipment manufacturers.

Published Literature. Although there is a considerable body of literature generally concerned with oil spills, it is almost entirely of a scientific nature, or is informational but not specific. Searches of relevant indices

revealed only one item of a pedagogic nature. To quote the publication itself, The Basics of Oilspill Cleanup:

> "...is designed to provide basic information to the public at large and to those persons who may actually have to deal with the cleanup of an oil spill, although it is not intended to serve as a field manual."
>
> (Fingas, Duval and Stevenson, 1979, Foreword)

The content of the book is both general (in terms of equipment) and specific (in terms of the theoretical apsects of oil spills). Whilst it provided interesting and useful background reading, it was judged to be of little direct value, either for adoption or adaptation. The main reason for this judgement was that the book contained no information on the actual operation of the equipment.

Materials from Other Courses. There were three oilspill countermeasures schools in English-speaking countries. Two were in Texas and one in England. Both Texan schools, at Texas A&M University and Texas A&I University issue manuals to their trainees, and copies of each were obtained for evaluation (Texas Engineering Extension Service, 1975; Texas A&I University, undated). Although differing greatly in presentation, both contained a little information on every

aspect of oil spills, and were apparently designed for those responsible for the management of a countermeasures operation. Furthermore, both concentrated on nearshore spills and associated equipment, and did not cover the offshore equipment which was to be fundamental in the OCTU course. Consequently, both were judged unsuitable.

The school in England was operated by British Petroleum Limited. A member of the OCTU group attended the school, and reported back that the materials available were duplicated hand-outs, and did not deal with the operation of the equipment. As with the Texan schools, the main audience was comprised of management level personnel.

Materials in languages other than English were not sought.

Materials from the Equipment Manufacturers. The CCG had copies of all the materials supplied with each piece of equipment. This material was of variable usefulness, both in content and format. None of it was published in the usual sense of the word.

The quality of the content ranged from the very minimal information contained in the brochure suplied with the Vikoma Seapack, to a full maintenance manual for the Framo skimmer system, which included considerably more information than an operator would need, or even want. Most of the basic operating instructions could be found in this material, but it was inadequate for use as instructional material.

The formats of the manufacturers' material also varied widely, both in page size, type size, and illustrative detail. The smaller typefaces were difficult to read, and reproduction would have been dificult.

Overall, it was considered that the use of the manufacturers' material "as supplied" would be innappropriate, and that adaptation would be as involved as developing new material, whilst less satisfactory. It was therefore concluded that new material should be developed.

Rationale for the Development of Material

Examination of existing material established that development of new instructional material was required, the purpose of which was to enable persons who had received

instruction in the basic operation of certain pieces of equipment during a one-week course to refresh their knowledge of operating procedures throughout extended periods without practice.

It was intended that occasional practice sessions might be arranged which would refresh sufficiently the actual motor skills involved, given that these are retained much better than procedural skills.

Content information was to be obtained from two main sources, the manufactuers' literature and staff at CCG Marine Emergencies (Newfoundland), who had considerable experience in operating the equipment. Primary responsibility for the development of the material was given to the author and MUN Extension Service.

The project schedule called for preliminary drafts of the sections on specifically offshore equipment to be available by April 1979, with a full draft edition to be produced by the end of July that year. This would be reviewed and evaluated, and a final edition would be produced under a new proposal at a later date.

Outline of the Development Process

Many models of the process of instructional development have been published, the complexity of which range from the very simple to the exceedingly complex. However, "regardless of the simplicity or complexity of a particular 'systems approach' to developing instruction, all models have many similarities" (Twelker, Urbach, and Buck, 1972, p.1). The process adopted for this project was modelled in Figure 1. It incorporated the common elements of published models, adapted to suit the particular circumstances of the project. The major steps in the process are reflected in the following chapters of the report.

For the purposes of the report, the steps of the process are described in linear fashion. This does not reflect accurately the sequence of events, particularly in the steps leading up to the testing of audience reaction. The interaction of the various activities during this phase are diagrammed in Figure 1, though still in a simplified way, as is usual in the presentation of such models.

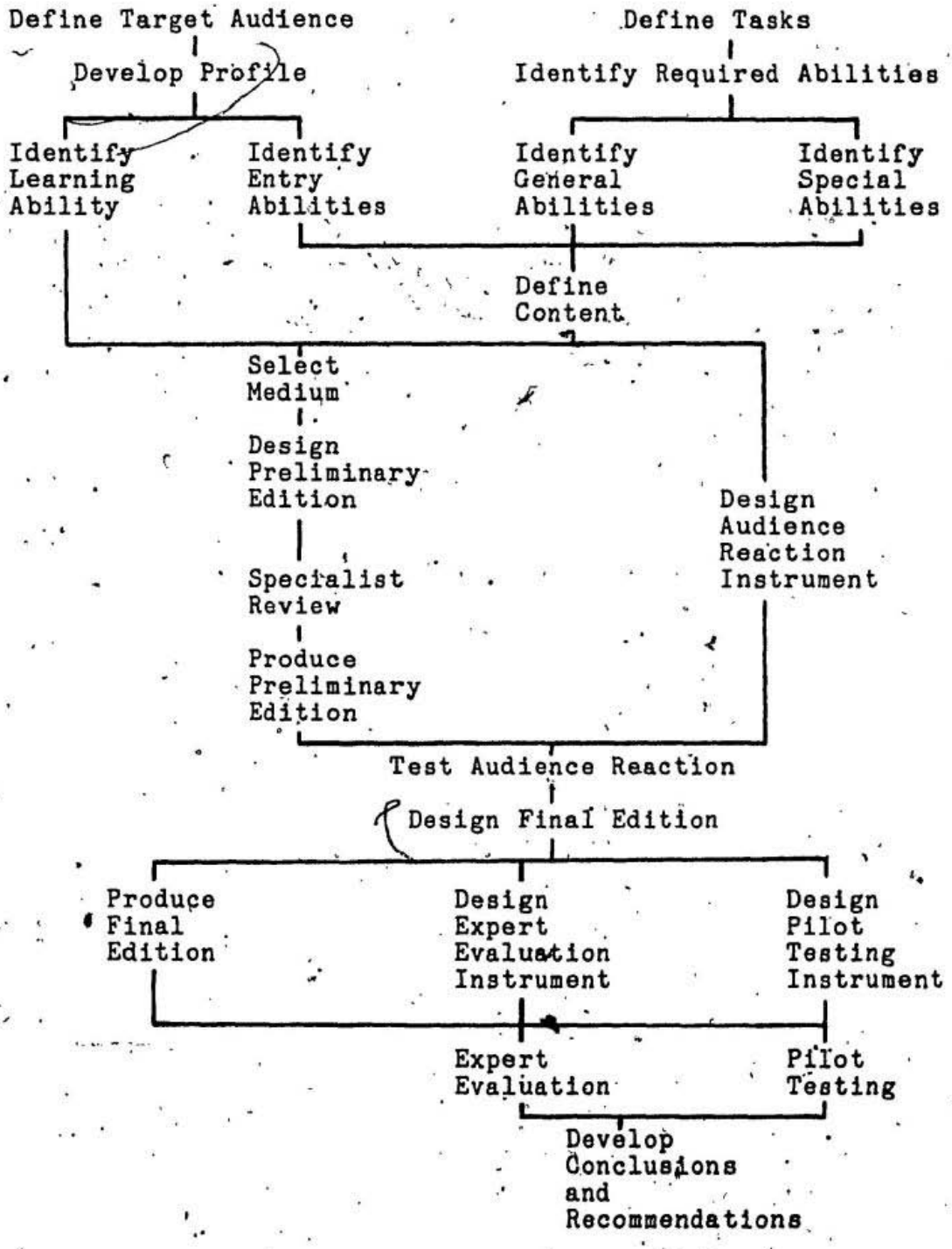

Figure 1. The development process.

CHAPTER THREE: ANALYSIS OF TRAINEE CHARACTERISTICS

Definition

The definition of the primary users for whom the material was designed was simply those persons who would be taking the OCTU course. Although a number of likely sources of trainees were identified during the early stages of the development of the course, it was decided by the OCTU group that these would not necessarily be the only persons admitted. It was therefore decided by the group that only a general profile should be used to define potential trainees, and hence users of the material (Cormack, 1979, Note 2). This general profile is presented in Table 1.

Expected Entry Abilities

The experience aspect of the profile was not seen as forming a definite requirement, rather that such a background would be desireable in assisting trainees to learn the course content. It was foreseen that the probability of persons totally lacking in relevant experience taking the course was low, since the trainees would be sent by an

Table 1

General profile of trainees.

Characteristic	Formal OCTU Criterion	Expected Norm
Age	Adult	18 to 45 or 50, depending on physical fitness
Sex	None	Males would be greatly predominant
Learning Ability	None	Functionally literate at general societal level for Atlantic Canada
Entry Abilities	None	General experience with common small tools; some familiarity with the operation of powered machinery; some familiarity with the sea.

employer in virtually all instances, and employers would be unlikely to be willing to pay for someone unsuitable.

This type of informal filter mechanism is not uncommon in agencies providing courses to industry on an actual-cost basis. It is used, for example, by the Petroleum Industry Training Service, which arranges many technical and trade courses for the oil industry (Anderson, 1983, Note 3).

Learning Abilities and Implications

With such a limited definition of the target audience and with no provision to be made for pre-testing, the establishment of any meaningful description of learning abilities was impossible. Even such limitations as "high-school graduates" would in all likelihood be broken, at least occasionally.

As an alternative, it was decided to design the prototype material on the basis of general principles (simplicity of language and copious illustration), and to correct for any deficiencies or comprehension problems after the formative evaluation.

CHAPTER FOUR: TASK ANALYSIS

The Tasks of an Equipment Operator

In examining just what an equipment operator needs to know, it was found that in addition to the basic operating principles of a number of pieces of equipment, some other aspects were important. Primarily these related to safety considerations, but the OCTU group requested that some content be included describing the situation in which the operator would be working, for example the management structure above him, a brief section on cleaning shorelines and harbours, and some information on the environment's effects on oil spills. These aspects were considered to be supplementary to the major job of equipment operation (Cormack, 1979, Note 2).

The Major Tasks - Operating the Equipment

There are two basic methods of counteracting an oil spill. The first, and preferable, method is to contain the oil and then to recover it. The alternative is to spray chemical dispersants on the floating oil, to speed up the

natural process of dispersal and degradation. There have been other methods proposed and experimentally tried, but none were operational at the time (Ryan, 1979, Note 4). The major pieces of equipment to be operated are shown in Table 2, in the context of their function and appropriate usage.

Figure 2 shows the first breakdown of the equipment operator's role into its major tasks. The operation of each piece of offshore equipment is further broken down into procedures in Figures 3 to 6. The next level down would be the actual elements of the procedures, which are described in the final material (Appendix A).

Subsidiary Tasks

Safety. Any work associated with the sea or with oil products can be dangerous. It was therefore considered essential to consider safety as a part of the material, although it does not readily fall into the category of a task. Five groups of hazards were identified in consultation with the content specialists: machinery and equipment; general hazards of being at sea; hazards on large vessels; hazards in small boats; and fire hazards. The rules for safety at sea are shown in Figure 7.

Table 2

Major equipment types

	Function		
	Containment	Recovery	Disposal
Offshore	Vikoma Oceanpack	Framo ACW 400	Warren Springs Spray Eqt.
Inshore	Vikoma Seapack	Slickbar Transvac	Warren Springs Spray Eqt.
	Hurum Flexy-Boom	Small Disc Skimmers	
		Slicklicker	

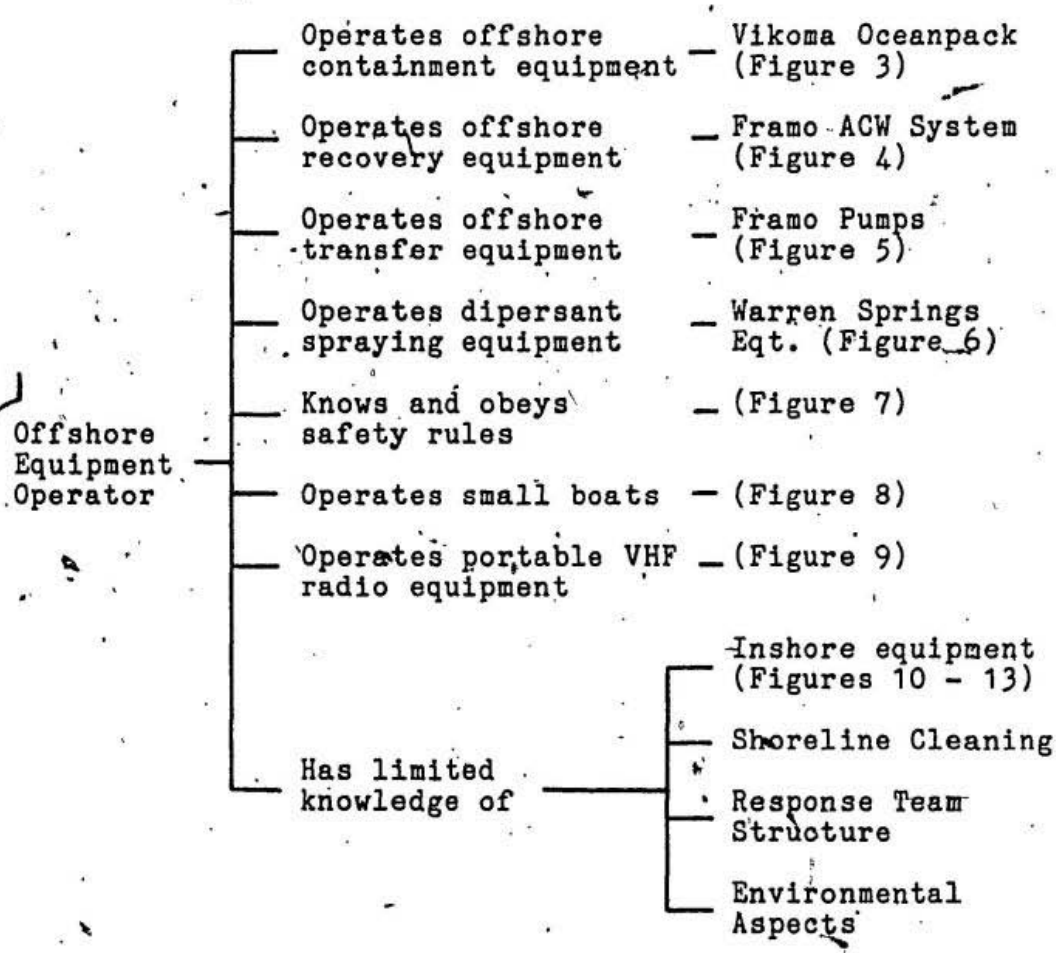

Figure 2. Overall task analysis for offshore equipment operator.

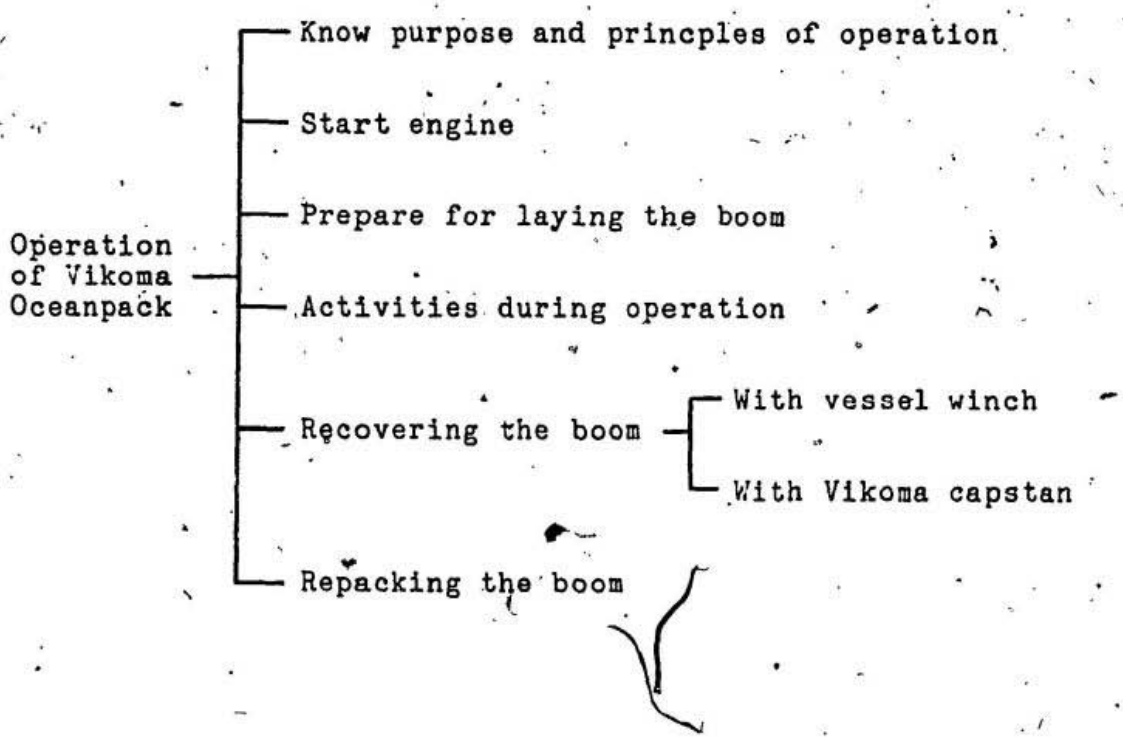

Figure 3. Task analysis for operation of Vikoma Oceanpack.

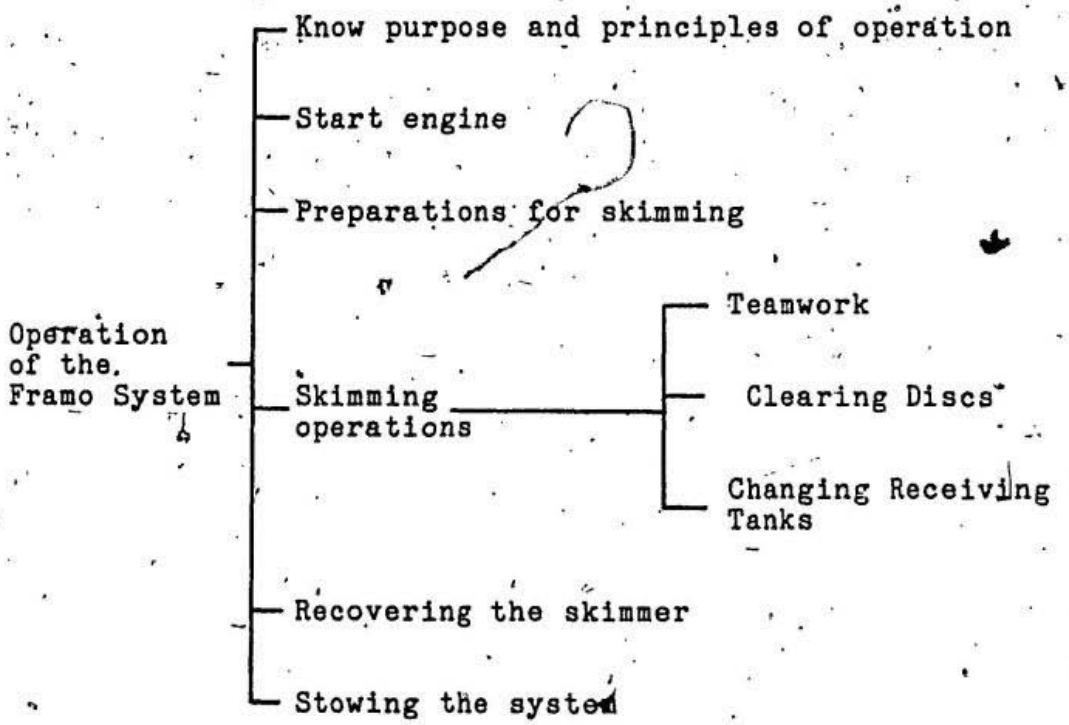

Figure 4. Task analysis for operation of Framo ACW System.

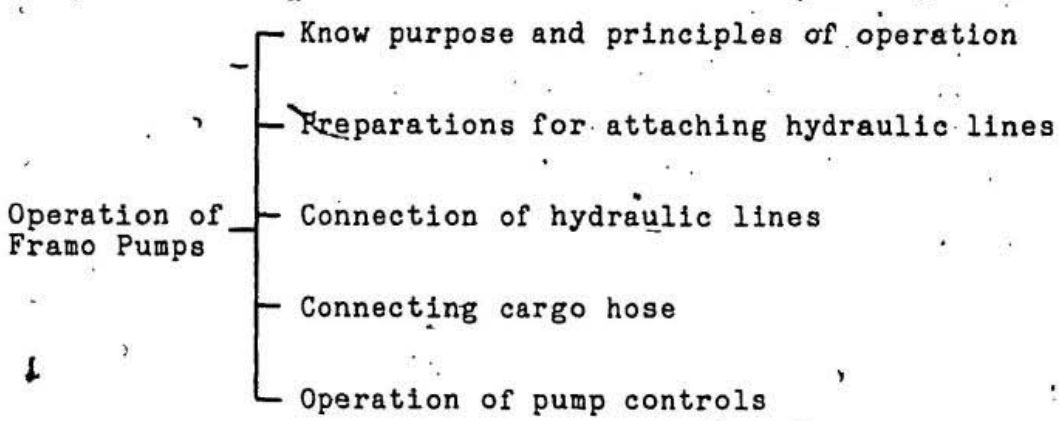

Figure 5. Task analysis for operation of Framo pumps.

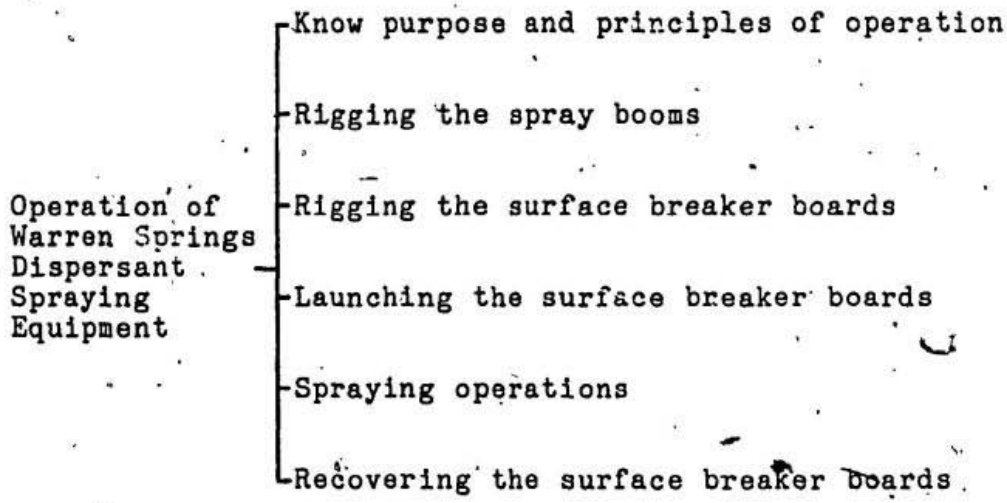

Figure 6. Task analysis for operation of Warren Springs dispersant spraying equipment.

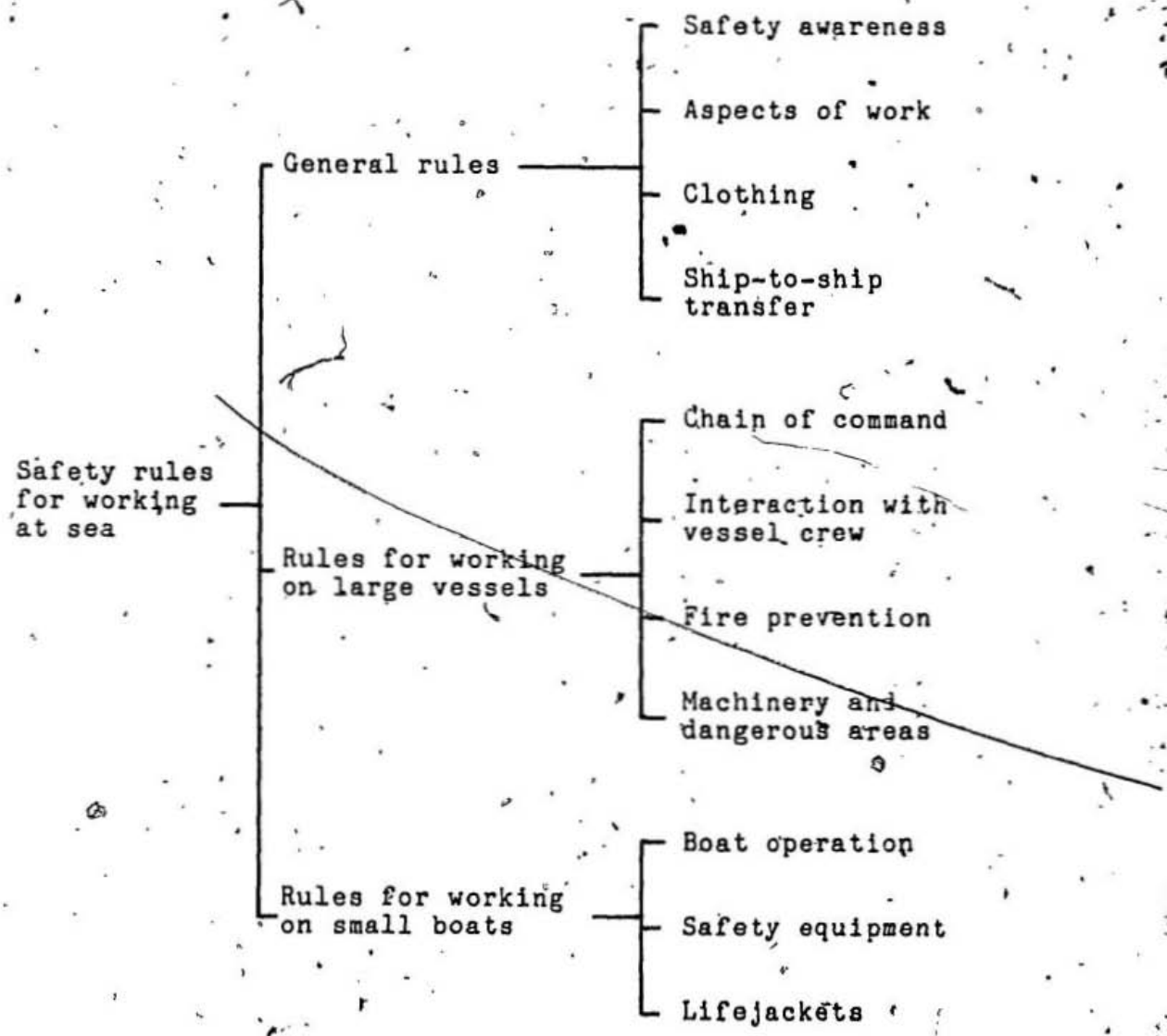

Figure 7. Task analysis for safety at sea.

Small Boat Work. Many aspects of oilspill work require the use of small boats. This is particularly true for inshore operations. It would be unwise to assign a person to handle even a small boat unless that person was experienced in doing so, but it was felt that this may happen under pressure of circumstances. Consequently, it was decided to incorporate content on general small boat handling.

Both CCG and the industry co-op, ~~the~~ Eastcoast Spill Response Association (ESRA) were equipped with 21 ft. Boston Whalers. The operation of these craft was included in the small boat section. A breakdown of these tasks is shown in Figure 8.

Radio Use. It was considered likely that operators might find it necessary to use portable VHF radios (walkie-talkie) or the sets fitted into the Boston Whalers. It was therefore appropriate to include some elementary instruction on the use of this equipment. The task elements are shown in Figure 9.

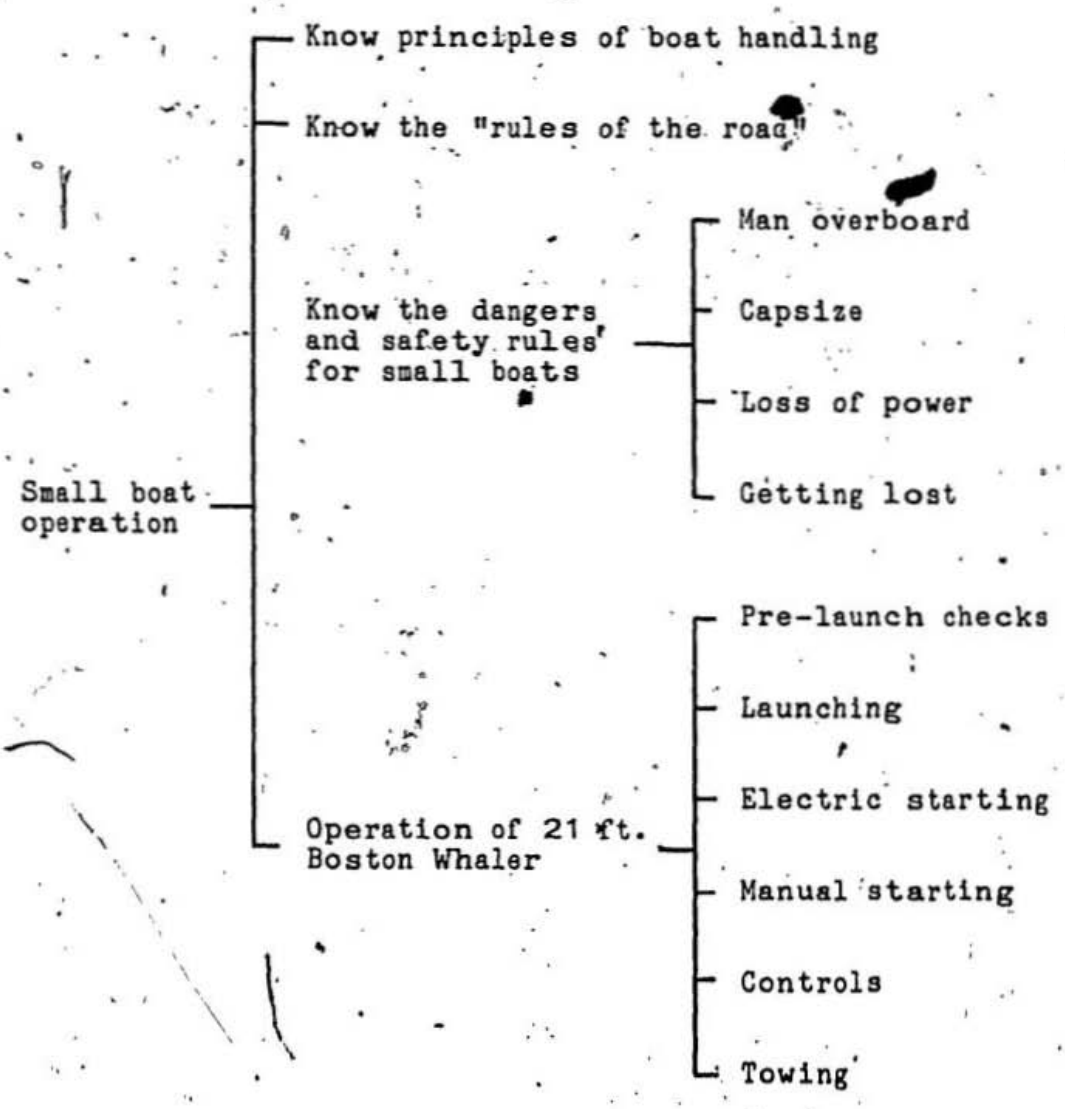

Figure 8. Task analysis for small boat operation.

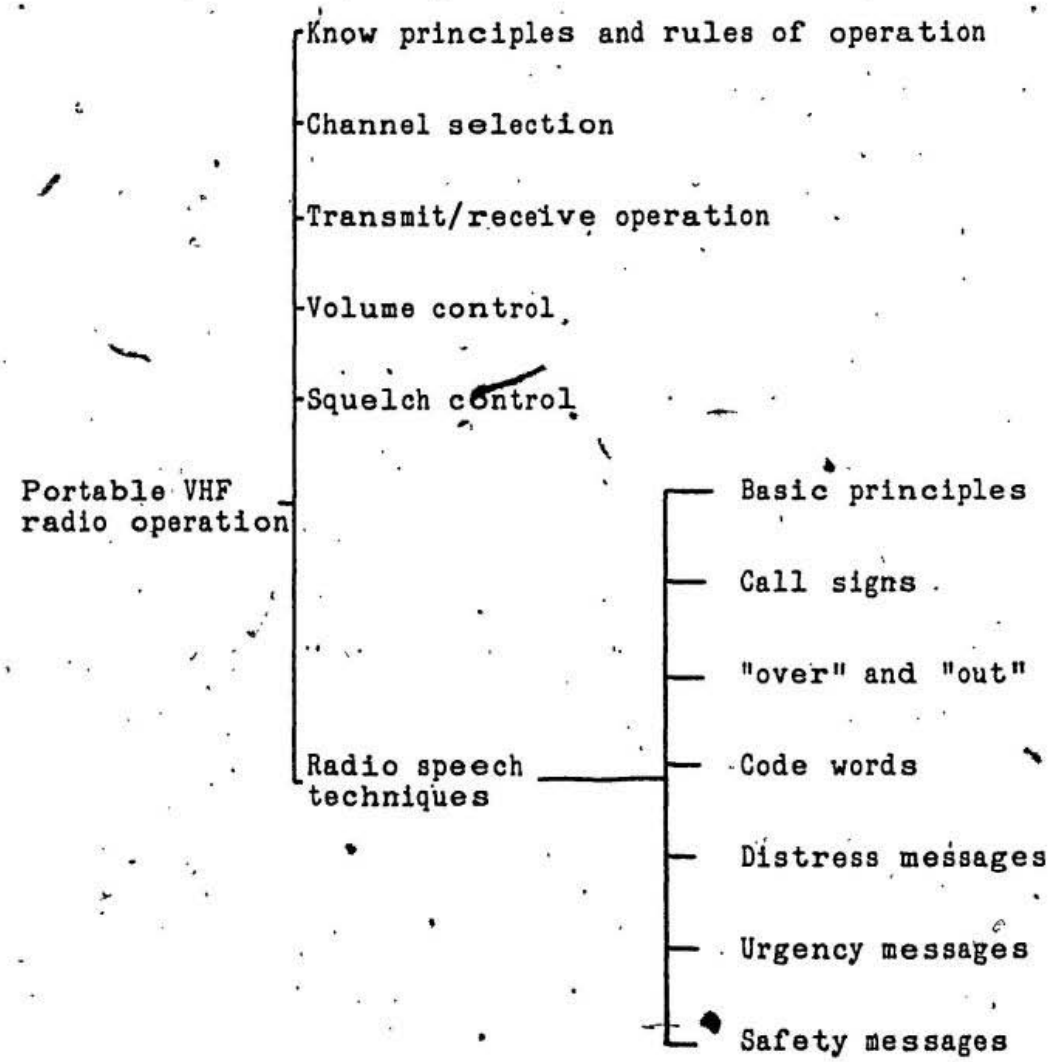

Figure 9. Task analysis for operation of portable VHF radio equipment.

Inshore Equipment Operation. Since the material was to serve for not only the offshore courses but also the inshore ones which were to be developed, full content was also required for this equipment. The relevant task analyses are shown in Figures 10 to 13.

Shoreline Cleaning. This type of work would not require much training for the operators, since it involves mostly work with shovels, buckets and hoses. Nevertheless, it was desired by the OCTU group that some general information be included. There were no set tasks to analyse.

Environmental Aspects. As with the shoreline cleaning, there were no tasks for this content, which was included only for background information.

This was the analysis of tasks done for the Preliminary Edition in 1979. Some changes were introduced for the 1981 Edition, which are discussed in Chapter Seven.

Interrelation of Tasks

At the task level, there were no critical interrelationships identified; that is it was not necessary for a

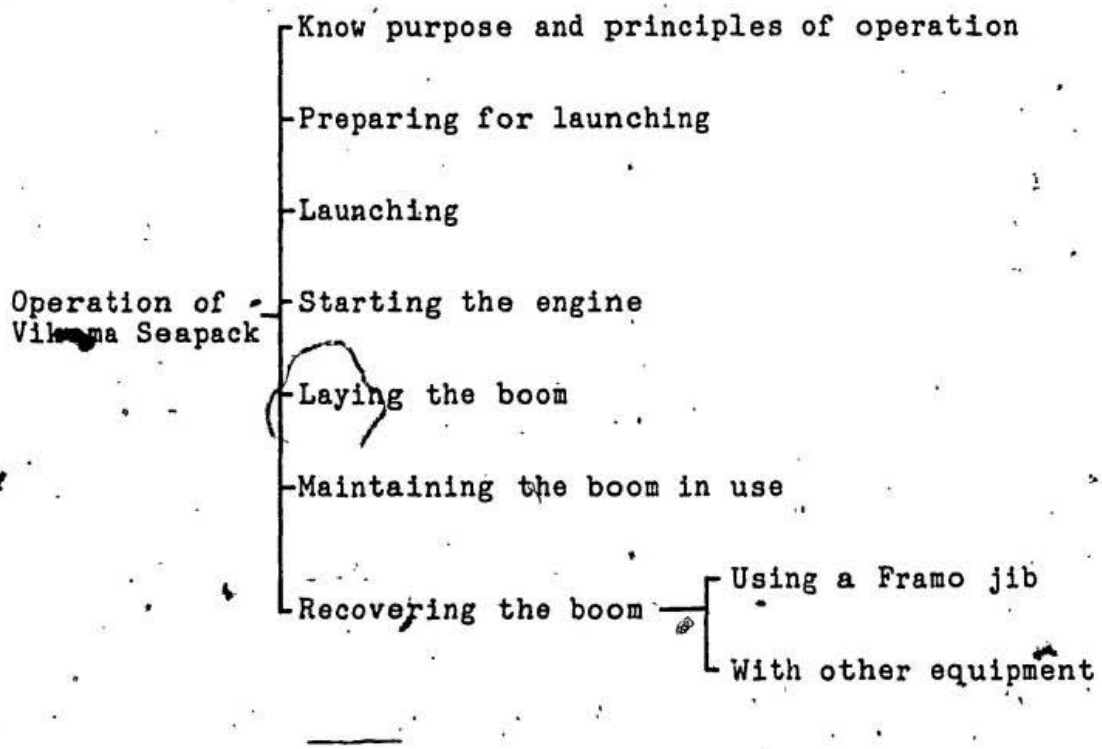

Figure 10. Task analysis for operation of Vikoma Seapack.

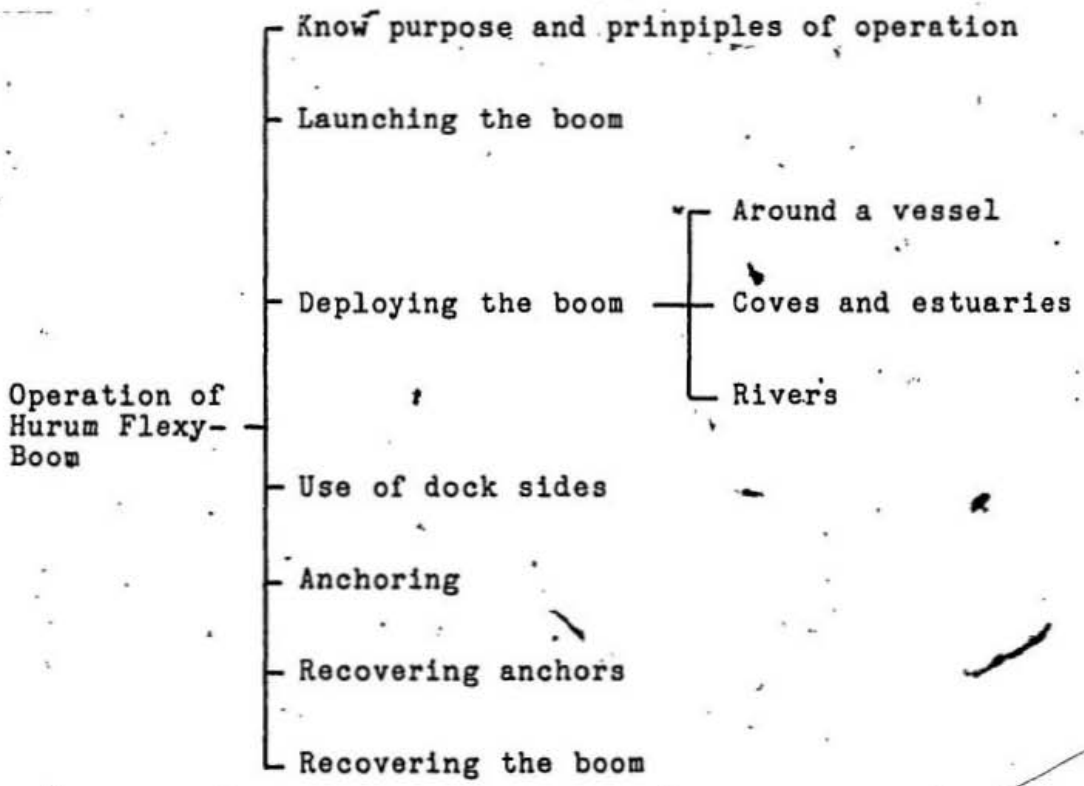

Figure 11. Task analysis for operation of Hurum Flexy-Boom

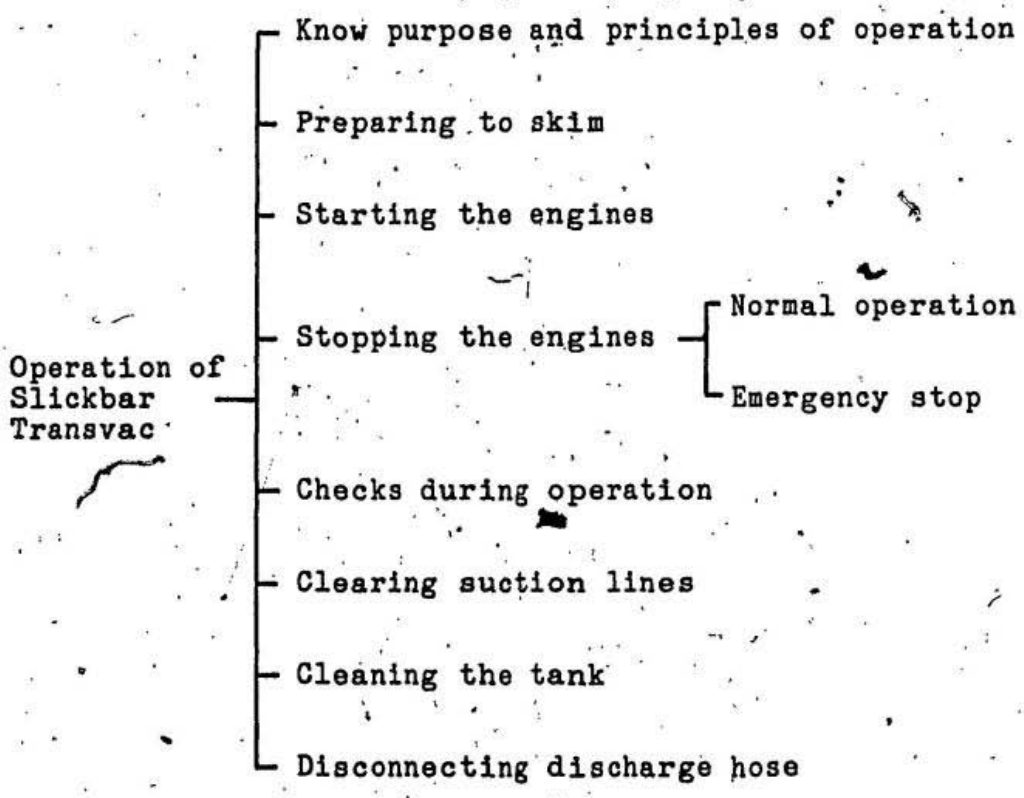

Figure 12. Task analysis for operation of Slickbar Transvac.

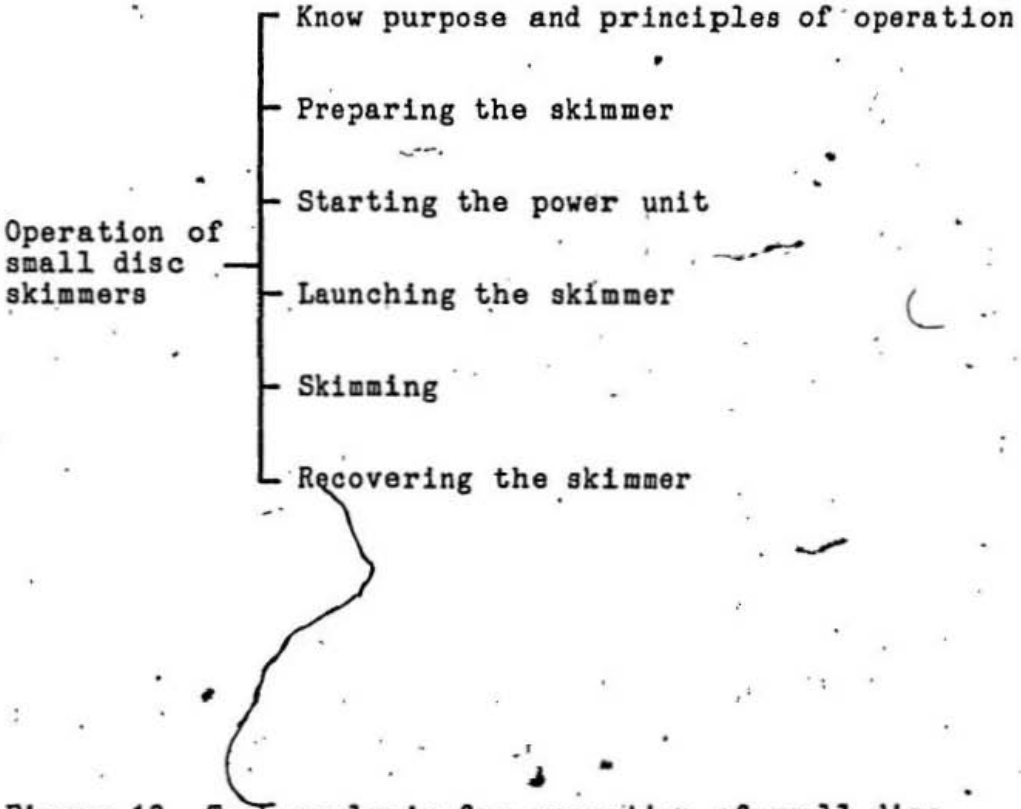

Figure 13. Task analysis for operation of small disc skimmers.

trainee to master one task before learning another. In the real operation of the equipment, the tasks are independent.

Emphasis and Specialization

The OCTU group desired to have one set of material developed to serve for both the offshore and inshore equipment, to equal depth. Although the first course given was for offshore operators, and this set the time schedule for material development, the inshore courses were to follow closely. In the event, these never fully materialized, and only offshore operators were trained.

CHAPTER FIVE: SELECTION OF INSTRUCTIONAL MEDIUM

The original proposal for the overall training development (C-CORE, 1978) referred to "a manual" as the medium to be employed. This was a prejudgement of the most suitable medium, so a review of its selection was carried out, in order to ensure that this judgement was justified.

Selection Criteria

The analysis of needs established that the material should be in a form in which it could be given to course participants for use afterwards. Thus the first criteria were that it should be portable, and should not require the use of special equipment.

The analysis of needs also established that the emphasis of the material should be on the procedural aspects of the tasks, rather than on the manipulative motions. This was due to the fact that none of the tasks required difficult or unusual motor skills, only new applications of common ones. It therefore appeared that both textual and visual content were necessary, but that motion was not.

It was foreseen that the material would be used by the recipients in two distinct ways. As normal reference material it might be reviewed periodically to refresh the knowledge of all the procedures learned in the course. But if a spill occurred and the person were required to perform at short notice, it might be used for last-minute revision, or even as a field guide, much as a car owner might use a service manual to repair the vehicle. The parallel was quite valid, since in a real operation, an operator would likely be assigned to one piece of equipment.

This second method of use gave rise to more criteria for medium selection; random access to all levels of tasks and subtasks, and a variable pace for review of any particular aspect.

Evaluation and Selection

To summarize, the criteria for the selection of an appropriate medium were:

Required Characteristics

textual and pictorial content

portability

useable without special equipment

random access

user-controlled pacing

Superfluous Characteristics

audio

depiction of motion.

It was readily apparent from these characteristics that some type of printed material was the most appropriate medium to use. This was also supported on cost grounds, since the number of copies required in order to be able to give one to each participant was significant (100 to 200 for the Preliminary Edition; several hundred for the finished version).

The details of actual format selection and design are discussed as part of the production process in Chapter Six.

CHAPTER SIX: DESIGN AND PRODUCTION

Initial Design

The design of printed material involves decisions on a variety of aspects. These include text style, illustrations, format, page layout, and typeface.

Text. Davies (1973) recommended that simple procedural tasks are best conveyed by prose or algorithm. Algorithms are, however, more commonly used in situations involving choice from among several alternatives (Hartley, 1978). This was not generally the case in this project and accordingly prose was selected as the form to be used.

Hartley also indicated that simple sentences (subject, verb, and object only) are the most readily understood in reading. For the main instructional portion of the material therefore, this form of prose was preferred. This resulted in these sections appering much like Davies' Task Elements (Davies, 1973), and indeed to meet the criteria for them.

One procedure appeared initially to be suitable for description by algorithm. Operation of the Slickbar Transvac involved some situations where the instructions would be "if (condition A) then do (action B)". Draft algorithms were created, but proved to be so complex that it was found that simple prose was more understandable, if less efficient in the use of space.

Illustrations. Most research on which type of illustration is the most effective points to line drawings as being preferable (e.g. Dwyer, 1967). However, this work tends to be done using situations where detailed information on the subject matter is to be conveyed. The need for illustration in the material developed was almost entirely to show the location of parts (such as controls) or to show how a piece of equipment looks in use. It was therefore decided that photographic illustrations would be adequate for most of the needs. Although it was not possible to test, it was believed that the intended readers would be more familiar with photographic illustration than with drawings. Photographs were taken by the author, and by a photographer working under the author's direction.

Some drawings were used. These were made by the author, based on diagrams from the manufacturers' information, and on observation of the equipment in use.

Format. Because a considerable number of illustrations were included, a page size of 216 x 279 mm (8½ x 11 in.) was chosen. The binding method selected was plastic spiral, in order to allow the manual to be laid flat when open. The content was designed to be printed in black and white, on both sides of the paper. The cover was designed by Terry Ridings, to be printed on KromeKote^{tm}. Offset lithography was chosen for the printing method.

The use of colour on inside pages was discussed, but the benefits appeared to be minor compared to the very large increase in cost.

Page Layout. In designing each page, related text and illustrations were kept in close proximity. This avoided two problems, the extensive use of references which would have otherwise been necessary, and having to turn pages to refer to the appropriate illustration. The page size allowed the use of reasonably sized illustrations, which was felt to be particularly important for the photographs.

Typeface. Twelve-point Univers was selected. This sans serif style was easy to read, reproduced well, and met Hartley's recommendations as "firm in line, open and even in spacing, and without idiosyncratic features ..." (Hartley, 1978, p.26)

Formative Evaluation

The were three facets to the formative evaluation of the manual. These were undertaken consecutively, with the specialist evaluation being followed by manufacturers' review and finally the audience evaluation.

Content Specialist Review. The content specialist was William J. Ryan, Regional Manager (Newfoundland), Marine Emergencies, for the Canadian Coast Guard. Ryan was in close contact with the project throughout, as a member of the OCTU group. The procedure adopted was that as the first draft of a particular section was completed, it was passed to Ryan for his comments. These were conveyed verbally, usually at a meeting between Ryan and the author. Illustration choice was left until after the text had been approved. Subsequent drafts with changes and illustrations were put through the same cycle.

Learner Specialist Review. The learner specialist was Captain Jack J. Strong, Head of Ministry of Transport Branch, Nautical Science Department, at the College of Fisheries, Navigation, Marine Engineering and Electronics. Strong was also a member of the OCTU group, and was also primarily responsible for the development of the OCTU course. Strong had been involved in teaching marine subjects at all levels for nearly twenty years. Once again, the process was continuous, beginning with drafts of individual sections and ending with the final draft of the complete preliminary edition. Strong also acted as content specialist for the sections on marine safety and radio communications.

Other Specialists. Certain other specialists reviewed particular sections of the draft manual. Alan Cormack, then of British Petroleum Canada Inc. and who was also Chairman of ESRA, took a close interest, and reviewed most of the material in draft form. David Grenville of C-CORE and Donald Balsom of MUN Extension Service did the same. The comments of these persons were not specifically directed towards either technical accuracy or appropriateness to the intended audience, but were largely of a general nature. Ernest M. Reimer of C-CORE, whose expertise was in the interaction of oil spills and the marine environment,

reviewed the environmental section.

Initial Production

Once the specialists were satisfied with the draft, the Preliminary Version was produced. The author worked directly with the printer's layout personnel to achieve the desired results.

Manufacturer Review

Printed copies of the Preliminary Version were sent to the manufacturer of each piece of equipment, with a request that their personnel check the correctness of the content. Four replies were received. All contained positive, encouraging comments on the overall manual, and two companies, Slickbar Incorporated and Vikoma International Limited, included some clarifying details on the operation of their products. These were quite minor in nature, and were filed for incorporation in the final version.

Audience Evaluation

The first opportunity for testing audience reation to the manual came in June, 1980 when the group which had attended the 1979 course reassembled for the first offering of "Offshore Two". There was no opportunity for examination-style testing of the trainees' retention, so a two-part strategy was developed. The course manager, Strong, was interviewed regarding his assessment of how well the trainees had remembered the procedures, and trainees completed a questionnaire which recorded their reaction to the manual, which they had had for about a year.

Strong reported that considering the time that had elapsed since the original course, the trainees' retention rate was very good (Strong, 1980, Note 5). This was further reinforced by members of CCG who did the practical instruction (Halley and Tizzard, 1980, Note 6). Since such a period of no-practice is usually enough to cause a high degree of retention failure for procedural tasks (Schendel et al, 1978) it appeared that the manual was fulfilling its purpose.

The questionnaire is presented in Appendix B. It was distributed and completed during the second day of the five-day course. The results are summarized in Table 3.

The results indicated that the attitude of these trainees to the manual was generally favorable. There appeared to be reservations over the size and clarity of some of the illustrations, and it was unanimous that labelling of important items in the pictures would be advantageous. Two of the ten respondents noted some difficulty with the terminology, but this rate was considered insufficient to rate the addition of a glossary, which would have occupied several pages and additional photographs.

Final Production

During the course of exercises during 1979 and early 1980, some new techniques for deployment of the offshore equipment were developed by CCG Marine Emergencies. These developments and the changes that had been suggested by manufacturers and trainees were incorporated in the design of the final version, which started in mid-1980.

Table 3

Results of audience evaluation of Preliminary Version (N=10)

	Question	Yes	No
1.	Did you read some of the manual before you came back to this second course?	8	2
2.	If yes, did it help you remember what you learned last year?	8	0
3.	Have you written any notes in your manual?	2	8
4.	Are there any technical words in the manual which you did not understand after last year's course?	2	8
5.	Did any of the pages tear out of your copy?	0	10
6.	Would it help if the important parts in each picture were labelled?	10	0

		All	Most	Some	Few	None
7.	How many of the pictures are large enough?	1	6	3	0	0
8.	How many of the pictures are clear enough?	1	6	2	1	0

This additional content called into question the structure of the manual. The Preliminary Version had been designed with a discrete chapter devoted to each piece of equipment. The chapters were sequenced by the function (containment, recovery, dispersal), rather than by situation (offshore or inshore operation). The new techniques required closer integration of all the offshore equipment, so it was decided to rearrange the content by situation. The task analysis for the new content is shown in Figure 14.

The other major change introduced was suggested by the trainees' reaction. The major focus of each illustration (a control or gauge for example) was labelled to reinforce the textual instruction.

Some additional work on the page layout was also done. The layout was condensed, heading and footing lines were added, and extra-large type was used for the chapter headings and folios. The author worked in collaboration with a graphic designer from MUN Extension Service on the design.

The final version was available in November 1980, and was identified as the 1981 Edition. Preliminary Version copies were recalled and replaced with the new edition.

- Additional tasks for offshore countermeasures
  - Knows requirements for and methods of installation of Oceanpack on supply vessels
  - Knows requirements for and methods of installation of Framo system on supply vessels
  - Knows requirements for and methods of transferring recovered oil to tanker
- Additional task for inshore countermeasures — Knows method of recovering seapack boom using power block onshore
- Additional General Task — Knows types and characteristics of diesel engines
  - Hand-cranked engines
  - Minor trouble shooting

Figure 14. Analysis of additional tasks.

CHAPTER SEVEN: EVALUATION

Methodology

The specialized nature of the material, and the fact that far fewer courses were run than had originally been predicted by the OCTU group, severely limited the size of the population which could be used for evaluation. Only 31 persons existed who fitted the audience profile and who had done the course. Of these, only five were willing to take part in evaluating the manual's effectiveness through testing. Since such a sample size was far too small for a thorough trial, only a small-scale pilot test was run while an alternative method of evaluation was developed.

An appropriate outline for expert appraisal of learning materials was described in Thiagarajan, Semmel, and Semmel (1974). Expert appraisal, it was suggested, should be from two major viewpoints, instructional experts and technical experts. Instructional experts should consider the appropriateness, effectiveness, and feasibility of the material. Technical experts should appraise the medium selection, format, and language. The guidelines proposed by

the authors included the use of five-point scales for each expert to quantify opinions of the material on individual aspects relating to the six areas described. such a method of expert appraisal was selected.

Expert Appraisal Procedure

Appraisal sheets were developed to record experts' ratings of the manual. Relevant items from the checklists given in Thiagarajan et al for the different areas were incorporated into four lists, with a five-point scale for each item. Experts were asked to rate each item from excellent through good, fair, and adequate, to poor.

The experts selected for the instructional review were William Ryan, Canadian Coast Guard, and Captain Jack Strong, College of Fisheries, Navigation, Marine Engineering and Electronics. Both were experienced in teaching technical material, including oilspill countermeasures, to new trainees, and were familiar with the manual, having been closeley involved in its initial specification and formative evaluation. Since they were both on the OCTU Board of Advisors, their ratings could also be considered to represent the "client's" satisfaction with the product.

For the appraisal of the technical aspects of the manual, qualified experts in the fields of media design and printing technology, and English usage and information participated. They were: Mr. William Griffin, Graphic Artist, Memorial University, Mr. George Morgan, Printing Instructor, College of Trades and Technology, Mr. Paul Bowdring, English Instructor, College of Trades and Technology, and Ms. Karen Lippold, Reference Librarian, Queen Elizabeth II Library, Memorial University. The instruments are contained in Appendix C.

Results. For the instructional review, the aspects rated were:

- instructional content
- appropriateness of the language to the intended readers
- style of presentation
- level of difficulty
- sequence of presentation
- clarity of explanation
- clarity of illustration
- degree of integration with course content
- flexibility for use by the trainees
- acceptibility to instructors

- acceptibility to trainees
- relevance to the general goals of oilspill countermeasures
- meaningfulness to the instructor
- meaningfulness to the trainees
- technical correctness of the content
- adequacy of the explanations of the procedures
- correct use of technical terms.

All of these aspects were rated "good" or "excellent" by both experts. Four aspects received two ratings of excellent, eleven received one excellent and one good, and two received two good ratings. From these results it was concluded that the instructional quality of the manual was acceptable.

The aspects addressed in the technical review were, for media design and printing technology:

- the size of the typeface selected
- the style of the typeface selected
- the layout of the pages
- the stock selected for the cover
- the stock selected for the inside
- the quality of the text printing

- the quality of the reproduction of the illustrations
- the appropriateness of the binding method
- the durability of the overall manual;

and for English usage and information:

- the organization of the contents
- suheading use
- clarity of language
- conciseness of language
- readability
- paragraphing
- consistency
- absence of spelling and grammatical errors
- accessibility of parts (via index/table of contents)
- ease of filing and retrieval

For media design and printing technology, two aspects were rated excellent by both reviewers, and five aspects were rated excellent by one and good by the other. The durability received a rating of adequate from one reviewer, who suggested that lamination of the pages would have been preferable (this was investigated during the initial stages

of the development process, but was found to be exorbitantly expensive, as it could not be done within the province). The other reviewer rated the durability as excellent.

In English usage and information, seven aspects were rated excellent by one reviewer and good by the other. The accessibility of parts was rated good by both, and both recommended that access could be improved further by an index or more detailed table of contents, and by placing section and page numbers on the free edge of each page. The readability was rated excellent by one reviewer, but only fair by the other. However the qualification was made that readability was down-rated primarily because of the general difficulty in reading technical material without prior familiarity, a situation in which the target audience would not be placed. One aspect, ease of filing and retrieval, was only rated by one reviewer. It received an excellent.

From the ratings received for the technical aspects, it was concluded that the manual was of acceptable quality in its writing, design, and production.

Overall, of thirty-six aspects rated each by two reviewers, six received two excellents (5), twenty-four

received one excellent (5) and one good (4), and four received two goods (4). Only two aspects received one rating lower than good (4)

Pilot Testing Procedure

To test knowledge of the full procedures would have required very extensive written or verbal testing. This is feasible where the audience sample is "captive" through working for an involved employer or through being enrolled on an instructional program, or where the appropriate population is large enough that sufficient volunteers can be obtained. Neither condition applied to this project. The volunteers who were available were only willing to do a short pilot test of the manual's effectiveness.

It was decided that at this level, the manual's effectiveness could be inferred from the answers to a small number of questions. An instrument was designed with a bias toward the major offshore equipment to match the course which the subjects had received. The instrument is presented in Appendix D.

The instrument was sent to the subjects by mail. If they still had a copy of the manual, they were instructed to use it to help answer the questions. If they had no copy, they were instructed to answer unaided for comparison.

Results of Pilot Testing. The results are summarized in Table 4. The marks achieved by the subjects who used the manual were exceptionally good, and much better than those who did not use it.

Table 4.

Pilot testing results.

Subject	Used Manual	No. of Exercises[1]	Years since Last Exercise[2]	Total Mark Raw	Total Mark %
1	yes	4	2	32/34	94
2	no	1	4	23/34	68
3	yes	1	4	30/34	88
4	no	4	1	26/34	76
5	yes	4	2	29/34	85

Mean per cent score of manual users: 89

Mean per cent score of non-users: 72

Table 4 (continued)

Note 1. Measure of amount of practice with equipment.

Note 2. Time since last practice with equipment.

On a third of the individual questions, manual users scored better than non-users. The reverse was true for only one-tenth of the questions.

Discussion of the Results

The research discussed in Chapter two implied that after a no-practice period of as little as one year, considerable forgetting of procedural tasks normally occurs. The pilot testing indicated that the manual could enhance retention of operating procedures up to a level of 89 per cent.

A panel of experts rated the manual as good or excellent in almost all aspects. Its physical durability, which could not have been improved within the project budget, and its readability were each down-rated by one expert reviewer. However, the readability criticism was inappropriate for the manual's intended use.

From the overall evaluation it was concluded that the manual successfully fulfilled its purpose. That it was highly acceptable to the Chairman of ESRA, who was instrumental in arranging the funding of the manual and the overall OCTU project was conveyed to the author personally (Cormack, 1981, Note 7).

CHAPTER EIGHT:
CONCLUSIONS, RECOMMENDATIONS AND IMPLEMENTATION

Conclusions

The manual was developed in accordance with the principles of instructional development practice. Relevant experts rated it as good to excellent, and pilot testing indicated that it achieved its objective of facilitating the recall of operating procedures after considerable periods of no-practice. The client was very satisfied with the product.

Recommendations

It is recommended that the use of the 1981 edition of the manual for OCTU courses be continued. Should future editions be required, due to changes in technology or techniques for oilspill countermeasures, similar design and style should be used. Consideration should be given at that time to adding more detail to the Table of Contents or an index, and to the cost-effectiveness of printing on laminated stock.

Implementation

The manual went into use immediately on its production in 1980, and was sent retroactively to those who had received the Preliminary Version. Since the manual was developed only for this specific application, no further action on implementation is necessary.

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Note 7. Cormack, A. Personal Communication, June 10, 1980.

APPENDIX A

Equipment Operators' Course Manual, 1981

(Bound Separately)

APPENDIX B

Audience Evaluation Instrument

Participants in OS2, June 1980

The Manual you received last year was a preliminary version which I am going to change. I would like to know what you think of the Manual, so that I can improve it. Please answer the questions below, and if you have any other ideas write them on the back.

Dave Bazeley, OCTU

1. Did you read some of the manual before you came back to this second course? Yes ☐ No ☐

2. If yes, did it help you remember what you learned last year? Yes ☐ No ☐

3. Have you written any notes in you manual? Yes ☐ No ☐

4. Are there any technical words in the manual which you did not understand after last year's course? Yes ☐ No ☐

5. Did any of the pages tear out of your copy? Yes ☐ No ☐

6. How many of the pictures are large enough? All ☐ Most ☐ Some ☐ Few ☐ None ☐

7. How many of the pictures are clear enough? All ☐ Most ☐ Some ☐ Few ☐ None ☐

8. Would it help if the important parts in each picture were labelled? Yes ☐ No ☐

APPENDIX C.

Expert Evaluation Instruments

EXPERT EVALUATION OF OCTU EQUIPMENT OPERATORS' COURSE MANUAL (1981 ED)

Please rate the following aspects of the manual by circling the appropriate number on the scale provided, using 5 to indicate excellence and 1 for a poor rating.

	Excellent	Good	Fair	Adequate	Poor
Relevance to the general goals of oilspill countermeasures:	5	4	3	2	1
Meaningfulness to the instructor:	5	4	3	2	1
Meaningfulness to the trainees (when used as intended):	5	4	3	2	1
Technical correctness of the content (as of 1981):	5	4	3	2	1
Adequacy of the explanations of the procedures:	5	4	3	2	1
Correct use of technical terms:	5	4	3	2	1

EXPERT EVALUATION OF OCTU EQUIPMENT OPERATORS' COURSE MANUAL (1981 ED)

Please rate the following aspects of the manual by circling the appropriate number on the scale provided, using 5 to indicate excellence and 1 for a poor rating.

	Excellent	Good	Fair	Adequate	Poor
Instructional content:	5	4	3	2	1
Appropriateness of the language to the intended readers:	5	4	3	2	1
Style of presentation:	5	4	3	2	1
Level of difficulty:	5	4	3	2	1
Sequence of presentation:	5	4	3	2	1
Clarity of explanation:	5	4	3	2	1
Clarity of illustration:	5	4	3	2	1
Degree of integration with course content:	5	4	3	2	1
Flexibility for use by the trainees:	5	4	3	2	1
Acceptability to Instructors:	5	4	3	2	1
Acceptability to trainees:	5	4	3	2	1

EXPERT EVALUATION OF OCTU EQUIPMENT OPERATORS' COURSE MANUAL (1981 ED)

Please rate the following aspects of the manual by circling the appropriate number on the scale provided, using 5 to indicate excellence and 1 for a poor rating.

	Excellent	Good	Fair	Adequate	Poor
Organization of contents:	5	4	3	2	1
Subheading use:	5	4	3	2	1
Clarity of language:	5	4	3	2	1
Conciseness of language:	5	4	3	2	1
Readability:	5	4	3	2	1
Paragraphing:	5	4	3	2	1
Consistency:	5	4	3	2	1
Absence of spelling and grammatical errors:	5	4	3	2	1
Accessibility of parts (via index/table of contents):	5	4	3	2	1
Ease of filing and retrieval	5	4	3	2	1

EXPERT EVALUATION OF OCTU EQUIPMENT OPERATORS' COURSE MANUAL (1981 ED)

Please rate the following aspects of the manual by circling the appropriate number on the scale provided, using 5 to indicate excellence and 1 for a poor rating.

	Excellent	Good	Fair	Adequate	Poor
The size of the typeface selected:	5	4	3	2	1
The style of the typeface selected:	5	4	3	2	1
The layout of the pages:	5	4	3	2	1
The stock selected for the cover:	5	4	3	2	1
The stock selected for the inside:	5	4	3	2	1
The quality of the text printing:	5	4	3	2	1
The quality of the reproduction of the illustrations:	5	4	3	2	1
The appropriateness of the binding method:	5	4	3	2	1
The durability of the overall manual:	5	4	3	2	1

APPENDIX D

Pilot Testing Instrument

Vikoma Oceanpack

1. Where on the deck of a supply vessel is the oceanpack usually mounted? (when you are on a ship facing the front, "port" is to your left, "starboard" to your right).

a) on the port side, halfway along

b) on the port side, near the stern

c) near the stern in the centre of the ship

2. How is it usually fixed to the deck?

a) tied to brackets welded to the deck, using turnbuckles and shackles

b) the oceanpack frame is welded to the deck

c) it is lashed down with cables over the top

---

3. What is the yellow stripe on the Air Duct for?

a) decoration

b) so you can tell if it is twisted

c) so that you know where the seam is

4. Where is the water pump which keeps the bottom tube of the boom filled?

a) next to the engine

b) there isn't one, you connect up to a fire hose

c) underneath the buoy at the end of the boom

5. When you want to lay out the boom, the grip wheel should

a) face the bow

b) face the stern

c) it doesn't matter

6. If the boom kinks and sinks while being put out, you should

a) increase the air supply to the boom

b) go out in a small boat to find the puncture

c) request the ship to stop until the boom comes up again

7. There is a pelican hook connecting the tail wire of the boom to the ship's winch. This must be let go when

a) you start putting out the boom

b) the line joined to the tail wire has been passed to the skimmer vessel and made fast

c) you need the winch for something else

8. You have to open the zippers in the boom

a) as each one comes over the stern of the ship

b) after each one has passed through the power block

c) when all the boom is stacked on the ship's deck

Framo Skimmer

1. How does the Framo skimmer work?
   a) by sucking up the oil like a vacuum cleaner
   b) by the oil soaking into spongy material which is the squeezed to remove the oil
   c) by the oil sticking to rotating discs and then being scraped off into a pump

2. What do you do if the Framo starter won't turn over the engine?
   a) get a new battery
   b) get a mechanic
   c) pump up the hydraulic pressure and try again

3. What is the working speed for the Framo engine?
   a) 1500 RPM
   b) 2500 RPM
   c) you just set the throttle wide open

4. If the skimmer discs get clogged with debris, what is the first way you would try to clear them?
   a) bring the skimmer aboard the vessel and clean the discs by hand
   b) reverse the disc rotation for a moment
   c) use a high-pressure hose to wash the debris away

5. Remembering that there are two types of engine used in Framo skimmers, if the lube dipstick is not right below the control panel, where will you find it?

a) up behind the control panel

b) behind the cab, on the other side of the motor

c) to the left, next to the fuel tank

6. How do you know if you connected the hydraulic hoses to the skimmer head correctly?

a) they are labelled

b) you have to check that the controls work properly

c) you cannot get it wrong because the fittings are different

7. To get the skimmer head to float on the water you have to adjust three controls, the "Floating- Lifting" lever, the main arm section control and

a) "pressure control - lifting cylinders"

b) the throttle

c) the main hydraulic control on the rear panel

8. When you are making ready the floating hose which will be used to transfer oil to a tanker, what should you do with the sealing plate on the end which will be passed to the other ship

a) make sure it is tight

b) take it off

c) loosen it up so the crew on the tanker can get it off quickly

Inshore and Miscellaneous Equipment

Circle T (True) or F (False)

Small Boat Operation

If your small boat capsizes, you should stay with it. T F

To set a Boston Whaler's engines in neutral for starting, you pull the throttle levers right back T F

Radio

When you are carrying a walky-talky radio, you should keep the volume turned right down when you are not actually using it, in order to save the batteries T F

If you are using a radio, and someone else comes in on your channel saying "Mayday", you should switch to another channel to go on working. T F

Diesel Engines

With a crank-started small diesel, you must never wrap your thumb around the crank handle T F

If, on a large diesel, the starter turns the motor, but it won't fire, it could be that the spark plugs are dirty T F

Vikoma Seapack

There are two compressed air bottles in the stern door of the Seapack. You only need one of them to lay out the boom, keeping the other as a spare. T F

The yellow stripe around the boom is to tell you when you are near the end T F

Inshore (Hurum) Boom

To anchor the boom, you just tie the anchor line to the bottom cable of the boom T F

There is a special buoy to attach to the front of the boom to tow it through the water T F

Miniskimmers

You cannot use a miniskimmer from a wharf more than ten feet above the water T F

You must leave the top cover on the miniskimmer when you use it T F

Dispersants and Spraying Equipment

There are three spray jet pipes on each boom. the longest one is fitted furthest from the ship T F

When you are setting up, the boom, it must be outside the supporting mast when you screw it into the gimbal T F

The dispersant pumps used have a preset speed which you must not change T F

Safety Rules

You must never cut a rope which is tight T F

You must do what your supervisor tells you, whatever the Captain of the ship says T F

If you want to smoke, you can always go out on deck T F

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The development of instructional material to facilitate long-term retention of operating procedures for oilspill countermeasures equipment.

written by David Peter Bazeley and submitted in partial fulfillment of the requirements for the degree of Master of Education at Memorial University of Newfoundland.

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EQUIPMENT OPERATORS' COURSE MANUAL

1981

OILSPILL COUNTERMEASURES TRAINING UNIT

COLLEGE OF FISHERIES, NAVIGATION, MARINE ENGINEERING AND ELECTRONICS

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EASTCOAST SPILL RESPONSE ASSOCIATION

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PREFACE

OCTU — the Oilspill Countermeasures Training Unit — was established in June 1979 at the College of Fisheries, Navigation, Marine Engineering and Electronics in St. John's, Newfoundland. It was formed to meet a need for practical training in cold ocean conditions on marine oilspill containment and recovery equipment. The initial goal was to provide potential equipment operators with an intensive five-day course (Offshore One) in running and handling presently available types of equipment in the kind of operating conditions for which they were designed. Heavy emphasis has therefore been placed in the program on 'hands-on' training and on field exercises. The theoretical aspects of the basic course have been restricted to the provision of general information on organization, on types of spills, on their environmental impact as it may affect cleanup operations and on the limitations of the current state of the art. A second five-day course (Offshore Two) has been developed to provide further training in the operation, preventive maintenance and troubleshooting of countermeasures equipment.

The basic training program and this manual on which it is based were developed by an organizing committee drawn from: the Marine Emergencies Service of the Canadian Coast Guard's Newfoundland Region, which has the equipment and expertise in marine oilspill countermeasures; C-CORE — the Centre for Cold Ocean Resources Engineering — which is undertaking research on oil in ice interactions and countermeasures; the College, which has extensive experience in running marine emergency courses and the necessary facilities, including a training vessel; and the Extension Service of Memorial University of Newfoundland, which provides adult education throughout the region. The original Committee, with the addition of representatives from member oil companies of the Eastcoast Spill Response Association, is now the OCTU Advisory Committee.

This manual was first issued in draft form as a preliminary version in order to permit its use, under pilot program conditions, as a basis for the initial courses. Following its issue and use in 1979 and in the spring of 1980, comments were sought and received. The manual was then evaluated and revised. This second edition, prepared for the 1981 training program, includes a number of corrections, fairly extensive revision of the content and layout of the original sections and some new material.

Both the preliminary version and this second edition of the manual were written and edited by David Bazeley, B.Tech., B.Ed., of C-CORE (previously Memorial's Extension Service), in close consultation with members of the OCTU's Advisory Committee. Layout of this edition of the manual was by Michael Clair of Memorial's Extension Service. The photographs included in it were taken by David Bazeley and Tia Renouf of C-CORE and by Jack Martin of Memorial's Educational Television Service, Photographic Section.

This manual provides the course content and basic reference for 'Offshore One' and 'Offshore Two'. It will also provide the basis for 'Inshore One', a course for members of inshore oilspill response teams. Participants in 'Command One', a course for potential on-scene commanders responsible for directing marine oilspill countermeasures, should regard this manual as a basic reference.

As more is understood about marine oilspills in cold ocean conditions, new countermeasures methods and equipment are developed. This evolutionary process makes it essential that OCTU should continue to evaluate, review and, if necessary, revise its manuals and associated reference material annually.

D. M. Grenville
Chairman
OCTU Advisory Committee

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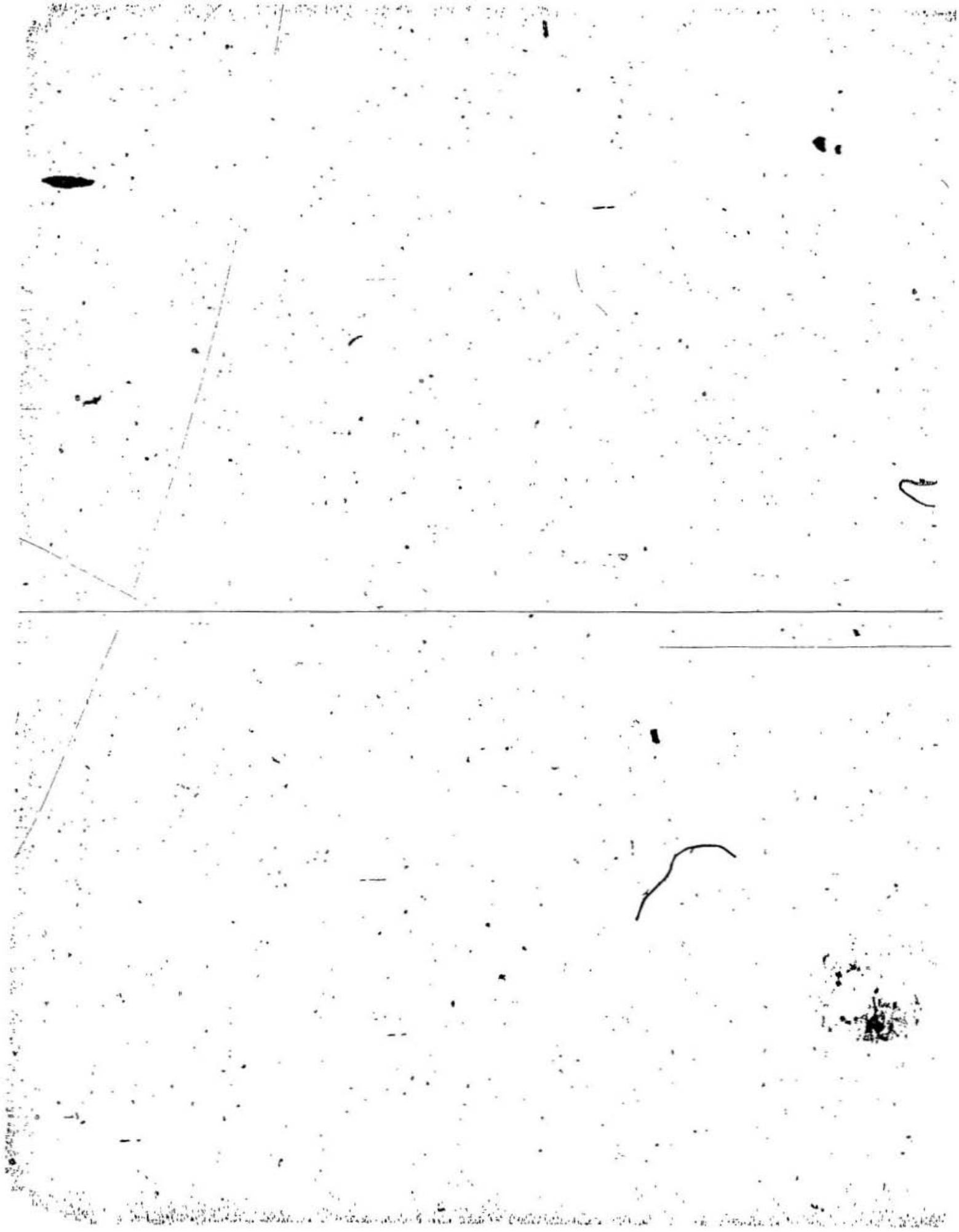


INTRODUCTION

Until a decade ago, the technology of oil-spill countermeasures was almost non-existent. The huge spills resulting from the groundings of the *Torrey Canyon* (1967) and the *Arrow* (1970) showed this dramatically. Since then, much progress has been made, and equipment has been designed and built which can contain and recover oil in many situations, although equipment and techniques for coping with offshore spills in ice or in rough seas has yet to be developed to a useable level. In order to get the best results from the equipment available, we need capable, experienced people, trained in its operation.

OCTU's initial training program consists of:

'Offshore One': A basic course which introduces those likely to be concerned with oilspills to the basic problems involved and to countermeasures procedures and equipment.

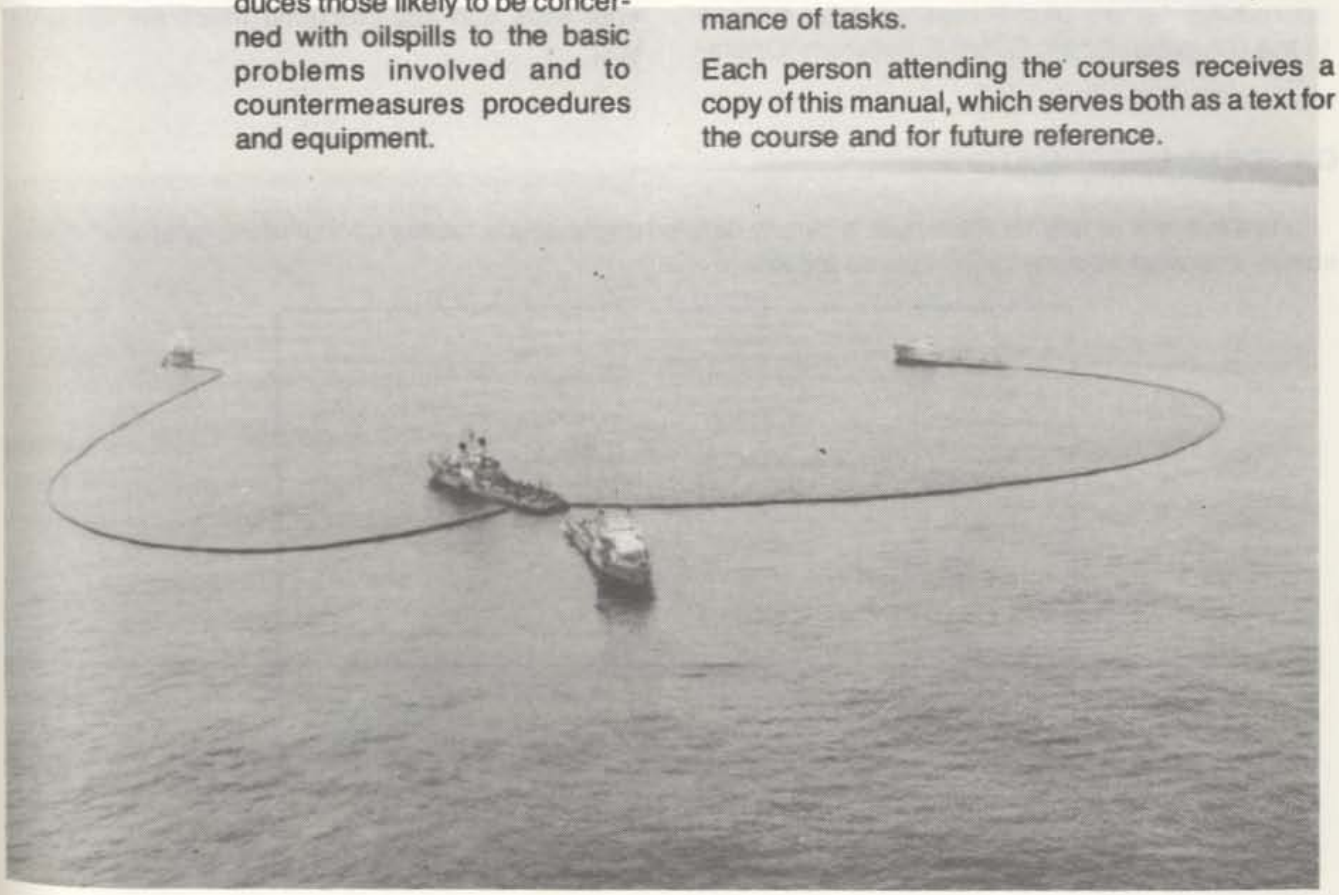
'Offshore Two': A course for graduates of 'Offshore One' providing further training in greater depth in the operation, preventive maintenance and troubleshooting of countermeasures equipment.

'Command One': An advanced course for potential on-scene commanders responsible for directing marine oilspill countermeasures operations.

'Inshore One' & 'Inshore Two': Courses parallel and similar to the 'Offshore' courses have also been developed.

OCTU courses consist of a mix of classroom instruction, audio-visual presentations and practical sessions, and concentrate on the actual performance of tasks.

Each person attending the courses receives a copy of this manual, which serves both as a text for the course and for future reference.



1: ORGANIZATION OF OILSPILL COUNTER-MEASURES

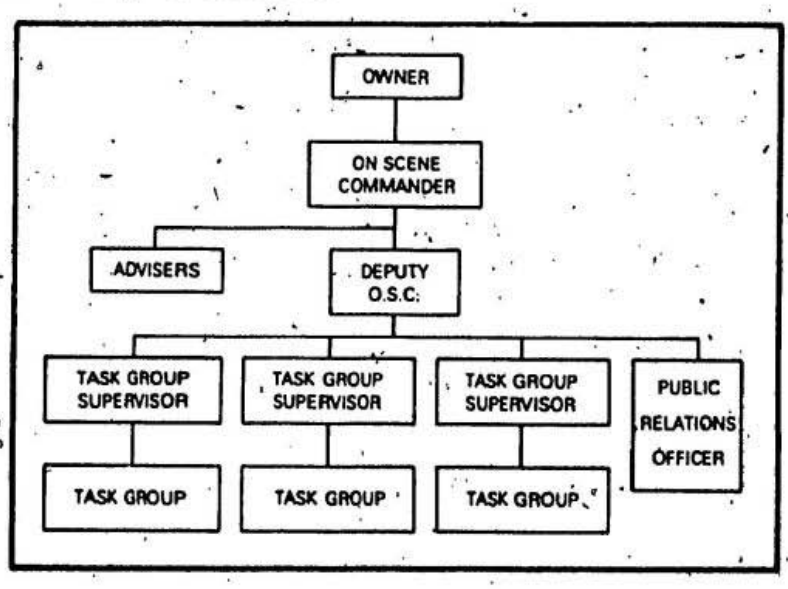
The responsibility for combatting an oilspill rests with the owner of the source of the spill, whether it's a well, a tanker, another vessel, a refinery or any other source. The owner can, if he is able, do the cleanup himself, or he can contract another organization with the capability. The oil companies drilling off the Canadian East Coast in 1979 formed the **Eastcoast Spill Response Association** in order to provide such a capability in the region. The equipment owned by the Association is located in St. John's at the Coast Guard's Emergency Operations base.

In certain circumstances, the operational responsibility for an oilspill cleanup task passes to the Canadian Coast Guard Emergency Operations for spills from vessels, or to other arms of government for spills on fresh water, on land, from drilling operations or from unknown sources.

As with any large operation, oilspill cleanups are very dependent on communications, as well as on each individual performing his role as responsibly and as effectively as possible. Not only the on-scene commander but supervisors and task group members are the eyes and ears of the people finally responsible for the whole operation, so anything you notice which is unusual should be relayed along the line, as should the progress of your work and any problems which are delaying you.

ON-SCENE ORGANIZATION

In the event of any sizeable spill, a clearly defined organization makes control of the operation much easier. A typical structure might be as follows:



2: TYPES OF OIL SPILLS

TYPES OF OIL PRODUCTS

For the purposes of cleanup, the whole range of oil products can be grouped in four categories: —

1. Gasoline types — These are the most dangerous, as there is a great risk of fire or explosion. The usual procedure is to evacuate the area and allow the spill to evaporate completely. This does not take very long. Apart from gasoline, this category includes naphtha, kerosene and liquid natural gas (LNG).
2. Light Oils — These are less dangerous as they are not explosive in the open. However, when recovered into tanks, there could be explosive fumes in the tank, so extreme care is still necessary. Appropriate cleanup methods may involve booms, skimmers and sorbent materials (straw, styrofoam sheets, etc.). The oils in this category include diesel, stove oil and lube oil.
3. Bunker C — In many ways this is the hardest type of oil to deal with, particularly in a cold sea. It does not spread very much on the water, but tends to form clumps. The longer it is in the water, the worse this becomes. Before it can be properly pumped, Bunker C needs to be heated.

   Booms will contain Bunker C, but the effectiveness of skimmers is doubtful in cold water. There is one machine (the Slicklicker) which will work, but at present this is only developed for use in calm water.
4. Crude Oil — This is what comes directly from the well, and it is a mixture of all the oil products we use. When freshly spilled, it can be dangerous, as the "light fractions", gasoline, etc., would be evaporating off. When these are gone the oil would be easier to handle for a while, but gradually it would change to become more like Bunker C.

   Fresh and fairly fresh crude oil would be recovered like light oils, with booms and skimmers. Old (weathered, as it is called) crude oil would be handled like Bunker C.

TYPES OF LOCATIONS OF SPILLS

The way of handling spills also depends on their location, whether offshore, near-shore or onshore.

1. Offshore — Here the priorities would be to contain the oil with booms to prevent it spreading and then to recover it with skimmers or sorbent materials, or to disperse it with chemicals.
2. Near-shore — Keeping the oil away from the shore, especially beaches, marshy shores or quiet coves, would be the first priority in this case. This would involve booms and possibly building barricades of boulders or sand. Recovery would usually involve skimmers and sorbent materials. Dispersants would not normally be approved near shore, except in extreme cases.
3. Onshore — Oil fouling the shoreline is often due to harbour spills or grounded vessels. The first priority is to surround the spill source with booms to keep the shoreline contamination as small as possible, then to recover oil on the water with skimmers or sorbents. Cleaning the shoreline itself is a different problem normally involving booms, sorbents and construction equipment, and possible dispersants. This part of the operation would usually be left until the oil on the water was recovered.

3: SAFETY

Safety is a two-sided thing. The situation where you work must be made as safe as possible. That is the job of your employer, and of the master of your vessel. But you must do your part by knowing **and following** the rules.

Almost any work can be hazardous if proper precautions are not taken. Working on ships or in boats at sea adds hazards to those which would go with similar work ashore.

The hazards which may affect you in your work come from six factors:

1. Using machinery and tools.
2. Working on a deck which is always moving.
3. Having other people around doing other jobs not connected with yours (the ship's crew).
4. Working outside and with cold water.
5. Falling out of or getting lost in small boats.
6. The inflammability of oil products.

GENERAL RULES FOR BEING AT SEA IN LARGE OR SMALL VESSELS

1. STAY ALERT — Keep aware of what is going on around you.

2. THINK BEFORE you do something. NEVER LET GO of a line unless you know what will happen.

3. If you are NOT SURE you can do something, DON'T TRY.

4. NEVER just put anything down. Put it in something or lash it down.

5. CLEAN UP IMMEDIATELY any spills of oil, grease or paint, etc.

6. Never leave a tangle of rope or wire — COIL IT.

7. NEVER CUT A TAUT ROPE.

8. Wear SUITABLE CLOTHES.

9. If you are issued any safety gear, WEAR IT.

10. For handling rope or cable, wear gloves.

11. If you have to go from vessel to vessel:

    a. Get the feel of the movement.

    b. Keep hold with one hand at all times.

    c. STEP — DO NOT JUMP.

SOME RULES FOR WORKING ON LARGER VESSELS

1. The general rules apply.

2. The master of the vessel is in **final** command of **you**, whoever else is directing your work.

3. Do not interfere with the crew members' work, and obey promptly if they ask you to do something.

4. Obey any signs posted on the ship.

5. Allow regular crew members to:

   a. Heave lines to other vessels or receive them.

   b. Launch small boats.

   c. Make fast any lines, particularly tow lines or lines to winches, etc., or to check them if you do it.

6. Do not smoke anywhere unless **you know** it is safe and permitted. Do not smoke on deck when the vessel is at the scene of a spill.

7. Do not go exploring the vessel, or into an area of it unless you know you are permitted.

8. Wear a HARD HAT on deck at ALL TIMES.

SOME RULES FOR WORKING IN SMALL BOATS

1. WEAR A LIFEJACKET.

2. Do not try to operate a small boat unless: —

   a. You know how to.

   b. You have practised under supervision on **that type of boat.**

3. Do not operate a small boat around other traffic unless you know the 'rules of the road'.

4. Do not operate a small boat alone. Make sure someone aboard can operate gear, especially the radio.

5. Before you set out, check that the boat has emergency gear (radio, flares, rations, oars) and that regular equipment is working.

6. Do not race around, or go faster than necessary.

7. Do not tow with a small boat unless:

   a. The boat is properly equipped for towing.

   b. You have towed with that type of boat before.

4: DIESEL ENGINES

This chapter will give a general description of how diesel engines work, some rules to follow when starting and operating diesels and some ideas as to basic trouble-shooting. The regular car engine will be used as a comparison.

WHY DIESELS?

When an engine is required to run for long periods of time **at a constant speed,** diesels have many advantages. They are more economical on fuel than gasoline engines, and because their electrical system is used for starting only, and so is much simpler (some diesels have no electrical system at all) and because they use **fuel injection** instead of a carburetor, they need very little maintenance once they are set up correctly. Diesel fuel is also much safer to handle than gasoline.

The use that oilspill countermeasures equipment gets is very suitable for diesel engines. The fact that an electrical system is only used (sometimes) to start the engine means that if the engine can be started away from the scene of the spill, there is much less risk of stray sparks setting fire to oil vapours than if a gas engine is used.

DIESEL ENGINE TYPES

Diesels, like gas engines, come in all shapes and sizes. They may have one, two, four, six, eight or more cylinders. Some newer designs have three or five cylinders, but you are unlikely to find one of these on oilspill equipment. Multi-cylinder engines may be 'straight' or 'v'. Almost all diesel engines on oilspill equipment are 'four-cycle', like a regular car engine. Diesels may be 'two-cycle', especially smaller ones. There are no differences in operating 'two-cycle' engines.

Larger diesels are usually self-starting. They either have an electric starter, like a car, or a starter which works from a pressurized liquid (usually hydraulic oil). With the hydraulic starter, you may get only one attempt to start the engine before the pressure is gone. Be sure you carry out the checks **before** you start the engine.

Small diesels are usually hand-started with a crank. These cranks do **not** work the same as an old-fashioned car crank. If not used correctly, they can be hazardous.

CRANK-STARTING A SMALL DIESEL

Check the fuel and lube oil levels. There is usually a lever or a knob with three positions labelled STOP-RUN-START. Set it to START.

There is another lever labelled DECOMPRESSION or COMPRESSION LIFTER. It will be spring-loaded.

There should be a label showing which way to turn the crank. It is usually clockwise as you look at the crank. Grasp the crank handle with your **right** hand. **DO NOT WRAP YOUR THUMB AROUND THE HANDLE.** This is called the "monkey grip".

Pull the DECOMPRESSION LEVER against its spring with your **left** hand and hold it there.

Turn the crank. DO NOT LET GO of the DECOMPRESSION LEVER while you build up the speed of the crank.

When the crank is turning **as fast as you can get it,** quickly let go of the decompression lever. Keep turning the crank. You will feel the engine go 'over' compression. It should start and continue to run. Let go of the crank. If the crank kicks back, you were not turning it fast enough. Try again.

Let the engine run for a minute, then set the STOP-RUN-START lever to RUN. Many diesels have a pre-set throttle. If there is a throttle to operate, you will have to open it to get power from the engine.

DIESEL ENGINE TROUBLE SHOOTING

Diesel engines do not have an ignition system. There are no spark plugs, distributor, points, condensers or coils. Some diesels have 'glowplugs', which are used only for starting the engine. An example of this type is the Ford diesel in the Transvac unit (page 73). On the Transvac it is called the heater plug.

This is a checklist of things **you** can check if the engine will not start or run. Do not attempt further maintenance yourself. A qualified diesel mechanic should be called in.

STARTER WILL NOT TURN ENGINE

Electric start:	
Battery connections loose or bad	Clean terminals and refit
Battery flat	Fit charged battery or jump start (beware of shorts and sparks) or use alternate starter if fitted, e.g., Oceanpack has spring starter.
Hydraulic start:	
Low pressure in starter	Pump up starter pressure

ENGINE TURNS BUT WILL NOT FIRE

Out of fuel	Check tank and replenish. Some diesels have fuel injection systems which will not refill themselves with fuel if allowed to run dry. This is a job for a mechanic.
Fuel tap off (if fitted)	Check
Glowplug switch was not 'on'	Try again with switch 'on'
Stop device left 'on'	Reset stop device and try again
Temperature too cold	Spray a little starting fluid into air cleaner
Throttle not open or set to 'RUN' or 'OFF'	Open throttle or set to 'START' and try again

ENGINE STARTS BUT WILL NOT RUN CORRECTLY

Clogged air filter	Replace or clean
Turbocharger belt loose	Tighten as for a car belt
RUN-START lever left on 'START' (small engines)	Set to 'RUN'

5: OPERATING SMALL BOATS

HANDLING

Operating a boat is not like driving a car, despite the fact that you often have a wheel that looks the same.

When you turn the wheel, you get a very different effect. True, the bow will turn the way you turn the wheel. But unlike a car, the stern of a boat will go out the opposite way.

This can be very tricky at low speed, because the slower the boat is moving, the more the back will go out. Of course, whenever you have fine manoeuvers to make, you will be moving very slowly.

Another point is that boats do not have brakes. The drag of the water will slow the boat when you shut off the drive, but not like the brakes on a car. This means you must think ahead, and act well in time, especially when there are other vessels around or near shore. At **very** low speeds, a touch of reverse on the motor can be used to stop the boat. This must not be used, however, when going any faster than dead slow, as it can be quite dangerous and very harmful to the motor, especially if the boat has outboard motors.

Because it is affected by wind and current (mostly wind at sea, current on rivers), you will find that a small boat is more easily handled when it is facing upwind (or current). This is the best direction to approach a mooring or another vessel from.

The use of small boats when large seas are running is not recommended. However, it may be unavoidable. If the boat is seaworthy, it should be no more than uncomfortable.

There are a couple of points, however, which make small boat operation in large waves safer.

Full power should not be used, especially in powerful boats. The main danger is that the boat may take off when cresting a large wave. This can be harmful to the engines, but also it can be very dangerous to the crew when the boat comes down again and can even break bones, or throw someone overboard.

There are three main hazardous situations in small boat operation. Any of them can occur, but simple precautions and good habits make them unlikely, and less dangerous if they do occur.

1. MAN OVERBOARD OR CAPSIZE

This can happen in the best of circumstances. That is why the first two rules of small boat safety are WEAR A LIFE-JACKET and NEVER OPERATE a small boat ALONE.

Falling overboard is mostly a result of not holding on or of taking chances. Remember, one hand for the job, one for yourself and do not take chances even if it means not doing what you are supposed to.

Capsizing can normally be avoided by not trying to operate a small boat unless you are well-practised. However, it can still happen. The golden rule is STAY WITH THE BOAT. Most small boats will not sink and are much easier to spot than a lone person.

2. LOSING POWER

Of course the simplest cause of this is to run out of fuel. This can be avoided by ALWAYS checking before you set out, and making sure you have MORE than enough fuel. If you don't know how much you are likely to need, ask.

Equally important is to not operate a boat unless you know it is in good working order, and has been well maintained. If an engine is hard to start when you are setting out, get it checked BEFORE you go.

Breakdowns can still occur. So before you set out, check that the boat has adequate emergency supplies.

These should include:

a) a radio

b) flares

c) minor engine spares and a tool kit

d) emergency food supply.

Make sure that at least one person on board knows how to use each piece of equipment on board. Check the radio before setting out.

'RULES OF THE ROAD'

1. Keep to the right of other vessels.

2. Give way (yield) when you are passing another vessel.

3. Do not go close to other vessels, especially fishing vessels, unless it is necessary.

4. Do not travel faster than necessary, especially in bays and harbours.

5. If you are crossing another vessel's path:

   a) they have right of way if they are on your starboard side;

   b) you have right of way if the other vessel is on your port side, but,
      — be prepared to give way anyway,
      — remember large vessels are much less manoeuvreable than small boats,
      — sailing vessels always have right of way over power boats.

3. GETTING LOST

The primary precaution against this is the radio. Also, if you are operating near shore, a chart should be taken.

If you do break down or get lost, summon help by radio on the emergency channel. Keep a good watch and if you have good reason to believe help is near, light a flare to attract attention.

THE BOSTON WHALER

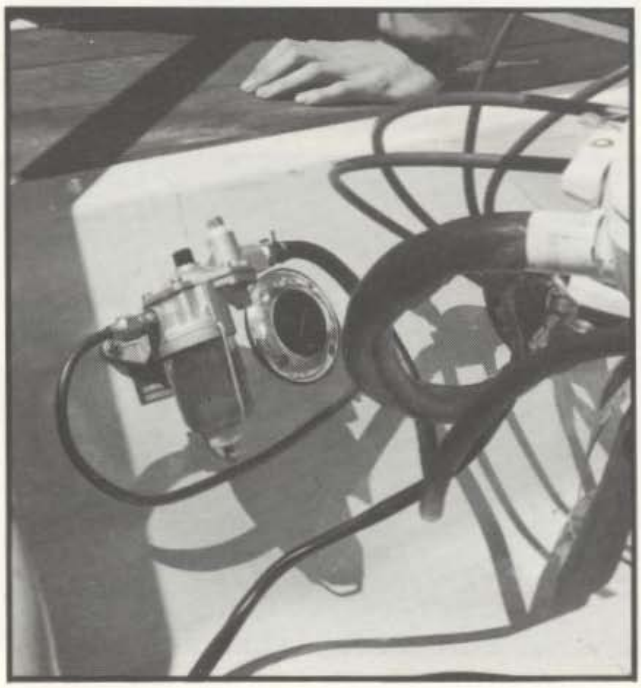
The Boston Whaler series are powerful 17 to 21 foot workboats. The Whalers here are 21 foot models with two 85 hp outboard motors, which will drive them at up to 40 knots. These boats are also equipped with VHF radio, compass, navigation lights and a towing line.

PRELAUNCH CHECKS

Check the hold for tool kit and emergency supplies.

Check that the spare tanks on deck are full.

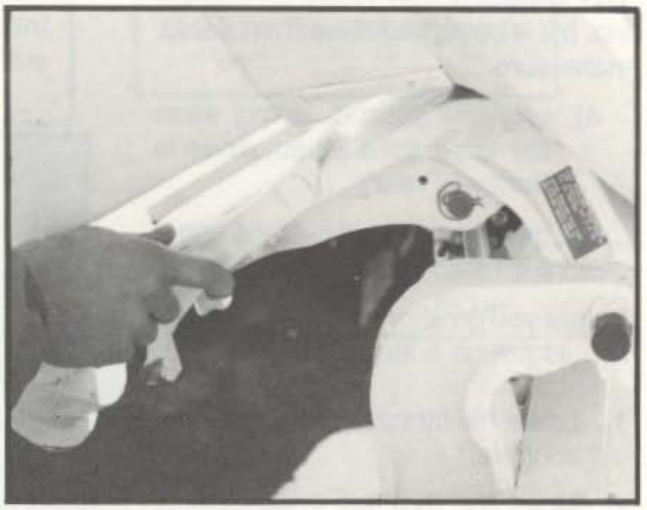
Check the fuel level in the built-in tanks.

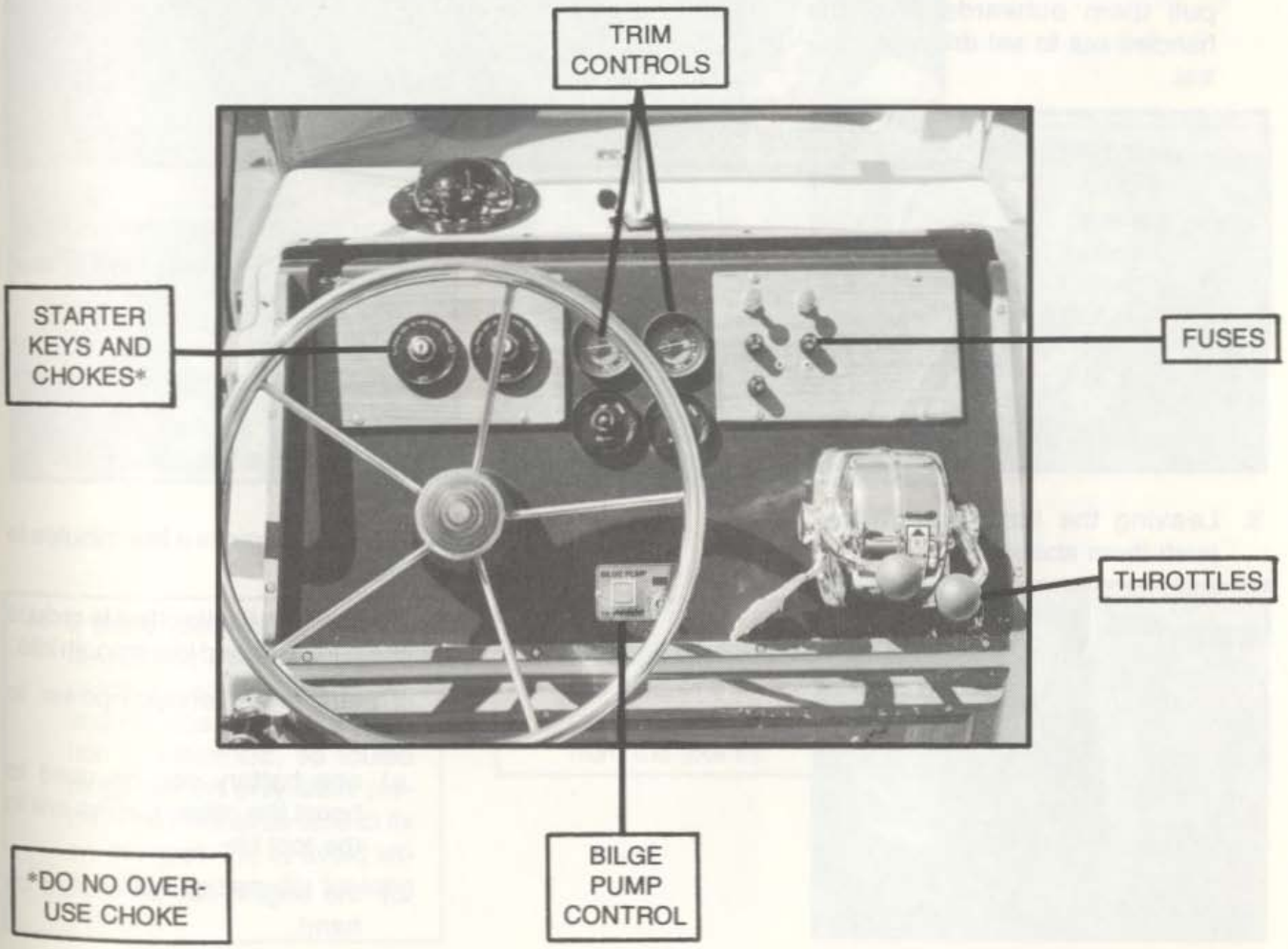


Check that the drain plugs fore and aft are closed.

Raise the engines using the trim controls, until the 'travel support' brackets are free.

Pull back the 'travel support' brackets and lower the engines.





LAUNCHING

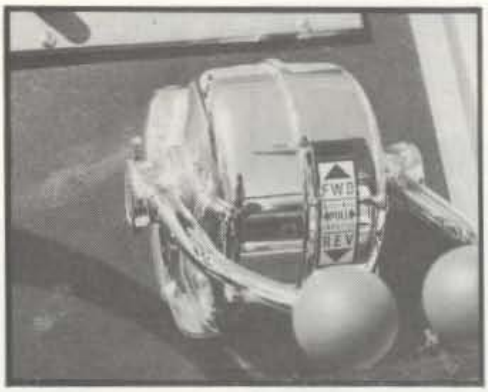
The Whaler is now ready for launching. If it is being launched from a ship, make sure

a) only the attached lifting wires are used (plus steady lines to front and rear),

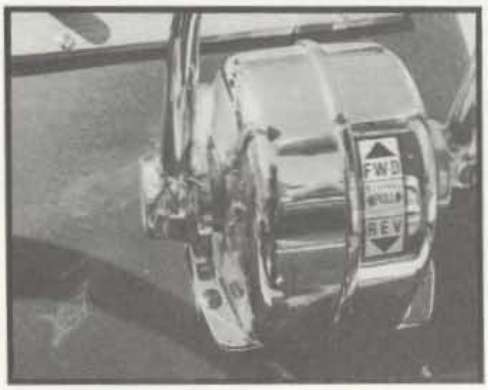
b) the wires are not passing under the towing frame.

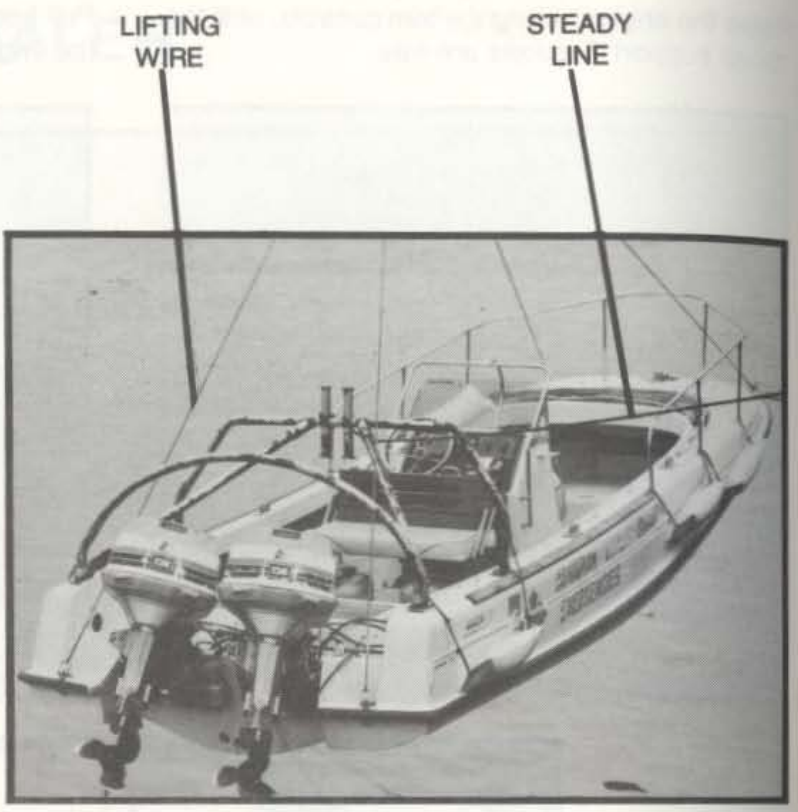
Before you go aboard the Whaler, you should put on a lifejacket.

1. Lower the motors fully with the trim controls.
2. Move the throttles until you can pull them outwards. Pull the handles out to set drives in neutral.



3. Leaving the handles outward, push them ahead half.





4. Turn the two ignition keys to start the engines.

   If the engines are cold, push in on the keys as you turn, to operate the choke.

5. Let go of the keys when the engines fire.
6. Allow the engines a few minutes to warm up.
7. Pull back on the throttles to reduce the engine speed to a smooth idle.

   If there is not enough power to start an engine:

   a) one battery can be used to boost the other. Cables are in the tool kit.

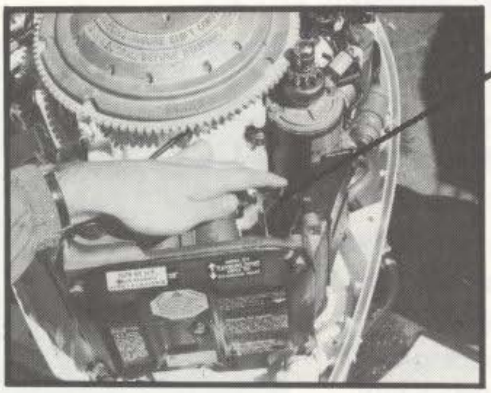
   b) the engine can be started by hand.

TO START THE ENGINE BY HAND

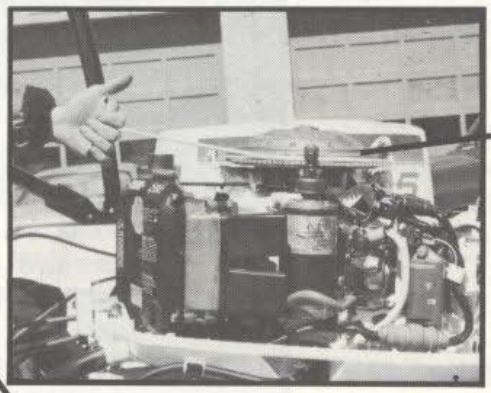
1. Remove the engine cover.

2. Remove the starter cord from its pouch inside the cover.

3. Turn the ignition key to 'on'.



4. Set the choke to 'on'.



5. Attach the cord to the flywheel. Full starting instructions are on the motor.

6. If there is no response from an engine, check the fuse on the side of the motor. If it is gone, replace it with a spare from the tool kit.

7. If the engine still refuses to start, remove the spark plugs, clean and dry them, and replace. The motor ignition is electronic, so fouled plugs are the only likely problem you would be able to fix on the spot. Try to avoid letting the engines idle for long periods.

OPERATING THE WHALER

Erect the radio antenna.

Check the radio operation.

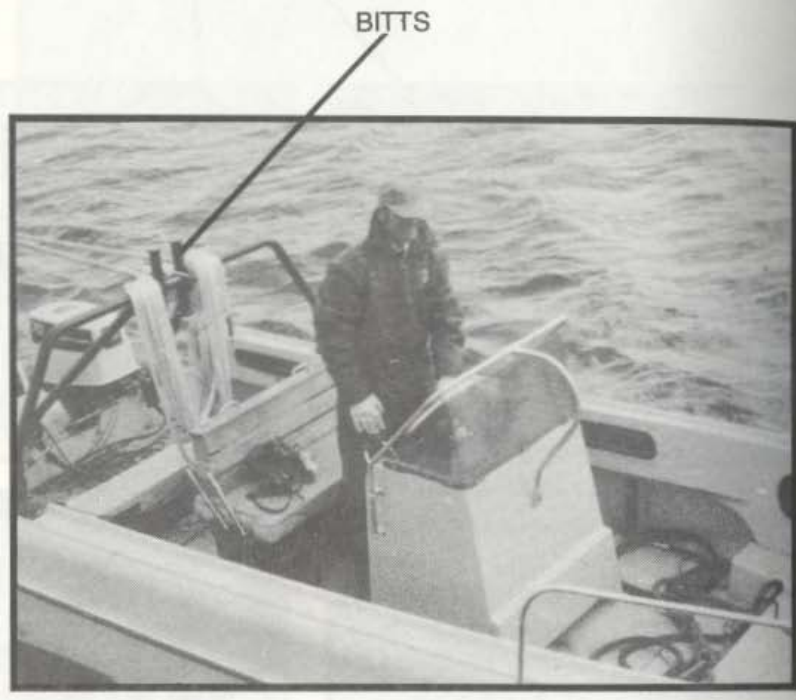
When the engines are warm, pull the throttles back until they click back inwards.

Now push forward to go ahead. Pull back to go astern. Use the controls gently and smoothly. These boats are very powerful.

If one engine stops, and you cannot restart it, you can operate the boat with one engine.

Raise the other engine out of the water, with the tilt control.

The tilt controls can be used to trim the engines under extreme loading conditions, but this is not often necessary.



TOWING

If you have to tow another vessel, bring the line over the rear hoop and make fast to it the bitts on the forward frame.

Be careful when towing. Stand clear of the lines at all times.

Do not open the throttles when the line is off to one side, or turn sharply. Either of these acts may capsize the Whaler.

6: RADIO COMMUNICATIONS

Good communication is vital in a large operation like an oilspill cleanup, not only so that the operation can be effectively controlled, but so that the controller can obtain the necessary information on which to base his decisions.

In offshore situations, most of the radio traffic would be handled by the main radios in the vessels and operated by the crew. But if you are in a small craft, or operating ashore in an inshore incident, you may have to use radio yourself.

There are two types of radio you may need to use, the sets fitted into boats and vehicles, and hand-held "walkie-talkie" sets. Both types have basically the same controls, and operate in the same way. You will have to find the controls on each set individually, as the details of operation may change from one to another, but the operating procedures are all alike.

CHANNEL SELECTION

You can only use radio to communicate when your set and the receiving set are tuned to the same frequency. Unlike broadcasting stations, two-way radio sets use a number of preset frequencies, as with television. Each of these is called a CHANNEL, and is referred to by a number. The sets you may need to use will usually have two or more channels.

Channel 16 is the international distress frequency. This is the channel used for the transmission of distress calls, and you should only use it for that purpose.

OTHER CHANNELS

Before you set out, find out from the co-ordinator of the operation which channel or channels you should use for messages if the set has more than two (CHANNEL 16 and one other), and make a note of the number(s).

SENDING AND RECEIVING MESSAGES

Nearly all mobile radios are automatically set on "receive" when left alone and switched on. All you need to do is make sure that the volume control is not right down and that the set is "on".

When you need to speak, usually all you have to do is press or turn a switch. This will be clearly marked "TRANSMIT" in most cases. It may be on the microphone which is often separate from the set and attached by a cord, or on the set.

A radio cannot send and receive at the same time, so it is important that the people at either end take it in turns to speak. There is a procedure which helps this which is explained further on.

OTHER CONTROLS

Volume

This controls the volume of received messages. If you turn it way down because of a loud message, turn it up again when finished so that you will be able to hear any faint calls.

Squelch

This controls the background noise which is nearly always present on two-way radios. Turning it clockwise will remove more background noise, but also tends to muffle the voice a bit. Turning it counter-clockwise gives a clearer voice but more noise. You have to find the best balance. If there is too much noise, turn it clockwise. If the voice is muffled or not clear, turn the squelch control counter-clockwise. Sets on small craft may be equipped to use headphones as well as a loudspeaker. These are very helpful when the engines are running.

THE TECHNIQUES OF RADIO SPEECH

Trained radio operators use quite a lot of standardized words and phrases. These are given fully in the "Radio Telephone Operator Handbook", published by the Canadian Government. It is not really necessary for you to know these in order to use radio in the event of an oilspill incident, but there are some ways that you can make your use of radio more effective.

1. Speak each word plainly and end each word clearly. Try not to run words together, and try to avoid saying "um", "er" etc.
2. Do not shout
3. Do not speak very quickly or very slowly and try to keep your speed constant.
4. If you know the 24-hour clock system, use it. If you do not, be **sure** to always say "a.m." or "p.m." so that mistakes do not occur.

When you have to say numbers, it is best to speak each digit. For example:

For 16 say "one six".

For 38,143 say "three eight one four three".

For 28,3 say two eight **decimal** three.

But for 5,000 say five thousand.

and

For 16,000 say one six thousand.

6. Some messages will have to include letters, or, when radio reception is not clear, you may have to spell out certain words. Radio operators use a "phonetic Alphabet". Instead of saying "ABC", they say "Alfa Bravo Charlie". There is a standard list of these words, and if you know them, you should use them. However, in emergency circumstances, it would be alright to say, for example "M for Monkey".

7. There are some other words which you may hear, particularly if the other operator is experienced in the use of radio. These words have special meaning when used on the radio.

CALL SIGNS

Each radio set should have a call sign allocated. This may be the name of the vessel or the registration code of the aircraft. In the case of small craft and hand sets, a call sign would often be allocated to each set for the operation. Before setting out, find out your call sign and the others in use from the operation co-ordinator. Write down these call signs along with your allocated channel(s).

You should use your call sign whenever you make or answer a call. For example, you may be 'Mobile 3' and you want to call your supervisor, who is on 'Mobile 1'.

Check your set is on the correct channel, and that no one else is speaking on it.

Press "Transmit"

Say "Mobile 1, this is Mobile 3, over" (Call up)

Release "Transmit".

Mobile 1 should reply with

"Mobile 3, this is Mobile 1, go ahead, over"

You should then transmit your message. If there is no reply, repeat the call-up.

"OVER" AND "OUT"

This is the way that one operator tells the other that he has finished his part of the communication and expects a reply, or does not expect a reply. When you have finished any part of your message and expect a reply, say "over". For instance, when you call up another station, you would say

"Mobile 1, this is Mobile 3, **over**"

After the word **over** you must release "Transmit" on your set so you can receive the reply.

When you have **completely** finished a communication, and **do not** expect any further reply from the other station, and if your call sign is Mobile 3, you should finish by saying

"This is Mobile 3, out"

and release "Transmit".

Word or Phrase	Meaning
ACKNOWLEDGE	Tell me if you understood this message
AFFIRMATIVE	Yes
CONFIRM	My version is . . . is that right?
GO AHEAD	Proceed with your message
NEGATIVE	No
CHANNEL	Change to channel . . . before continuing the message.
ROGER	I have received all of your last transmission
WILCO	I have received your message and will do as you ask.

There are a few others, but they are obvious in meaning.

Example

Putting all this together, a typical message may be as follows:

MOBILE 3	Base, this is Mobile 3, over
BASE	Mobile 3, this is Base, go ahead, over.
MOBILE 3	Sea Pack Boom deployed two miles northwest of Dog Point, over
BASE	Roger, Mobile 3, Vessel Janie **Bravo** due one four three zero hours with skimmer aboard. Hold the boom in position until spill recovered, over
MOBILE 3	Wilco Base, This is Mobile 3. out.

DISTRESS CALLS

There are three types of calls concerned with safety which you may hear. They are identified by special words at the beginning of the call.

DISTRESS SIGNALS

The key word is MAYDAY. These signals have priority over all others. If you hear one, stop any communication you are having, listen to the message and note down the details. A MAYDAY signal means that whoever is sending it is in danger and needs help. The message should be something like this:

MAYDAY MAYDAY MAYDAY THIS IS MOTOR VESSEL NORTHERN STAR, MOTOR VESSEL NORTHERN STAR, MOTOR VESSEL NORTHERN STAR. I AM THREE MILES EAST OF CAPE SPEAR LOST POWER AND DRIFTING ONSHORE. I NEED A TOW OR RESCUE. MY VESSEL IS TWO SIX FEET LONG. MOTOR VESSEL NORTHERN STAR OVER.

If you hear such a message, the person in command of your craft should take these actions:

A. **IF** you are in the area of the distress vessel:

1. Acknowledge the MAYDAY call

   NORTHERN STAR, NORTHERN STAR, NORTHERN STAR, THIS IS MOTOR VESSEL MAKKOVIK, MOTOR VESSEL MAKKOVIK, MOTOR VESSEL MAKKOVIK, ROGER MAYDAY, OUT.

2. Begin going to the aid of the distressed vessel if this is possible and appropriate.
3. Relay the information to your communication base, or directly to Search and Rescue, if possible.
4. Stop all communication on the frequency in use by the distressed vessel.
5. Listen continuously on that frequency. Other vessels may respond to the call and may be in a better position to help than yours.

B. **IF** you are not in the area, you should listen on that frequency. If no station responds to the MAYDAY call within a minute or two, acknowledge and call and continue steps 1 - 5 above.

If a station nearer the scene responds, take steps 3, 4 and 5 **only.**

Other types of calls you may hear are concerned with safety, either of specific vessels, or generally to all vessels.

URGENCY SIGNALS

The key words here are PAN PAN, PAN PAN, PAN PAN. These mean the message is concerned with the safety of a specific vessel or person. They have priority over all signals except distress signals (MAYDAY).

Actions

1. Listen to the message.
2. If it does not concern you, continue work but do not use that frequency for at least three minutes.
3. If it does concern you, take appropriate action.

SAFETY SIGNALS

The key words here are SECURITY, SECURITY, SECURITY. They mean the message is concerned with general safety. These calls have priority over all signals except MAYDAY and PAN PAN calls.

Actions

1. Listen to the message.
2. Take appropriate action.
3. Continue to listen on that frequency for further calls.

MAKING SPECIAL CALLS

It is unlikely you will need to make urgency or safety calls. If it does seem appropriate, the best action to take would be to call your communication base and allow them to broadcast the message, unless it is to a specific craft in your operation. However, you may need to make a distress call.

MAKING A DISTRESS CALL

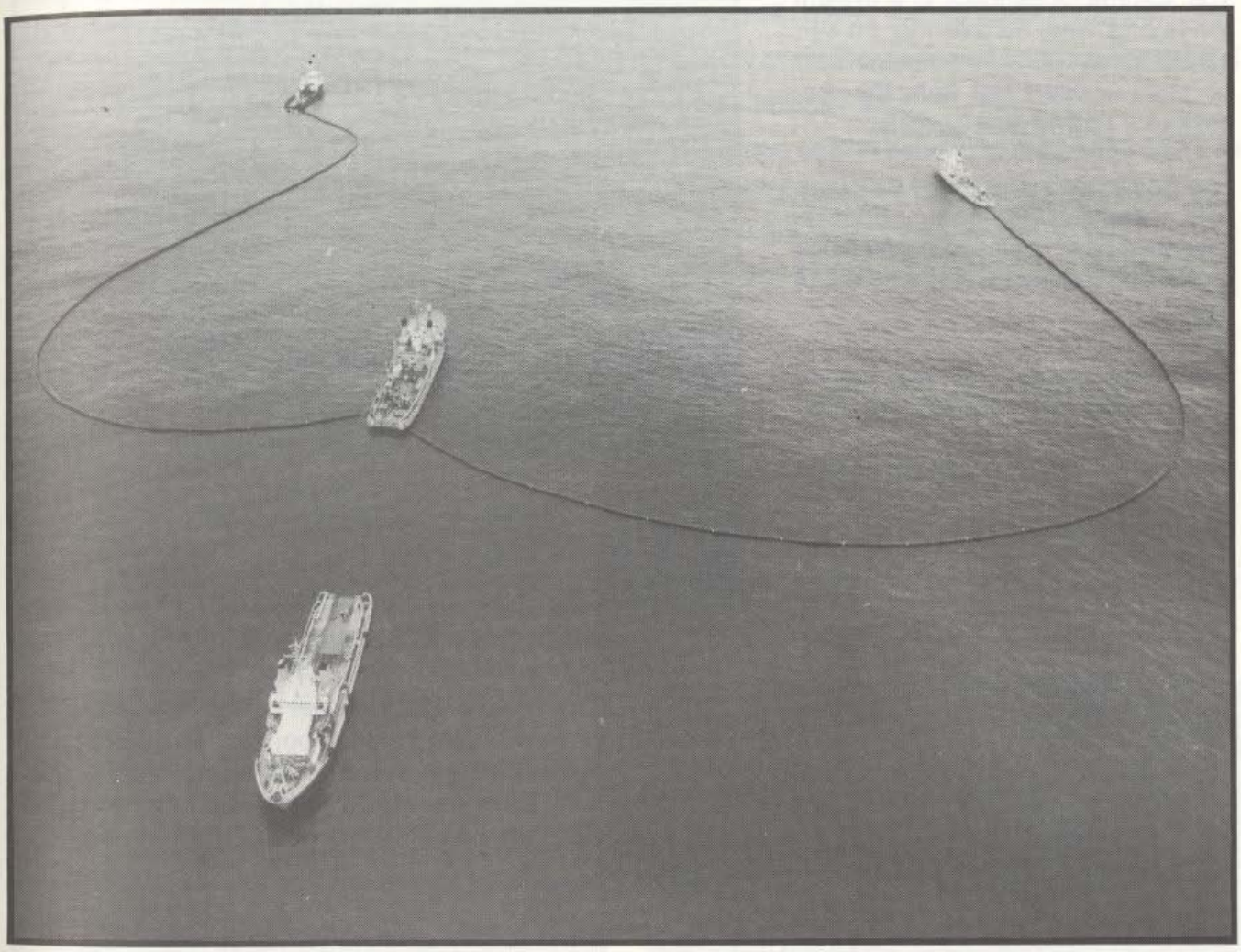
If you are in danger and need help, make a distress call.

1. Decide exactly what to say. Your message should contain the following:

   MAYDAY, MAYDAY, MAYDAY. THIS IS (your call sign, **three** times).
   Where you are.
   What is your problem.
   Any other useful information (how many people aboard, any injuries, etc.).

2. Make the call on your regular working frequency.
3. If no station responds, repeat the call on CHANNEL 16. Keep repeating the call on these frequencies alternately until a station responds.

7: OFFSHORE COUNTERMEASURES



INTRODUCTION

Contingency plans for countermeasures operations in the waters offshore from Canada's east coast all involve the use of the Vikoma Oceanpack boom and Framo skimmers, deployed from rig supply vessels. Earlier procedures required three vessels to deploy a **set** consisting of one boom and one skimmer. A procedure developed in St. John's during 1979 enables two booms and two skimmers to be deployed from three vessels, and also makes the vessel maneuvers required much easier.

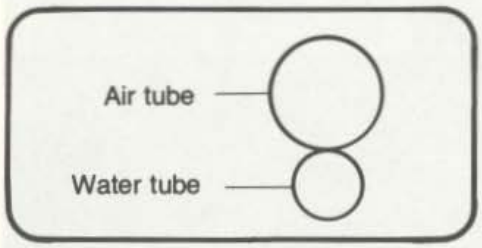
This new procedure does mean, however, that **exactly** what you have to do when you work with the Oceanpack at some stages of the operation depends on whether that boom will be to port or starboard of the skimmer vessel when final deployment is complete. The starboard vessel has its Oceanpack mounted conventionally, and the following instructions are given for this situation. The other vessel has the Oceanpack mounted on its starboard quarter and all actions on this are opposite.

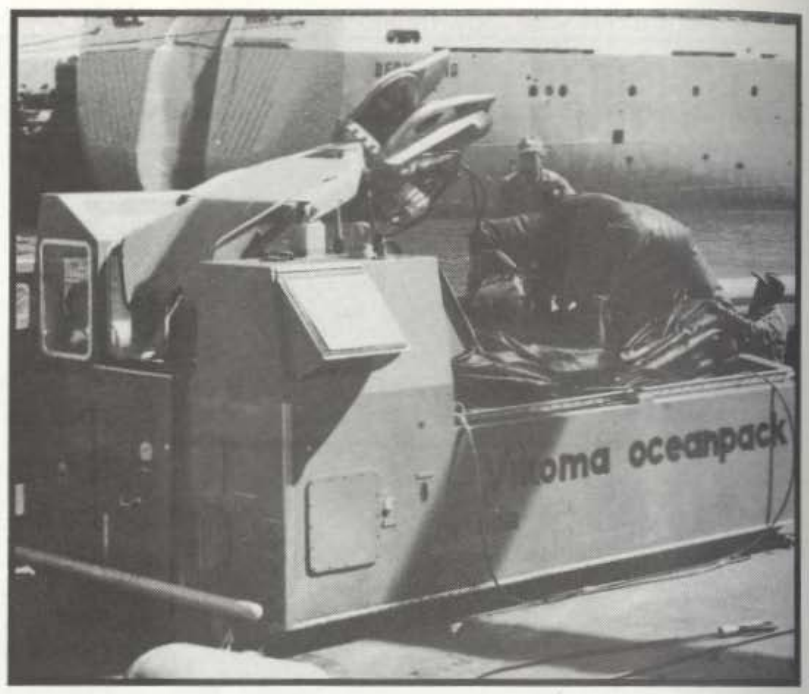
THE VIKOMA OCEANPACK

The Vikoma Oceanpack is a system for laying and recovering an oil-containment boom. It is designed to be used in open sea from the rear deck of a drill-rig supply vessel.

The Oceanpack consists of a storage hold containing the boom, a Ford diesel power unit, a jib and power block for hauling the boom, and the control cab.

The system comes with 500 metres (about 1,600 feet) of boom. This type of boom is made up of two tubes, one filled with air and one with water. The air is pressurized by a fan inside the Oceanpack. The water is pressurized by a submerged pump driven hydraulically.





The Oceanpack on vessel bottom left is mounted conventionally, near the port rail. The Oceanpack on the *Heritage Service* is mounted near the vessel's starboard rail for deployment to port of the skimmer vessel.

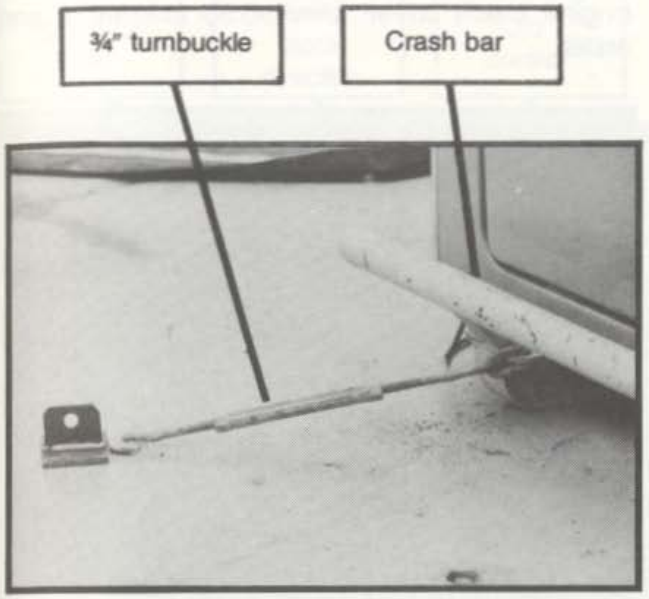
FIXING TO THE VESSEL

The Oceanpack weighs about 6 tons. The crane used to lift it aboard the ship must have adequate capacity — 30 tons is usually used in St. John's harbour.

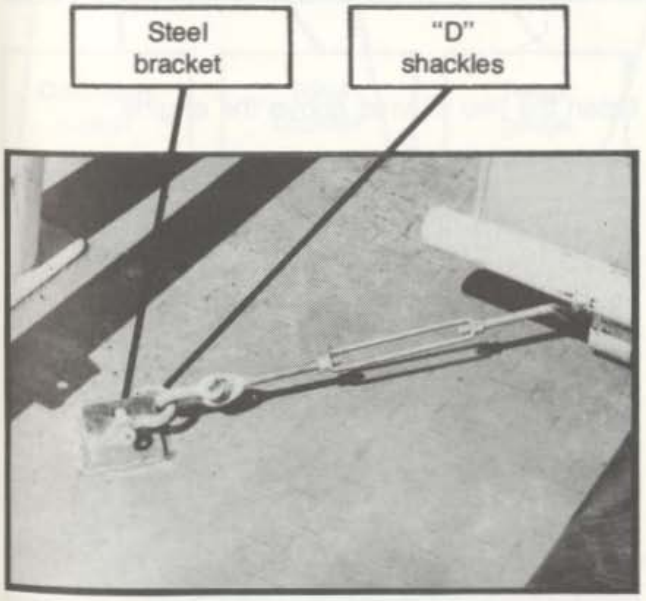
Four lifting cables are attached to the Oceanpack, use **only** these cables.

The Oceanpack should be placed on the aft deck, about 15 feet from the stern and about four feet from the **port** rail, with the cab facing the stern.

Attach a three-quarter inch turnbuckle to the crash bar on each corner.



Steel brackets have been made up to go with each Oceanpack. Weld these to the deck at the right distance to attach the turnbuckle. They should be placed a little outside the fore and aft line of the side of the Oceanpack.



Attach the turnbuckles to the brackets and tighten.

Before leaving port check that you have aboard:

Spare fuel and lube oil;

All hydraulic hoses and the water pump and buoy;

A supply of shackles, rope and pelican hooks; and

A radar reflector buoy.

Start up the engine before leaving port to check its operation.

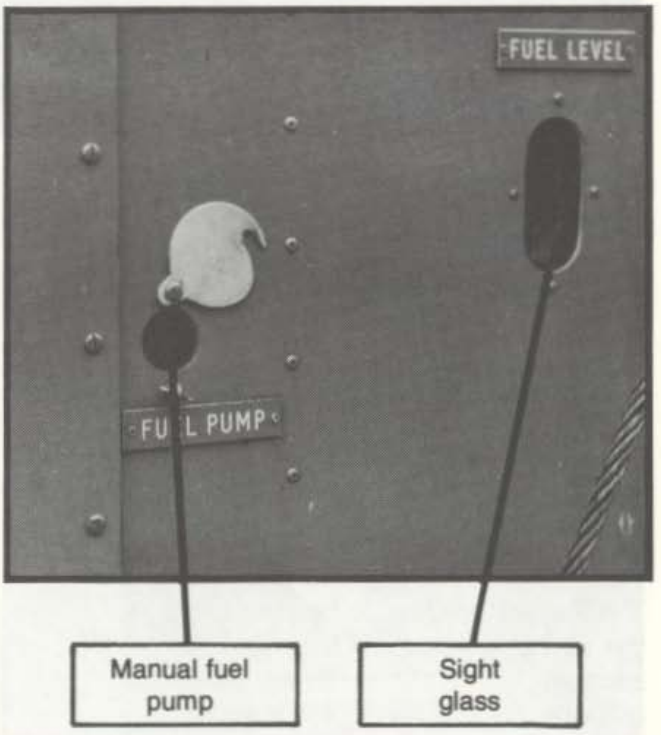
Replace the hold cover and lash down.

Secure the cab door.

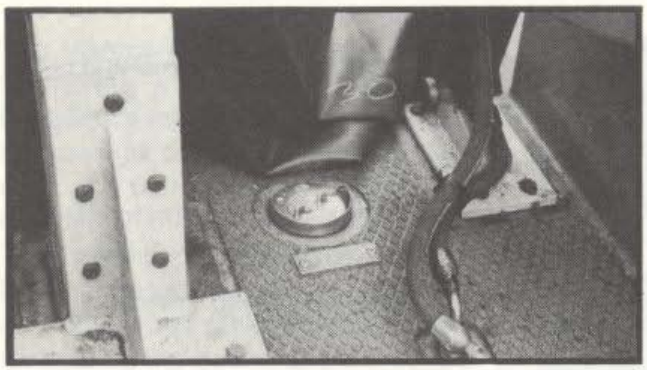
STARTING THE ENGINE

Check the fuel level in the sight glass.

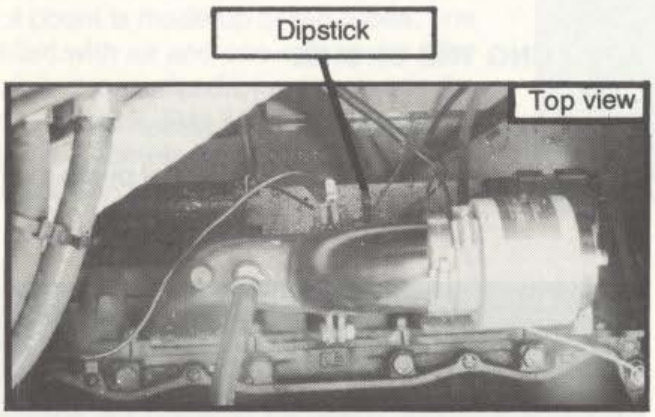
If using barrels to refill, the manual fuel pump may be used.

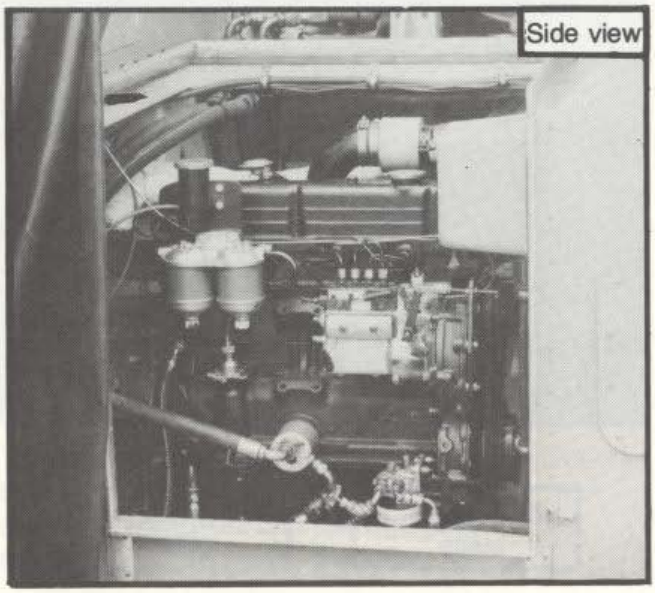


The fuel filler is beneath the jib, above the engine hatch cover.



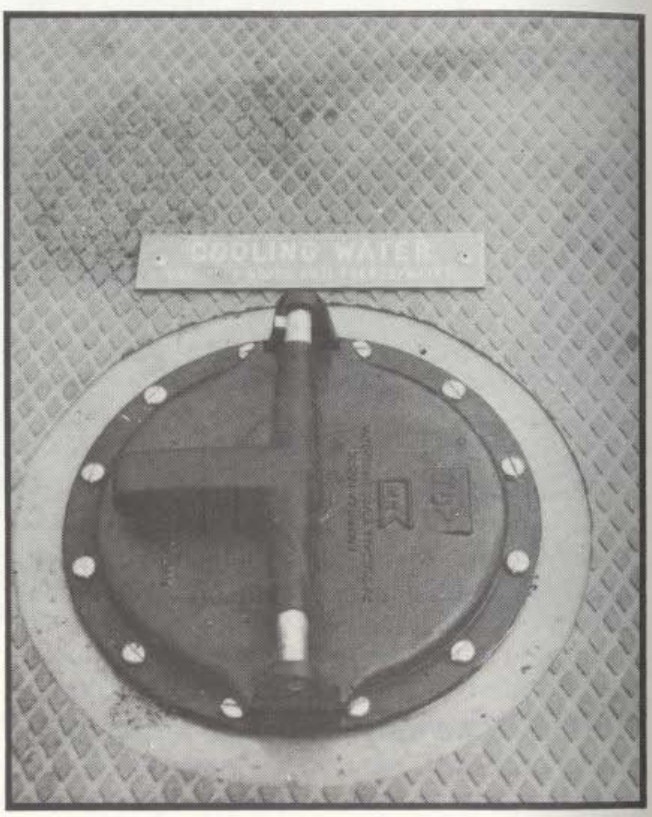
Check the engine oil level, and top up if necessary. Use 10W30 or similar oil.



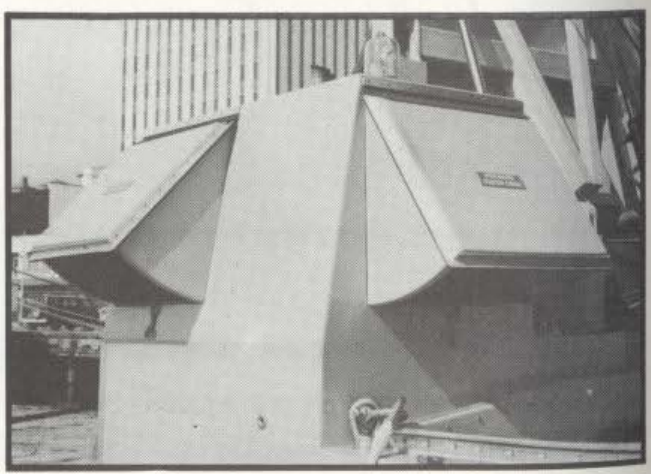


Check radiator coolant level.

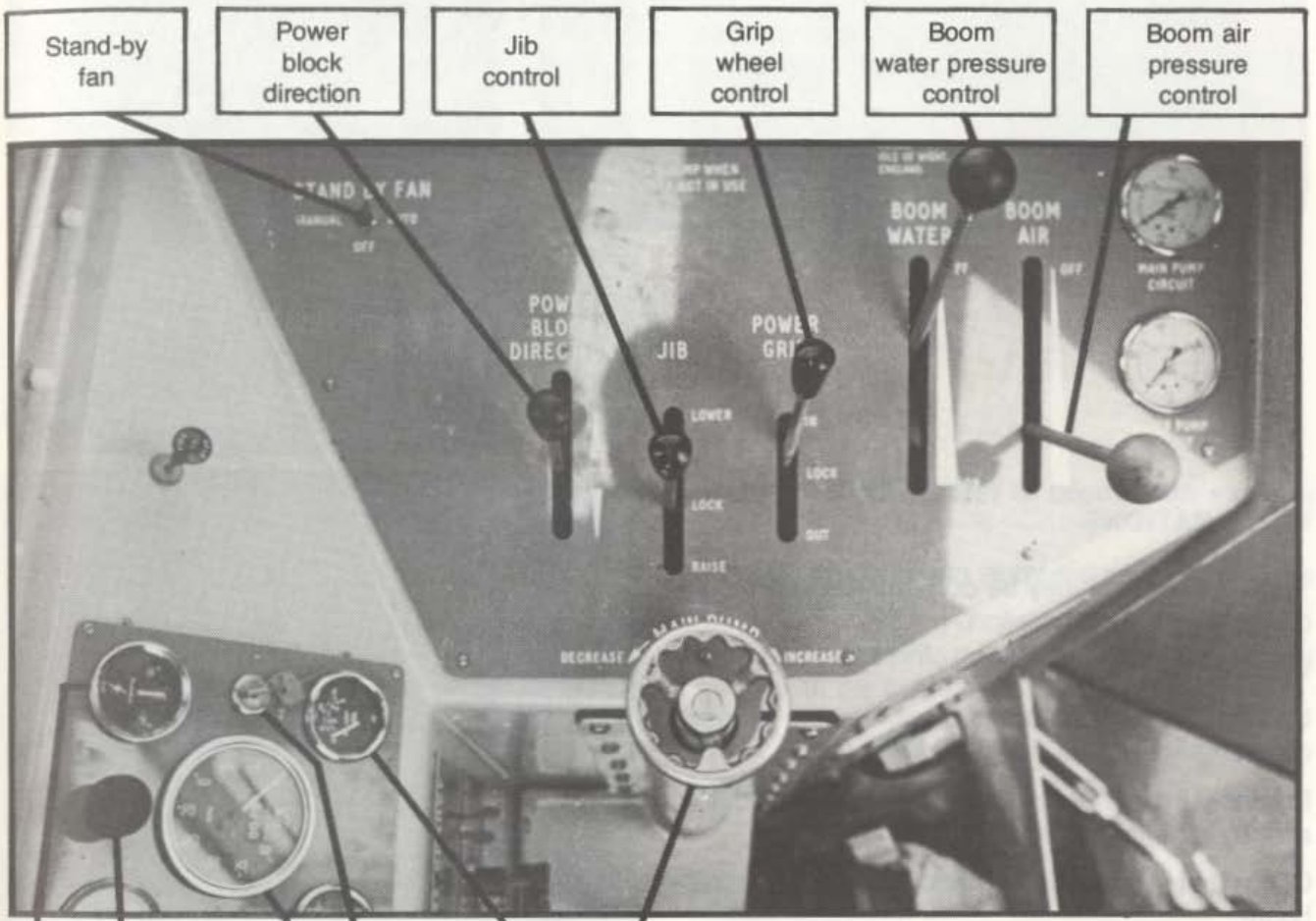
The filler pipe for the radiator is also above the engine hatch cover. Use 50/50 antifreeze and water.



Open the two louvres above the engine.



Check that all control levers are 'off'. Turn battery isolator to 'on'. Start the engine with the key. Allow the engine to warm up until it is running at 1800 RPM.



In cold weather, open the swing cover on the engine hatch and push excess fuel button.

In sub-zero weather:

— Fill the dashpot on the front of the engine with diesel fuel.

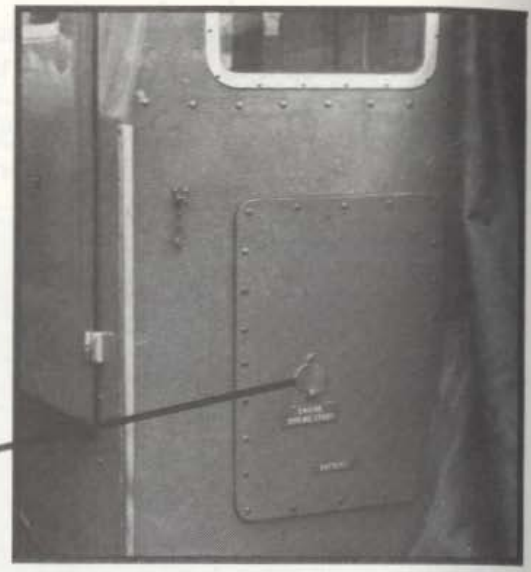
— Push the cold start button on the panel for 30 seconds.

Start the engine with the key.

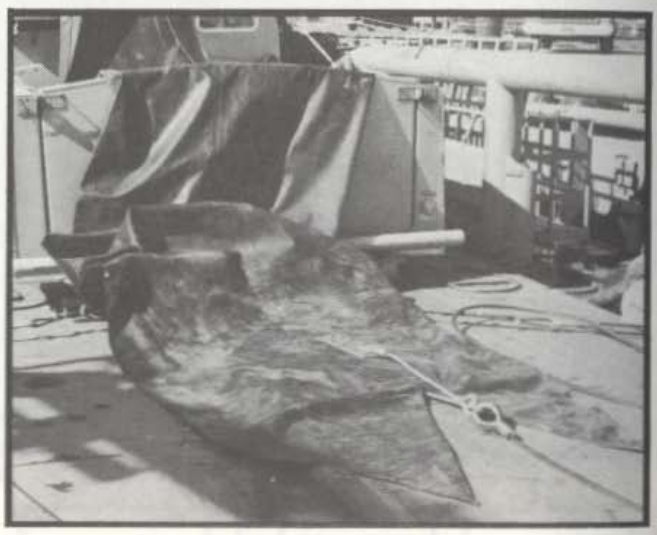
If the battery is flat, use the spring starter. Follow the instructions in the cab.

The spring starter drive is behind the panel on the front of the cab.

Allow the engine to warm up until it is running at 1,800 RPM.



PREPARATIONS



These operations may be done before sailing, or on the way to an operation.

Uncover the hold.

Unload the water pump, buoy, towing wires, capstan sheave unit and the air duct.

Pull the tail of the boom forward over the hold door and lay it on the deck.

Check that the tail wire is shackled to the tail of the boom.

Make fast the free end of the tail wire to the main deck winch cable with a Pelican Hook.

Attach 100 feet of ¾ inch line to the tail wire near the Pelican Hook.

Open the main pump control enough to give hydraulic pressure.

Erect the jib.

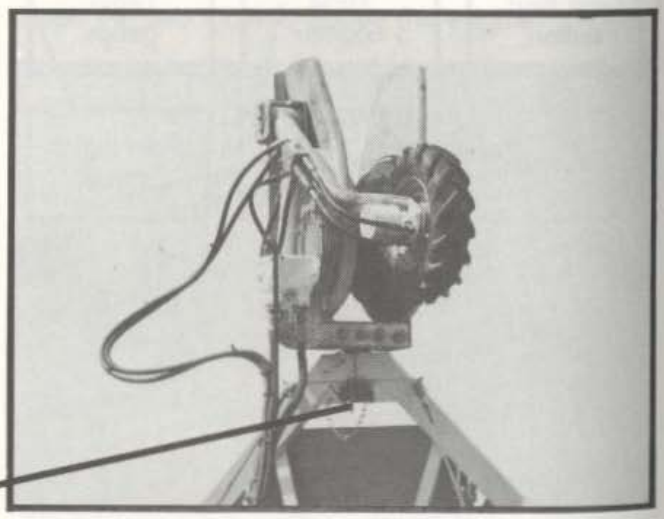
If the grip wheel is not facing the ship's stern, turn the block so that it does. To do this:

— Remove the pin at the base of the block.

— Turn the block.

— Replace the pin.

Open the grip wheel.



Check which way the power block control operates.

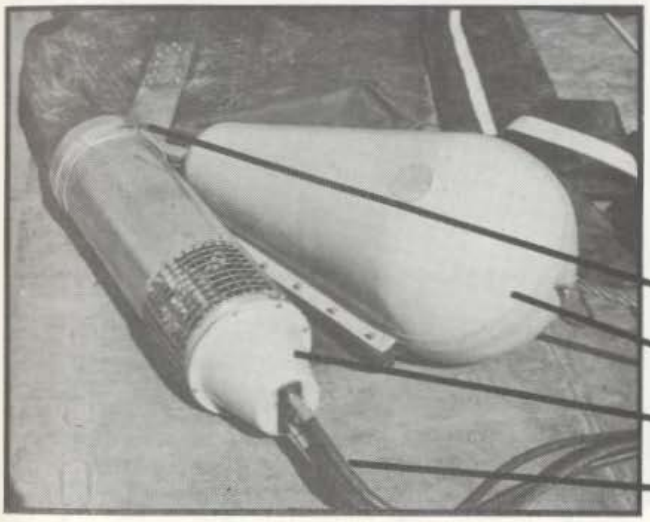
Lower the jib.

Pull the top fold of the boom over the block.

Erect the jib.

Lock the jib.

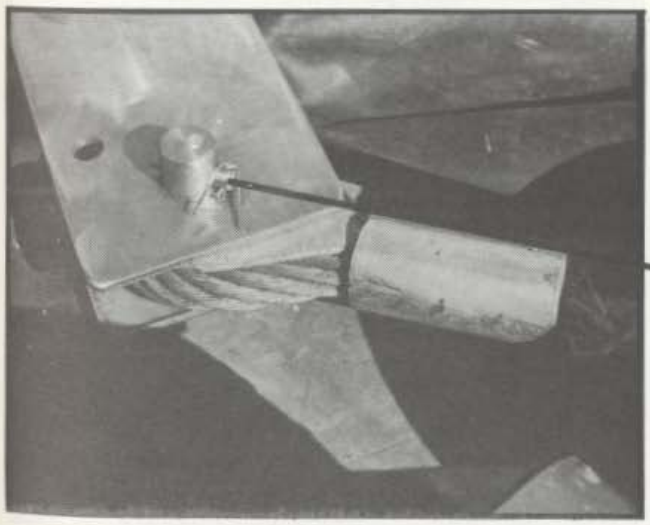
Close the grip wheel.



Feed out about 15 feet of boom, then stop the block.

Attach the water pump, buoy and towing wire to the head of the boom.

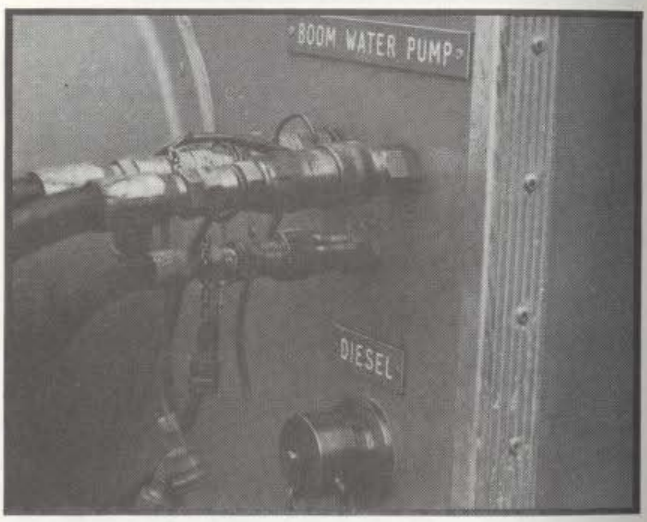
— Insert the pin into the water pump coupling, and fix with the split pin.



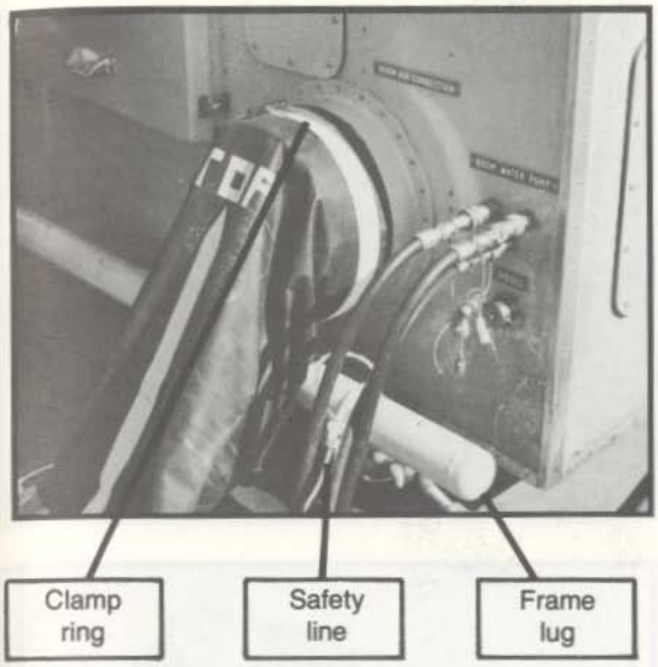
— Insert the pin and split pin to the towing wire coupling.

Attach the air duct to the boom. Make sure the wing bolts are tight.

Couple the hydraulic lines from the water pump to the couplings on the Oceanpack.



Follow the yellow band on the duct to make sure it is not twisted or tangled with the hydraulic lines.



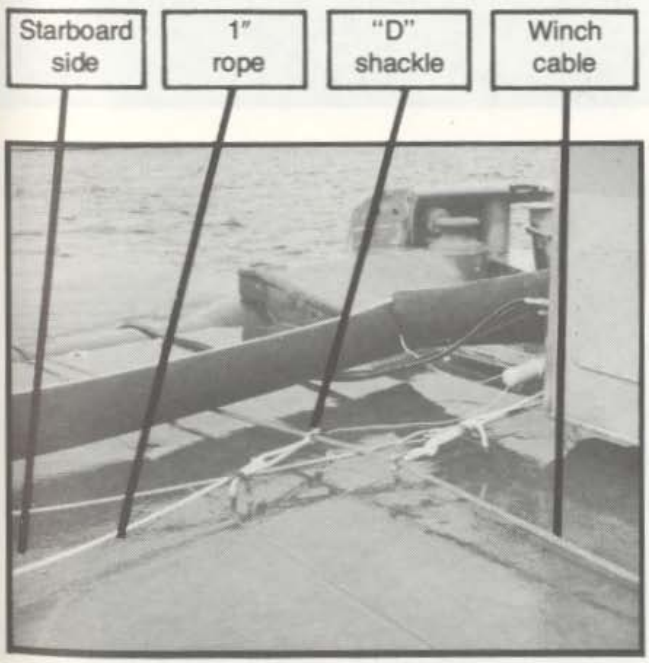
Open the two zips in the air duct. Push the end of the air duct well onto the outlet on the Oceanpack.

Tighten the clamp ring.

Attach the safety line to the frame lug.

Close the two zips in the air duct.

The air duct and the first part of the boom should inflate.



Join the towing wire to the deck winch cable.

Let out enough cable to have 10 metres aft of the Oceanpack.

Put two D shackles over the winch cable.

Tie a length of 1 inch rope to one shackle. It must be long enough to reach across the deck. Make the rope fast to the starboard side of the vessel so that the cable is on the deck close to the starboard rail.

Tie a similar length of rope to the other shackle, and make fast to the port side of the vessel, without moving the winch cable.

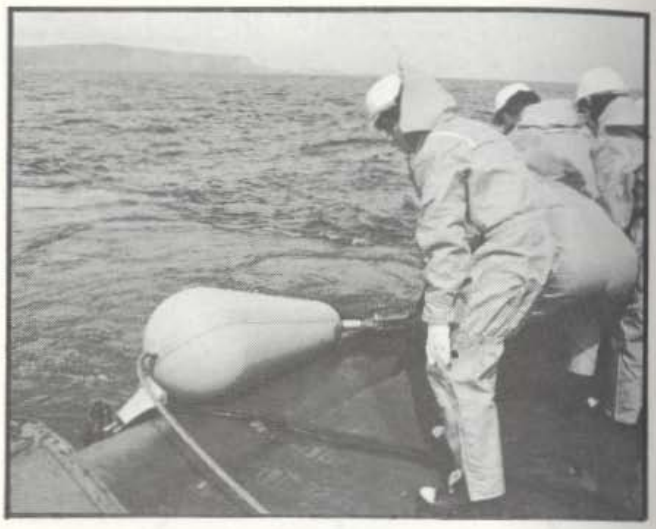
OCEANPACK BOOM DEPLOYMENT

Boom laying can begin when the skimmer vessel is anchored on station.

The boom vessel which will lay its boom first should be about a half to one mile **directly downwind** of the skimmer vessel.

All other vessels should stay well clear.

To begin laying, the boom vessel steams upwind at about 2 knots as the boom is gradually deployed. There should be sufficient time to lay all the boom before the skimmer vessel is reached.



LAYING THE BOOM

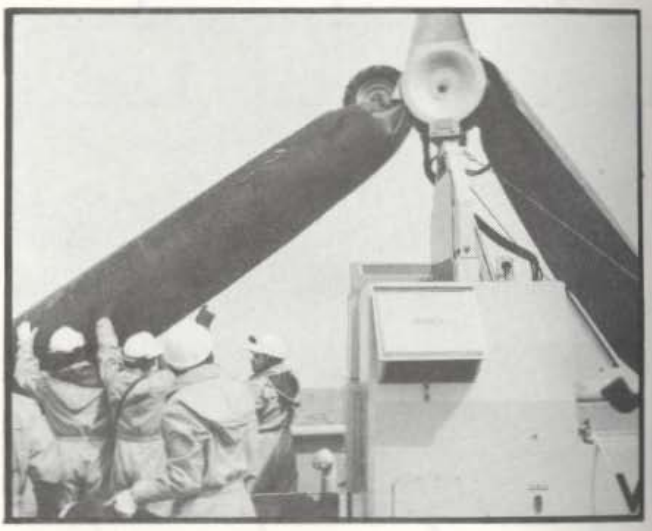
Wait until the vessel is heading upwind at about 2 knots.

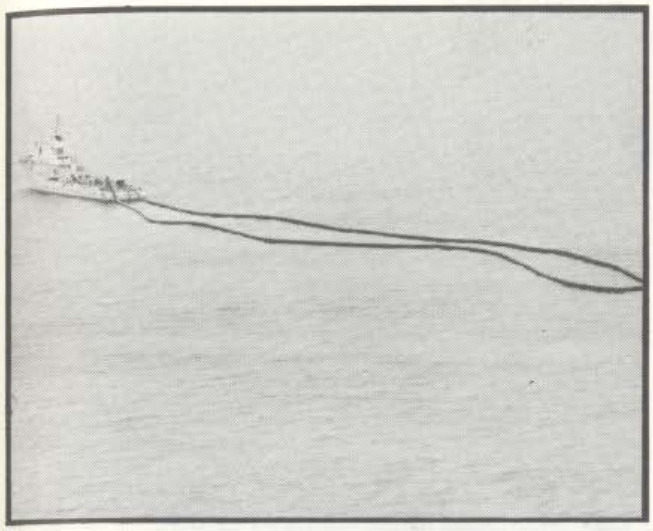
Move the boom air lever to inflate the boom to "4 inches water gauge."

Launch the buoy and water pump over the stern. Stand clear of the towing line.

Check there are no tangles in the air duct or the hydraulic lines.

Operate the power block to feed out the boom. Engage the water pump. Control the speed of the block with the main pump control wheel.





Lay the boom as fast as possible without causing bights (kinks) in the boom.

If the boom sinks at the end, the vessel should stop until the boom returns to the surface.

Bight at end of boom caused by vessel going too fast.

If you have to stop laying the boom for more than a few minutes, stop the block when there is a zip in the top layer of boom in the hold.

Open this zip, and prop it open.

Remember to close the zip before you start to lay boom again.

When all but the tail of the boom is laid, stop the block and open the grip wheel. Unlock and lower the jib.

Reel out the deck winch cable until the Pelican Hook is **astern** of the Oceanpack.

Attach a radar reflector buoy to the boom tail wire. Lay the buoy on the after deck, close to the edge.

Heave the 100 foot line across to the skimmer vessel.

When the line is made fast aboard the skimmer vessel, strike the Pelican Hook.

This will allow the tail of the boom to be pulled over to the skimmer vessel.

The boom vessel then moves off and anchors on station about 300 yards to the side and about one hundred yards ahead of the skimmer vessel.

Loosen the lines shackled over the winch cable.

Haul in on the line next to the Oceanpack until the cable is alongside the Oceanpack. Tighten both lines.

Switch the standby fan to 'auto'.

The other boom vessel then repeats this procedure on the other side.

ABOARD THE SKIMMER VESSEL

Attach the messenger line to a winch line with a Pelican Hook (the opposite quarter is a good location if a winch is there). Winch in the line until the tail of the boom is about ten feet from the vessel. Attach PVC skirts to the outboard line with shackles (see photo on page 52).

WHILE THE BOOM IS DEPLOYED

While the boom is laid, the engine is kept running.

Every 12 hours you should:

Stop the engine.
Check the fuel level and refill it if it is low.
Check the lube oil level and top up if necessary.

Check the hydraulic oil level and top up if necessary.

Restart the engine.

Also, you should check quite often:

Engine temperature.
Ammeter.
Boom air and water pressure.
Hydraulic oil pressure.

A serious drop in oil pressure will cause the engine to stop and the warning light to flash.

RECOVERING THE BOOM USING THE DECK WINCH

ABOARD THE SKIMMER VESSEL

Remove the PVC skirts from the tail wire of the boom.

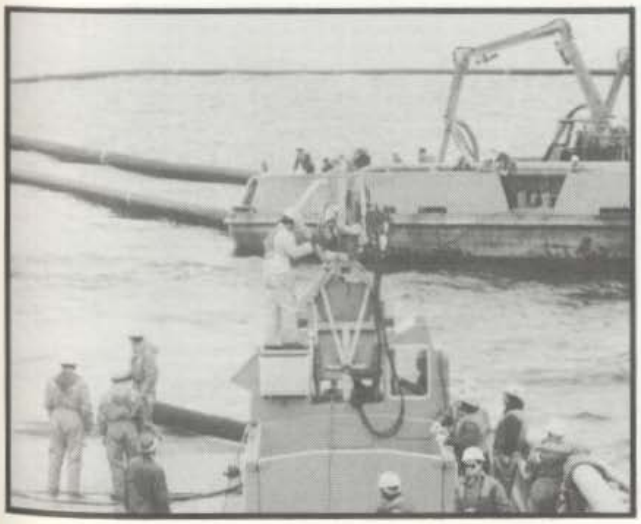
Winch out the wire until the Pelican Hook is very close to the rail.

Attach the radar reflector buoy to the tail wire outboard of the rail.

Hold the buoy outboard of the rail, and release the Pelican Hook.

ABOARD THE BOOM VESSEL

When the tail of the boom is released from the skimmer vessel, the boom vessel should steam clear of the skimmer vessel, towing its boom. It should then make a large circle and recover the tail of its boom.



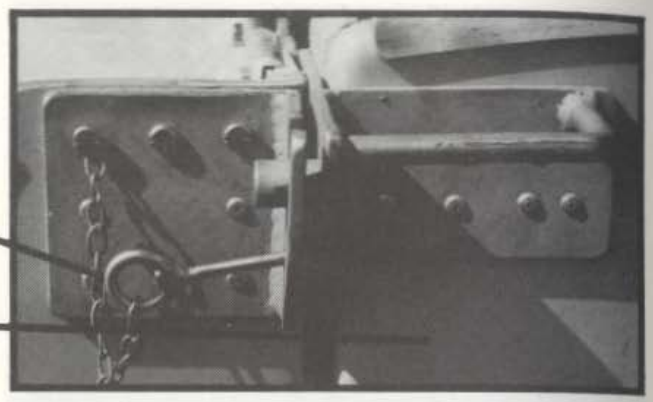
Open the main pump control.

Erect the jib.

Rotate the power block so that the grip wheel faces the ship's bow. Replace the pin (see page 24).

Shut off the water pump.

Remove the rear door of the hold. Stow it in a safe place.



Remove the buoy.

Pass the tail wire over the block and make fast to the winch cable.

Winch in until the tail of the boom comes through the block, as far as the reinforcing plate.

Control the boom air pressure between 4 and 6 "inches water gauge", but if a part of the boom starts to sink, open the pressure control immediately and stop recovery until it floats again.

If there is oil sticking to the boom, wash it down with a fire hose as it comes aboard.

As the last of the boom comes aboard, haul in the towing wire and recover the buoy and water pump.

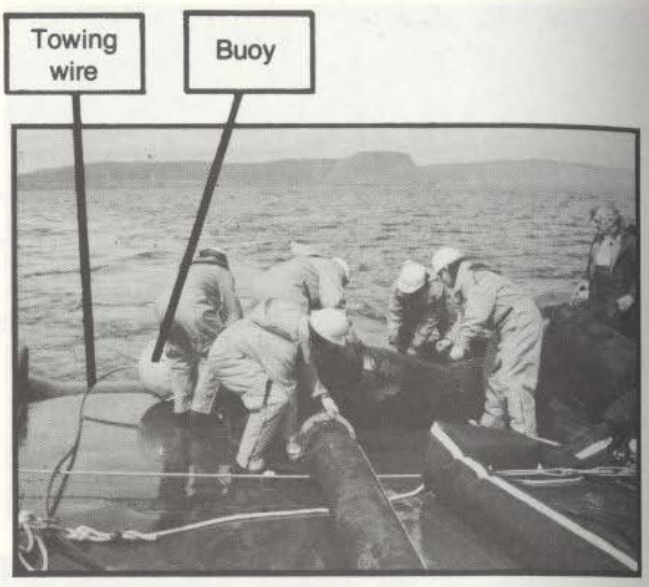
Stop the power block, leaving enough boom aft so that the boom is not taking the weight of the buoy or water pump.

If it is a long trip back to port, or if the boom is not going to be redeployed for some time, open the grip wheel, unlock and lower the jib.

Stop the engine.

Close the engines louvres.

If the weather is bad, lash down the boom.



If the boom is needed again, it can be redeployed from this position. If not, it is best to repack the boom on return to port.

ALTERNATIVE METHOD OF RECOVERING THE BOOM USING THE OCEANPACK CAPSTAN

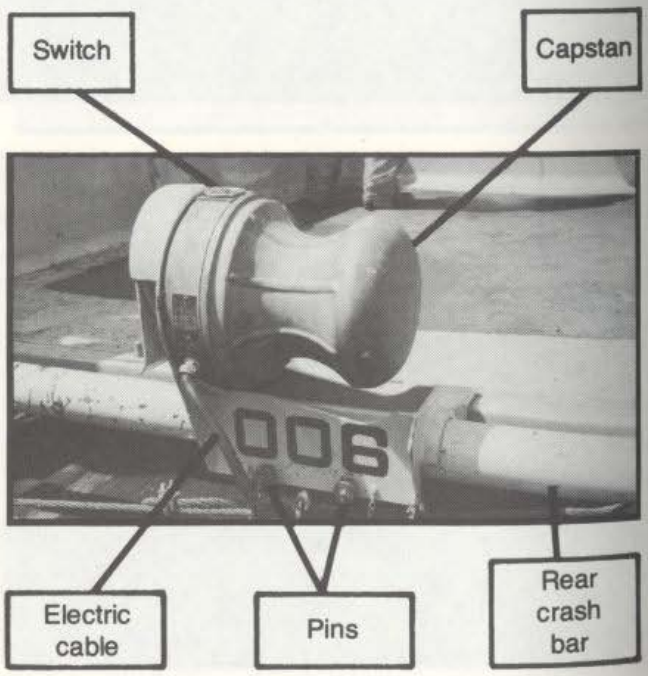
Clamp the capstan to the rear crash bar.

Always use both pins.

Connect the electric cable.

There is a switch on top of the capstan.

Push once for 'on'.
Push again for 'off'.



Open the grip wheel.

Lower the jib.

Recover the tail wire of the boom. Pass the line over the power block, make fast the end and take two turns round the capstan.

Start the capstan and pull on the tail line. This will haul the tail of the boom aboard.

Thread the boom between the power block and the grip wheel.

Continue hauling in boom until the reinforcing plate is past the block.

Stop the capstan.

Open the zip in the tail of the boom.

Remove the buoy from the end of the tail wire.

Close the grip wheel.

Remove the capstan.

Continue recovery as before.

REPACKING THE BOOM

The boom must be packed in the hold starting with the tail end. To do this, it is first necessary to get all the boom back aft of the Oceanpack.

Open the engine louvres.

Start the engine.

Erect the jib it if was lowered and lock it.

Check that the grip wheel is open.

Operate the power block to haul the boom over to the deck aft of the Oceanpack.

Make sure sufficient hands are available to stack the boom in neat folds.

As the boom comes over the block, the hand on the port side should pull the **water** tube towards him.

The starboard hand should look for the natural fold in the **air** tube, and pull that towards him, so that the boom is neatly flattened as it is stacked.

When the last 15 feet of boom is reached, stop the power block.

Unshackle the towing line from the tail of the boom.

Fold the tail of the boom into the Oceanpack hold.

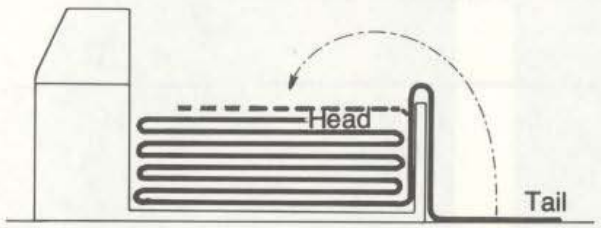
Refit the door to the Oceanpack hold, and put in the safety pins. Make sure the lifting wires are outside the hold. Arrange the end of the boom so that it lays flat in the bottom of the hold, up and over the stern door and out onto the deck. Tuck the boom neatly into the corners of the hold.

Start the power block and as the boom comes down into the hold:

— lubricate and close each zipper.

— pack the boom into the full length of the hold. Pay special attention to each end so that the boom is neatly folded square across.

Final Repacking of Oceanpack Boom



Disconnect the air duct, the water pump, buoy, and towing wire from the head of the boom.

Haul all the boom into the hold, until the head end plates are up by the power block, then stop the block.

Lower the jib.

Unload the boom from the block.

Erect the jib.

Reload the head of the boom into the jib.

Fold the **tail** end of the boom into the hold.

Disconnect the air duct and the water pump hydraulic lines from the Oceanpack.

Roll up the air duct and load it into the hold, along with the water pump and buoy and the capstan unit.

Rotate the power block so that the grip wheel faces aft.

Lower the jib.

Shut off the engine and turn the battery isolator to OFF.

Shut and fasten the cab door.

Close the engine louvres.

FRAMO OIL RECOVERY SYSTEM

Introduction

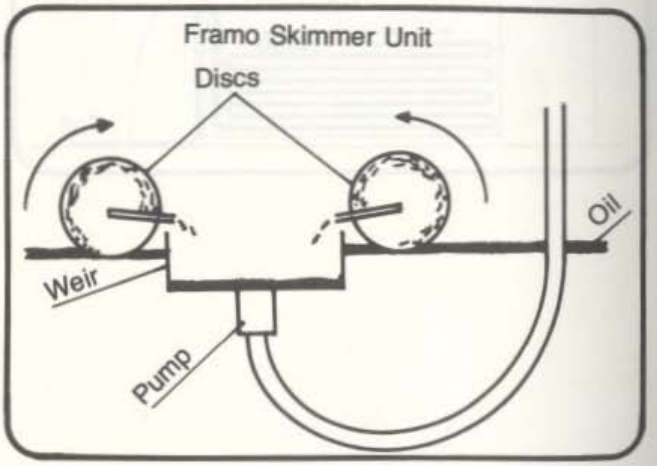
Fluid oil which has been contained by a boom can be recovered from the sea surface by the Framo skimmer. This system is suitable for mounting on the aft deck of a rig supply vessel.

All of the actual oil recovery equipment is in the skimmer unit, which floats in the water on the end of the crane jib. A special hydraulic system allows the jib to absorb the roll of the vessel, leaving the skimmer resting on the surface.

Inside the skimmer are four sets of metal discs. In action, these rotate, and are set to dip into oil on the water surface. The oil coats the discs, and so is carried up off the water. Scrapers remove the oil from the discs, and channel it into a well, from where it is pumped up to the vessel.

The sides of the well (the 'weir') are normally raised. In thick oil, the weir can be lowered to allow the oil to flow freely into the well. The pump can handle up to 400 tons of oil per hour.

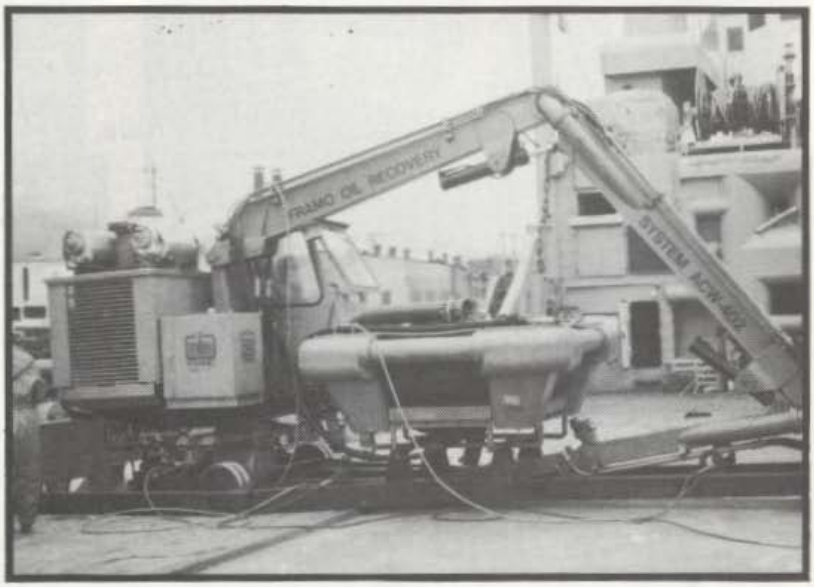
The Framo system is usually powered by a General Motors diesel engine. (A Deutz engine is also available). All the power systems are hydraulic. A hydraulic starter system is also fitted. There is no electrical system in the Framo.



MOUNTING THE FRAMO

Each Framo system is mounted on a wheeled trailer. This trailer should be used to hoist the Framo aboard the vessel. The current operational plans call for two Framos, two Framo pumps and two 5000 gallon tanks on the deck of one supply vessel. Clear the deck before shipping the equipment aboard.

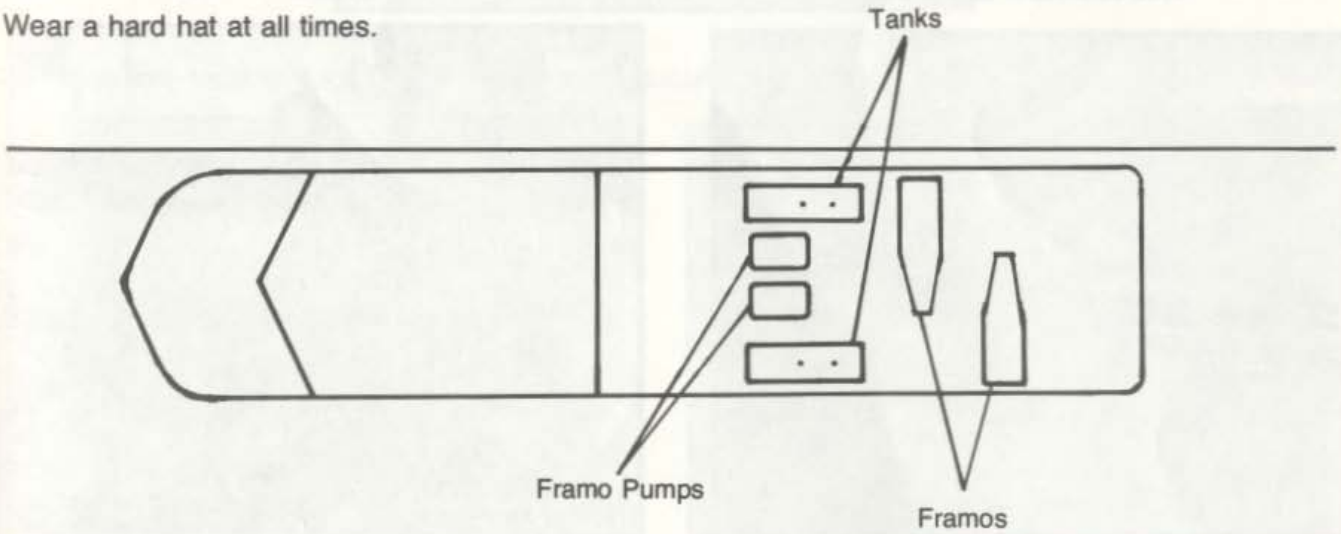
If there is time, the skimmer units may be detached and loaded separately. If not, check the turnbuckles which hold the unit to the trailer.



The deck layout should be as the diagram shows. It is normally easiest to load the outboard tank, the ouboard Framo, the inboard tank and the inboard Framo in that order.

Be careful **never** to get underneath any equipment being hoisted.

Wear a hard hat at all times.



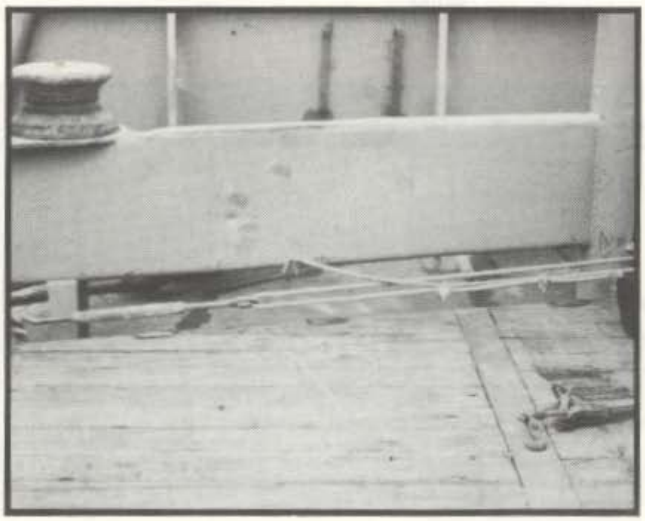
The Framo systems must be firmly secured on the deck. The end of the trailer away from the power unit must be firmly fixed, as it has to counter the weight of the jib and skimmer unit over the rail of the vessel.

Exactly how the unit is secured will depend on the vessel. Chains and chain tensioners, bolts, cables and turnbuckles are the usual items used — an adequate supply should be available.

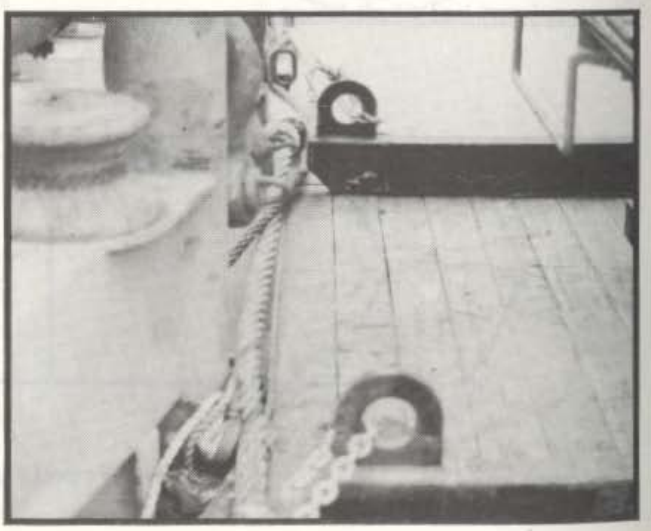
The pictures in this section illustrate some methods. The vessel's First Officer should be on hand and must be satisfied with the securing.

Chains

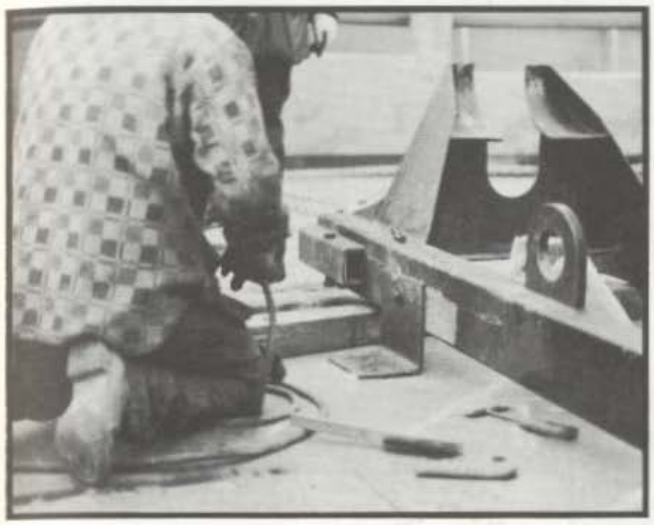
Wire cable and turnbuckle

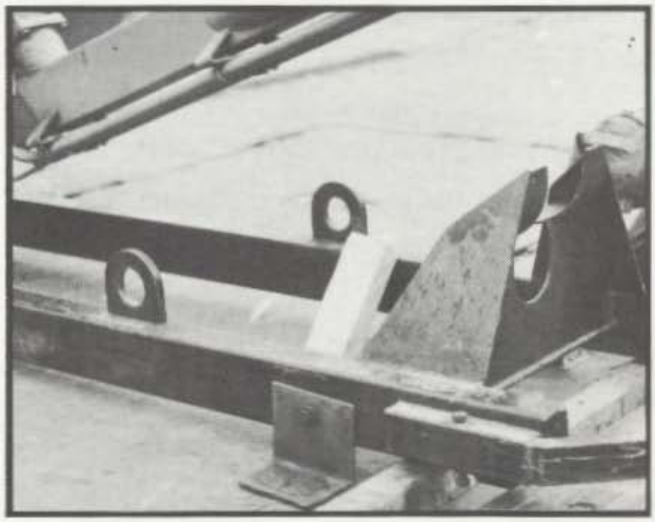


Chains

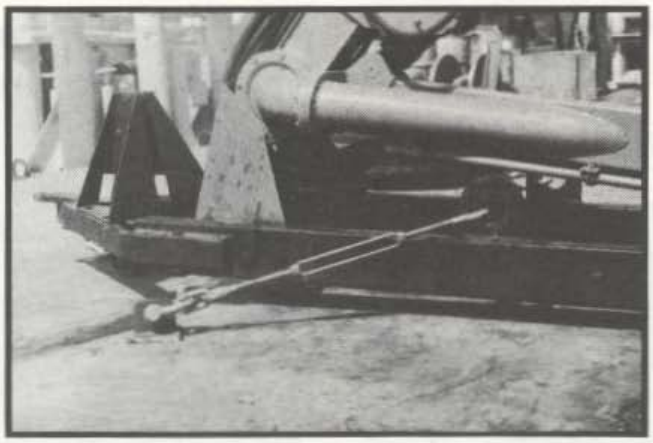


Bolts and welded brackets

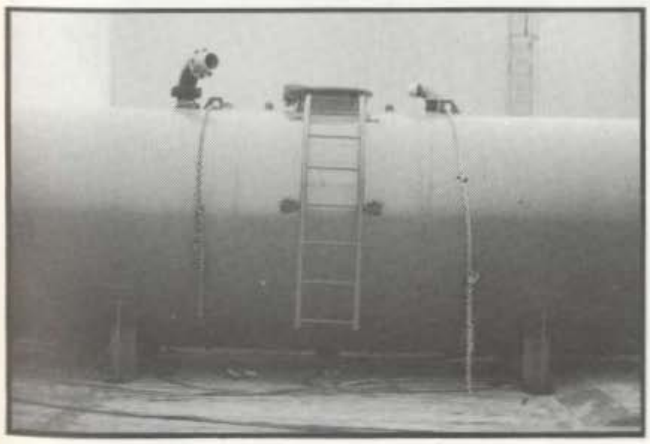




Turnbuckle and welded brackets



The tanks are usually secured by chains right around the middle.



Make certain the following items are aboard and available:

— Enough 6 inch cam-lock hose to run from each Framo to the tank on that side;

— Framo auxiliary power unit and 2 TK5 pumps;

— 100 yards of 6-inch **floating** hose;

— Diesel fuel;

— Lube oil, grade 10 N-30 or 10 W-40;

— Hydraulic oil;

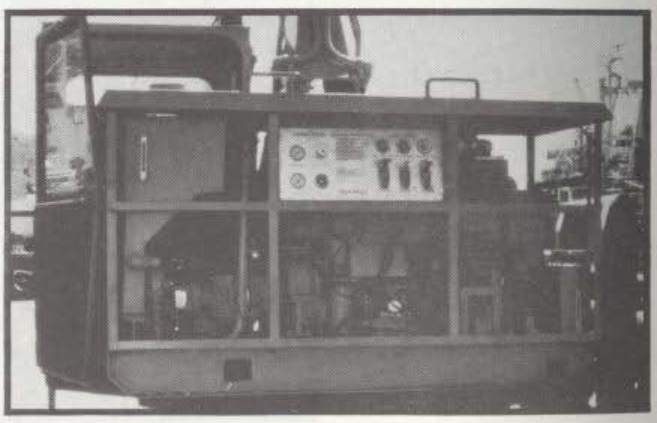
— Hand held VHF sets;

— Hard hats, floater suits and rubber boots for cleanup crew.

Before leaving port, start the engine. Check out the hydraulic systems.

Check that the starter pressure has built up. Stop the engine.

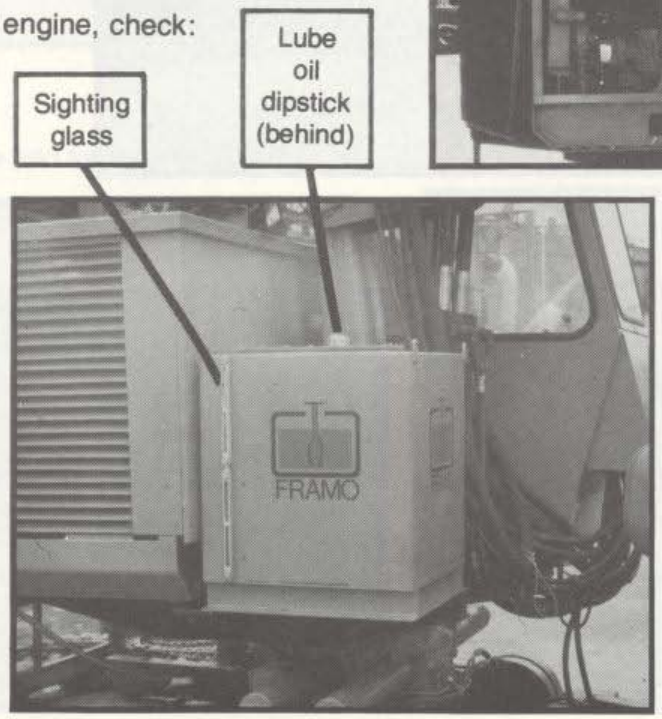
Secure everything left on deck. Lash down the skimmer unit.



STARTING THE ENGINE

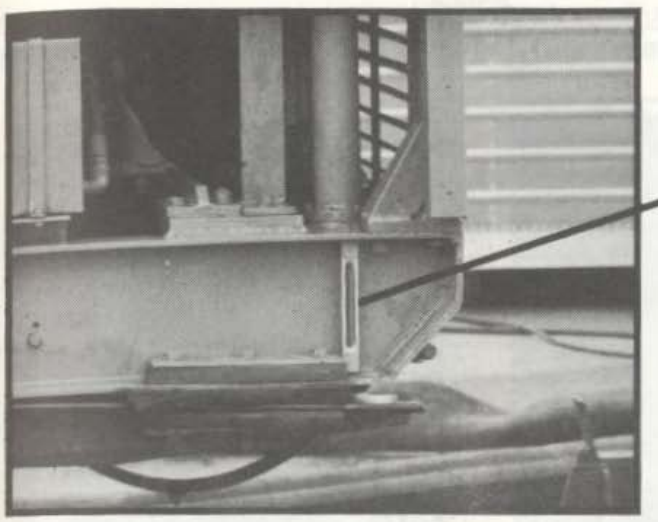
Some Framo systems come with a Deutz turbocharged, air cooled diesel. The information here applies to the GM engine. Instructions for the Deutz engine are on the rear panel.

Before you start the engine, check:



Fuel tanks. There is a large tank next to the cab which feeds a small tank below the engine.

Fill the large tank with diesel fuel.

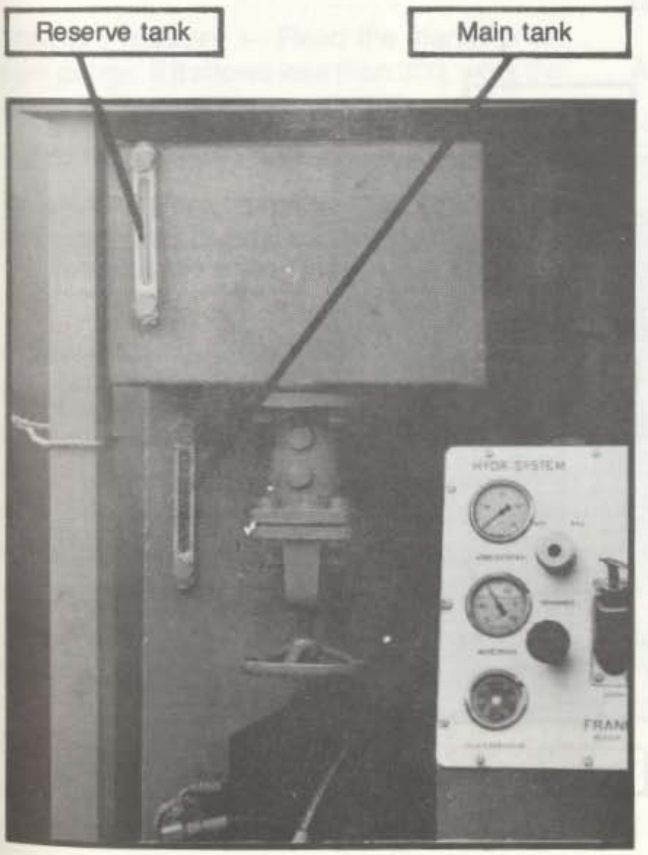


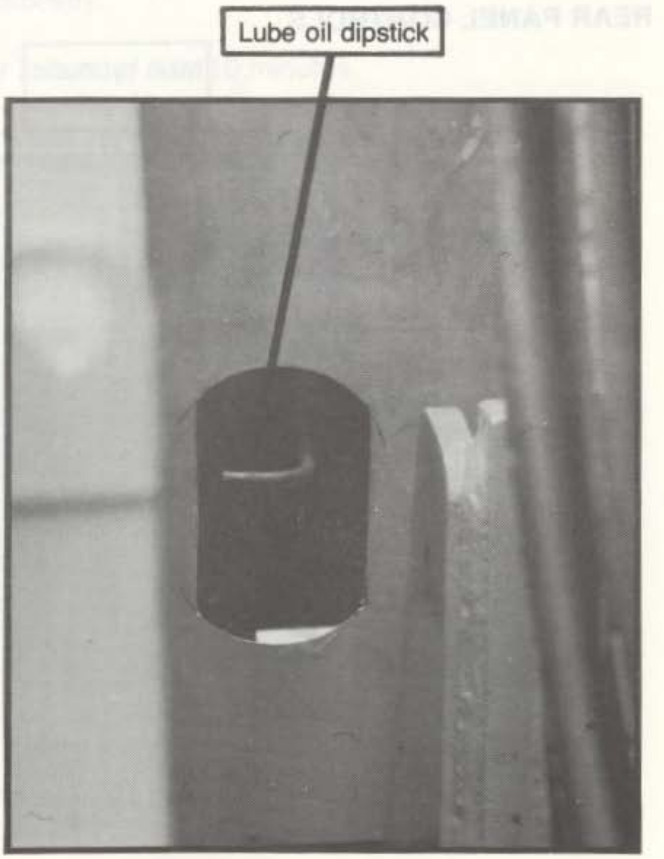
Hydraulic Oil — Check that hydraulic oil is three quarters up the sight glass on the main tank. Add hydraulic oil until it is.

Also check there is hydraulic oil in the reserve tank.

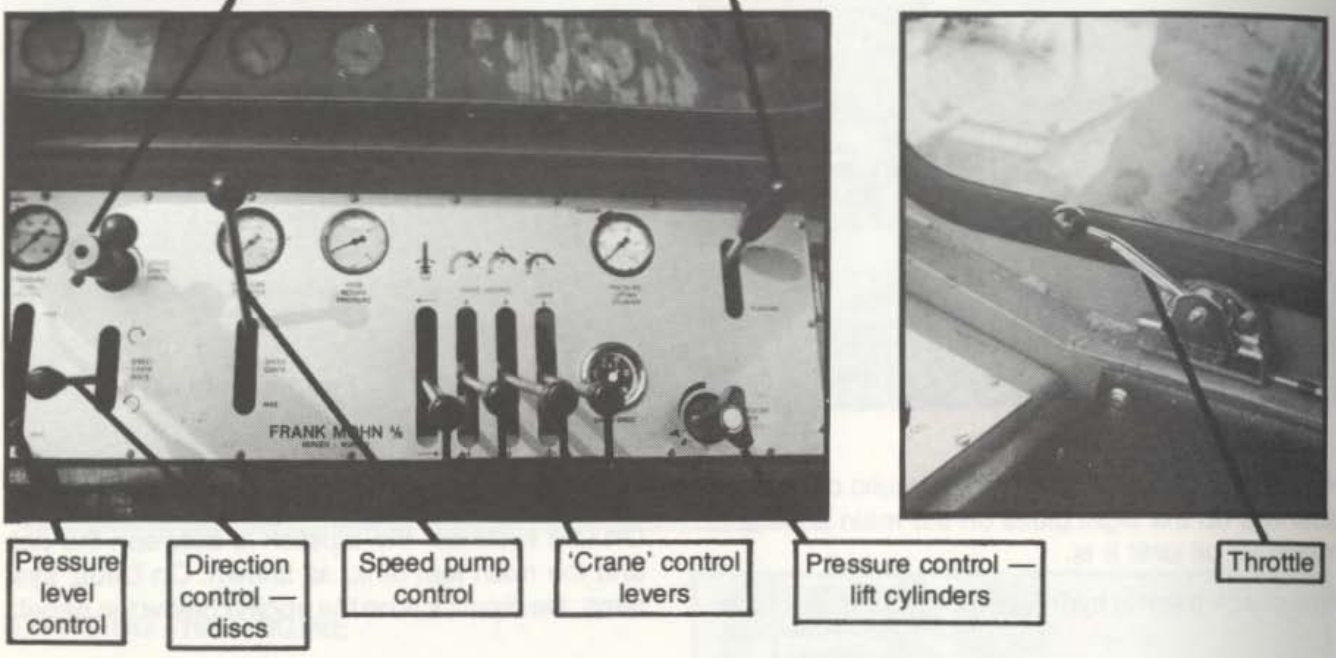
Lube Oil — Check the lube oil dipstick and add oil if necessary.

On GM systems, the dipstick is between the cab and the main fuel tank, as shown. On Deutz systems, the dipstick is on the engine below the panel.

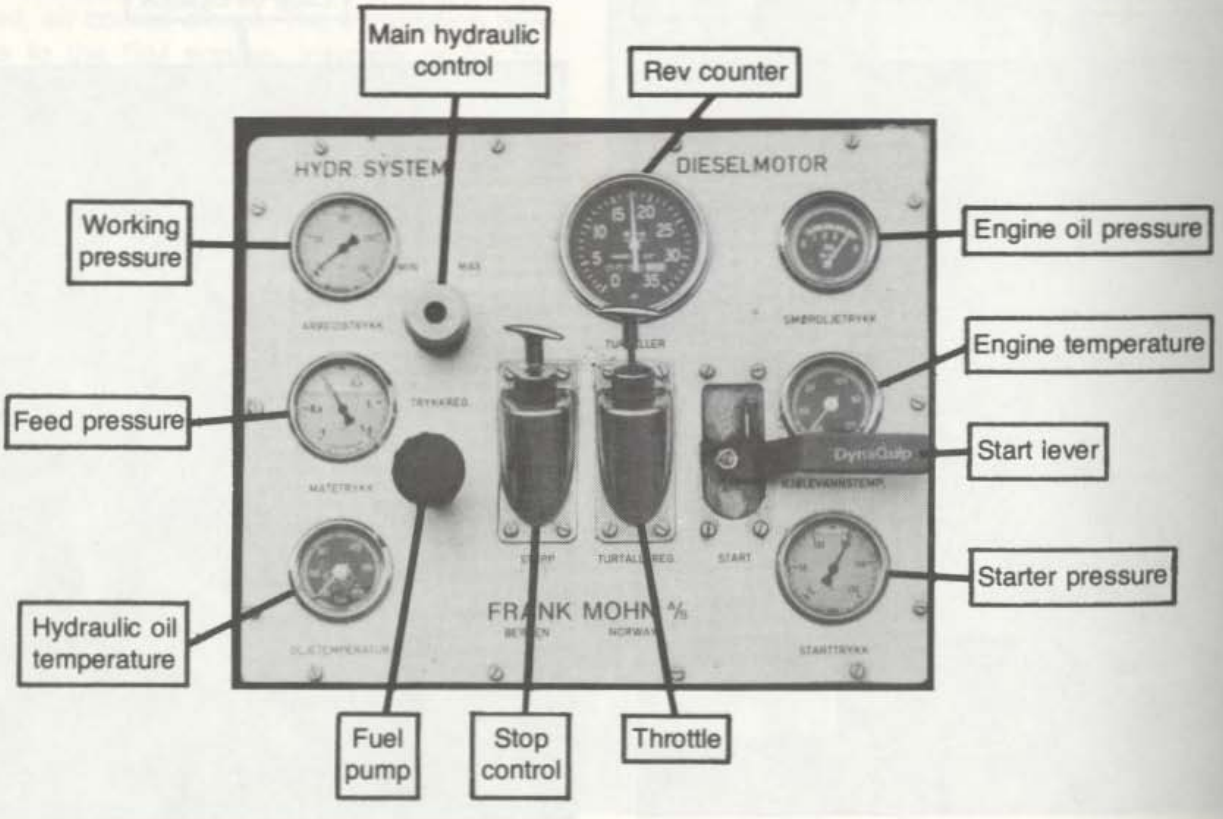




CAB CONTROLS



REAR PANEL CONTROLS



ALWAYS set the controls in the cab to these positions before you start the engine:

CONTROL	POSITION
Crane Control Levers	Centre
Pressure Level Control	Min
Speed Control — Discs	Fully Clockwise
Direction Control — Discs	Centre
Speed Control — Pump	Min
Pressure Control — Lift Cylinder	Fully Anti-clockwise
Lifting-Floating Lever	Lifting

Starter Pressure — Read the starter pressure gauge. If it shows less than 200, work the pump until the gauge reads 200.

Set the throttle to 'mid-way'.

(In cold weather, prepare to squirt a **little** Quickstart into the air intake).

Pump the black fuel pump knob until you feel some pressure.

Push in the stop control on the panel.

Set the stop latch on the engine.

— push the large lever across, and

— turn the small lever down.

Pull the start handle down.

Engine should fire and run.

Push the start handle back up.

If it fails, crank starter pressure up to 200 and try again.

Repeat until engine starts.

Adjust throttle so engine is running at 1,500 RPM (15 on tachometer).

Allow to run for 5 to 10 minutes.

Check that the engine temperature and oil pressure are normal.

Engine Revs should be steady at 1,500 RPM.

CONNECTING SKIMMER TO THE JIB

This procedure is best done before leaving port.

Pull out throttle until engine speed is 1,700 RPM.

Turn the hydraulic valve on the engine panel fully anti-clockwise.

You must now use the arm lifting controls.

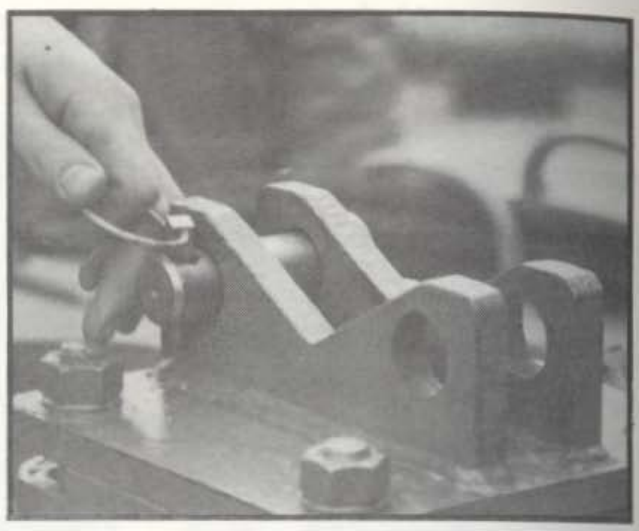
The panel shows which lever moves which part of the arm, and which way.

Move the arm carefully out from under the skimmer.

Release the hooks holding the skimmer in place.

Move the tip of the arm to the joint on top of the skimmer.

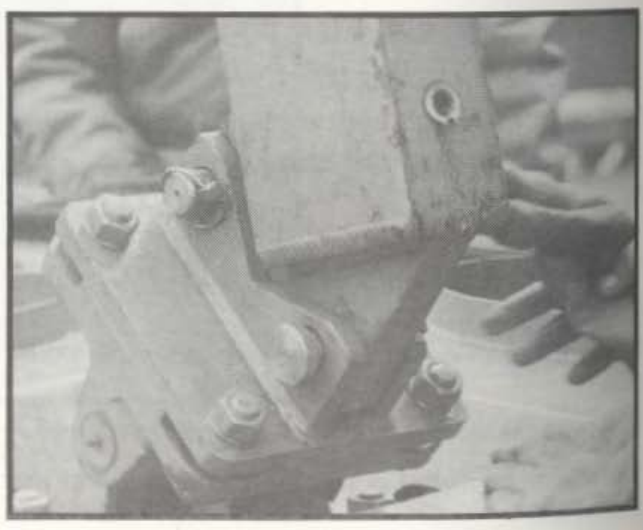
Remove both safety pins and bolts from the top of the skimmer. Do not put them down except in a safe place.



Line up one set of holes in arm joint with those in skimmer joint. Refit bolt and pin.

Raise arm, lifting the skimmer clear of frame, swing cab round and lower the skimmer onto the ship's deck.

You should now be able to fit the second bolt and pin.



CONNECTING THE DISCHARGE HOSES

There are five hydraulic hoses attached to the skimmer unit. They must be connected to the nozzles on the arm.

Remove the dust caps from each nozzle and each hose fitting. It is not possible to make a wrong coupling.

To join a hose and nozzle, wipe the nozzle and hose end, pull back on the lock ring, push in the hose, let the lock ring back into place and turn to lock it.

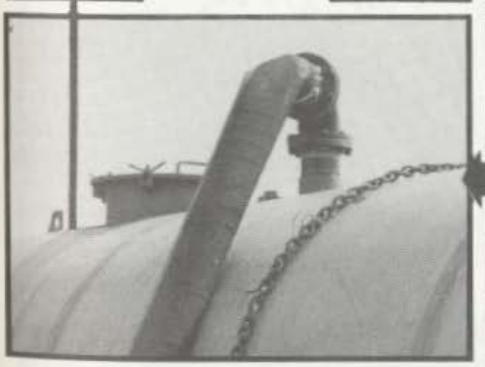
Hydraulic hoses

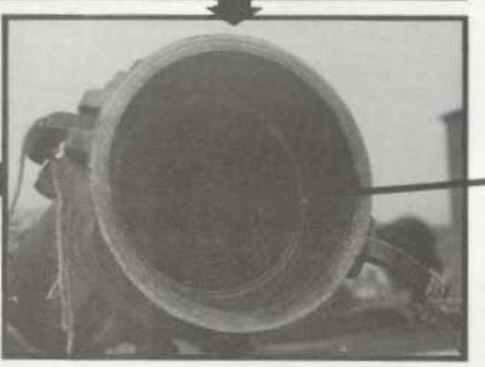
Large cargo hose

Cam-Lock handle

Connect the large cargo hose from the skimmer to the fitting on the arm. Make sure the rubber washer is in place and that the hose is on straight before you push down the Cam-Lock handles. Lash the handles with thin rope.

Tank





Washer

Fit another large discharge hose to the outlet on the arm next to the cab.

Again make sure the washer is in place and that the hose is straight on. Lash these handles as well.

Fit the other end of the discharge hose to the tank you are using to hold the recovered oil.

If it is not a bolted or locked joint, lower the hose into the tank and lash securely in place.

Check that the bleed valve on the bottom of the end of the tank is closed.

SKIMMING

To begin skimming, accelerate the engine to its working speed of 2,500 RPM.

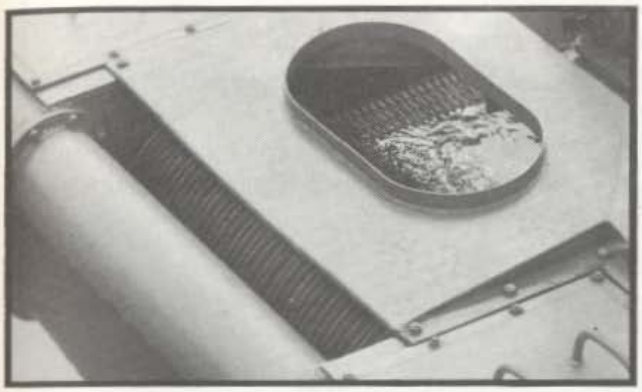
Lift the skimmer unit clear of the rail, swing it out over the side of the vessel and lower it into the oil inside the boom.

NOTE: Avoid lifting the skimmer unit with the outer two sections of the arm extended more than you need to keep the skimmer clear of the vessel and level.

When the skimmer is in the water, move floating-lifting lever to 'floating'.

Pull main arm section lever back.

Reduce 'pressure control lifting cylinder' until the skimmer is just floating. The pressure gauge should be reading between 90-110.



Select 'disc rotation direction'. Start the discs rotating slowly. The correct direction is **outward** at the top. The helper should watch through the top of the skimmer to check the direction if the operator cannot see.

Increase disc speed to operating speed. Generally, this will be 'full'. For very thin layers, reduce speed until helper can see very little water being taken into pump-well. The speed should not need to go below about ¾ of full speed.

Start transfer pump, set on low speed.

If the oil layer is very thick, lower the pump well, using 'pressure level control' until water just starts to flow into the well, then raise it just a little.

Adjust the speed of transfer pump to suit the rate of the oil flow into the well, which can be seen through the top of the skimmer.

The main operator has two major things to do.

1. To keep the skimming action going. To do this:

— use the 'pressure lifting cylinder' to keep the skimmer unit floating correctly.

— use the arm and cab controls to move the skimmer around inside the boom to 'sweep up' the oil.

2. Watch the gauges in the cab for signs of trouble.

— A sudden drop in a pressure gauge. This would be because of a leak in the hydraulics, low hydraulic oil level or an obstruction in the discs.

WORKING AS A TEAM

The operator must stay in the cab at all times. Once the engine is started, the helper should stay by the panel, watching the gauges until engine is warmed up. The helper should then guide the operator while getting the skimmer unit connected, and into the water.

He should then watch the skimmer action through the skimmer's ports, until proper skimming is achieved.

The helper has several things to check on at regular intervals.

1. Check the level of oil in the receiving tank and bleed the water from the bottom of the holding tank.

2. Check the engine control panel.
   — oil pressure and temperature. If either warning light is on, get skimmer aboard, shut down engine and tell your superior.
   — hydraulic oil temperature. A sudden rise probably means the discs are blocked with debris.

3. Check the levels of fuel and hydraulic oil.

   It is very important that Deutz engines are not allowed to run out of fuel.

4. Check the skimmer by looking over the side of the vessel. See that
   — all the discs are turning freely,
   — not too much water is being taken in,
   — the pump well is not empty or completely full. This can happen if the pump is running too fast or too slow.

CLEARING SKIMMER DISCS

If debris gets in among the discs, it can jam them and cause the hydraulic system to overheat.

There are two ways to clear a blockage:

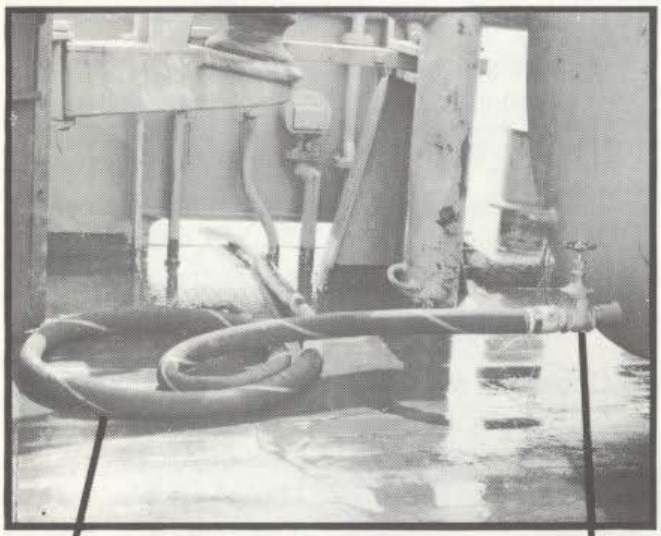
— Stop the transfer pump and reverse the rotation of the discs for a moment. Then return to first direction. If blockage is cleared, start pump again and continue skimming.

— Stop transfer pump and discs, bring skimmer in close to side of vessel, hoist aboard and clear blockage by hand. Return skimmer to water and continue.

BLEEDING THE HOLDING TANK

Connect a suitable drain hose to the bleed valve and run out over vessel side.

Open the bleed valve until water flow stops and oil comes out, then close the valve quickly.



RECOVERING AND STOWING

Getting the Skimmer Aboard:

Stop the discs rotating.

Run the transfer pump until the pump well is empty, then stop the pump.

Bring the skimmer as close as possible to the side of the vessel.

Move 'floating-lifting' lever to 'lifting'.

Raise pressure in lifting cylinders with 'Pressure Control Lift Cylinder'.

Lift the skimmer clear of the vessel's rail. Keep the outer sections of the jib down as much as possible. Swing the arm over the deck. Lower the skimmer gently onto the deck.

Disconnect the discharge hose from the fitting on the arm.

Make a 50/50 mix of diesel fuel and lube oil. Pour a gallon of this mix into the pump well and pump it slowly out of the hose back into a barrel.

Stowing Framo System:

It is advisable to leave the Framo system set up until you reach port.

In rough weather, lash down the skimmer unit.

If it would be more convenient, disconnect the skimmer head and lash it down. Park the jib out of the way.

Disconnecting the Skimmer:

When the skimmer is on deck, pull the pins and remove the bolts.

Disconnect the hydraulic lines on the boom. Replace **all** the dust caps.

Unbolt the cargo hose.

Replace the bolts in the flange, with the nuts on.

Raise engine speed to 1,700 RPM.

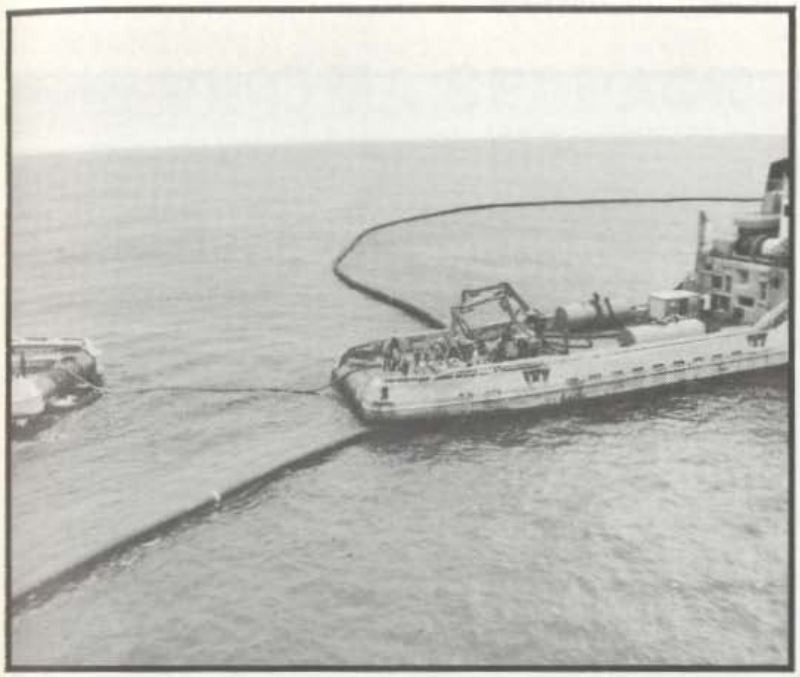
Move the jib to the parked position.

Reduce the pressure in the lifting cylinder to minimum. Turn the main hydraulic valve on to the rear panel to "min".

Push the throttle fully in.

Stop the engine.

OFFSHORE TRANSFER OF RECOVERED OIL



(These photos were taken on an exercise using a supply vessel in place of a tanker).

The power and hydraulic unit of the Framo skimmer system can be used to power a pump for transferring recovered oil to a tanker, so that more oil can be recovered from the water.

The system is designed to use the TK5 pump, made by Framo.

Attached to the pump is one hydraulic hose, which runs to a small block with a valve on it. Two hydraulic hoses then come from this block, and these must be attached to the Framo hydraulic system.

Connect the pump hydraulic hoses. You are not able to connect them the wrong way around. Close the valve on the block near the pump. Turn it fully clockwise.

Connect enough large cargo hose to the outlet on the pump to reach the Y-piece.

Attach a lifting rope to the pump.

Lower the pump into the holding tank until it touches bottom. Do not let the hoses take the weight of the pump.

Connect the 6 inch cargo hose from each pump to the inlet arms of the Y-piece.

Remove the sealing plate from one end of the floating hose, and attach the hose to the outlet arm of the Y-piece.

Attach a hauling line to the other end of the floating hose. **DO NOT** remove the sealing plate from this end.

When the tanker comes into position astern of the skimmer vessel, pass a hauling line ('messenger') to her.

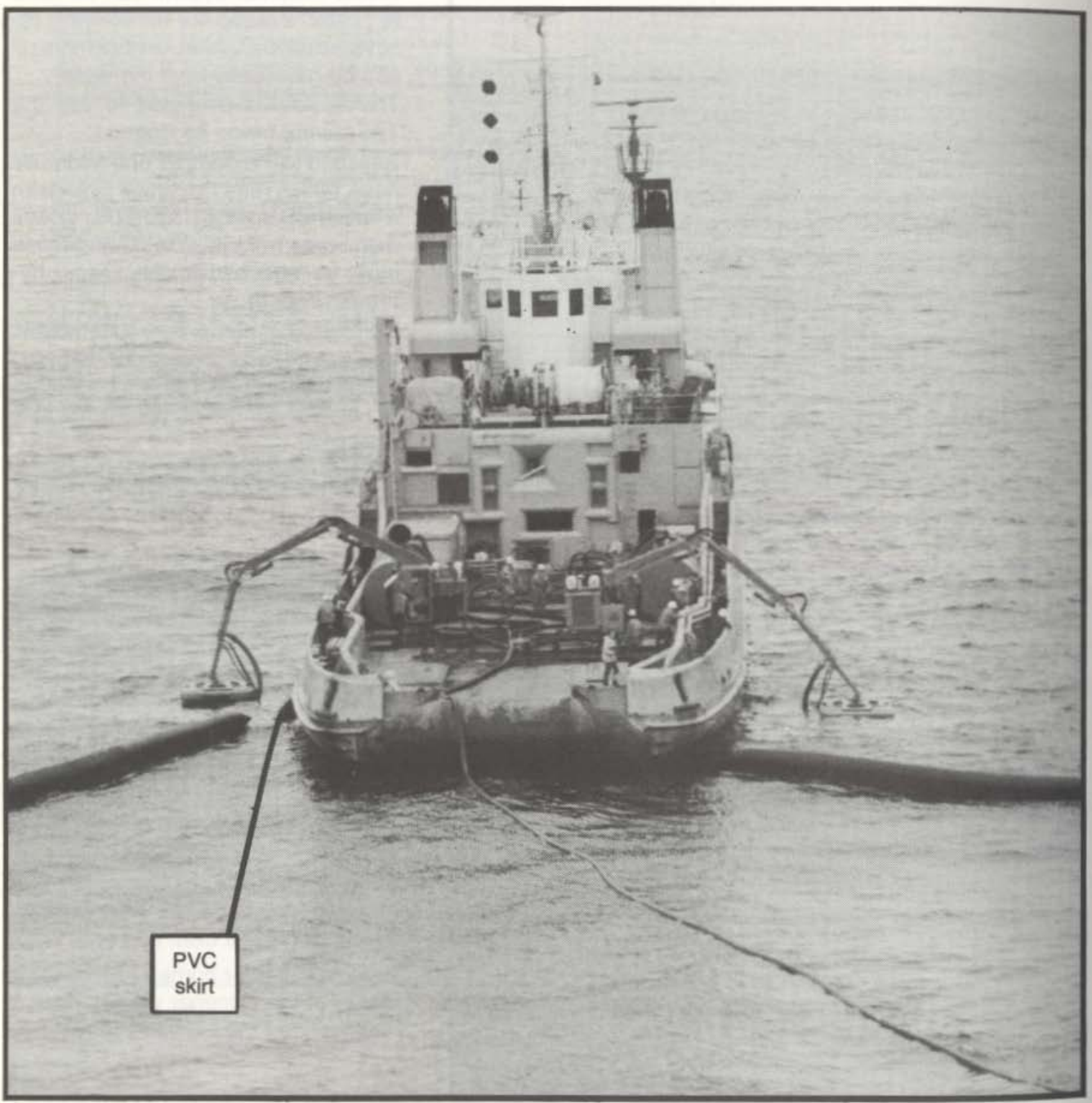
Do not attempt to use any of the 'guns' or similar equipment for passing lines. Tell the vessel's officers what has to be done and let them organize it.

Signal the tanker to haul over the floating hose.

When the hose is across and connected to the tanker's inlet port, signal you are ready to pump.

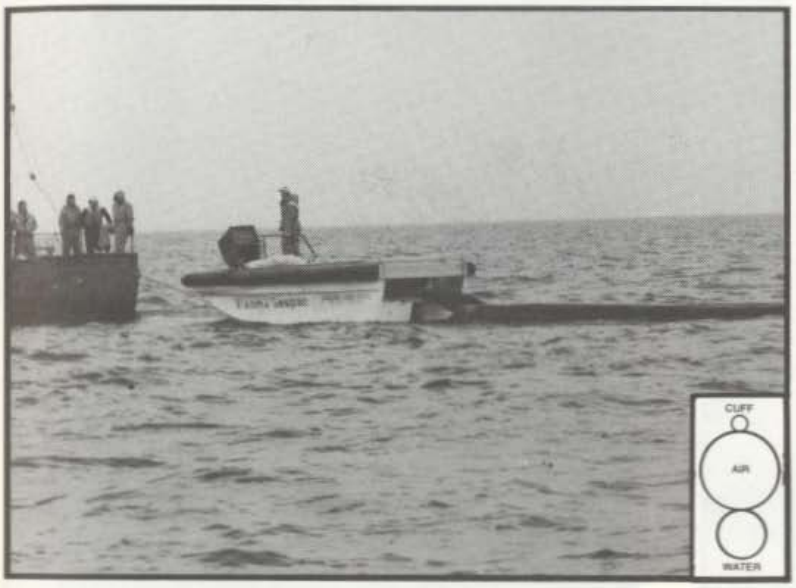
When the tanker replies to go ahead, open the control tap on the hydraulic lines to the pump.

The engine in the power unit should be running at 1,700 RPM.



8: NEARSHORE OPERATIONS

THE VIKOMA SEAPACK



The seapack is a boom system for use near shore or at sea in calm weather. The actual boom is like the Oceanpack boom, except it has another small tube (the cuff) on top which keeps it afloat during laying.

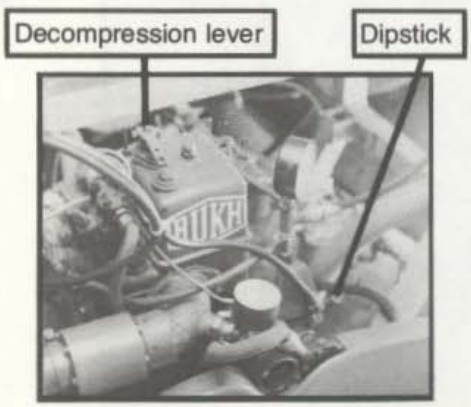
The boom, the engine and the pumps are housed in a 23 ft. fiberglass barge.

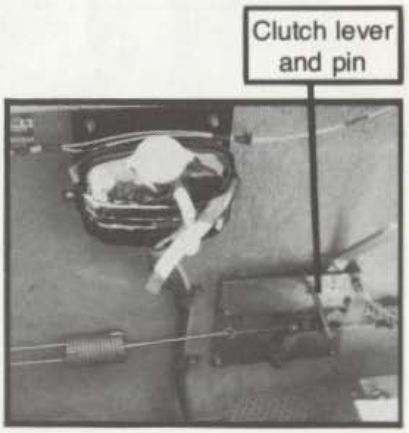
This may be carried or towed to the scene of a spill by a larger vessel or towed by trailer on land.

If the spill is near the launch site, the engine can be started after the Seapack is launched from land. If it is a long tow, it is better to wait until you are near the scene.

PREPARATION FOR LAUNCHING

1. Check the fuel level.
2. Pump out the bilge.
3. Check the lube oil level.
4. Check the coolant level in the radiator (do not remove the cap when the engine is hot).





LAUNCHING THE SEAPACK

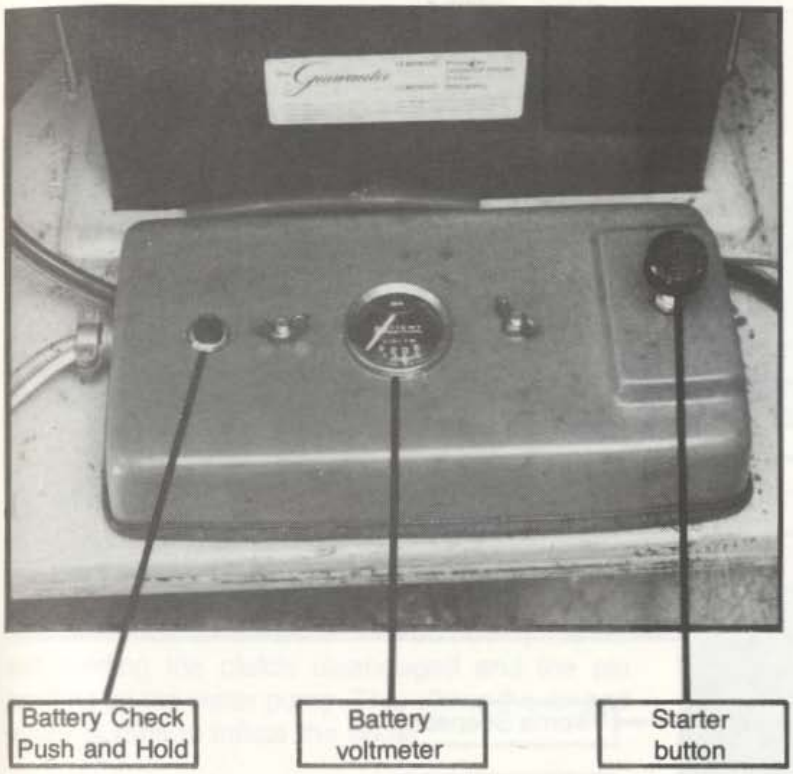
It is best to launch from a wharf.

There are lifting wires attached to the Seapack. You must use these only.

Attach steady lines to bow and stern.

Lower the Seapack into the water.

The Seapack can also be launched from a slipway using its trailer.



STARTING THE ENGINE

Put on your lifejacket and get aboard the Seapack.

Push the decompression lever and the starter button.

When the engine is turning quite quickly, release the decompression lever, but keep the starter button down, until the engine runs.

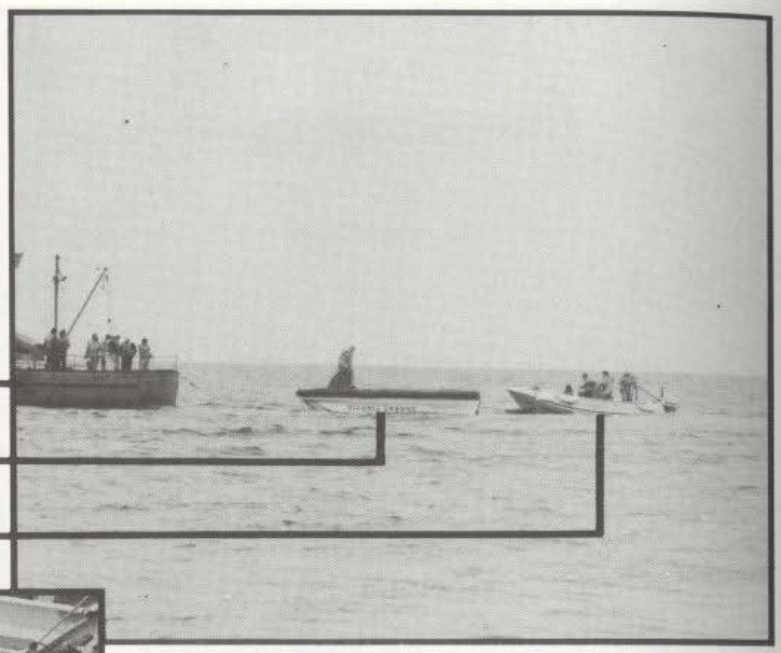
In cold weather, spray a little Quick-start into the air intake as you let go the decompression lever.

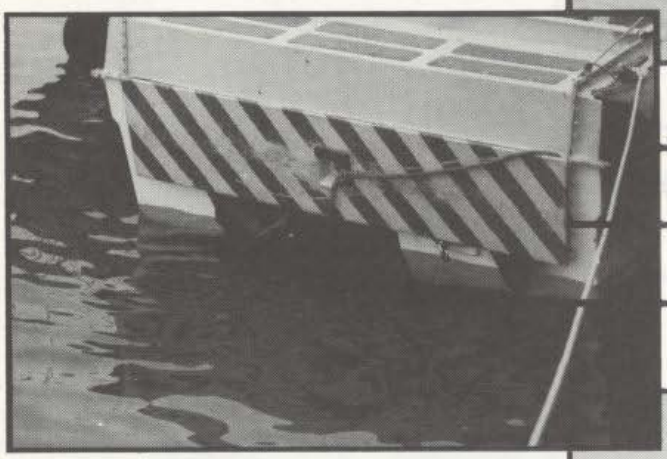
LAYING THE BOOM

Reach down inside the rear door and turn on **one** air bottle and the main valve.

(It has been found that one bottle is enough to deploy the boom and so the second bottle can be kept for a spare).

The holding vessel should now go alongside the Seapack, recover the tail line and make it fast.





Then the towing vessel should steam **downwind** at about 1 knot. The vessel holding the tail line should hold station. When the tail line tightens, the rear door will come off automatically and the boom will start to come out. The cuff will automatically inflate.

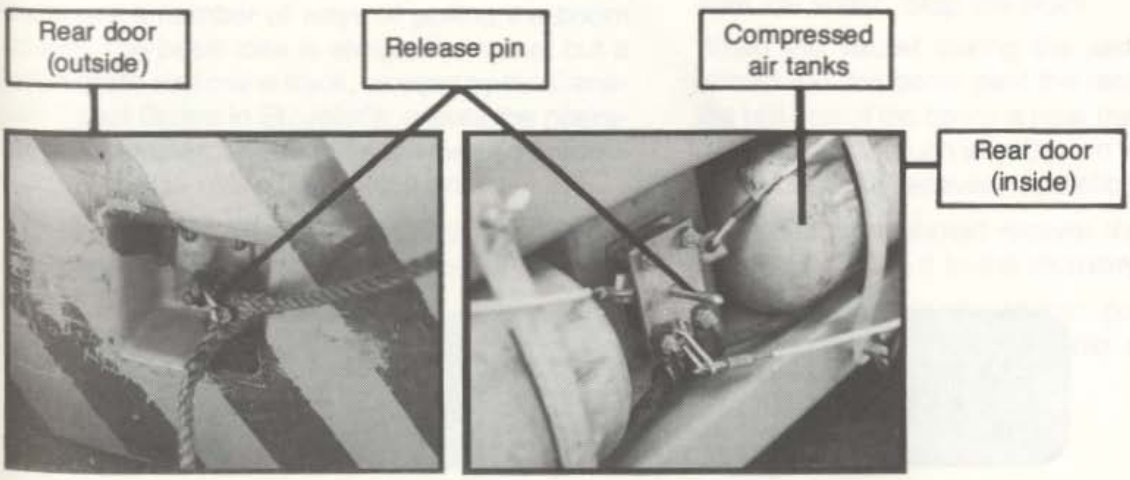
Once the boom-laying has begun, it should continue smoothly until all the boom is deployed.

If the laying is interrupted, you will have to go back aboard the Seapack and turn on the second air bottle when restarting.

When the yellow stripe on the boom comes out of the hold, there are 100 feet left to go. The vessel should slow.

As the last part of the boom comes out, it pulls the pin holding the clutch disengaged and the pin holding up the water pump. This allows the air and water pumps to inflate the boom.

As the boom starts to inflate, the towing vessel should stop and maintain station until the boom is fully inflated.



The tail-end vessel should recover the rear door with the air bottles attached.

The boom is now ready to deploy around a spill.

For patterns of deployment, see the section on Near-shore Operations on page 87.

WHILE THE BOOM IS DEPLOYED

Every 12 hours, you should go aboard the Seapack.

1. Stop the engine.
2. Wait a few minutes for the oil to drain down.
3. Check the fuel level. (Full tanks should last 8 days).
4. Open the hatches in the floor of the hold. Check the bearings for looseness and the universal joints. (This can also be done by disengaging the clutch if you want to keep the engine running).
5. Check the oil level and top up if it is low.
6. Restart the engine. Go back aboard the main vessel.

RECOVERING THE SEAPACK BOOM

The best place is a wharf but **carefully** inspect the area to see if there are nails or other sharp objects which could damage the boom.

There are a number of ways of pulling the boom ashore. The basic idea is always the same, but a power block and crane truck, as used by the Canadian Coast Guard in St. John's, makes the operation much easier. This section will describe recovering the boom using this equipment.

If at all possible, park the truck with open water downwind, and some clear flat space on the other side of the truck.

Lay out some lifting cables on this clear space. Connect the hydraulic lines from the truck's auxillary outlets to the block. Start the truck's engine and switch on the hydraulics.

Hang the block from the crane hook, and raise it just clear of the deck. Run the block, and turn it around so that the top of the block is turning **away** from the water. Stop the block.

When the vessel towing the seapack arrives, it should tow the boom past the recovery point until the **tail** end of the boom is near the recovery point. A small boat — such as a Boston Whaler — is also needed for the recovery operation.

The small boat should recover the tail line of the boom, and bring it to the recovery point.

The towing vessel should then put a man aboard the seapack with a hand radio and release the towing line.

ABOARD THE SEAPACK

Declutch the engine and insert the **spare** pin to hold the clutch open. Close the throttle, and close the fuel supply valve. This will stop the engine.

ABOARD THE SMALL BOAT

Go to the **tail** of the boom and open the first few zips in the side of the air tube.

Keep opening zips when they approach the shore as the boom is hauled in.

ASHORE

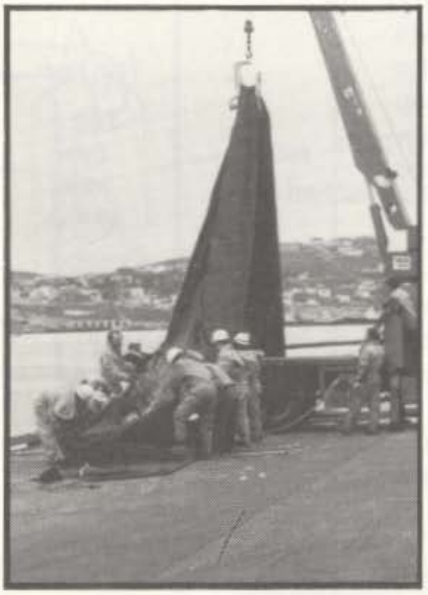
1. Pass the tail line through the block.

2. Run the block until the tail of the boom is next to the block. Stop the block.

3. Swing and lower the block to the edge of the wharf. Start the block and haul the tail of the boom through.

4. Keep the block running slowly and raise the block to about 15 feet above the deck. Be careful not to strain the hydraulic lines.

5. Pull the tail of the boom over to the clear space where it will be stacked.



6. Lay the tail of the boom over **both** lifting cables. Keep hauling in the boom, laying it concertina-fashion over **both** lifting cables.

7. As the boom is coming through the block, the recovery crew should straighten it out so that the water tube is on one side and the air tube on the other.

ABOARD THE SEAPACK

1. Find the tool kit.
2. As the yellow band (100 foot mark) is going ashore, undo the ring which clamps the end of the air tube over the fan duct.
3. Open the hatch in the aft floor of the hold.
4. Pull the pin which holds the water tube to the pump.
5. Unshackle the towing wires from the rings on the transom.

   The boom is now free of the Seapack.
6. Have the small boat come and take you in tow.
7. Lay the flexible bulkhead over the fan duct. Clamp it in place with the ring.

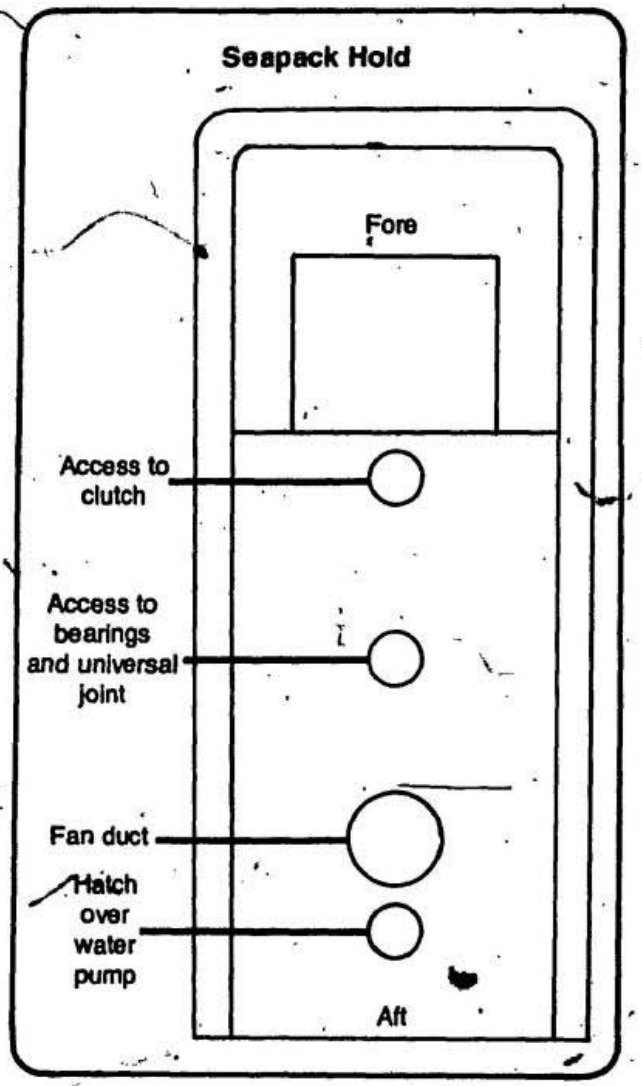
ASHORE

When all the boom is neatly stacked, attach the lifting cables to the crane hook and hoist the boom aboard the truck.

ABOARD THE SMALL BOAT

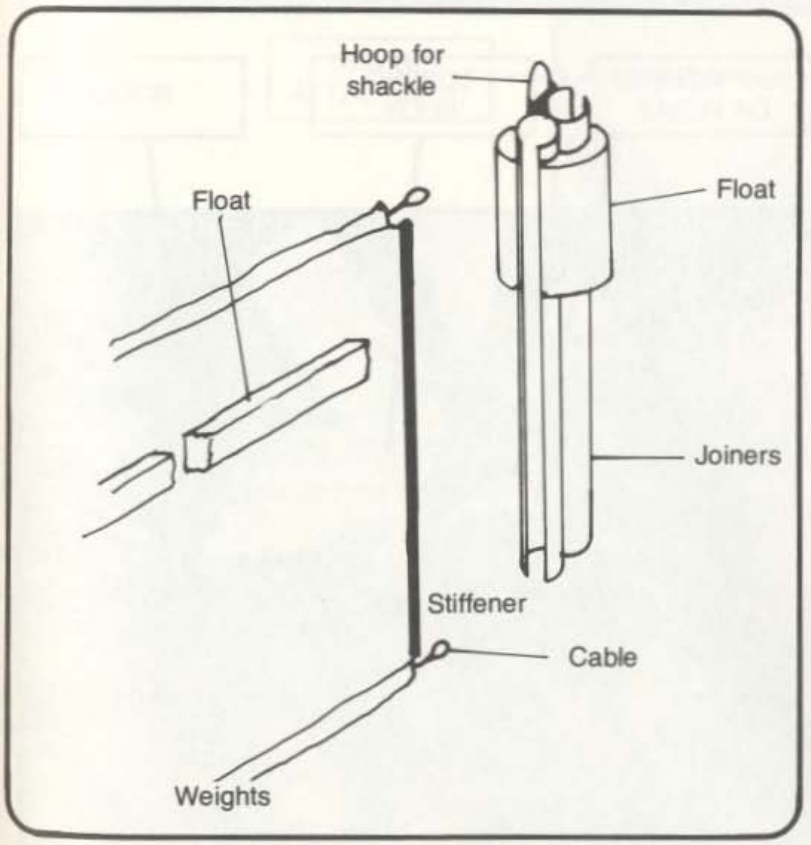
Tow the Seapack hull to its recovery point.

Lift it out of the water using the cables attached (or use the trailer on a slipway.)



HURUM FLEXY-BOOM

The Hurum Flexy-Boom is made on a different principle to the Vikoma-type booms. It consists of 50 foot by 18 or 36-inch PVC sheet sections. These have weights along one edge and floats sewn in three-quarters of the width up toward the other edge, so that they float upright in the water. Cables run through the top and bottom edges to take the strain when deployed and at the ends of each section are stiffeners which slide into the joiners used to join sections together.



The joiners consist of two split tubes joined along their length. The end edges of the boom sections slide down into these tubes and the cables are shackled together to connect sections.

Locally, it has been found more effective to store the boom with 10 sections already joined to make 500 foot lengths ready for deployment.

There are special joiners to make anchoring points, and to put at the head of the boom for towing.

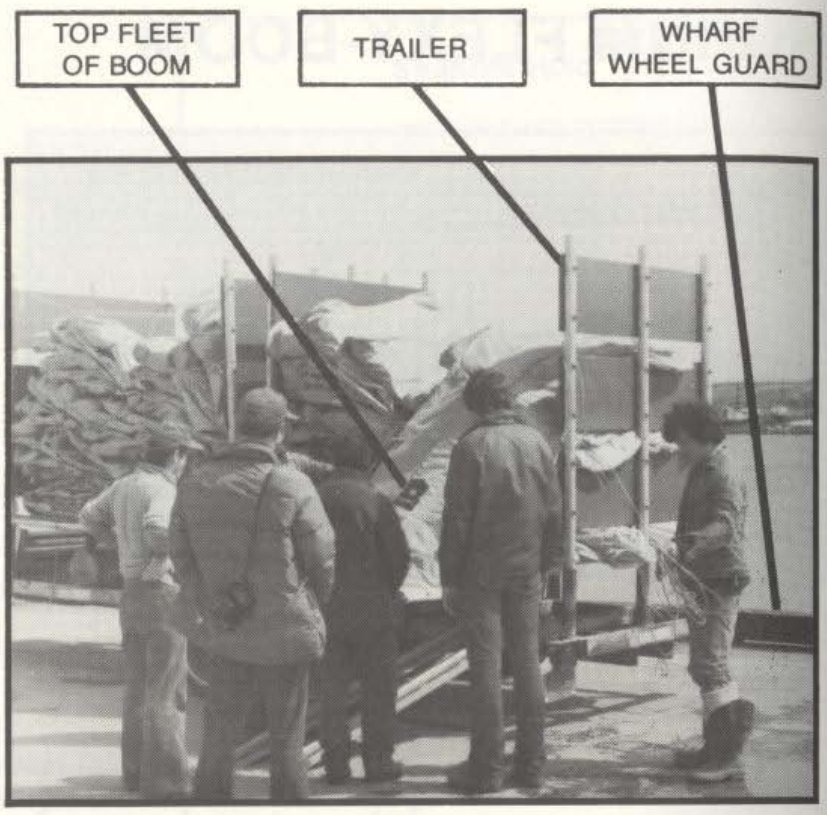
This type of boom is designed for containing oilspills in calm, sheltered water, such as harbours or small coves, or inland waters. It is mainly used either to enclose spills, or to protect sensitive points from approaching uncontained slicks.

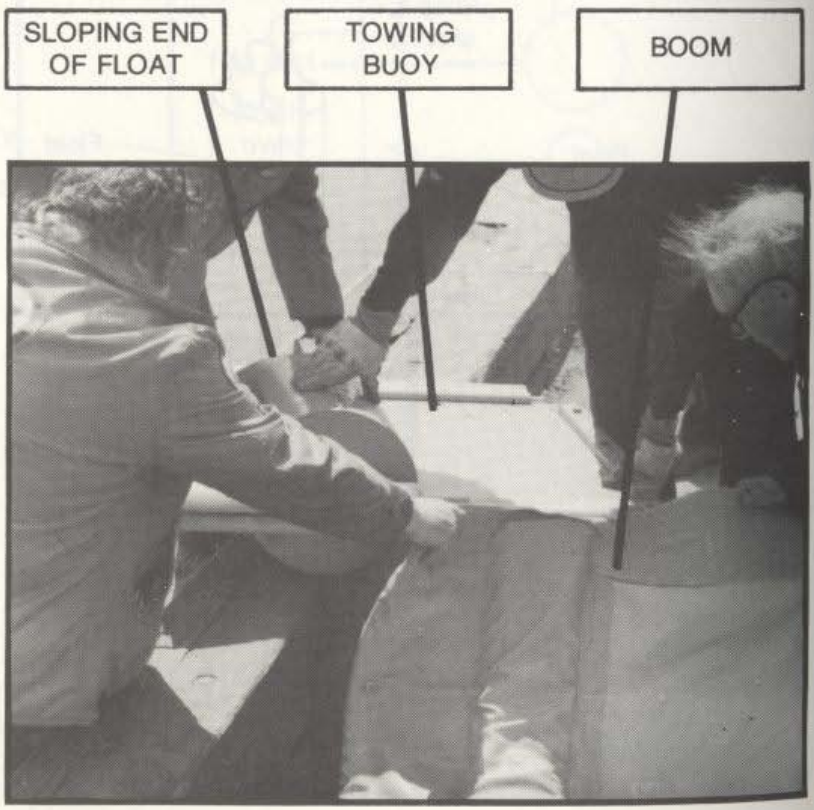
LAUNCHING THE BOOM

Any spot where the trailer can be parked within about eight feet of the edge of the water will be suitable. This may be a beach or a wharf.

Park the trailer about eight feet from the edge, with the right-hand side of the trailer parallel to the edge.

If the trailer is on a wharf, remove the wharf roller from the trailer, and attach it to the wharf wheel-guard with the clamp screws.





Remove the towing buoy from underneath the trailer. Pull down the top fleet of boom from the trailer. Set the buoy with the sloping end of the float away from the boom. Slide the reinforced end of the boom into the slot on the buoy.

Shackle the boom cables to the buoy.

Tie a length of one inch line to each towing attachment on the sloping ends of the float and fix these to a towing line.

Pass the free end of this towing line to the boat which will tow out the boom.

When the line is made fast, pull down a couple of fleets (folds) to allow some slack in the boom.

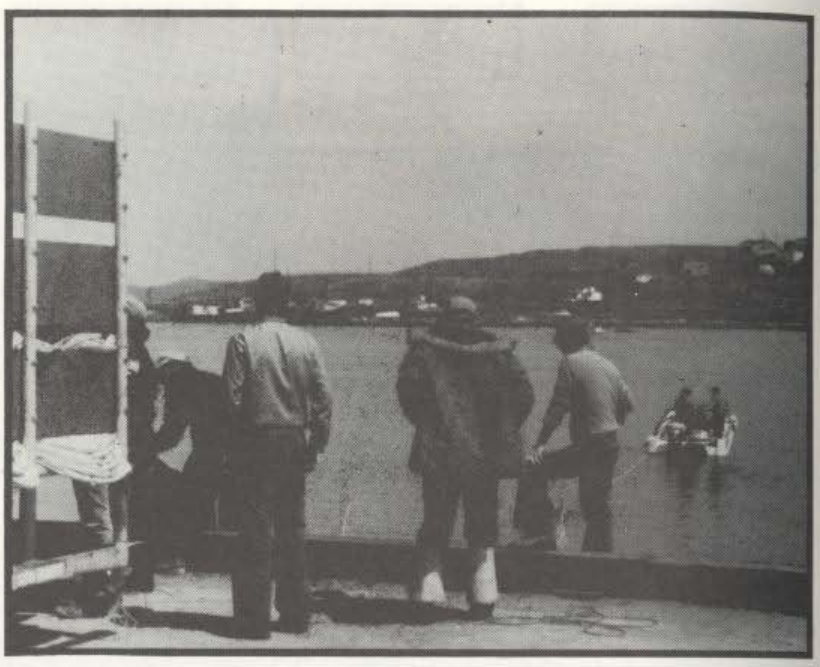
Launch the towing buoy into the water.

The boat should then go ahead **very** slowly, and **directly** away from the launch site.

As the slack is taken up in the boom, unload more fleets from the trailer and assist them into the water, over the roller if it is used.

The amount of boom you need to put out depends very much on what you are doing with it. Each trailer holds two 500 foot lengths. These can be joined together, or disconnected at 50 feet intervals to give the length you need.

When all the boom required is out, tow it into position with dockside joiners, anchors, or by having the end(s) made fast ashore.



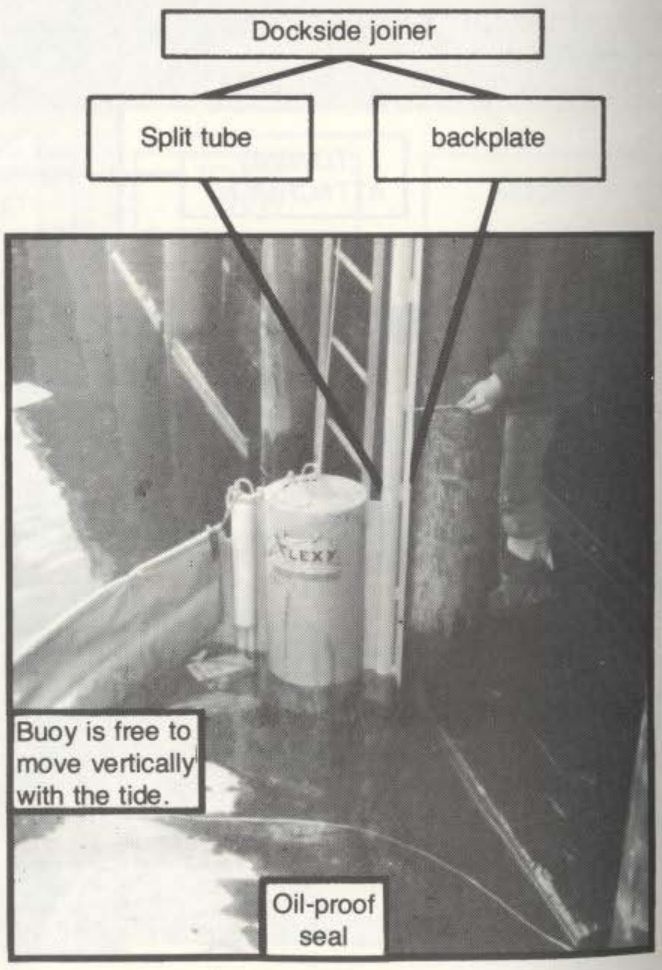
JOINING TO A DOCKSIDE

Each trailer carries two special attachments for joining the boom to the side of a dock or other structure. They are only for use when the structure itself makes an oil-proof seal for one side. If that is not the case, the boom must go to the edge of the water, even if that is under the structure.

The dockside joiners each consist of a long split tube fixed to a long back plate. They allow the boom to seal against the structure, but to move up and down with the tide. The boom is connected using an anchoring buoy.

Fix the plate to the side of the dock, using the large nails supplied. At low tide, have ¾ of it out of the water, at high tide, ¾ down in the water. If the tide is running, about half in and half out should be right.

Slide the buoy down into the split tube. Make sure it can run smoothly in the tube.



ANCHORING

As you can see from the section on deployment, anchors must nearly always be used. Danforth-style anchors are best, but in an emergency any type may be used.

Go alongside the join between sections where you want to anchor the boom.

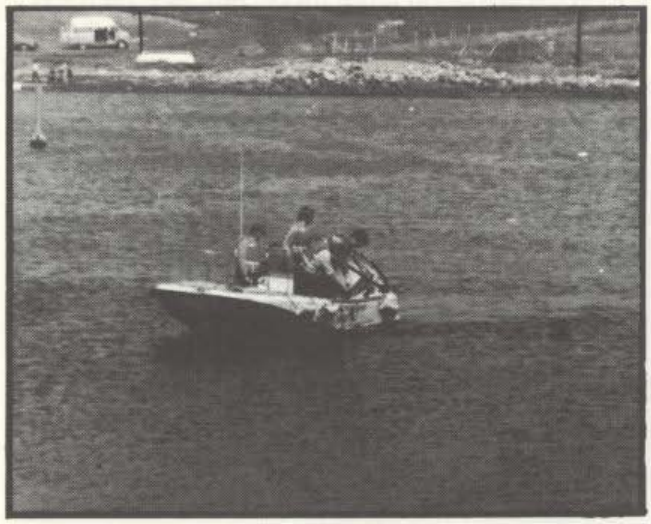
Unshackle the cables from the joiner and slide the ends of the boom out of the tubes. Be careful not to drop the joiner.

Shackle sufficient line, usually three to five times the estimated depth of the water, to the anchor chain, and to the anchoring buoy.

Put the anchoring buoy over the side and slide the ends of the boom down into the split tubes. Shackle the top and bottom cables on each side.

Tow the buoy out to where you want it to be. Then go further out, paying out the anchor line as you go. Keep strain on the line to stop the buoy moving.

When all the line is out, heave the anchor overboard. Be careful that the line is well clear of the propellor.



RECOVERING THE ANCHOR

Retrieve the line from the buoy.

Head out in the direction of the anchor. Take in the line as you go and coil it.

With the line over the bow of the boat, pass over the anchor very slowly, while hauling on the line. The anchor should come free. Haul it in and get it aboard.

If you have to leave the anchor temporarily, tie a marker buoy securely to the line and release it.

RECOVERING THE BOOM

Arrange to have 5 men at the trailer.

Recover all anchors.

Release the boom from its moorings.

Tow it (if necessary) to the launch site.

Pass the towline up to the hands at the trailer. The boat should then take up the tail of the boom, to make sure it does not foul during recovery.

Haul in the boom (up over the roller if it is being used) and pack it onto the trailer at the same time. As any anchor buoys come ashore, stop, detach the cables, remove the buoy, reconnect the boom with a joiner and reshackle the cables. Continue recovery.

Recover any dock mounting plates, and check around for other gear, such as joiners, shackles, etc.

Stow all gear aboard the trailer.

Lash the boom down to the trailer.

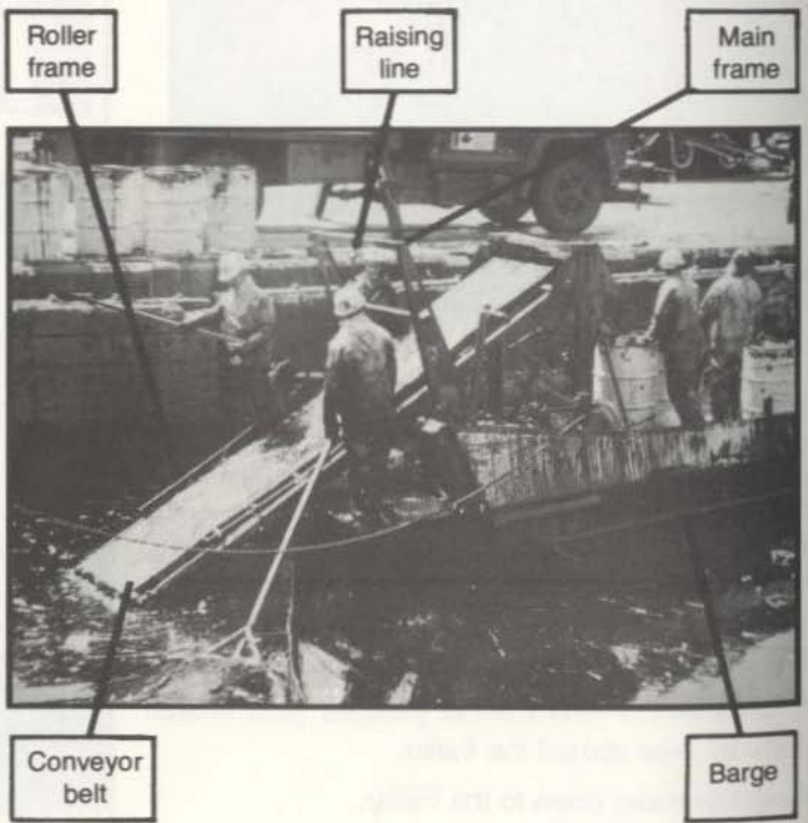
THE SLICKLICKER

Marine fuel oil (Bunker C) and old 'weathered' crude oil present special problems for cleanup, particularly in the cold waters off Canada's East Coast. This is because these oils would be below their 'pour point'. This means that they would not be liquid, but rather the oil would be very tarry.

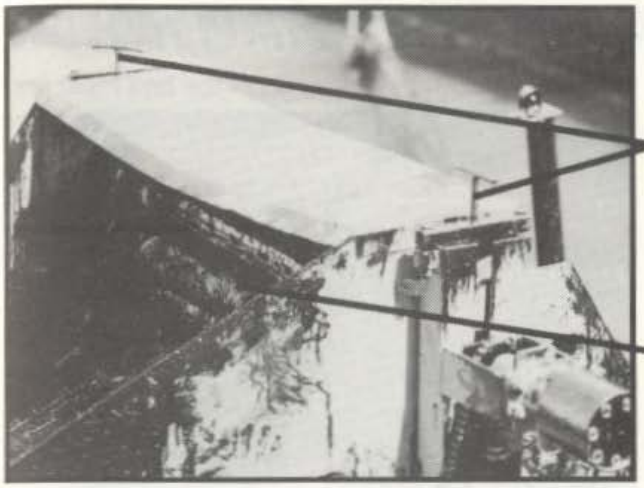
In this condition, the oil cannot be pumped, so most recovery equipment will not work. The only system found to be effective so far is the Slicklicker.

The basic idea of the Slicklicker is a conveyor belt made of a material which will attract oil but not water. The manufacturers supply a terrycloth belt which must be soaked with oil before it will work. The Canadian Coast Guard has experimented with neoprene rubber belts which perform more reliably.

The Slicklicker has to be mounted on a barge with low freeboard, which makes it unsuitable for open water work. In sheltered waters however, it can be very effective.



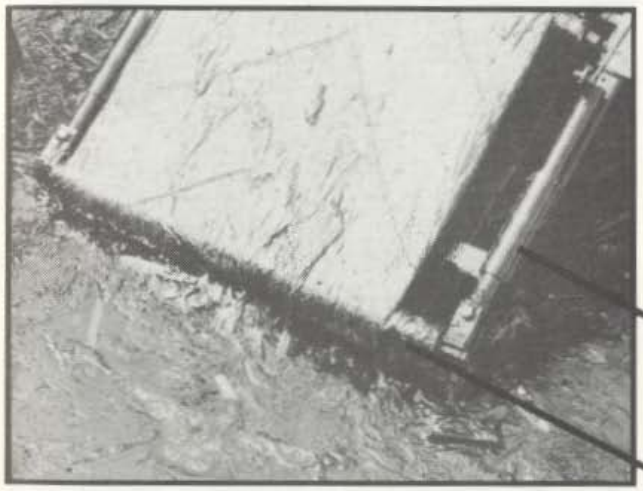
SETTING UP THE SLICKLICKER



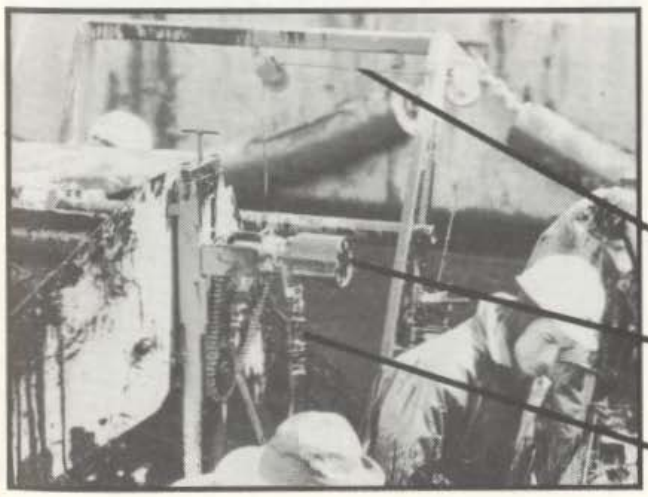
Fix the roller frame to the main frame. Connect the raising line from the block on the main frame.

If the belt ends are joined, pull out the pin to separate them.

Loosen the pressure between the top rollers with the turnscrews.



Adjust the tensioning roller at the end of the frame right in. Thread the belt between the top rollers, around the roller frame and rejoin the ends.



Connect the hydraulic lines from the power unit to the hydraulic motor.

STARTING THE ENGINE

Check the fuel tank (gasoline) and lube oil levels.

Pull out the choke if the engine is cold.

Set the throttle half way.

Pull the starter.

Allow the engine to warm up.

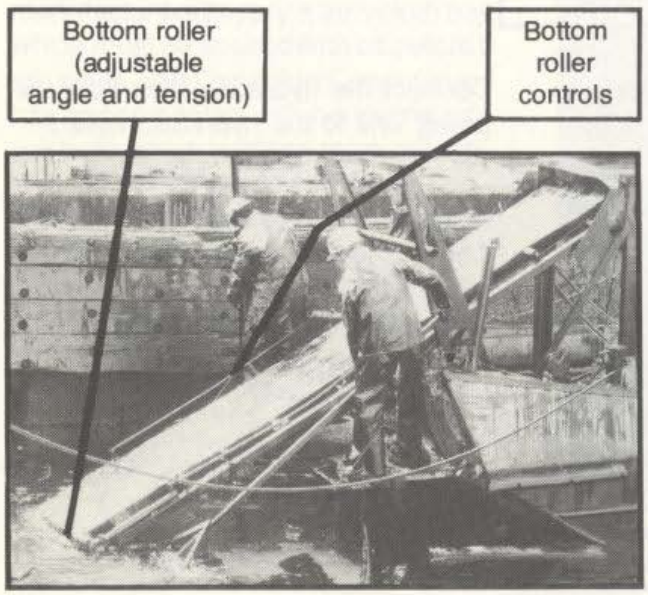
Turn the large wheel to allow pressure to the hydraulics.

This controls the speed of the belt.

Start the belt running slowly.

Apply some pressure to the top rollers with the turnscrews.

Adjust the belt tension and tracking with the bottom roller.

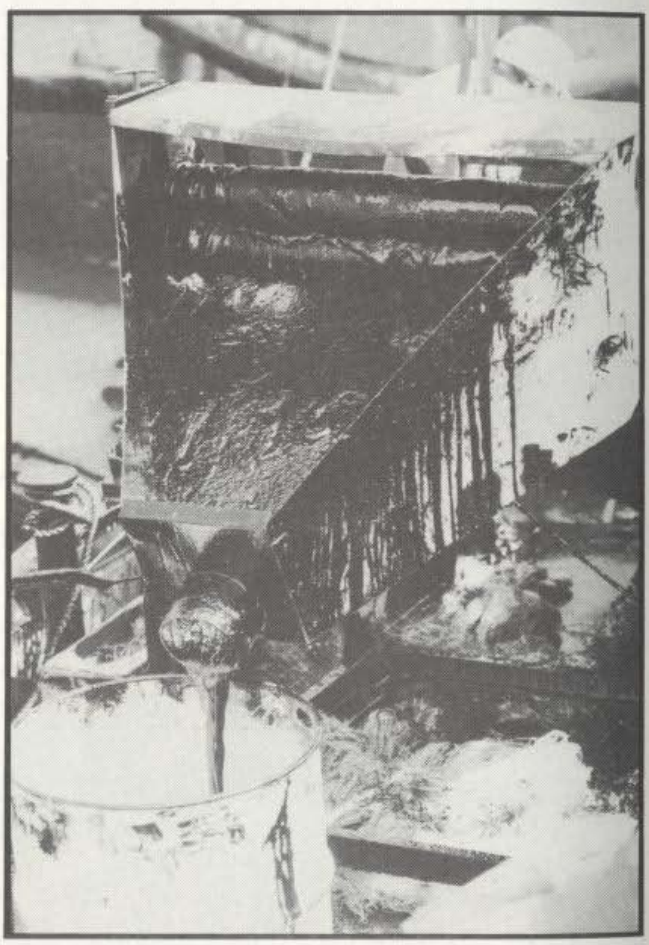


Lower the end of the frame to the water.

With a terrycloth belt, the end of the belt must **just** touch the oil.

With the new rubber belts, it may go into the water.

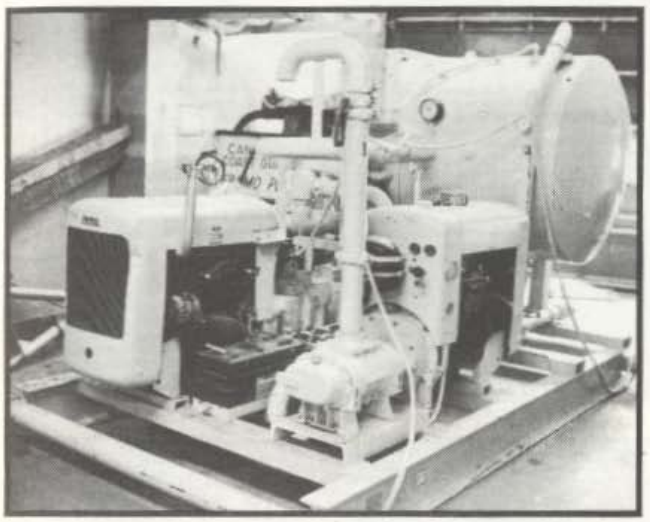
Put a container behind the outlet at the back of the slicklicker to receive the oil.



If there is little wind or current, it will be necessary to use rakes to bring the oil to the end of the belt.

Adjust the speed of the belt to give the best recovery rate.

SLICKBAR TRANSVAC 500D

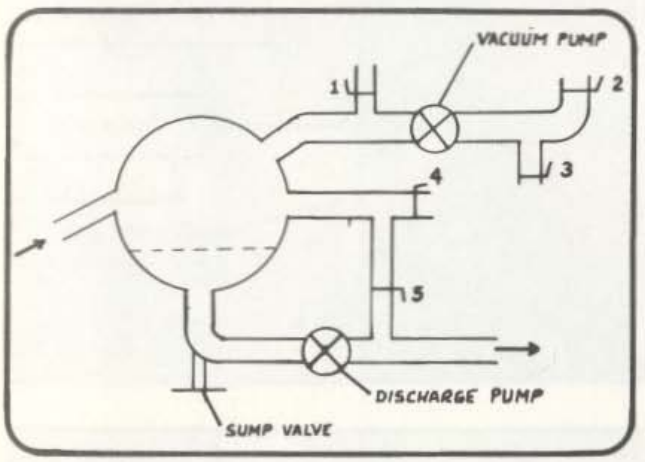


In nearshore spills of fresh crude or lighter oils, the Transvac is a very effective recovery system. One four-cylinder Ford diesel drives a vacuum pump, which sucks oil into a large tank through up to three manta-ray type skimmer heads. These float on the water, with openings at the level of the oil.

A second Ford diesel runs a discharge pump to transfer the oil through two outlets into large tanks or rail cars. Because of the high vacuum, there are a number of valves which must be opened or closed for various operations.

These are:

Valve #1. Vacuum pump intake vent
2. Vacuum pump exhaust vent
3. Suction hose blowback
4. Tank vacuum relief
5. Discharge hose suckback

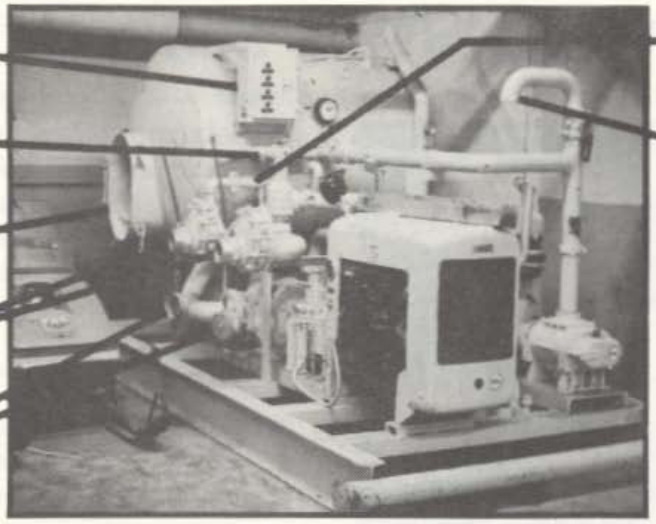


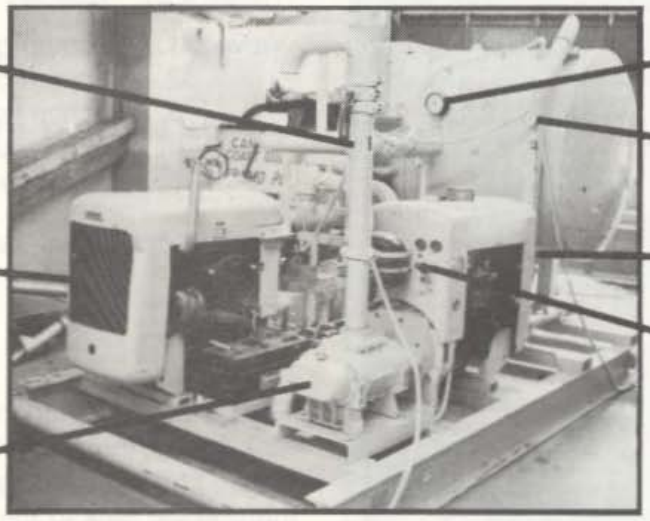
The oil, and air taken in with it, goes into the large tank. Inside, the oil falls to the bottom through a grid which strains out any debris. The air passes through the tank to the outside.

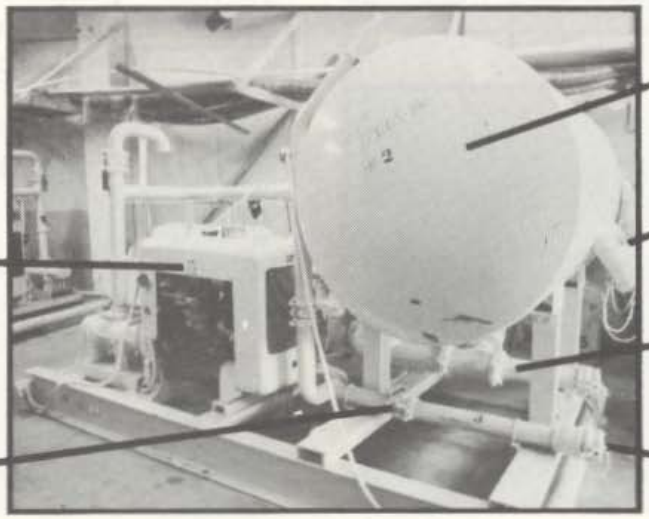
The oil collects in a sump. From there it is removed by another pump, which is powered by a second Ford diesel engine.

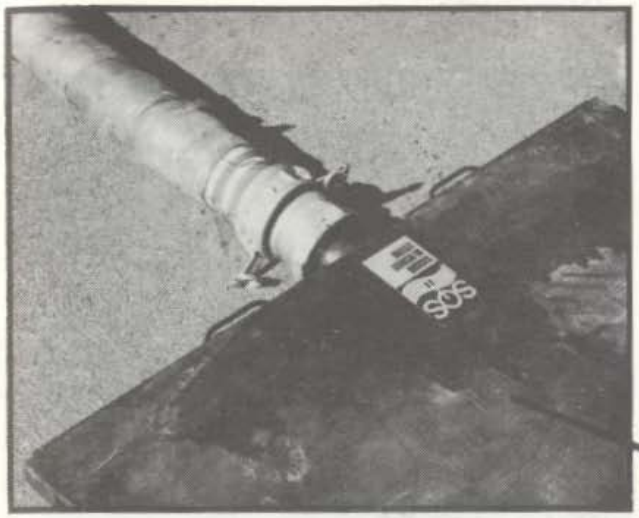
The Transvac may be used from the shore, or mounted on a suitable vessel, such as a barge.

The vessel must be able to carry the weight of the Transvac and the recovered oil.


Warning light panel
Valve #4
Vacuum-tank door
Discharge outlets
Outlet caps
Valve #5
Vacuum pump intake vent


Valve #1
Discharge engine
Vacuum pump
Vacuum gauge
Temperature gauge
Valve #2
Control panel


Vacuum pump engine
Valve #3
Tank
Inlet ports
Sump valve (behind)
Blowback outlet



PREPARING TO SKIM

Join together enough lengths of 3-inch or 4-inch hose so that it will reach from the Transvac to where you are going to skim with at least 20 feet of hose floating in the water. Make sure each join contains a gasket.

Connect the skimmer head to one end.

It has Cam-lock fittings. Close the handles and lash.

Put a hose float on the end of the hose, and at 5 foot intervals along the hose.

Skimmer head

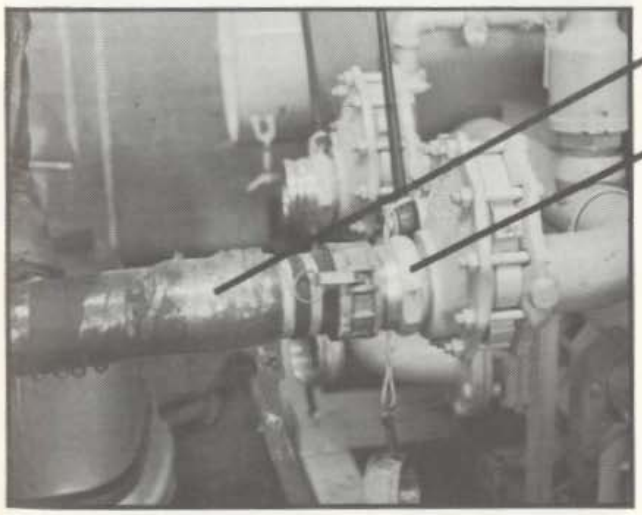
Connect the other end of the hose to one of the inlet ports on the Transvac. Make sure the washer is in place.

Make sure the other inlet ports are capped.

(If you are using a 3-inch hose, use a 4 x 3 inch reducer).

Glass to detect oil movement

Cam-lock fittings



Discharge hose

Discharge outlet

Uncap one of the discharge outlets. Check that the washer is in place.

Connect the discharge hose.

Run the hose to the receiving tank.

Fix the hose to the tank, by bolts or by lashing.

Launch the skimmer head.

STARTING THE ENGINES

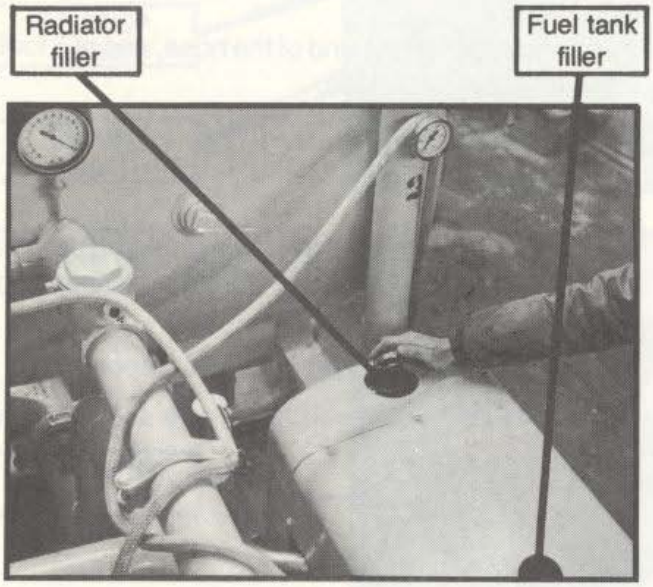
Check on **BOTH** engines:

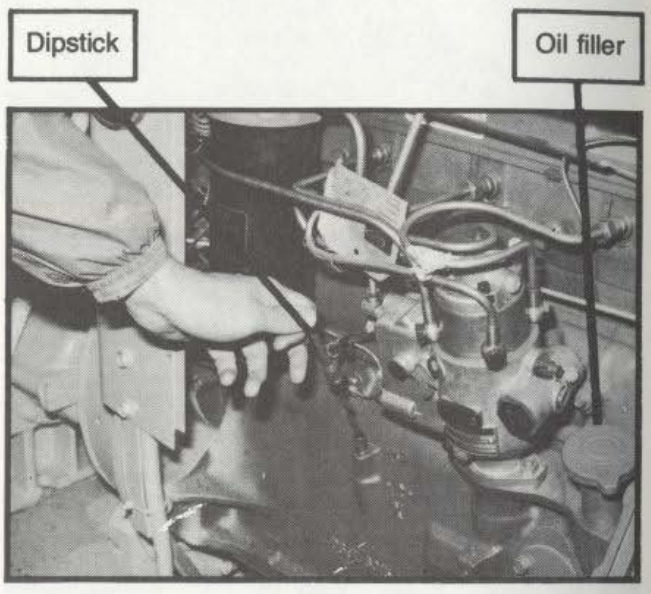
Fuel tanks are full.

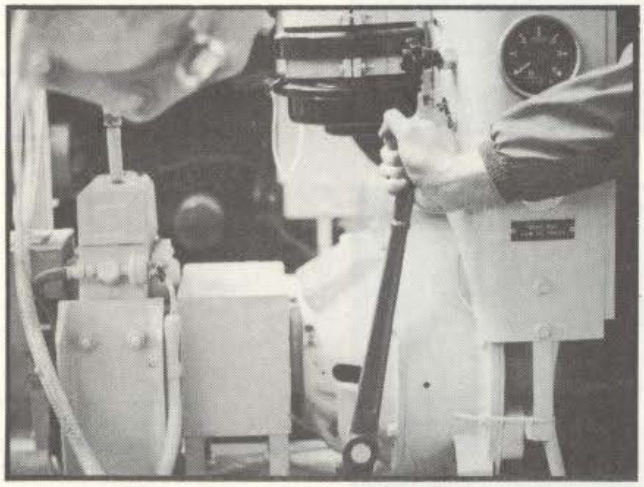
Radiators are full.

Lube oil levels are correct.

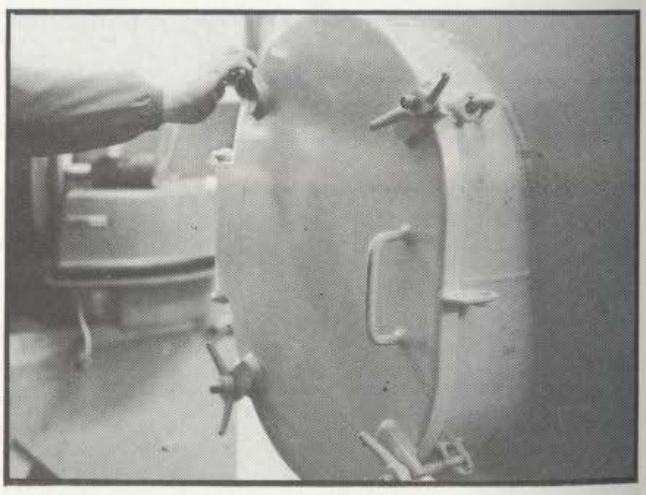
Top up any that are low.







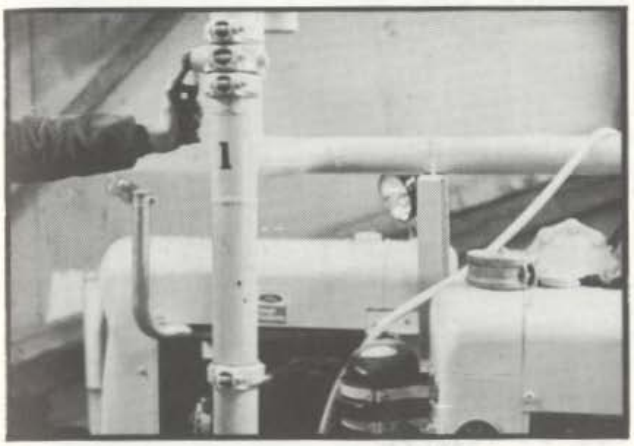
Disengage the clutch on the discharge engine.



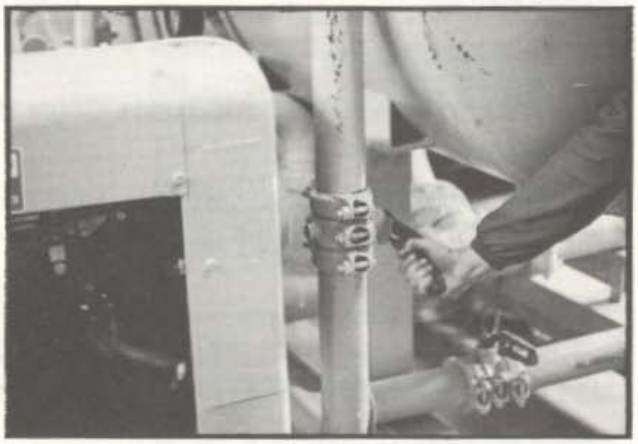
Check that vacuum-tank door is properly closed.

The handles should only be hand-tightened. They are made of brass, and can easily be damaged or broken if they are screwed too tight.

Open valve #1

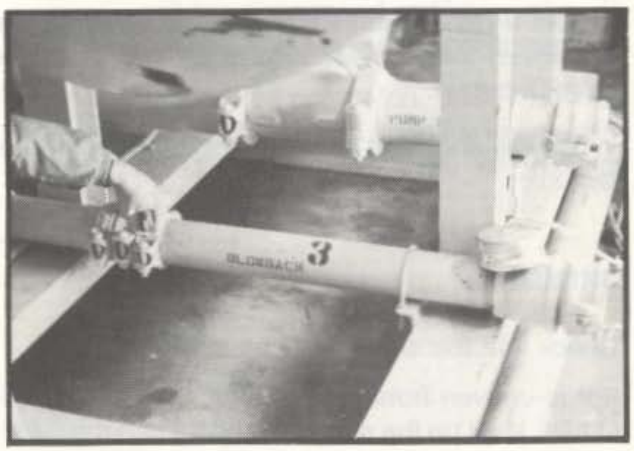


Open valve #2



(Valves are **OPEN** when the handle is **ALONG** the pipe).

Close valve #3



Close valve #5

Close valve #4

Turn ignition switch to ON. The warning lights should light up.

Pull the throttle halfway out.

Push and hold in HEATER PLUG button. Count 30 seconds.

Push the oil pressure sensor override. Hold it in until the engine starts and the oil pressure is up.

Push start button.

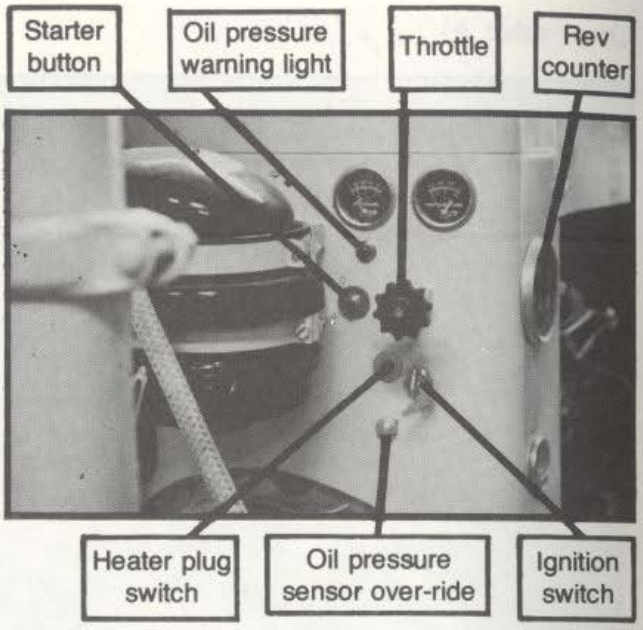
If the engine tries to start but falters, release the start button (but not the HEATER PLUG button).

Wait 5 seconds.

Push start button again.

In cold weather, with a cold engine, spray a **little** Quickstart into the **air intake** as you push the START button.

When the engine is running, set the throttle for a fast idle.



Start the vacuum pump engine the same way.

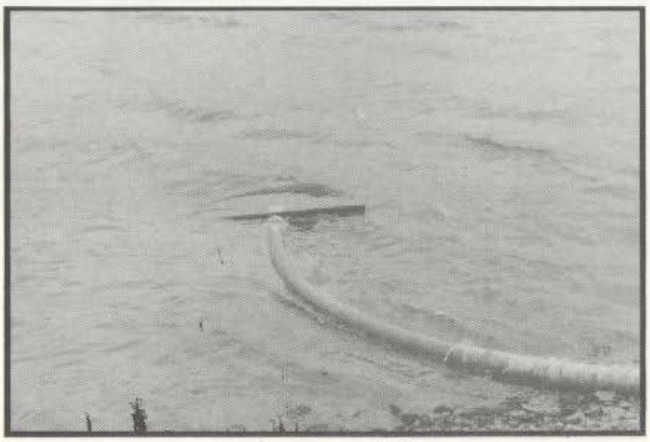
Allow about 5 minutes for each engine to warm up. Check the panels to see that no warning lights are on.

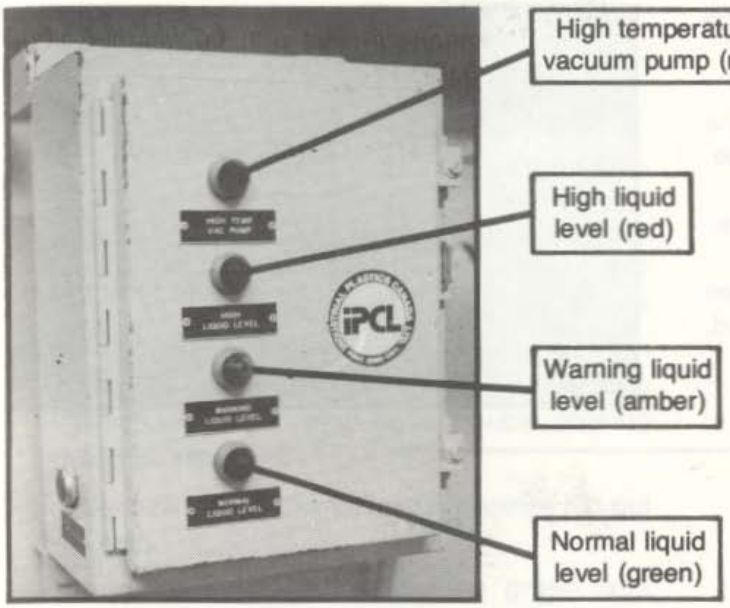
SKIMMING

Check that the skimmer head is floating level.

If it is uneven from side to side, undo the CAM-LOCK, level up the skimmer and tighten the CAM-LOCK again.

Close valve #1.





WARNING LIGHTS

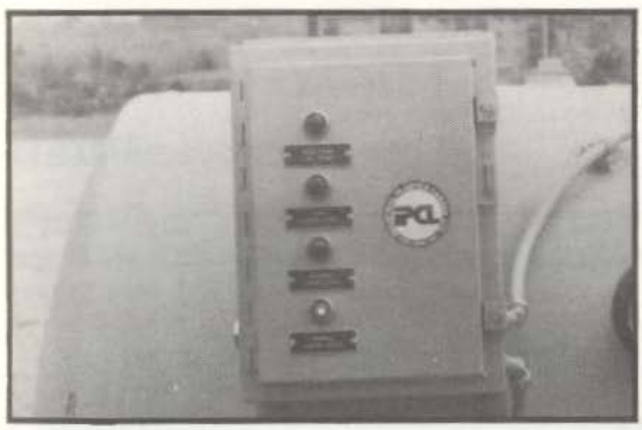
Once the Transvac is operating, you must adjust the pumping speed to suit the amount of oil being recovered.

The lights on the panel indicate how good the balance is. The idea is to keep the bottom (green) light on, and all the other lights off.

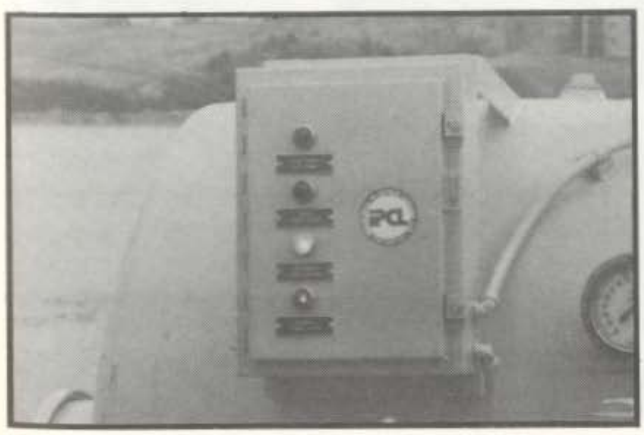
There are several ways of doing this, but the manufacturer suggests that this is how you should do it.

Run both engines at about 1500 RPM.

Keep the discharge pump engine's clutch disengaged and keep valve #1 closed until the green light comes on.



When the green light comes on, open the sump valve, engage the clutch and open the lever on the outlet being used. The Transvac will now be pumping out oil.



If the amber light comes on, speed up the discharge pump engine a little.

If the amber light stays on, open valve #1 **slightly.** This allows some air to leak into the vacuum pump and makes it less efficient. This is better than slowing the vacuum pump engine.

The amber light should soon go out. When it does, you may close valve #1 a little (not all the way) or slow down the discharge pump engine a little.

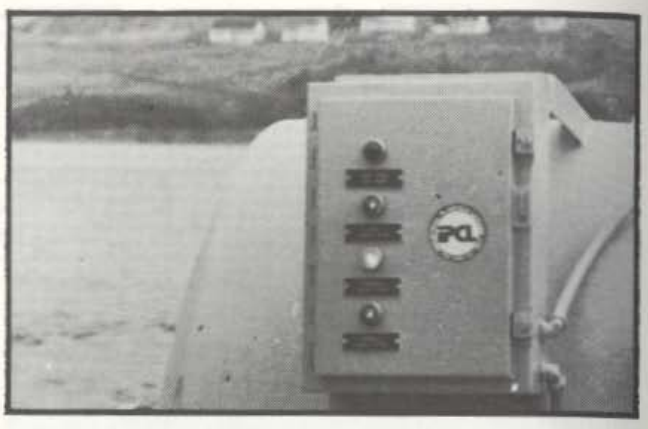
Continue making small adjustments to valve #1 and the engine speed until the green light stays on, but all the other lights are out.

If the HIGH LIQUID LEVEL (RED) light ever comes on, you must act quickly.

Stop the suction by opening valve #1. Push in the vacuum pump engine's throttle to slow the engine.

Continue pumping out with the discharge engine.

If the 'HIGH TEMP. VAC PUMP' (RED) light comes on, it usually means that the suction line is blocked. See the section on Clearing Suction Lines.



STOPPING THE ENGINES

NORMALLY

Disengage the clutch for the discharge pump engine. Open valve #1 for the vacuum pump engine.

If the engine is hot, allow it to run at fast idle for five minutes.

Push in throttle until the engine is running at a slow idle.

Turn the ignition switch to OFF.

Push the throttle right in.

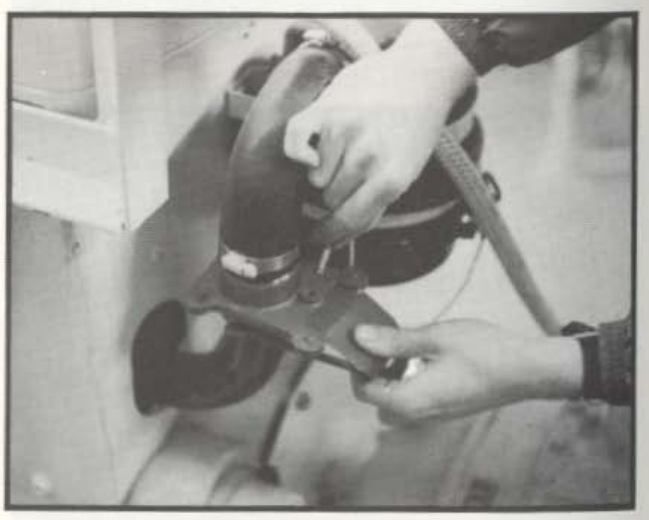
EMERGENCY

If petroleum vapours are present, a diesel engine may start to accelerate out of control. If this happens, use the EMERGENCY STOP procedure.

Pull the safety pin.

Push in the damper plate.

Turn the ignition switch to OFF.



CHECKS WHILE RUNNING

— Oil pressure warning lights. If one lights up, shut down the engine quickly.

— Temperature gauges. Should be in the NORMAL range. If high, disengage clutch on discharge engine, open valve #1 and set engines to fast idle. If temperature does not drop, shut off engines. Allow them to cool down. Check water level in radiator.

— Ammeters. Should show "Charge". If showing "Discharge", you may have trouble starting engines next time.

— Fuel tank levels. Do not let the engines run out of fuel.

— Panel warning lights. Only the green light should be on.

CLEARING SUCTION LINES

The main problem you are likely to have is a blockage in the suction hoses. There are several ways you can tell if this has happened: —

— You will see debris around the skimmer head.

— The vacuum gauge shows more than 18 inches.

— You cannot see oil flow through the glass on the inlet port.

— The air coming out of the vacuum pump outlet is very much hotter than normal.

— The suction hose to the skimmer stops 'pulsing'.

There are two ways to clear the hose: "blowing back" or by hand.

BLOWBACK PROCEDURE.

Open valve #1.

Open valve #2.

Disengage the discharge pump clutch.

Disconnect the blocked suction hose from its port.

Connect the hose to the blowback outlet.

Open valve #3.

Close valve #2.

Accelerate the vacuum pump engine to 1,500 RPM.

This should clear the blockage.

CLEARING THE HOSE BY HAND

If it does not work, the second way to clear the hose is by hand.

The most common places to get blocked are where the hose connects to the inlet port, and where the hose connects to the skimmer head.

Slow vacuum pump engine to idle.

Open valve #2.

Close valve #3.

Disconnect the suction hose from the blowback outlet.

Recover the skimmer head, dismantle the hose and clean out.

Reconnect the hose to the skimmer head and to the inlet port.

Launch the skimmer head.

Close valve #1.

Close valve #3.

Close valve #4.

You will now be skimming again.

CLEANING OUT THE TANK

How often you have to do this depends on the amount of debris in the oil slick.

A garden rake or a clam rake is a good tool for this job. You also need a container to put the oily debris in.

Slow both engines to idle.

Open valve #1. This stops the suction.

When the flow of liquid from the discharge pump stops, disengage the clutch and close the sump valve.

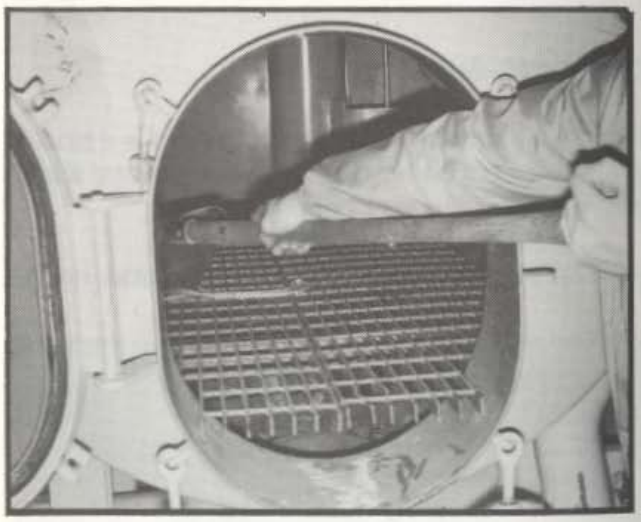
Open valve #4.

Make sure there are no lighted cigarettes or pipes or other flame sources around.

Open the tank door.

Rake out the debris.

Check inside to make sure it is free of debris.



Close the door.

Close valve #4.

Open the sump valve.

Engage the clutch.

Accelerate both engines.

Close valve #1 and continue skimming.

DISCONNECTING THE DISCHARGE HOSE

Slow both engines to idle.

Disengage the clutch.

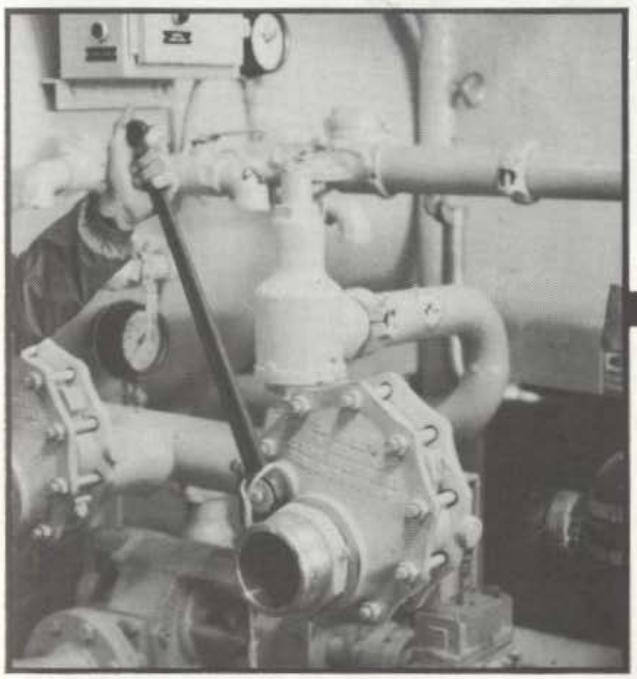
Open valve #5. This draws all the liquids in the hose back into the tank. Allow 2 minutes.

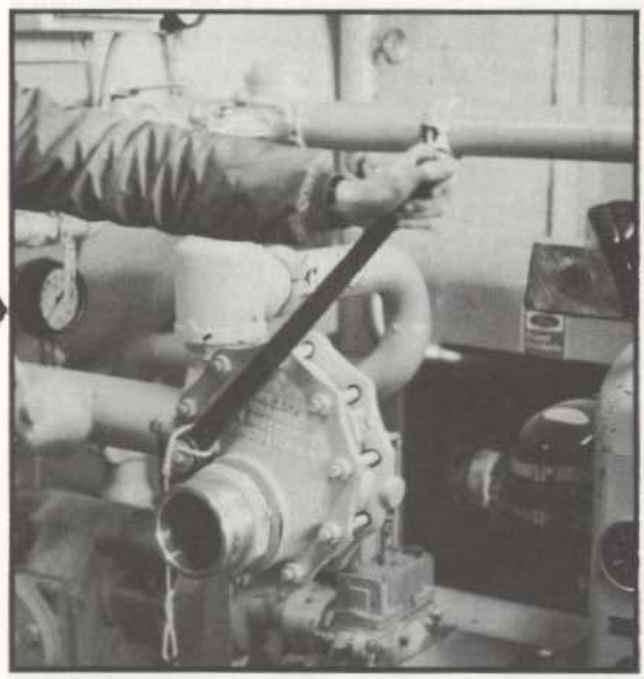
Open valve #1.

Close valve #5.

Disconnect the discharge hose.

Shut off the outlet:





To resume skimming, reconnect the hose, open the outlet, engage the clutch, close valve #1 and accelerate the engines.

When the Transvac is to be shut down after the job:

— Flush the tank and discharge pump with fresh water;

— Drain the water out of the pump through the valve on the pump base.

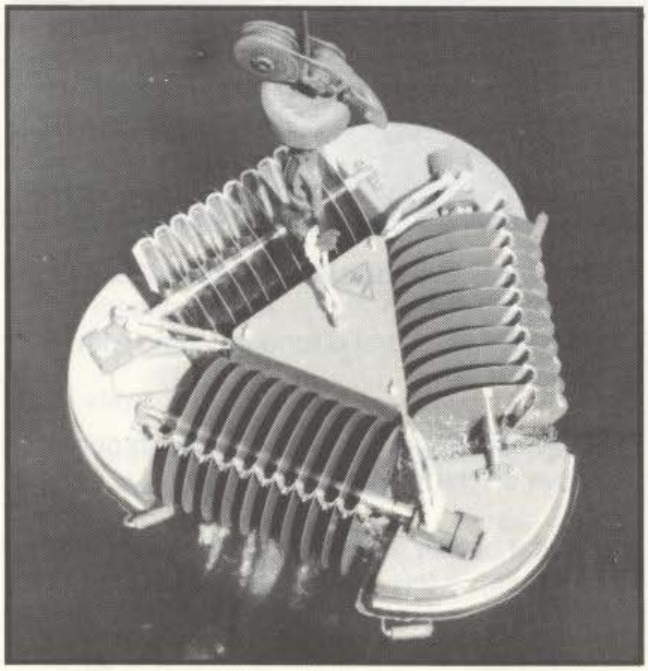
— Pour a bucket of light oil into the tank and turn the pump a few revolutions.

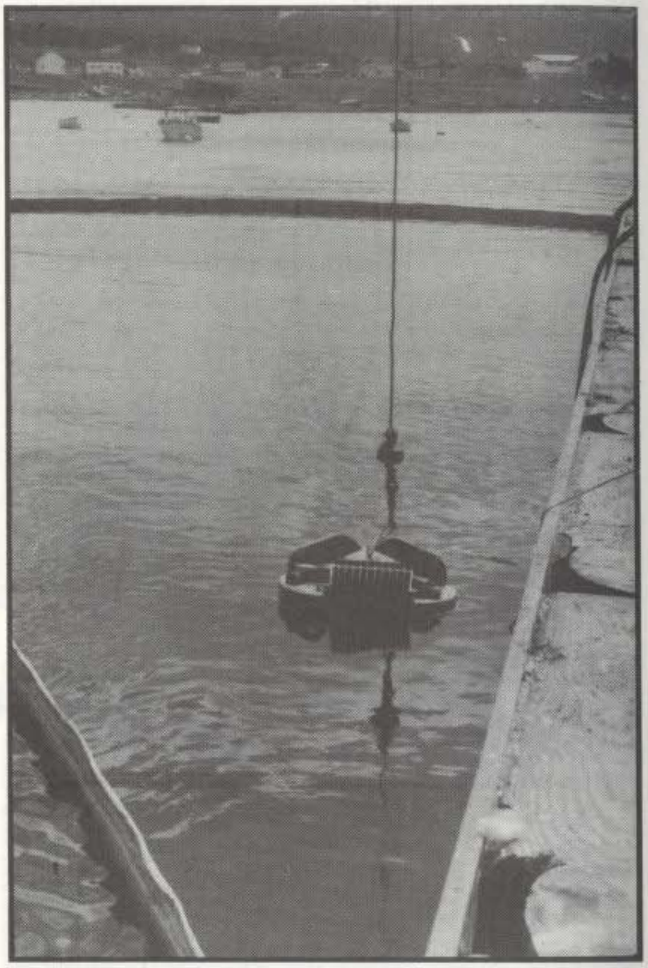
SMALL DISC SKIMMERS

These small skimmers work on the same principle as the Framo system, that is they use rotating discs to skim the oil from the surface of the water. However, this type is much smaller and free-floating, which make them suitable only for inshore, calmer waters.

The normal use of these skimmers would be from the shore or small vessels, in conjunction with inshore booms such as the flexy-boom. If a wharf is used, the height above water should not be more than 10 feet. If the power unit is to be mounted on a small boat, the carrying capacity of the boat must be sufficient for the crew, the power unit, the skimmer unit **and** the weight of the oil to be recovered.

If debris fouls the discs, shut off the hydraulic power, recover the skimmer and clean it out by hand. Be careful when lifting the skimmer from the water. Make sure it does not swing against the dock or other objects, which could damage it.





Dismantling the system is the simple reverse of setting it up. Stop the engine, disconnect the hoses, and replace the cover on the skimmer unit.

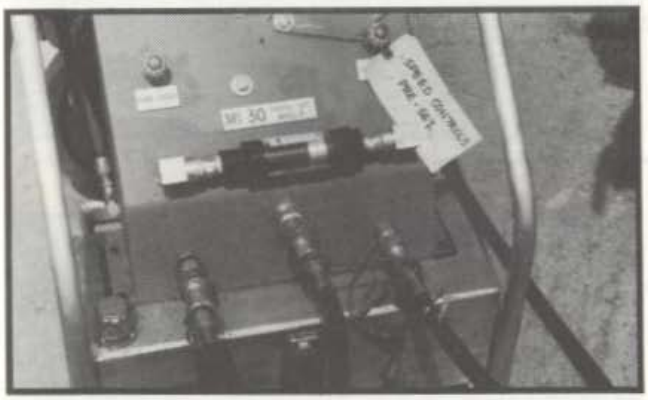
There are several makes of small disc skimmers available. The remainder of this section will use the Morris Miniskimmer to illustrate their use, but all types operate on the same principles.

SETTING UP

The power unit supplies hydraulic power to the skimmer unit for two purposes, to turn the discs, and to power the pump which transfers the oil to the recovery tank.

Connect the three hydraulic lines to the power unit.

Wipe each fitting before you make the connection.

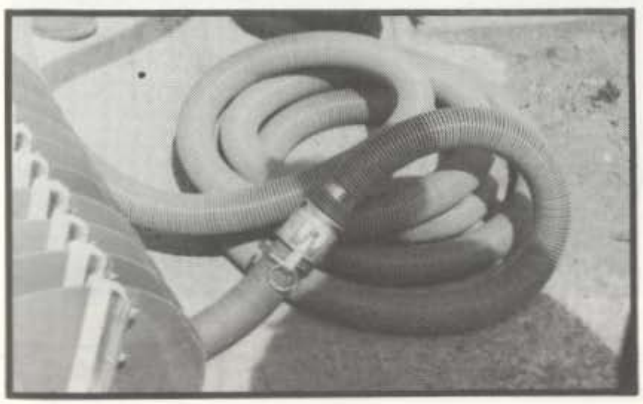


The fittings for each line are different, so you cannot make wrong connections.

To connect a line to an outlet, pull back on the knurled ring on the female fitting, push the line onto the outlet, let the ring spring back and twist it clockwise.

Connect the lines to the skimmer unit in the same way.

Connect the discharge hose to the skimmer unit. Fit the other end to the tank you are using, either with a proper fitting or by lashing.



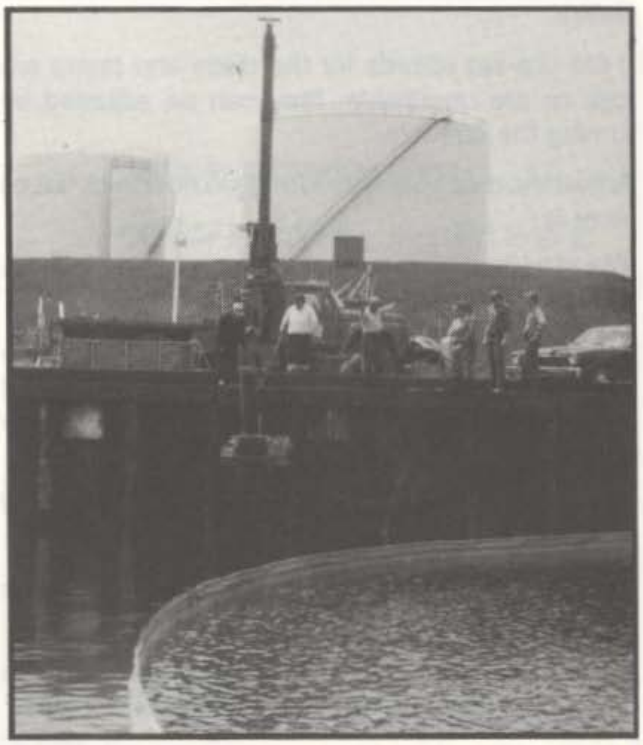
Remove the wing bolts and lift off the top cover.

Tie a lifting rope to the lug on the top of the skimmer unit.

LAUNCHING THE SKIMMER

Any suitable lifting system can be used to launch the skimmer, even hand-lifting by three or four men.

Lower the skimmer gently into the oil.



STARTING THE POWER UNIT

Check that the fuel tank is full.

Check the lube oil level.

Check the hydraulic oil level.

Set the pump control to neutral.

Start the engine as described in Chapter 4.

SKIMMING

The pump and disc speed controls are pre-set. To begin skimming, simply engage the main control levers.

If the pre-set speeds for the discs and pump are lost, or are unsuitable, they can be adjusted by turning the controls.

Adjust the disc speed according to how thick the oil layer is.

The thicker the layer, the faster the discs can be run.

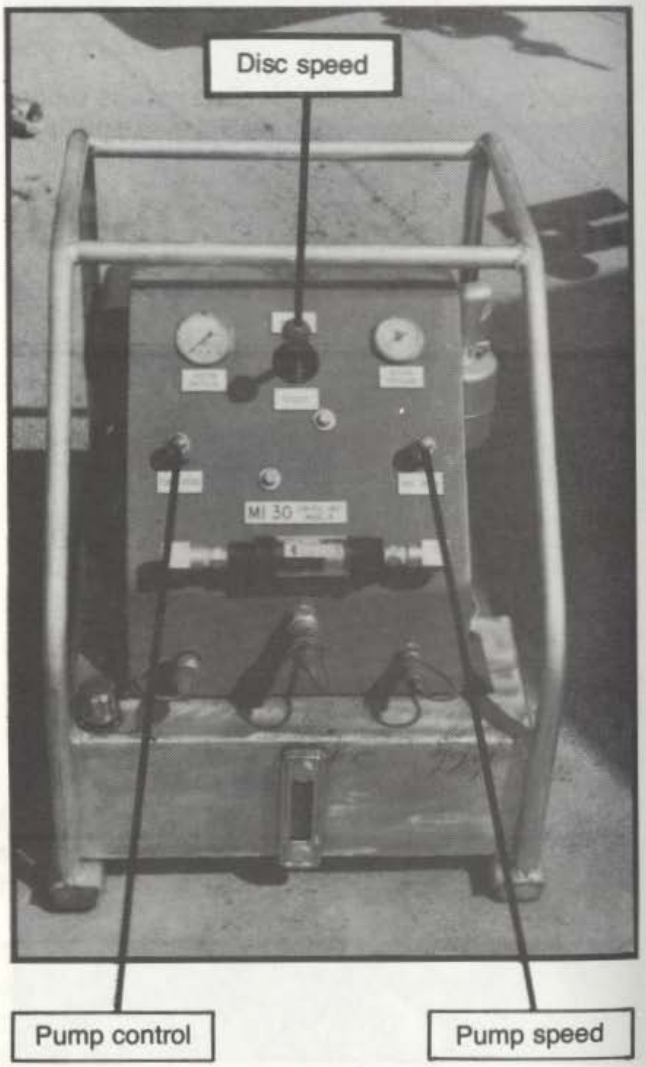
By watching the discs and scrapers, you can see whether much water is being taken in. If a lot of water is being taken with the oil, run the discs a little slower.

Adjust the pump speed according to the rate of recovery of oil.

If the flow of oil and water into the tank stops, run the pump slower.

If the tubes below the scrapers on the discs are constantly full, increase the pump speed a little.

Use the lifting rope to manoeuvre the skimmer in the oil, in order to recover as much as possible.



RECOVERING THE SKIMMER

Recovery of the skimmer is the reverse of launching.

Put pump control to neutral.

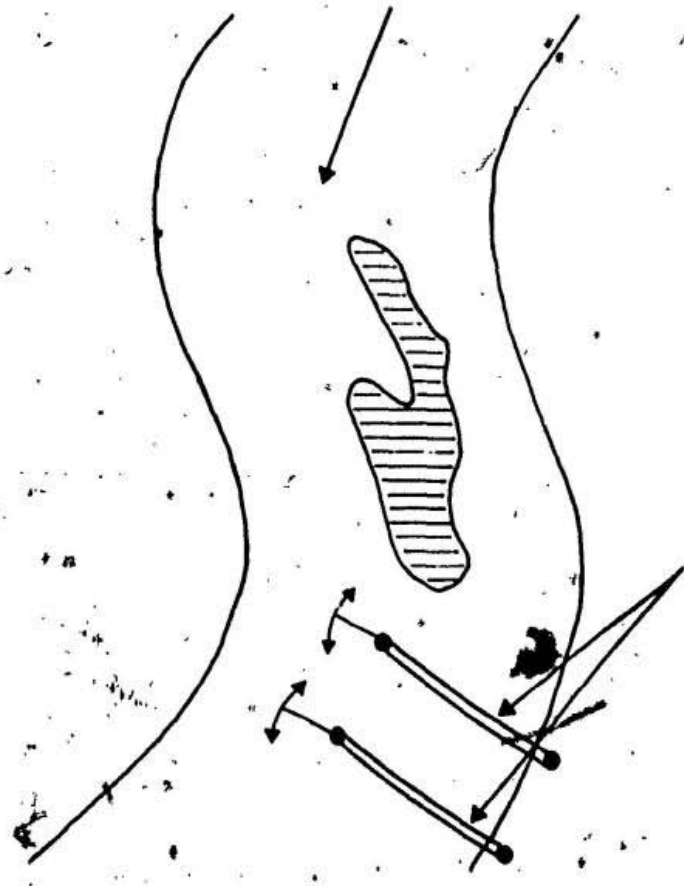
Lift the skimmer gently out of the water.

NEARSHORE OPERATIONS

A much wider variety of equipment is available for near-shore operations than for offshore. The equipment is generally much smaller, and so can be mounted on a wider range of craft.

Oil is, generally-speaking, easier to recover from the water than if it gets ashore. Because of this, it is important when oil is near shore to react speedily. Unfortunately, because currents are more unpredictable near shore, it is also critical to deploy booms in appropriate places.

Because the shape of the shoreline affects the operation so much, it is impossible to describe how to set out the equipment — improvisation is your biggest asset! However, there are some guidelines that may be useful in typical situations.

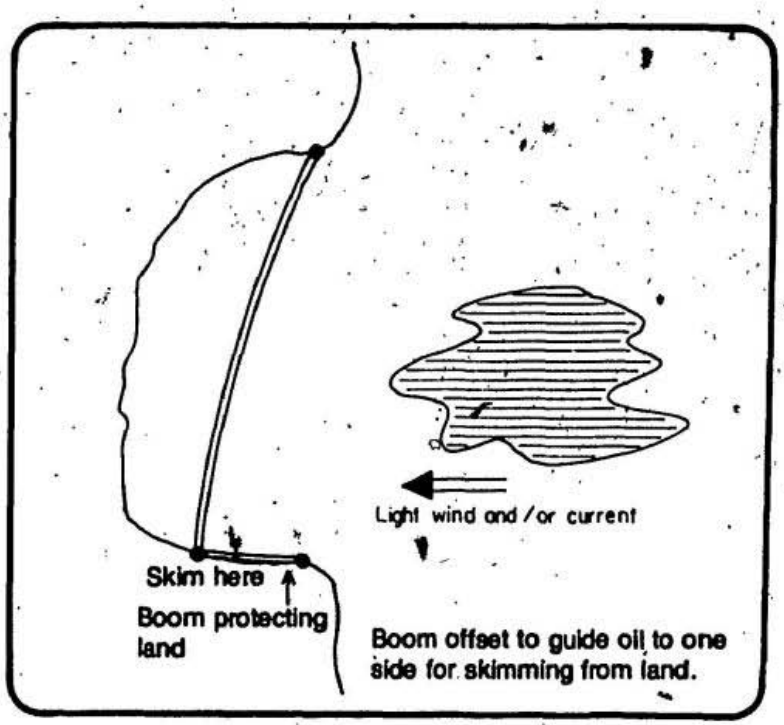


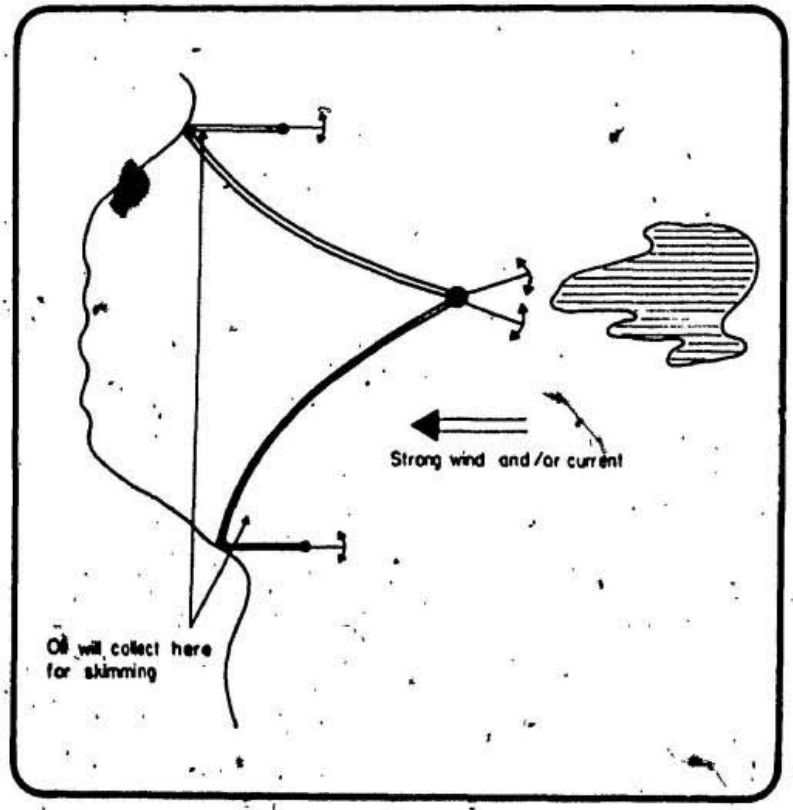
Spills in a Flowing River

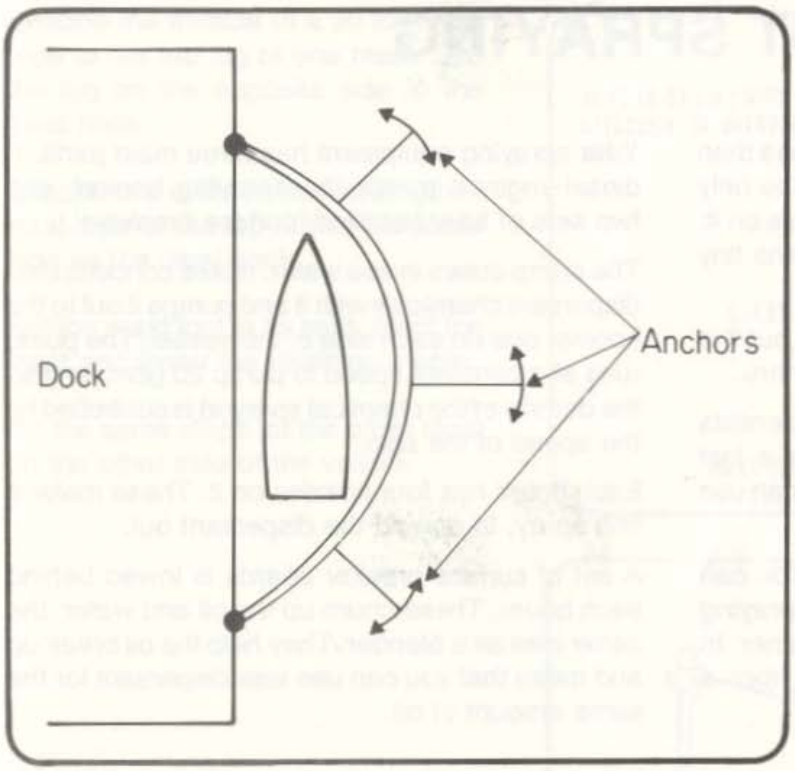
Oilspills in a flowing river will tend to drift to the outside of the bends. This can be used to make containment more effective. Two booms are usually used in case some oil escapes under the first one.

Protecting a Small Cove or River Mouth

The main feature here is the strength of the wind or the current. If both are light, the boom can simply be strung across the mouth. If either is strong, say current more than 1 mph (2 kmph), or wind more than 30 mph (50 kmph) the boom should be set to deflect the oil to the edges, where it can be easily skimmed.



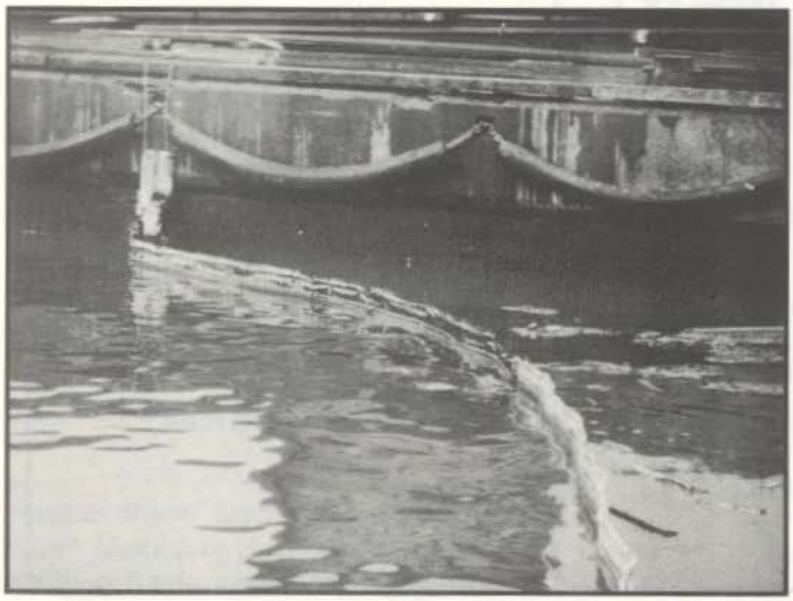




Leaking Vessel Moored to Wharf

The important thing here is that the boom goes around the vessel and makes an oil-proof join to the dock wall, or to the land under the wharf if there is no barrier across the water surface along the wharf.

Whenever a boom is deployed joining to the land in tidal waters, remember to make sure there is some way the boom can rise and fall with the tide and still contain the oil. Also, if the boom will be out overnight, fix lights to its buoys to prevent collision.



9: DISPERSANT SPRAYING

It is much better to recover oil spilled in the sea than to do anything else. But in some cases, the only thing that can be done is to spray chemicals on it. These chemicals make the oil break up into tiny droplets.

Of course, the oil is still there in the water, but it is less dangerous and not a nuisance any more.

The chemicals have been tested, and scientists believe they are safe. Even so, they are a last resort, and permits must be got before you can use them.

There are two ways to spray an oil spill. You can spray it from an aeroplane or from a ship. Spraying by plane is useful in open seas, in fine weather. In other situations, spraying must be done from a ship.

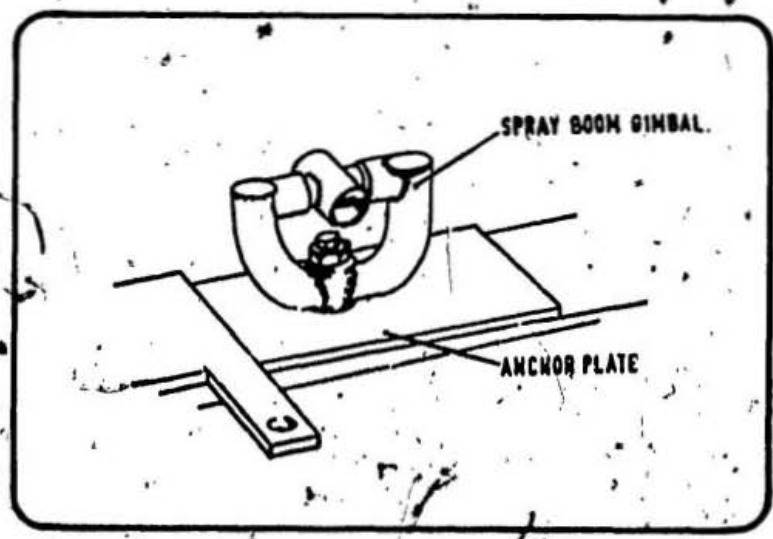
Your spraying equipment has three main parts. A diesel-engined pump, the spraying booms, and two sets of boards called 'surface-breakers'.

The pump draws in sea water, mixes concentrated dispersant chemicals with it and pumps it out to the booms, one on each side of the vessel. The pump runs at a constant speed to pump 20 gpm, and so the density of the chemical sprayed is controlled by the speed of the ship.

Each boom has four nozzles on it. These make a fine spray, to spread the dispersant out.

A set of surface-breaker boards is towed behind each boom. These churn up the oil and water, the same idea as a blender. They help the oil break up and mean that you can use less dispersant for the same amount of oil.

SPRAYING EQUIPMENT



1. RIGGING THE BOOMS

This will need 4 people.

Do one step at a time, and go as slowly as you need.

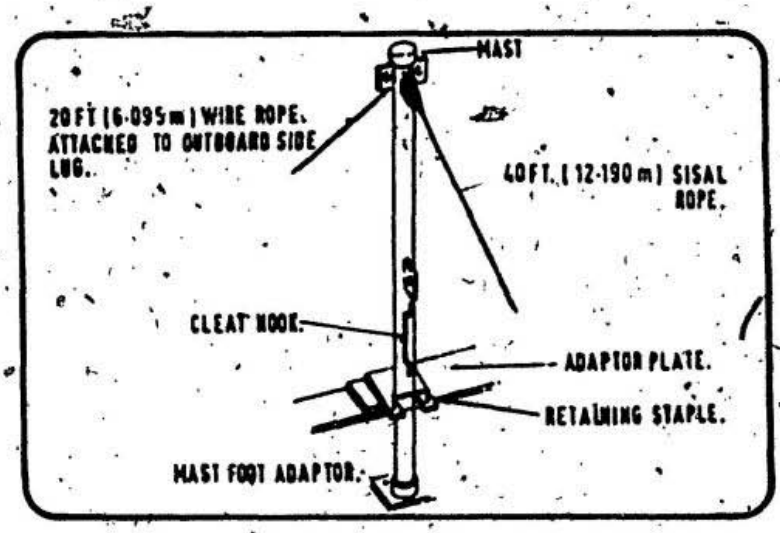
Bolt a gimbal onto the anchor plate.

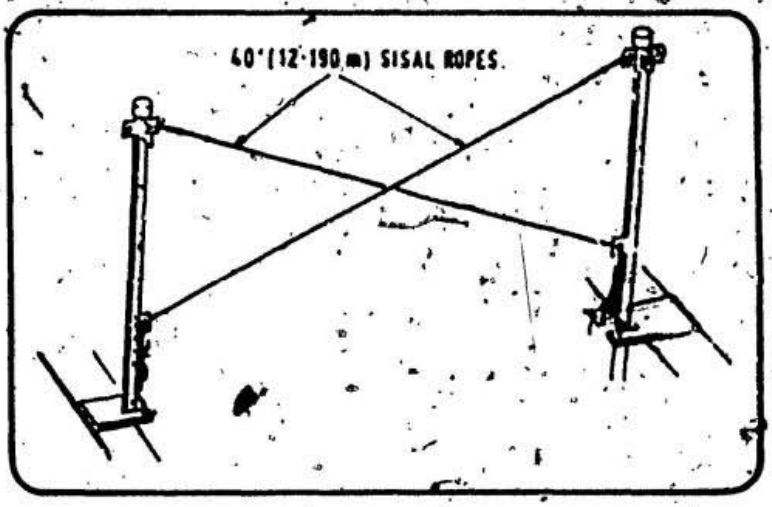
Shackle the thimble of a 20 foot wire rope to the top lug of one mast. Use the lug on the opposite side to the cleat hook.

Shackle one end of a 40 foot length of sisal rope to the top lug on the same side as the cleat hook.

Set the mast foot in its seat, erect the mast and insert the retaining staple.

Do the same steps for the other mast on the other side of the vessel.





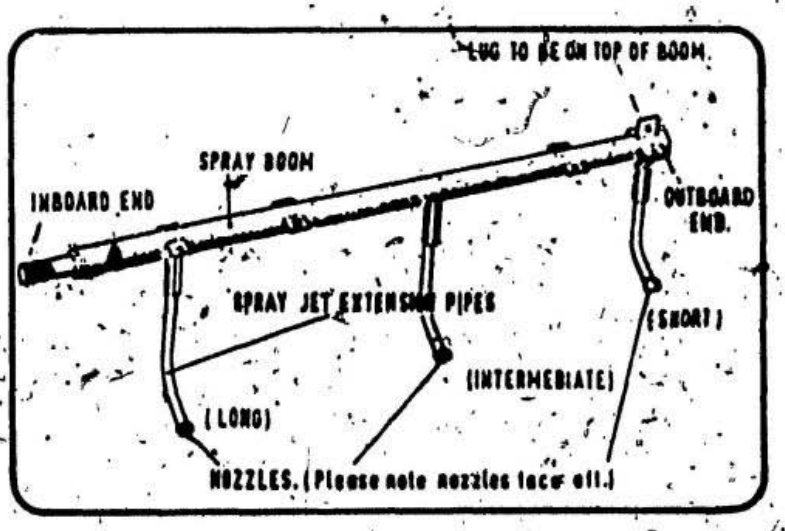
Cross-brace the masts with the sisal ropes. Use the cleat hooks.

Fit the spray jet extension pipes to each boom. There are three lengths of pipe. Fit a long one inboard, a middle-length one half-way out, and a short pipe outboard.

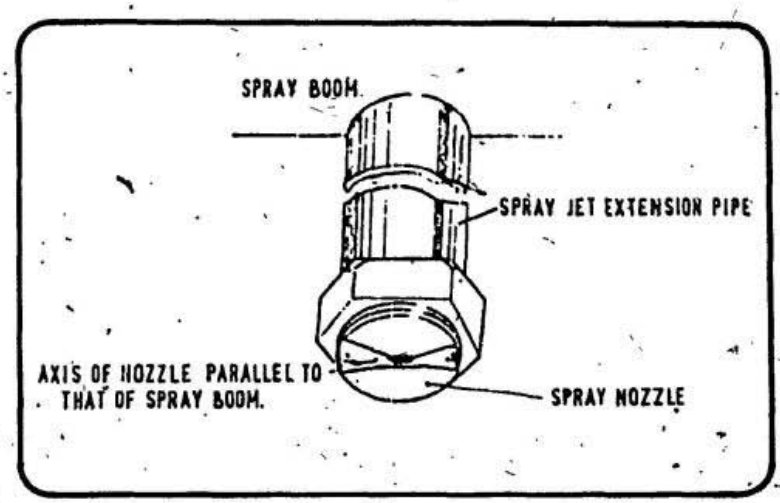
Turn the boom so that there is a lug on top at the outboard end when the pipes point down.

Now turn the pipes so that they bend aft.

Repeat these steps for the other boom. Make sure you have one boom for the port side and one for starboard.

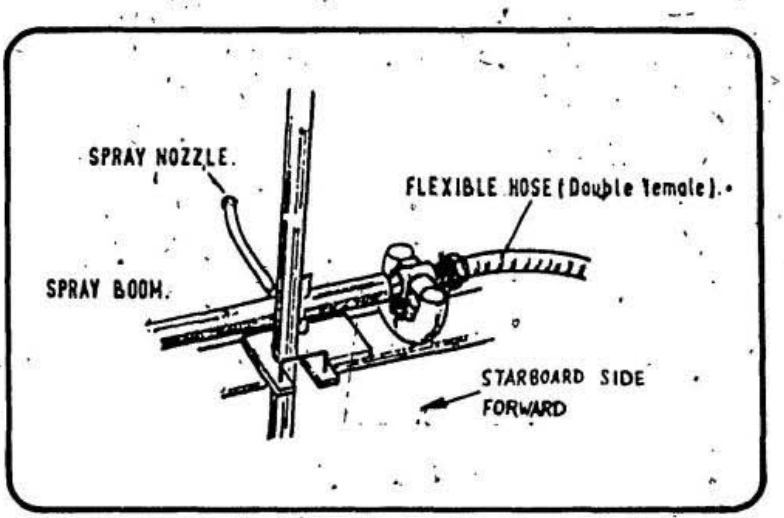


Screw an adaptor and a nozzle into each pipe. Make sure the slot in each nozzle is parallel to the boom.



Turn the starboard gimbal so it faces fore and aft. Screw the starboard boom into the gimbal from the forward side. Make sure you have boom **outside** the mast. Have someone hold the outboard end of the boom.

Now screw one of the double female hoses into the boom end. The drawing shows this for the starboard side.

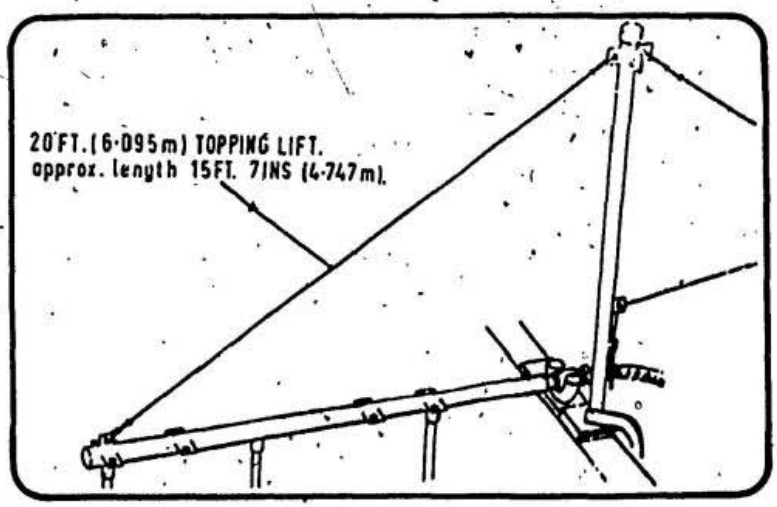


Collect the loose end of the wire rope which is joined to the top outside lug on the mast.

Attach this end to the top outboard lug on the boom with a thimble and shackle.

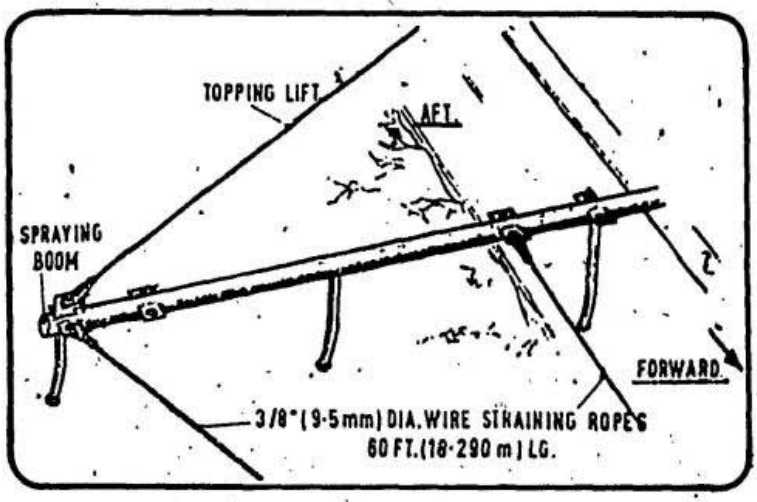
Adjust the length of this wire so that the boom is about horizontal. You should need about 16 feet of the wire rope. Clamp the extra rope with three ¼ inch wire clips. This is called the TOPPING LIFT.

If the sea is rough, shorten the wire to raise the end of the boom above horizontal so it will not dip into the water as the vessel rolls.

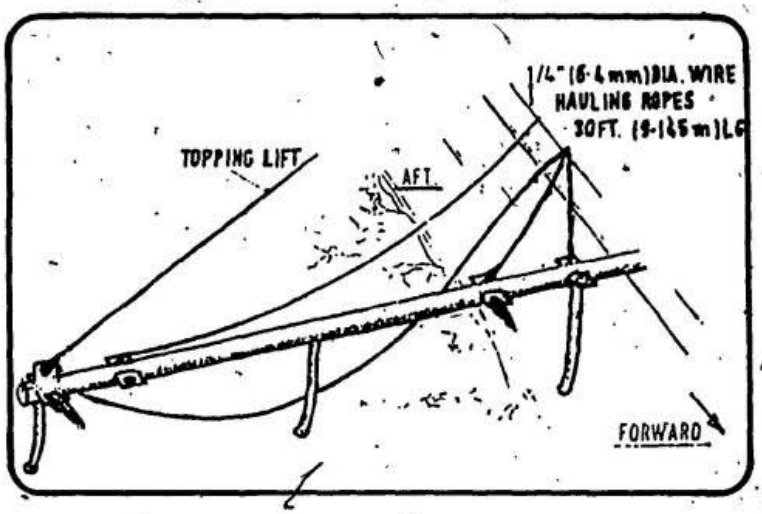


Take 2 wire ropes, ⅜ inch diameter, 60 feet long. Shackle one to the outer forward lug on the boom. Shackle the other to the centre forward lug (second lug out on forward side).

Leave the spare rope forward on the deck.

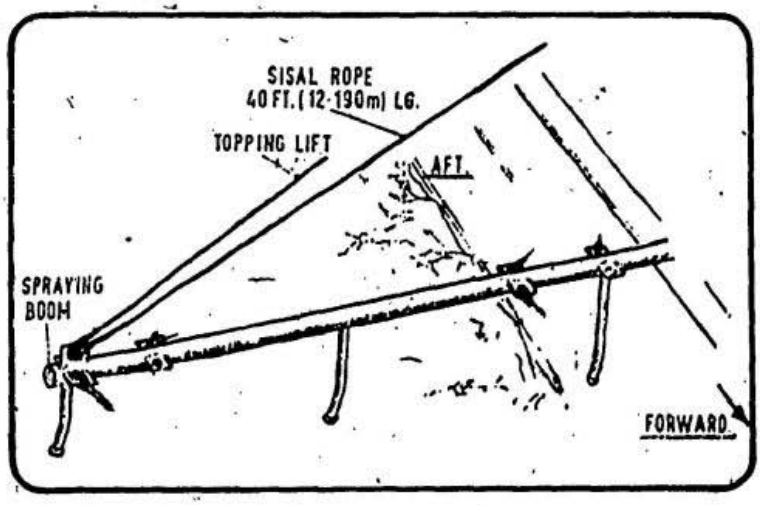


Shackle one 30 foot ¼ inch rope to each aft lug on the boom. There are 4 lugs. Pass the spare lengths outside the mast and back onto the deck.



Tie 40 feet sisal rope to the outer top lug on the boom. Pass the rope back outside the mast on to the deck.

Lift the boom over the rail.



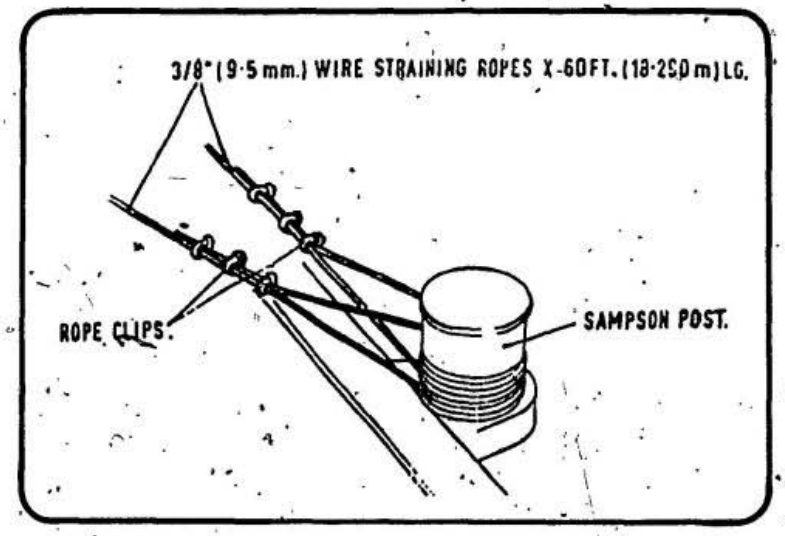
Haul in the sisal rope aft, and pay out the 2 wire ropes forward, so that the boom swings out, stop when the boom is lined up with the two masts.

Take up any slack in the two wire ropes. Loop them around a sampson post (or another convenient fixing) well forward.

Fix each loose end to its rope with three, ⅜ inch wire rope clips.

Make fast the sisal rope astern, so it holds the boom firmly against the two wire ropes.

Repeat all these steps on the other side of the vessel.



2. RIGGING THE SURFACE BREAKER BOARDS.

Lay out three surface-breaker boards across the deck aft of the mast. Have the sloping edge forward and underneath.

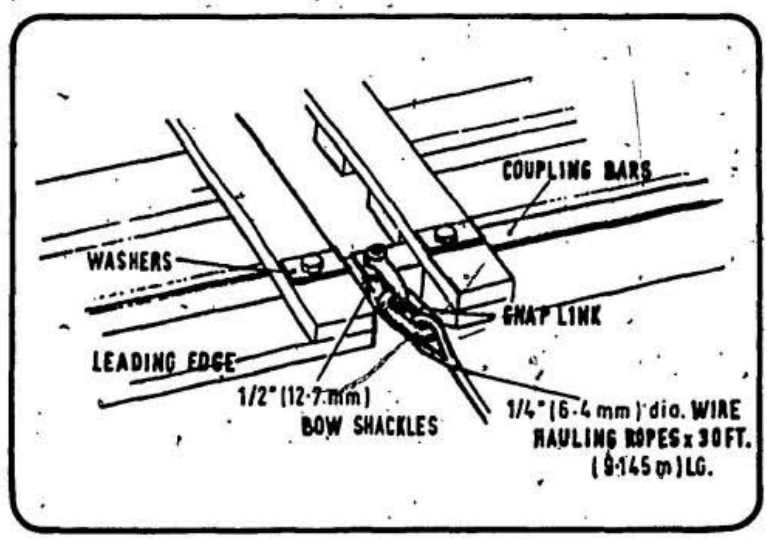
Bolt the coupling bars to the bars of the boards, just behind the front edge. Use the 4 by 2 inch washers on the outside.

Join the boards together with ½ inch bow shackles (with ⅝ inch pins).

Fit a snaplink to each shackle and one to the outer and inner coupling bar ends as well.

Collect the free ends of the four hauling wires on the boom.

Clip the free end of each wire to the snaplinks, in the proper order, as in the drawing on the bottom of the next page.



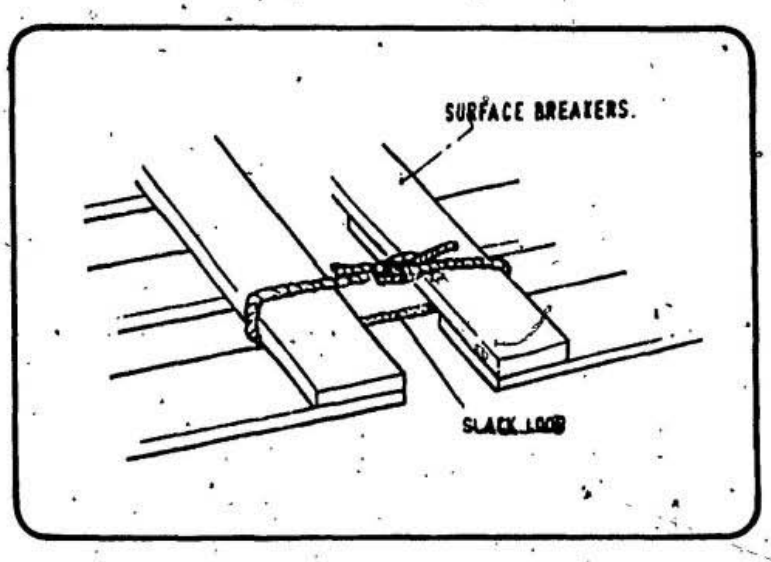
Tie 5½ feet of sisal rope around the back edges of the outer and middle boards in a **slack** loop.

Do this to the inner and middle boards as well.

Tie 35 feet of sisal rope to the innermost snaplink, and tie the other end to the gimbal.

Tie two double-eyed floats to the top side of the coupling bars of each in the outer and inner boards.

Repeat these steps for the other side. Be careful not to cross the ropes.



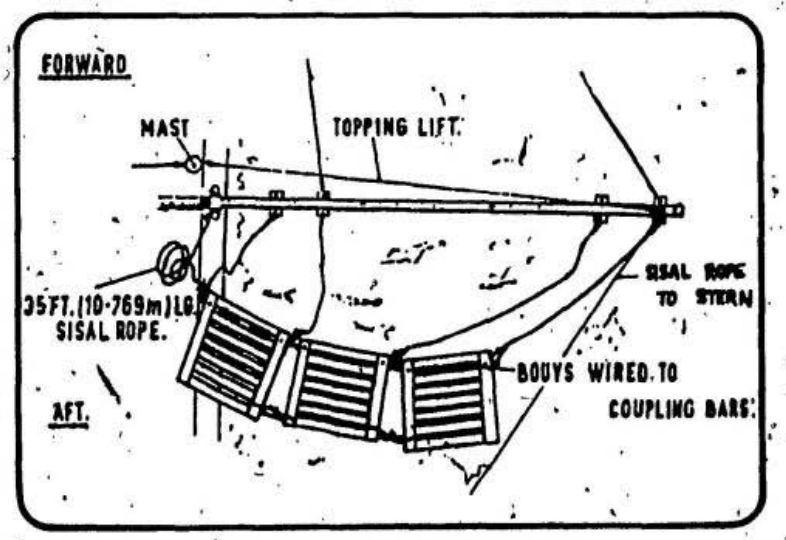
3. LAUNCHING THE SURFACE BREAKERS.

The vessel should go ahead as slow as possible.

Push the starboard set of boards over the rail. Be careful not to tangle the ropes. At the same time the vessel should go to starboard.

When the boards are trailing properly, slacken the rope tied to the gimbal, so it takes no strain.

Repeat this for the port side with the vessel going to port.



4. SETTING UP THE PUMP SYSTEM.

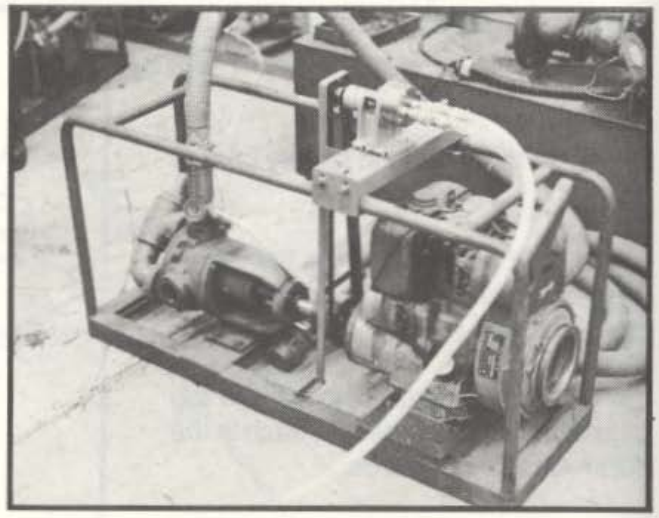
There are two types of pumps, but the engines used are the same.

Choose a convenient place at the aft deck and lash down the pump unit.

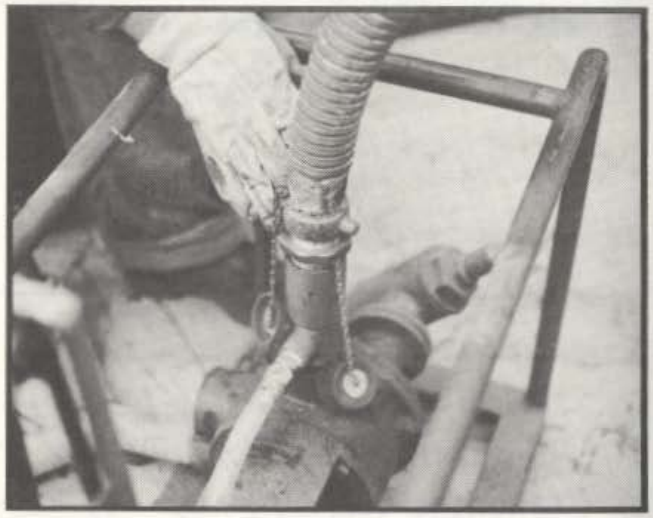
If you are using barrels, stow the barrels of dispersant near the pump unit. Make sure all the bungs are on top.

Fit the dispersant intake hose to the outlet if your vessel has large tanks, or to the first barrel.

Fill the fuel tank with diesel oil.

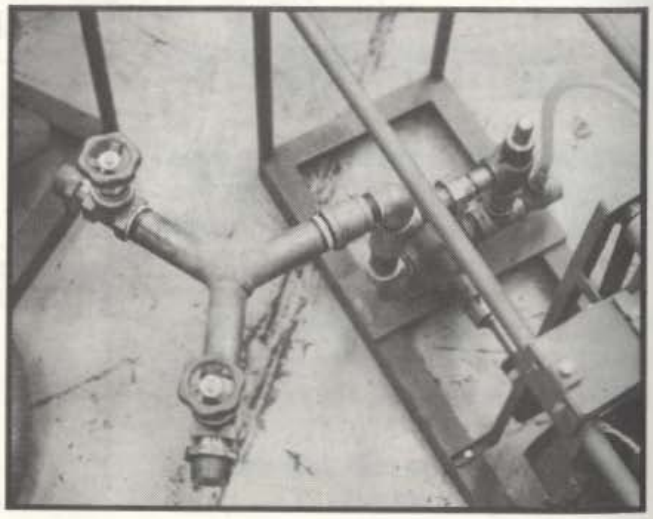


Connect the sea water intake hose to the pump and to a sea water outlet.



Fit the Y-piece to the outlet.

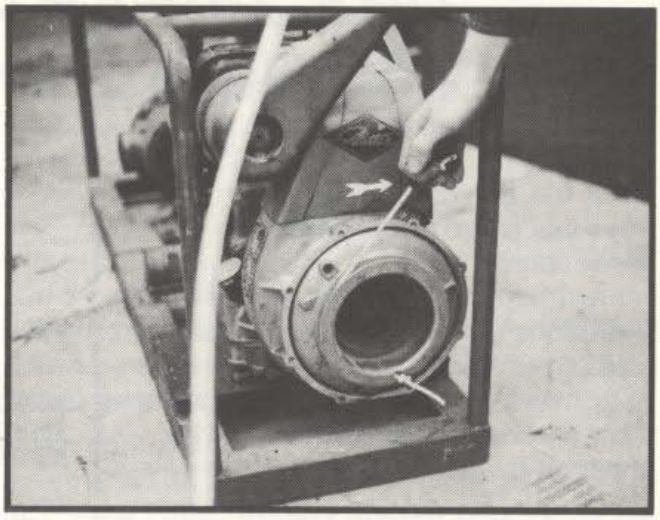
Screw the hoses from the booms into the ends of the Y-piece.



Set the throttle to midway.

Start the engine with the cord. (Use a little Quickstart in cold weather).

The throttle is pre-set. Do not try to adjust the engine speed.



You do not have to stop the pump to change barrels. Just pull out the hose and put it into a new barrel.

Large slicks in the open sea are usually sprayed by going around the edge and gradually working inward. You need to keep the spray going continuously.

If the slick is near shore, the vessel will go back and forth parallel to the shore. In this case, you should stop dispersant spray as the vessel goes out of the slick to go about.

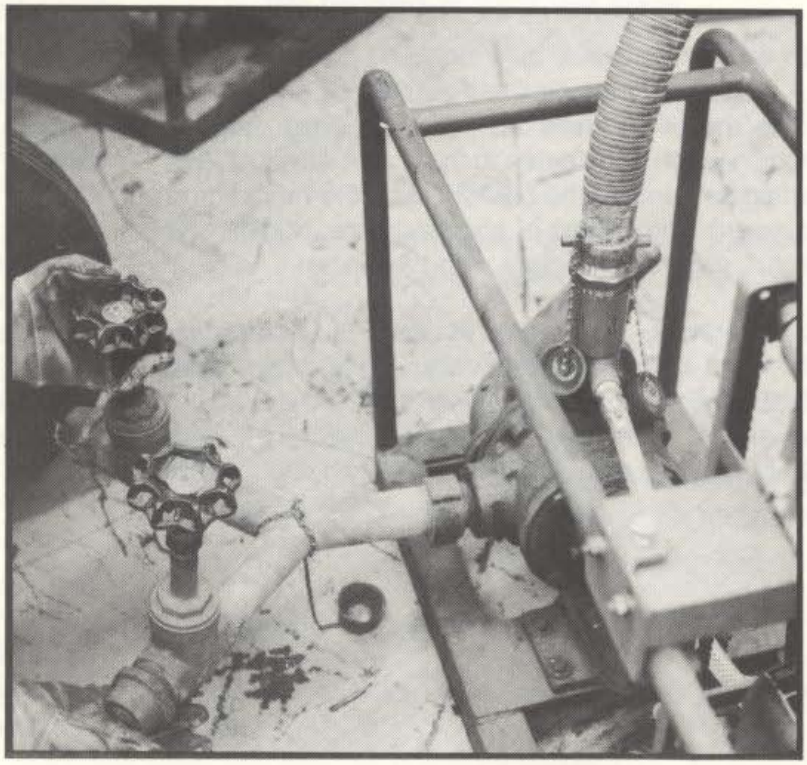
To stop dispersant spraying, shut off the valve on the intake, or just pull off the suction pipe out of the barrel. There will still be spray, but it will only be sea water.

To begin the dispersant again, put the suction pipe back into the barrel, or open the valve.

If the spill is heavy oil — bunker or crude oil — and the weather is cold, you might have to close off one outlet valve on the pump. This way twice as much dispersant is sprayed on one side only. Do not do this unless you are instructed.

This is the only control you can use.

Do not spray with either outlet valve part-closed. Only **both open** or **one open, one closed**, for special conditions as said before.



5. RECOVERING THE SURFACE BREAKER BOARDS.

The vessel should heave to.

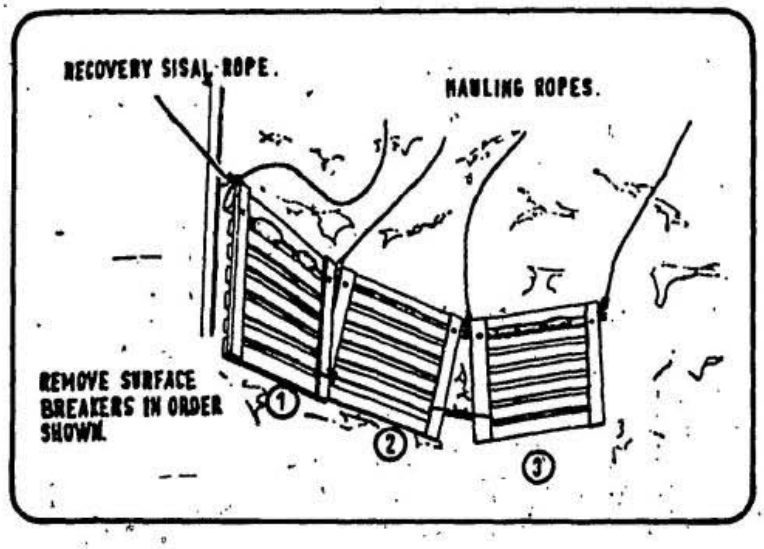
Haul the boards alongside with the rope that is tied to the gimbal and the inner board.

Spread a large tarpaulin over the deck.

Haul the boards in over the rail and lay them on the tarpaulin.

Slack off the sisal rope at the stern.

Swing the boom forward and bring inboard with the slack of the forward ropes.



DISPERSANT CHEMICALS

A dispersant chemical is a substance which enables the oil to break up into very small droplets which will then disperse in the water. Although this does not remove the oil, it reduces fire hazard and prevents the fouling of shores, boats, wildlife and other objects in contact with the water.

Although the dispersants in use in the late sixties seemed to do more harm than good, much work has gone into their improvement since then. Those available today are claimed to be much less harmful to marine life. This is greatly helped by the proper application of measured amounts, which ensures the maximum dispersal with a minimum of harm.

Modern dispersants are quite complex mixtures, and what the actual ingredients are is not particularly important. The regulations covering their use are quite strict. The exact product to be used in an incident, how it is applied and in what amounts would be decided by the On-Scene Commander, in consultation with advisors.

10: SHORELINE CLEANUP, AND DISPOSAL OF OIL & DEBRIS

OIL ON THE SHORELINE

1. Rocky Shores and Cliffs

The action taken on rocky shores depends on how active the water is. If large waves are common, then probably nature would be left to deal with the oil. If action is necessary, the following sequence could be followed:

(i) Boom off a section of the shore. Sections about 100 ft. long are suggested. Spread sorbent material below the rocks.

(ii) Wash loose oil off with low pressure water hoses.

(iii) If permitted, spray on concentrated oil-based dispersant.

(iv) Wash down with high pressure water or steam hoses or 3% water-base dispersant with high-pressure water hose. You must wear protective clothing and glasses.

(v) Remove the used sorbent and dispose, then remove the boom to another section.

2. Beaches

If protection from spilled oil is too late or is unsuccessful, the beach must be cleaned. This normally involves the use of earth moving equipment. If the beach is accessible, this would usually be graders or backhoes, possibly fitted with balloon tyres on soft sand. On inaccessible beaches, you may have to use rakes and shovels.

The sand or gravel must be removed as deep as the oil penetrates. This can be as little as an inch or as much as a foot. This is best done when the threat of further oil coming ashore is over, even if it means a little more sand has to be removed.

On some beaches, at certain times of the year, the beach may need to have its material replaced if much is removed. This can be done with the same equipment used to remove the oiled sand.

3. Tidal Flats, Marshy Shores and Estuaries

These are frequently the most easily damaged shore types, as many creatures and plants live there, and the water is usually quiet, and covers a large area with the incoming tide.

The cleanup of these shores normally follows this procedure:

(i) Use low pressure hoses to wash loose oil into boomed containment areas.

(ii) Spread sorbents over this oil, allow the oil to sink in, then remove and dispose.

(iii) Either

- leave to nature, or
- cut and remove plants and grasses, and remove contaminated mud and sand, or
- pull up plants and grasses by their roots, and remove contaminated mud and sand.

Which action is best depends on many circumstances, and the decision would be taken by the controllers of the operation.

4. Harbour Facilities

These are cleaned up in the same way as rocky shores.

OIL ON BOATS AND FISHING GEAR

The main requirement here is to prevent the oil from getting back into the water. Cleaning usually would involve the use of dispersant chemicals, and so must be done in a permitted area.

Small Items, Fishing Gear and Small Boats Pulled Ashore

These would normally be cleaned by washing with dispersants and water in a suitable spot ashore where runoff can be collected. Runoff must **not be** allowed into drainage systems, rivers, ponds, bare soil, beaches, or the sea.

Larger Boats

These would normally be cleaned in port, in the same way as rocky shores.

DISPOSAL OF COLLECTED OIL

There are four ways of disposing of collected oil, all of which require outside consultation and assistance.

Re-refining

Oil picked up from the sea, in large quantities, can be taken to a refinery which will process it. This is the best way to dispose of collected oil.

Burning and Burial

These are possible, but require government permission and supervision. However, they are the most likely methods for unrefinable oil and for oily debris.

"Landfarming"

Bacteria in soil can break down oil which is ploughed in. This also would be under government control.

CONCLUSION

The main factors influencing oilspill cleanup operations in cold ocean conditions are the weather and ice which can affect the efficiency of the techniques used in a variety of ways, from creating a mild hindrance to making it impossible to contain and recover the oil with the present technology. Ice can also be helpful in certain conditions by keeping oilspills away from the shoreline.

WIND

Oil on surface of water moves at about 3% of the wind speed. So in a 30 knot wind, the oil will move at about 1 knot. This does not seem very fast, but it is about the limit to which most booms will contain oil. If the oil moves against the boom at much more than 1 knot, some will escape by running underneath the boom. Making the boom deeper does not improve the situation very much.

In the open sea this does not matter, because the boom can also be allowed to move with the wind, and so the real speed of the oil against the boom will be less than 1 knot. However, if the oil is near shore in a strong onshore wind, booms cannot keep all the oil off the shoreline, although they still stop quite a lot.

Another way to get around the problem in harbours or near shore is to use booms to guide the oil rather than trap it, as detailed in the Nearshore Operations section. This can be very effective, not only in high winds, but also in high-current areas.

Strangely enough, winds can be helpful in some circumstances. When dangerous oil products such as gasoline are spilled, winds speed up the evaporation of the spill, and also blow away the explosive vapors. This also applies to spills of crude oil too, and so make it safe earlier to recover the heavier fractions of the crude oil which do not evaporate.

WAVES

Heavy seas also hamper oilspill countermeasures. The effectiveness of booms is reduced by oil splashing over the top although this is lessened by the calming effect of oil on the water. The other major problem is that the efficiency of most skimmers now available is very much affected by waves. Most inshore skimmers will be ineffective in waves over 3 ft. The offshore skimmers such as the FRAMO are generally effective in swell up to about eight feet, although they will work in much higher swells if the waves are very long.

TEMPERATURE

The effects of temperature depend very much on the type of oil spilled. For light oils and gasoline-type products, the temperature is not very important. However, with crude oils and Bunker C it is a different story. This is because their "pour point", the lowest temperature at which they can be pumped effectively is often above the range of temperatures found in the environment. The pour points of Bunker C and crude oils can be up to 30°C. At temperatures below the pour point, disc and suction skimmers, and sorbent materials are ineffective. The Slicklicker will recover oil under these conditions, but it is unsuited for offshore work. This is one field where research and development in technology and techniques is needed.

ICE

Whilst icebergs may pose a greater hazard to offshore oil exploration and production, and to general marine activity, pack ice is a more serious problem in the event of a spill. As of 1980, there are no procedures nor any equipment available which

can recover or dispose of oil under pack ice or mixed in with broken ice. Research is being done to discover ways to deal with these problems, which should be found before large-scale production from arctic and northern oceans is begun. The Canadian Government's Arctic Marine Oilspill Program is one part of this research activity.

The Labrador Sea presents one of the harshest marine environments in the world. In the event of an oilspill or blowout the cleanup operations will demand skill, ingenuity and sheer endurance. Some of the best equipment available is now located in St. John's; the development of better, ice compatible equipment is underway. Regardless of the capabilities of the hardware available, the ultimate success or failure of a cleanup operation will depend upon the skill of the operators. OCTU's training program is intended to provide you with a technical background and equipment familiarity which will help you to meet that challenge.

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