Transport Canada
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Termpol Review Process 2001

Marine Safety

Canada

FOREWORD

An interdepartmental committee reviewing marine pollution issues identified the need for a means of precisely and reliably measuring the navigational risks associated with the location and operation of marine terminals for large oil tankers. The objectives set by that committee led to the publication, in 1977, of the first edition of the TERMPOL Code. This publication was made possible with the cooperation, expertise and editorial assistance of representatives from the Departments of the Environment, Fisheries and Oceans, Transport, and Public Works. Representatives from other departments and agencies as well as elements of the marine industry also contributed to the content of the Code.

In 1982, following the successful conclusion of a number of TERMPOL assessments, an interdepartmental committee concluded that a second edition of the TERMPOL Code should be produced and that its applicability should be expanded to include, on a voluntary basis, proposals for marine terminals designed to handle bulk shipments of liquefied natural gas (LNG), liquefied petroleum gas (LPG), and chemicals. The production of the second edition was also made possible by the continued cooperation and the technical expertise of representatives of the listed departments.

In 1995 the Canadian *Environmental Assessment Act* entered into force making parts of the existing Code irrelevant to respond fully to the requirements of the new Act. The same year, the Canadian Coast Guard joined the Department of Fisheries and Oceans (DFO) and in 1999 it was decided that navigation assessments under the Navigable Waters Protection Act (NWPA) would be made by the Department according to the newly developed codes.

After considering different avenues Transport Canada Marine Safety has now decided to issue a third edition, for the guidance of proponents, covering operational safety aspects of dedicated ships transporting pollutants or hazardous cargoes in bulk.

Although highly technical in nature, we hope it will be useful for those studying the prospects of a new trade in Canadian waters.

Bud Streeter
Director General
Transport Canada
Marine Safety

TERMPOL
REVIEW PROCESS

Termpol Review Process: Definitions and Acronyms

Definitions:

DESIGN SHIP:	The marine carrier's prototype that the proponent intends to use to ship cargo of the nature contemplated by the TERMPOL Review Process, including, *inter alia* bulk oil, chemicals, liquefied gas, or any other cargo identified by Transport Canada - Marine Safety as posing a risk to a ship, its crew, the public or the environment; or the prototype of the ship contemplated to use the proponent's proposed cargo transshipment facilities.
ENVIRONMENT:	The components of the Earth and includes: - a) air, land and water; b) all layers of the atmosphere; c) all organic and inorganic matter and living organisms; and d) the interacting natural systems that include components referred to in paragraphs (a) to (c).
MARINE TRAFFIC NETWORK:	A network of marine traffic that comprises various types of vessels engaged in different operations that utilize the various waterways that provide access to and from marine terminals or transshipment sites located in waters under Canadian jurisdiction.
PROJECT:	For purposes of environmental impact assessment, a physical work that a proponent proposes to construct, operate, modify, recommission, abandon, or otherwise carry out, or a physical activity that a proponent proposes to undertake or otherwise carry out.
RESPONSIBLE AUTHORITY:	A federal authority required to ensure that an environmental assessment of the proposed project is conducted.
WATERS UNDER CANADIAN JURISDICTION	All internal waters of Canada, the territorial sea of Canada and waters in the exclusive economic zone of Canada, including the shipping safety control zones prescribed pursuant to the *Arctic Waters Pollution Prevention Act.*

Acronyms

ARPA	Automatic Radar Plotting Aid
CCG	Canadian Coast Guard
CEAA	*Canadian Environmental Assessment Act*
DFO	Department of Fisheries and Oceans
I.M.O.	International Maritime Organisation
L.B.P.	Length Between Perpendiculars
L.O.A.	Length Overall
LNG	Liquefied Natural Gas
LPG	Liquefied Petroleum Gas
NWPA	*Navigable Waters Protection Act*
OCIMF	Oil Companies International Marine Forum
SPM	Single Point Mooring
TCMS	Transport Canada - Marine Safety
TOM	Terminal / Transshipment Site Operations Manual
TRC	TERMPOL Review Committee
TRP	TERMPOL Review Process
TRR	TERMPOL Review Report
UHF	Ultra High Frequency
VHF	Very High Frequency

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PART 1

APPLICATION AND INTENT OF THE TERMPOL REVIEW PROCESS

PART 1
1 APPLICATION AND INTENT OF THE TERMPOL REVIEW PROCESS

1.1 INTRODUCTION

1.1.1 "TERMPOL Review Process (TRP)" refers to the Technical Review Process of Marine Terminal Systems and Transshipment Sites". The TRP focuses on a dedicated design ship's selected route in waters under Canadian jurisdiction to its berth at a proposed marine terminal or transshipment site and, specifically, to the process of cargo handling between vessels, or off-loading from ship to shore or vice-versa. The TRP applies to:

- the specialized equipment and procedures necessary at proposed bulk oil, chemical, liquefied gas terminals and any other cargoes which may be identified by Transport Canada, Marine Safety (TCMS);
- proposed transshipment facilities for these substances; and
- any proposed changes to existing terminals or designated transshipment sites or facilities for these substances.

1.1.2 A marine terminal system is arbitrarily defined in the TRP to mean the ship's berth, its approaches from seaward and related port or terminal infrastructures. A transshipment site is defined in the TRP to mean a designated location for the transfer of cargo between vessels, including bulk oil, chemicals, liquefied gases and any other cargoes which may be identified by the TCMS as posing a risk to the ship, public or environmental safety.

1.1.3 The intent of the TRP is to ameliorate, where possible, those elements of a proposal which could, in certain circumstances, threaten the integrity of the ship's hull and its cargo containment system and, consequently, the environment in the vicinity of the design ship while it is navigating in waters under Canadian Jurisdiction. The TRP also applies the same considerations to cargo transfer operations both alongside the proposed terminal and at any designated transshipment site. The TRP applies to operational safety measures intended to address site-specific circumstances and those along the associated navigational route(s).

1.1.4 In conducting a TEMPOL Review, it is necessary that the proponent's submission demonstrates that:

- the operator's or owner's safety management system is in accordance with recognized safe management procedures;
- arrangements are planned to conduct on-going operational audits of the safety and management system;
- major accident hazard in the context of the proposed operation have been identified; and
- the risks therefrom have been evaluated and measures taken to reduce those risks to an acceptable level using the best available technology.

1.2 TRP EXCLUSIONS AND OVERLAPS

1.2.1 The TRP is not intended to assess the terminal's land based shore installations, hinterland cargo handling or storage facilities. Nevertheless, the TRP addresses several specific "terrestrial"

1.2.2 aspects such as the terminal wharf structure, mooring specifications and instrumentation, and those aspects of the terminal's operation and associated contingency planning that are applicable to the design ships using the terminal. This inclusion of terrestrial elements in the vicinity of the berth is minimal, but necessary from the perspective of inter-dependent safety aspects.

1.2.3 The TRP does not prescribe detailed standards for the siting, design, construction, and operation of marine terminal and transportation systems. Nor does the TRP replace, or necessarily satisfy the requirements of an environmental impact assessment process under the *Canadian Environmental Assessment Act* (CEAA) or navigation impact assessment under the *Navigable Water Protection Act* (NWPA). The TRP, however, may contribute to the fulfillment of the first stage of the federal environmental assessment process. Appropriate agencies should be consulted in this regard.

1.3 RATIONALE FOR THE TRP

1.3.1 The construction and subsequent operation of a new, modified, or recommissioned marine terminal system for oil, chemicals, liquefied gases, or any other identified substance, or of a new, modified, or recommissioned transshipment site, would introduce changes in regional shipping activity. Such developments may also pose a threat to the environment or to the safety of the communities along the proposed route(s) to and from the terminal or transshipment site. A TRP requires consideration be given to a range of subject matters such as, but not limited to:

- the potential effects of increased shipping activity on existing regional shipping networks and fishing ground activities;
- the perceived environmental concerns attributable to pollutant cargoes carried by the additional ships;
- perceived risks to communities along the route to the terminal or transshipment site in the case of ships carrying commodities such as, but not limited to, those considered in this document which may pose a concern to public safety or health;
- the navigational safety of the ship route(s) leading to a proposed new, modified, or recommissioned marine terminal or transshipment site;
- the level of services required to facilitate safe navigation such as fixed and floating aids, vessel traffic services, offshore electronic position fixing systems, requirements for pilotage and radiocommunications along the ship route(s);
- the suitability of the design ship;
- the design ship's manoeuvring characteristics, navigational and radiocommunications equipment, its cargo containment and handling systems in terms of operational safety;
- the adequacy of the design ship's berth and related terminal service requirements;
- pollution prevention programs; and
- marine contingency planning and related emergency counter-measures.

1.4 STATUS OF THE TRP

1.4.1 The TRP is not a regulatory instrument. Its provisions, therefore are not mandatory. The TRP's criteria, however, are used by TCMS in determining the need for making or revising specific regulations, or for implementing special precautionary measures that may affect a ship's operation within a particular marine terminal system or transshipment site.

1.4.2 Any report issued by a TERMPOL Review Committee (TRP) should neither be interpreted as a statement of government policy, nor should it be inferred that the government endorses the report in whole, or in part. The report reflects only the judgments of the departmental representatives who reviewed the proposal and prepared the report. Consequently, the conclusions and recommendations presented in a TERMPOL report are not binding on any department, agency, group or individual. Implementation of any recommendation, however, is the prerogative of applicable departmental executives performing regulatory functions or of the proponent, as appropriate.

1.4.3 Fisheries and Oceans Canada will ensure the safe and environmentally responsible use of Canada's waters, support understanding and management of oceans resources, facilitate the use of Canadian waters for shipping, recreation and fishing, and provide marine expertise in support of Canada's domestic and international interests.

Transport Canada Marine Safety is responsible for the administration of national and international laws designed to ensure the safe operation, navigation, design and maintenance of ships, protection of life and property and prevention of ship source pollution.

It must be understood, however, that DFO CCG and TCMS regulatory roles are separate and distinct from their roles in the TRP which is essentially a data and operational review process. The conclusions and recommendations contained in a TERMPOL report do not relieve a proponent from an obligation to fully comply with all applicable legislative and regulatory requirements promulgated, and as amended from time to time, by the various federal and provincial statutes and regulations which apply to shipping safety and to the protection of the environment. These Acts include but are not limited to:

- the *Canada Shipping Act*;
- the *Navigable Waters Protection Act*;
- the *Arctic Waters Protection Act*;
- the *Canadian Environmental Protection Act*;
- the *Canadian Environmental Assessment Act*;
- the *Transportation of Dangerous Goods Act*;
- the *Fisheries Act*;
- the *Oceans Act; and*
- the *Canada Marine Act.*

1.4.4 The purpose of the TRP is to objectively appraise operational ship safety, route safety, management and environmental concerns associated with the location, construction and subsequent operation of a marine terminal system for the bulk handling of oil, chemicals, liquefied gases or other cargoes identified by TCMS, or of the designation and subsequent operation of any transshipment site for these or other substances which may pose a risk to public safety or the environment. Such an appraisal, using the procedures and methodologies described in the TRP, enables an inter-departmental committee to identify potential problems and to recommend appropriate ameliorative measures.

1.4.5 TCMS publishes and coordinates the TRP. Each participating department involved in the review is individually responsible for its contributions and recommendations within its own particular area of expertise and responsibility.

1.4.6 An integral part of the TRP is to aid in the development of operationally safe marine transportation systems in waters under Canadian jurisdiction.

1.5 PROPONENT'S PARTICIPATION

1.5.1 The success of the TRP depends largely upon the proponent's adherence to the procedures described in the TRP, and the quality of the data submitted to the Committee conducting the review. The TRC is not necessarily limited to the data supplied by the proponent because departmental databases or other sources of information may enable the TRC to verify much of the substance of the proponent's submission and to identify potential problems. Through this cooperative "one window" procedure, the proponent and the department(s) can conduct an informed and comprehensive review of a particular proposal and ascertain, objectively, those measures which will improve the safe navigation and operation of the design ship in waters under Canadian jurisdiction and ameliorate environmental concerns at an early stage of a proposed project.

1.6 INITIATION OF THE TERMPOL REVIEW PROCESS

1.6.1 The TRP would be initiated by the proponent addressing a request for review, in writing, to TCMS as a complement to the requirements of NWPA process.

The CCG administers NWPA. The purpose of the NWPA is to protect the public right of navigation by prohibiting the building or placement of any work in, upon, over, under, through, or across a navigable waterway without the approval of the Minister of Fisheries and Oceans.

1.6.2 The proponent's project manager and other representatives are encouraged to informally discuss all relevant subject matters relating to a TRP submission with representatives of the department(s) listed in Section 2.1 as soon as designated. This recommended procedure ensures:

- a clear understanding of the review process;
- identifies data available to the proponent from departmental sources; and
- enables the proponent's representatives to determine the scope and depth of the data required.

(See Figure 1, "Responsibilities of the TERMPOL Review Committee (TRC)")

1.6.3 After the proponent formally requests a review under the TRP, the Director General (AMS) of TCMS appoints a chairperson who convenes a TRC comprising representatives from all departments or agencies with expertise or responsibilities relevant to the project.

1.6.4 The TRC and the proponent's representatives should meet soon after the Committee is convened in order to:

- agree on the scope, and format of the studies and surveys required from the proponent;

- establish administrative lines of communication between the TRC and the proponent's representatives;
- agree on a schedule of periodic progress meetings with the proponent's representatives; and
- inform the proponent's representatives of federal databases and other information resources available to them.

1.6.5 Twenty five (25) printed copies of the proponent's submission will be required as well as floppy disks using current word processing software, IBM compatible. The submission should be sent to:

Director General
Marine Safety
Transport Canada
Tower C, Place de Ville
Sparks Street 11th floor
Ottawa, Ontario
K1A 0N8
Tel.: (613) 998-0610
Fax: (613) 954-1032

Alternatively, if the TRC is based in a Region, the submission could be sent to the Regional Director Transport Canada, Marine Safety.

1.6.6 During the TRP, the Committee may identify information gaps, or it may require amplification of data provided by the proponent. Requests of this nature will be directed to the proponent's representatives using the administrative procedure agreed upon during the initial meeting.

1.6.7 The proponent's submission, or submissions, will be treated as "industrially confidential" information if required for the duration of the review. The information will be available to the public only after the release of the TERMPOL Review Report (TRR).

1.6.8 The composition and operation of the TRC is described in greater detail in Part 2 of the TRP. Part 3 of the TRP describes the various surveys and studies which may be required in the TRR.

STAGE	ACTIVITY
1 TERMPOL Review Committee (TRC) constituted.	1.1 Initial review of proposed project outline.
	1.2 Initial discussion of surveys and studies required.
	1.3 Identify departmental resources available.
2. TRC meets with proponent/proponent's representatives.	2.1 Agree on scope and depth of surveys and studies required.
	2.2 Inform proponent / proponent's representatives of departmental information resources available.
	2.3 Agree on format of proponent's submission.
	2.4 Establish administrative lines of communication.
	2.5 Agree on schedule of progress meetings (if necessary).
3. TRC Chairperson receives proponent's submission.	3.1 Proponent's submission distributed to TRC.
4. TRC begins review process.	4.1 TRC identifies need for additional information or amplification of information provided.
	4.2 TRC meets with proponent's representatives (if necessary).
	4.3 TRC may seek expert advice on matters raised in proponent's submission.
5. TRC submits report to TCMS - AMS	5.1 AMS approves TRC Report with authorities from other departments.
6. AMS forwards report to Proponent.	

Figure 1: Responsibilities of the TERMPOL Review Committee (TRC)

PART 2

TERMPOL REVIEW COMMITTEE (TRC)

PART 2
2 TERMPOL REVIEW COMMITTEE (TRC)

2.1 INTRODUCTION

2.1.1 The TRC may include representatives from the following directorates of the CCG, Fisheries and Oceans Canada Marine Program Management and TCMS:

- Marine Communications and Traffic Services;
- Marine Navigation System (*Navigable Waters Protection Act)*;
- Icebreaking;
- Environmental Response System (SERS);
- Sounding and Dredging; and
- Marine Safety.

2.1.2 Depending on the geographical location of the proposed marine terminal system or transshipment site and the nature of the cargo, it may be appropriate to invite representatives of other federal or provincial departments, agencies or specialized consultants to participate on the TRC. These may include:

- Environment Canada;
- Public Works Canada;
- Natural Resources Canada;
- Atomic Energy Control Board;
- Indian and Northern Affairs Canada for projects proposed for the Arctic region, or other areas of aboriginal interests;
- Canada Ports Corporation when the proposed project is located in an existing harbour administered by these authorities;
- St. Lawrence Seaway Management Corporation when the proposed terminal is located within the Seaway region;
- appropriate regional Pilotage Authority;
- provincial Department of the Environment; or
- any other department, agency, organization or specialized consultants depending on the circumstances under consideration.

2.1.3 When public safety is perceived to be an issue it may be appropriate to include representatives from provincial departments or agencies such as emergency measures organizations.

2.1.4 Since sailing to the Great Lakes and entering certain ports on the West Coast involves passing through United States waters, US regulations will apply in that leg of the voyage. The proponent should contact US Coast Guard for any additional requirements that may affect the transit of his vessels while in US waters at the following addresses:

Ninth US Coast Guard District
Marine Safety Division
1240 East Ninth Street
Cleveland Ohio USA 44199-2060
Tel.: (216) 902-6045
Fax: (216) 902-6059

Thirteenth US Coast Guard District
Marine Safety Division
915 Second Avenue Room 3506
Seattle, Washington USA 98174
Tel.: (206) 220-7210
Fax: (206) 220-7225

2.2 CHAIRPERSON - TERMPOL REVIEW COMMITTEE

2.2.1 The Chairperson of a TRC is normally selected by TCMS Director General. If the TRC is based within one of the Transport Canada regions, then the Regional Director General of that region would assist the Director General in selecting the chairperson. The chairperson would be concerned with:

- the nature of the proposal;
- the provisions of the review process;
- the constitution of the Committee; and
- the administration of the review process.

The Chairperson is normally assisted by a committee secretary provided by TCMS. The remaining members of the TRC are selected by the executives of the appropriate participating departments or agencies as determined with reference to the project proposal.

2.2.2 When a regional representative is the chairperson, one or more representatives from TCMS Headquarters or from other relevant departments may, at the request of the chairperson, assist in the review process relating to the technical subjects under consideration. These may include, but are not limited to:

- dedicated ship design and operations;
- statistical inference techniques;
- marine operations research;
- marine traffic analysis;
- special ship inspection and approval procedures authorized by the Board of Steamship Inspection;
- marine aspects of port operations;
- pollution prevention and planning; and
- contingency planning.

2.3 COMMITTEE RESPONSIBILITY

2.3.1 The TRC carries out the review of the project proposal. The primary responsibilities of the members of the TRC are to:

- review the project proposal submitted by the proponent;
- determine if there are information gaps or areas requiring amplification and request any supplementary information that may be required from the proponent;

- advise the TRC chairperson in the various departmental perspectives and, when applicable, departmental policies relating to the TRP;
- assist the TRC chairperson in producing such reports as required, either interim or the final Executive Summary; and
- inform their respective departments or agencies on the review process.

2.3.2 Although the TRC will develop the list of reports required for each Review with reference to the specifics of the proposed project, the topic areas in which reports are normally required are:

- ship design and operation;
- navigational and physical characteristics of the approaches to the terminal;
- terminal design and infrastructure;
- environmental impact;
- risk and accident analysis along the transit route and at the terminal and related mitigating measures;
- pollution prevention program; and
- contingency plan(s).

2.4 RECAPITULATION

2.4.1 The success of the TRP will depend to a large extent on the proponent's submissions. These will vary greatly according to the nature and size of the proposed project. Is it a marine terminal to serve oil tankers, bulk chemical carriers, or liquefied gas carriers? Is it a transshipment site intended to facilitate the transport of products through the St. Lawrence Seaway? Is it a new installation intended to handle large quantities of cargo in an environmentally sensitive area with severe weather conditions? Is it a minor modification to an existing facility with an excellent environmental safety record? Each review process will be designed to address the particular circumstances of the project under consideration.

2.4.2 This dependence on the proponent is recognized. The TRC may, however, also use the resources of the various departments represented on the Committee to augment their knowledge base and to comment on the proponent's submission.

2.4.3 The data that may be required by the TRC could include, but not necessarily be limited to, the following:

- the proposed project's sea transportation profile;
- the design ship's operation characteristics;
- the design ship's cargo containment characteristics;
- the coastal network analysis;
- coastal, climatic and oceanographic data in terms of their effects on ship navigation and terminal operations;
- an analysis of the safety of the route selected by the proponent through waters under Canadian jurisdiction;
- the proponent's accident survey and ship casualty analysis;
- analysis of the safety of ship operations within the ship terminal zone including berthing facilities;

- the proponent's risk and consequences analysis including proposals for mitigating risks and providing counter-measures;
- any other perceived environmental impacts of the proponent's proposal; and
- proposed prevention, mitigation, contingency and restoration measures.

2.5 COMMITTEE REPORT

2.5.1 The format, substance, and number of copies of the final report is left to the discretion of the TRC.

2.5.2 On completion of the TRP, a report is normally submitted by the TRC to the Director General of TCMS and to representatives of the participating departments or agencies. This report will usually take the following form:

- an Executive Summary stating interdepartmental participation, conclusions and recommendations; and
- reports on specific topics that have been identified as necessary to the review and prepared as part of the TRP.

2.5.3 The TERMPOL Report prepared by the Committee is reviewed and approved by the senior managers of all the participating departments and agencies before it is forwarded to the proponent.

2.5.4 Copies of the final report along with the Executive Summary comprising the TRC's conclusions and recommendations are forwarded to the participating department's libraries after they have been released by the senior managers of the respective departments.

PART 3

TERMPOL SURVEYS AND STUDIES

PART 3
3 TERMPOL SURVEYS AND STUDIES

3.1 INTRODUCTION

3.1.1 In order to develop optimally safe vessel operational criteria and a pollution prevention program, the planning of a new or modified marine terminal, or establishment of a transshipment site, to serve oil tankers, liquefied gas, or chemical carriers requires the compilation and analysis of diverse data sets. The presentation of the material should be in a form that can be readily used by the TRC.

3.1.2 The selection of appropriate risk assessment models is dependent on the nature of the project and the characteristics of the marine terminal location or transshipment site and, since the TRC normally accepts the data produced and the conclusions drawn from the studies developed, the proponent is encouraged to discuss the selection of models with the TRC. In some circumstances it may be necessary for a proponent to compile primary data, rather than relying on existing information, on a specific topic in relation to the site identified.

The statistical and other data sets necessary for the studies and surveys identified in this Part may be obtained by the proponent from a number of sources, some of which are identified in the respective sections. Proponents are requested to use their own judgment in selecting sources of required data and the best application of that data while keeping in mind that the TRC may request additional information on any topic.

3.1.3 The proponent is encouraged to establish early informal contact with the TCMS and relevant federal departments or agencies in order to gain access to pertinent environmental data and advice. The applicable surveys, studies and technical data, which are amplified in the sections that follow include:

- Origin, Destination and Marine Traffic Volume Survey;
- Fishing Vessel Operations Survey;
- Offshore Exercise and Offshore Exploration and Exploitation Activities Survey;
- Route Analysis, Approach Characteristics and Navigability Survey;
- Special Underkeel Clearance Survey;
- Transit Time and Delay Survey;
- Casualty Data Survey;
- Ship Specifications;
- Site Plans and Technical Data;
- Cargo Transfer and Transshipment Systems;
- Channel, Manoeuvring and Anchorage Elements;
- Berth Procedures and Provisions;
- Single Point Mooring Provisions and Procedures;
- General Risk Analysis and Intended Methods of Reducing Risks;
- Port Information Book;
- Terminal Operations Manual;
- Contingency Planning; and
- Oil Handling Facilities Requirements.

3.2 ORIGIN, DESTINATION AND MARINE TRAFFIC VOLUME SURVEY

3.2.1 The objectives of this survey are to quantify and describe all recreational, commercial and any other traffic movement that collectively form the regional marine traffic network. For this survey the proponent is to identify:

- particulars of the types and sizes of ships operating in the region, particularly those likely to be encountered by the design ship en route to and from the proposed terminal or transshipment site;
- variations in traffic density statistics including those projected as a result of the proponent's vessels;
- special operational area (naval and airborne exercise areas, offshore exploration and exploitation activities and seaplane activities);
- network focal point, or nodes, which indicate the geographical locations where close-quarter situations are likely to occur and, particularly, where there is crossing traffic;
- major fishing grounds and the periods they are used by fishermen, pertinent data concerning species including spawning times and locations;
- major traffic routes including seasonal variations attributable to climatic influences or other causes;
- sensitive biological and human environments along or adjacent to the proposed routes, identifying sensitive species habitats, ecosystems, or other human or biotic environments that may be particularly vulnerable to contamination; and
- possible alternative routes for the design ship in light of the above information and assessment of the experience of similar ships travelling in the same or similar areas.

3.2.2 Possible sources of statistical data include the Coast Guard's Marine Communications and Traffic Services records, the Department of Fisheries and Oceans, the Canada Ports Corporation, Harbour and Ports Directorates, Statistics Canada, ferry schedules, and consultants reports. Sources of data pertinent to the marine, terrestrial and human environments may include the federal, provincial and municipal departments and agencies with environmental and land-use mandates.

3.2.3 From this Survey the proponent may determine which of the possible shipping routes offers the optimum navigational and operational safety and poses the least threat to the human and biotic environment in relation to any potential pollution incident.

3.2.4 A marine traffic network consists of one or more finite capacity waterways leading to various marine terminals located in coastal zones or inland waters. The flow of traffic within the network may be classified as:

- predictable flows comprising regular or predictable ship transits; and
- unpredictable flows comprising unscheduled or random ship transits.

Statistical counts of regional traffic for a particular coastal region's marine network over specified periods may be available from CCG sources, or from marine consultants. Other marine activities often superimposed on the regional traffic patterns could include:

- seasonal and year-round fishing activities;

- military exercises;
- recreational boating and sailing activities;
- offshore exploration and exploitation activities;
- ferry routes and schedules and
- seaplane activities.

Counts and supplementary data in respect to the above are available from a variety of sources including several federal departments.

3.2.5 The shipping component of the proponent's proposal will add to the observed or estimated ship counts in some of the ship channels and coastal routes within the existing regional network. The additions can be estimated by considering both the proposed annual loading or receiving throughput for the proposed marine terminal, and the mix of design ships in terms of the minimum number of voyages per year required to meet the proposed annual throughput volume. As the proposed marine terminal may either be an importing or an exporting terminal, then the estimated additional ship counts (voyages) should include an estimation of the incremental numbers required to transship cargo to and from the terminal.

3.2.6 All of the considerations noted will apply to any proposed transshipment site with the additional fact that any such designated site may limit the capacity of the waterway to handle traffic flow by reserving a portion of the area for the site.

3.2.7 A local marine traffic survey focuses on the immediate geographical area of the proposed marine terminal. The objectives are to identify:

- particulars of the types and sizes of ships in the area of the terminal;
- particulars of local fishing operations;
- particulars of local recreational and other marine activities; and
- routing traffic support services in the terminal area and approaches.

Possible sources of statistical data include the Coast Guard's Marine Communications and Traffic Services records, port and Harbour Master's records, the Department of Fisheries and Oceans, local marine recreational interests, and consultants reports.

3.3 FISHERY RESOURCES SURVEY

3.3.1 The objectives of this survey are to identify:

- fish and fish habitat including any sensitive marine areas which maybe affected by the project;
- the geographical locations of regional fishing operations;
- the seasonal variations of fishing activities; and
- the customary routes to major fishing grounds from ports used by fishing vessels.

3.3.2 Possible sources of statistical data are Fisheries and Oceans, provincial departments of fisheries, and consultants reports.

3.3.3 Data collected for this survey may be used in conjunction with the Origin, Destination and Marine Traffic Volume Survey.

3.4 OFFSHORE EXERCISE AND OFFSHORE EXPLORATION AND EXPLOITATION ACTIVITIES SURVEY

3.4.1 The objectives of this survey are to identify:

- the geographical locations and frequency of use of military exercise areas involving ships and aircrafts; and
- the geographical locations and frequency of offshore exploration and exploitation and the routes used by offshore supply, seismic and survey vessels.

3.4.2 Data concerning offshore exploration and exploitation activities can be obtained from the companies concerned and Natural Resources Canada.

3.4.3 Data concerning military exercise areas can be obtained from the following sources:

- depictions of exercise areas on nautical charts published by the Canadian Hydrographic Service, Fisheries and Oceans Canada;
- Notice to Mariners No. 2, “Firing Practice and Exercise Areas”, in the annual edition of the Canadian *Notices to Mariners*, published by the CCG; and
- the Director of Maritime Operations and Plans, National Defense Headquarters in Ottawa.

3.4.4 Data collected for this survey may be used in conjunction with the Origin, Destination and Marine Traffic Volume Survey.

3.5 ROUTE ANALYSIS, APPROACH CHARACTERISTICS AND NAVIGABILITY SURVEY

3.5.1 In accordance with the stated intent of the TRP, the objectives of this survey are to assess ship and route safety, the adverse effects of ship accidents and, when applicable, public safety matters associated with the transportation of bulk oil, liquefied gas, chemicals or other identified cargoes in ships that serve the marine terminal system or transshipment site. The Route Analysis, Approach Characteristics and Navigability Survey is therefore a major component of the review. The survey should be considered in terms of the design ship’s applicable characteristics, the physical characteristics of the approach route to the terminal or transshipment site and prevailing atmospheric factors. The components of the survey are:

- to confirm that the loaded design ship can safely navigate the channel, or channels, between the proposed marine terminal or transshipment site and its coastal approaches, or vice versa. (As a rule of thumb the survey should commence at the termination of the ship’s ocean passage, at the first landfall, or seabuoy {inbound} and terminate at the commencement of the ship’s ocean passage {outbound}.)
- to identify hydrographic factors which could adversely affect the safety of the design ship (e.g., tides);
- to identify the suitability, if any, of alternative routes to the proposed marine terminal or transshipment site;

- to identify any climatic or oceanographic factors which adversely affect navigational safety;
- to identify any navigational hazards or ship manoeuvring problems along the route;
- to identify any physical limitations along the route (e.g. bridges, power transmission lines, narrows, bars etc.);
- to identify the need, if any, for proposed improvements to existing aids to navigation or vessel traffic services;
- to identify the need, if any, for escort / assist tugs;
- to identify the coastal communities located close to the intended route;
- to identify the geographical locations of suitable emergency and holding anchorages for the design ship;
- to provide a depicted base of collations with data acquired for the Origin, Destination and Marine Traffic Volume Survey, the Offshore Exercise and Offshore Exploration and Exploitation Activities Survey and the Fishing Vessel Operations Survey; and
- to identify supplemental, but significant, matters such as the geographical location of the pilot station, the regional radiocommunications infrastructure, and any other relevant matters of interest to the proponent or the TRC.

3.5.2 The design ship is required to carry the appropriate charts and nautical publications in accordance with the *Charts and Nautical Publications Regulations*, when navigating in waters under Canadian jurisdiction. A list of the required charts and publications and acceptable equivalents is contained in the annual edition of the Canadian *Notices to Mariners*, published by the CCG. This document is also required to be carried on all vessels entering waters under Canadian jurisdiction.

3.5.3 The design vessel is required to comply with the *Navigating Appliances and Equipment Regulations* when in waters under Canadian jurisdiction. These regulations require vessels to be fitted with specific navigational equipment appropriate to the area in which the vessel is navigating. The proper use of such equipment, as addressed in the *Canadian Watchkeeping Standards*, provides guidelines for the mariner to navigate effectively and safely in all weather conditions, in darkness, and during the oceanic, coastal, and pilotage phases of the voyage thereby ensuring both vessel safety and pollution prevention. This Code or its equivalent is also required to be carried on all vessels entering waters under Canadian jurisdiction.

3.5.4 Data Sources for the Route Analysis, Approach Characteristics and Navigability Survey include:

- applicable nautical charts, published by the Canadian Hydrographic Service, Fisheries and Oceans Canada, as listed in the annual edition of the Canadian *Notices to Mariners* (see section 3.5.2, above), and other required nautical publications also cited therein, including:
    - radio aids to marine navigation,
    - sailing directions,
    - list of lights, buoys and fog signals, and
    - tide and current tables;
- Ocean Sciences and Surveys, Fisheries and Oceans Canada for oceanographic and iceberg data;
- The Atmospheric Environment Service, Environment Canada for climatic data and for data on ice covered waters; and
- Consultants' reports.

3.5.5 The annual edition of the Canadian *Notices to Mariners* provides additional information on various other regulatory initiatives that may affect the safety of the ship.

3.6 SPECIAL UNDERKEEL CLEARANCE SURVEY

3.6.1 The objective of this survey is to consider all relevant factors which may affect underkeel clearance and to ensure that the design ship has an adequate underkeel clearance at all times as outlined in section 3.6.2

3.6.2 Nominally, the design ship's minimum underkeel clearance should be fifteen percent of its maximum permissible draught or meet the requirements established and published by the appropriate government authority for a specific waterway. A proposal for a minimum underkeel clearance in the approach of less than fifteen percent of the design ship's deepest draught will be considered, but the proposal should be supported by explicit operational details and calculations associated with each of the following factors:

- minimum chart datum measurements supplemented with tidal heights over a specified time base;
- the accuracy of predicted tidal heights and the predicted times of high water and low water;
- details of any tidal surges and wind set-up;
- the allowances made for the degree of accuracy in the hydrographic survey (chart datum) and for dredging tolerances;
- the incidence and degree of channel silting between maintenance dredgings and the identification of all critical depth areas;
- the increase in effective draught due to the rolling, pitching, and heaving of the ship under wave action within the ship channel and at the terminal or transshipment site;
- the estimated squat for the design ship calculated for each critical depth area based on the maximum permissible operating ship speed in the area and the most constricted channel section within the critical depth area;
- the effects of sagging or hogging;
- the nominal trim and changes of trim experienced by the design ship;
- draught and trim changes attributed to any changes in water density;
- any climatical and related depth anomalies;
- nature of the bottom;
- allowance for maneuverability in shallow water; and
- an operational plan to ensure safe transit.

3.7 TRANSIT TIME AND DELAY SURVEY

3.7.1 The objective of the "transit time" component of this survey is to determine the safest coastal zone and/or inland waterway speed profile for ships proceeding to and from the proposed marine terminal or transshipment site. The objective of the "delay" component of this survey is to determine the probable causes, locations, durations and the frequencies of delays in the movements of marine traffic through a ship channel or ship channels connecting the coastal approaches and the proposed marine terminal or transshipment site. The methods of ascertaining this information may include:

- conclusions drawn from the Route Analysis, Approach Characteristics and Navigability Survey;
- completing a simulated or actual test run, or runs, using a ship similar to the design ship;
- the use of questionnaires distributed to selected ship masters;
- advice from the applicable Pilotage Authority; and
- data maintained by CCG Marine Communications and Traffic Services.

3.8 CASUALTY DATA SURVEY

3.8.1 As the breaching of a ship's cargo containment system, or hull, is usually attributable to a grounding or a collision, the object of this survey is to develop a means of calculating the likelihood or probability of such an occurrence through the analysis of statistical casualty data within terms of:

- the mathematical probability of casualties in the future taking into account the additional traffic within the regional zone of the proposed marine terminal or transshipment site;
- the inferred vulnerability of the design ship over a specified period of time; and
- the inferred vulnerability of the marine environment or of communities located close to the intended ship route.

3.8.2 Casualty data surveys involving releases of cargo in bulk should not be confined to those attributable to collisions and grounding but should include a listing of small scale incidents and the effects of these releases.

3.8.3 The application of the inferential statistical methodologies is a recommended approach to this survey. Sources of casualty data applicable to this survey include:

- Classification Societies;
- P&I Clubs and underwriters;
- Transportation Safety Board casualty records or summaries;
- U.S. Coast Guard casualty records or summaries;
- I.M.O. summaries;
- CCG Marine Communications and Traffic Services records; and
- consultants reports.

3.9 SHIP SPECIFICATIONS

3.9.1 The objective of this survey is to determine the suitability of the design ship, or when applicable, design ships, selected by the proponent. Plans or technical documents of the design ship(s) should be provided as the TRC is interested in the following particulars and characteristics of the design ship, including but not limited to:

- the L.O.A., L.B.P., breadth, beam and depth;
- the light draughts and air draughts;
- the summer and winter draughts and corresponding deadweight and displacement;
- tonnages - gross and net;
- ship classification and identification of the Classification Society;
- ice class, where applicable, as designated by the responsible Classification Society;

- cargo capacity;
- cargo containment and cargo transfer systems;
- main propulsion system (summary description);
- steering gear arrangements;
- main and auxiliary engine cooling systems;
- de-icing or re-circulation systems;
- ship stability data, both intact and damaged;
- manoeuvring data and information in accordance with IMO standards;
- intended shipboard navigational equipment;
- intended radio and internal communications equipment to be installed; and
- intended crewing and certification standards.

3.9.2 The vessel should comply with all applicable IMO conventions and initiatives, directed at marine safety, marine pollution prevention and atmospheric protection. In addition the vessel is to be certificated to comply with the *Canada Shipping Act* and other relevant Canadian statutes and all applicable marine and regulatory requirements.

3.10 SITE PLANS AND TECHNICAL DATA

3.10.1 The objective of this survey is to provide the proponent with guidelines in respect to the level of detail which should be addressed by site plans and associated development studies.

3.10.2 The following plans, environmental and site studies should be provided by the proponent as part of the TERMPOL submissions:

- overall site plan showing the location of the proposed structures in relation to existing structures and coastal features in the area;
- general arrangement plan with bottom contours of not less than 3 m (10 ft.) showing the proposed location and size of:
  - all structures, floating and fixed;
  - turning basins and other manoeuvring areas;
  - separation between adjacent berths; between vessels and structures and between berths and navigational channels;
  - proposed anchorage areas;
  - existing and proposed submarine pipelines, cable and other underwater installations;
  - description and simulation of the proposed vessel manoeuvring procedures for docking and undocking under normal and maximum operating parameters; and
  - areas to be dredged or filled, volumes involved and type of equipment to be used, type and source of fill, analysis and proposed disposal of dredged spoil;
  - provincial environmental standards may also apply
- plans showing all structural arrangements including dimensions, the proposed type of construction and methods of installation;
- geotechnical data relating to foundation design with a plan showing the location of drill holes and logs;
- wind data based on actual wind speeds recorded in the vicinity of the site, and available in statistical form from Environment Canada’s Atmospheric Environment Service;

- wave data based on the actual wave climate recorded at the site or estimated from the recorded wind data, and available in statistical form from Environment Canada's Atmospheric Environment Service. The data may be presented in the form of wave energy spectra or wave height period parameters and direction at the locations of the berths and proposed structures. Where site specific information is unavailable, regional averages may be sufficient to estimate likely wind and wave patterns. For example, this information may be available in the *Wind and Wave Climate Atlases for the East Coast of Canada, the Gulf of St. Lawrence and the Great Lakes*, commissioned by the Transportation Development Centre (Transport Canada);
- hydrologic survey and simulation showing, among other things, the tide and current data, taking into account variations with depths and direction , to be provided at each berth and its adjacent manoeuvring area, and to include predicted changes in tidal depths and current directions and velocities attributable to the construction of the proposed marine terminal or dredging in the terminal area;
- ice data including:
  - nature, types, coverage and movement of ice;
  - mechanical properties of the ice;
  - predicted ice formation, season and duration at the terminal;
  - average ice thickness; and
  - simulation showing its effect on the terminal structures; and
- water temperatures, including both annual and historical variances.

3.10.3 The proponent should also provide the basic terminal design, operating and safety parameters, including, but not limited to, the following:

- the principal dimensions of the largest and smallest ship to be accommodated at each terminal;
- an analysis and justification of the underkeel clearance and other clearances specified in this TRP, if different from the recommended nominal value;
- design environmental loads, function loads and load combinations for each type of structure and methods of derivation;
- maximum operating parameters assumed in the design, in terms of wind, wave, current and ice conditions beyond which:
  - docking / undocking would not be attempted;
  - cargo transfer operations would cease; and
  - the vessel would vacate the berth;
- all engineering standards, codes and recommended practices, horizontal and vertical datum used in developing the proposal pursuant to this TRP, including the methods of analysis used to process the environmental data and load criteria;
- description of any model testing, field testing or observations carried out to verify the methods or assumptions used in the design;
- interpretation of geotechnical data and allowable foundations loads used;
- design flow rates, pressures, temperatures, and liquid characteristics in different cargo transfer lines and hoses;
- description of the fire protection system;
- description of the electrical power requirements, illumination and location of the power distribution system;
- description of the terminal identification / obstruction lighting;

- description of any docking monitoring system;
- description of any mooring load monitoring system;
- description of the control and instrumentation system, the leak detection alarm system and the emergency shut-down equipment;
- description of instrumentation for monitoring the wind, wave and current conditions;
- description of waste management plan;
- description of the pollution prevention equipment / programs and contingency plans (see page 33) at the terminal or transshipment site;
- description of the operational safety procedures and facilities at the terminal or transshipment site; and
- description of the intended berthing strategy.

3.10.4 The TRC can supply further direction on the matters listed in the above paragraphs concerning the environment and site data studies and plans, to the proponent upon request.

3.11 CARGO TRANSFER AND TRANSSHIPMENT SYSTEMS

3.11.1 The objective of this survey is to assess the suitability of the arrangements for transferring the cargo from ship to shore (or vice versa) or from ship to ship. To this end, the proponent is expected to provide the TRC with plans and descriptions of the design ship's cargo containment and transfer systems including, for purposes of continuity, the important shore components.

3.11.2 The following nominal listing of preferred data is provided for general guidance. The proponent should, however, be guided by applicability and continuity of descriptions:

- general details of cargo pipelines and hoses connecting the ship to the marine terminal;
- intended rating of cargo transfer pumps;
- general details of cargo manifold and loading arm connections;
- number and size of cargo transfer arms, their height above an identified datum, and their operational envelope;
- proposed visual and audible alarms for loading arms when reaching their limiting angle within their operating envelope including:
    - the point at which the cargo transfer will be automatically stopped; and
    - the extreme limit of loading arm envelope when flange coupler between ship's manifold and loading arm will be released automatically or by means of manual controls;
- general details of electrical discontinuity arrangements between the ship and the terminal;
- loading arm and shore manifold warming-up / cooling down procedures;
- general details of purging, venting and inerting of cargo lines;
- temperature sensors in the berth area, their location and alarm systems;
- gas alarms, their number, sensitivity, and the details of continuous and/or intermittent sampling within the berth area;
- visual and audible warning systems at the berth and main control rooms;
- fire detection and protection including main and auxiliary fire pumps coverage for berth and ship;
- monitoring systems from control room ashore for:
    - loading arm(s), gas sensors and fire detection;

- primary, secondary and emergency communication systems;
- automatic and manual shut-down methods following a valve power failure in hydraulic, pneumatic or electric systems;
- cargo pressures, temperatures and transfer rates;
- activating a fixed fire protection device;
- safety equipment storage;

- source of emergency power supply;
- procedures governing access to ship during transfer operations;
- pre-cargo transfer circulation test;
- outline of proposed bunkering, ship repair and provisioning schedules in relation to cargo transfer operations;
- general details concerning reception facilities for ballast and/or for contaminated ballast from oil tankers;
- general details showing the arrangements to receive tank washings from chemical carriers; and
- special arrangements required by the nature of a particular substance being handled / transferred.

3.11.3 If it is the proponent's intention to install an automated stability calculation and cargo transfer control system in the design ship, then an abstract of the system's capability and limitations should be included in the proponent's submission including the relevant details of the design ship's stability characteristics and the approval Authority.

3.11.4 The proponent should adhere to the procedures provided in the latest version of the Cargo Transfer Safety Checklist System for Tankships as contained in Appendix 1. Alternative procedures may be considered through consultation with the TRC concerning cargoes not covered by this checklist system, however, the general principles and objectives of the checklist system should apply.

3.12 CHANNEL, MANEUVERING AND ANCHORAGE ELEMENTS

3.12.1 The objectives of this study are to determine the suitability of existing channels for the design ship(s) and to identify those areas of concern where navigation requires particular attention.

3.12.2 The guidelines provided in Appendix 2 are based on optimum operational conditions, and an accurate system of marine aids to navigation being in place. Proposed ship channels, anchorages and emergency containment areas should be depicted on large scale nautical charts or engineering plans.

3.13 BERTH PROCEDURES AND PROVISIONS

3.13.1 The objective of this study is to determine whether the berthing provisions are adequate for the design ship(s). Berths and moorings should be capable of handling the full range of ships the terminal is intended to accommodate under normal operating conditions. The proponent is responsible for demonstrating, through simulation or other means, the suitability of berths and moorings to safely accommodate the design ships which will use them. Suggested criteria and guidelines for these facilities are included in Appendix 3.

3.13.2 Calculations of the loads imposed on the various components and structural elements of the terminal berths should include, but not be limited to, the following forces and appropriate combinations thereof applicable to each structural element:

- dead loads of all piping, mechanical equipment, their liquid contents, superstructures and supporting structures;
- berthing forces arising from normal fender thrusts and horizontal and vertical frictional shear forces;
- mooring forces arising from wind, current, ice and wave pressures on largest ships in ballast and full displacement conditions at the extreme operating conditions;
- seismic forces from any horizontal direction computed for the dead loads and superimposed static loads, as well as seismic loads transmitted through pipeline anchors. Seismic forces should be computed in accordance with the methods specified in the National Building Code and for piled structures, seismic forces should be assumed to be concentrated at the deck elevation;
- temperature loads due to thermal expansion and contraction of the structures including those transmitted through pipeline anchors;
- wind load on the structures, superstructures and equipment;
- wind, wave and ice pressures on components of structure. Wind and wave forces should be based on a storm loading having average expected recurrence interval of 50 years;
- live loads of moving vehicles and cranes and,
- earth fill and hydrostatic pressures

Each structural component should be proportioned to resist bending and shear in two directions, torsion and axial forces.

3.13.3 Each structure should be analyzed for combination of permanent loads and transient peak loads. In general, allowable stresses and design procedures should conform to the National Building Code requirements. Increased allowable stresses may be considered depending on the probable recurrence of the loading, the load duration and the corresponding risk factors.

3.13.4 Detailed consideration of intended berthing strategy should be an integral part of the Route Analysis, Approach Characteristics and Navigability Survey. The following guidelines are provided for the proponent’s consideration:

- determine the upper limits of wind velocity for design ship berthing operations - arrivals and departures;
- determine the wind velocity which would require the design ship to vacate the berth;
- determine any other limiting environmental / operational criteria;
- provision of speed of approach measurement devices and a means of communicating this information to the berthing vessel;
- ascertain maximum current measurements in the vicinity of the berth and its effect on berthing operations;
- ascertain tidal range, velocities and directions and the maximum recorded spring tide measurements;
- ascertain prevailing wind statistics in relation to the directional lie of the berth;
- consider the effects, if any, of bathymetry in the vicinity of the berth and its approaches, on berthing strategy;

- consider berth loading and dolphin fendering aspects;
- consider the use of mooring points, mooring techniques, quick release hooks, and mooring line monitoring systems; and
- determine the method of docking and undocking the design ship and the number of tugs, if required.

3.13.5 When berthing ships of 65,000 deadweight tonnes or over, it is recommended that the proponent give favourable consideration to the use of:

- two mooring launches;
- sufficient linesmen forming fore and aft mooring gangs; and
- intrinsically safe UHF and VHF radio transceivers for two way communications between the ship's bridge and mooring personnel.

3.13.6 It is incumbent upon the terminal operator to provide adequate reception facilities.

3.13.7 The safety of the ship and the terminal berth may be threatened by the simultaneous transfer of some bulk cargoes and ship's stores. The proponent's intentions in this regard are of particular interest to the TRC. Accordingly, the proponent is required to submit plans in relation to the safety and security of the ship and its personnel while alongside the berth.

3.14 SINGLE POINT MOORING PROVISIONS AND PROCEDURES

3.14.1 The objective of this study is to determine the suitability of any proposed single point mooring (SPM) for the design ships intending to use it.

3.14.2 A TRP submission which proposes the use of a SPM, whether a buoy or a tower, should include:

- the geographical coordinates of the intended location;
- the rationale for the site selected;
- the relevant design details and the standards employed in the design;
- the integral piping; and
- the ship securing components.

3.14.3 The proponent should outline the operational guidelines relevant to the SPM design specifications. A proposal to position a SPM in ice-covered waters would require special consideration by both the proponent and the TRC.

3.14.4 A single point mooring system should not be sited close to shipping routes or anchorage areas.

3.14.5 Design loads, based on an average expected recurrence interval of 50 years should be calculated for the various components of the SPM (buoy or tower) using the most adverse combinations of forces generated by wind, wave, current, ice accretion, dead loads, surge, drag, collision, and wave wash that are within the operating criteria. Mooring forces should be derived with the aid of model tests

and/or computer analysis. Model tests may also be required to evaluate the overall stability, dynamic behaviour and interaction of the system components under all design loading conditions.

3.14.6 The proponent must outline connect and disconnect procedures taking into account environmental and operational criteria.

3.14.7 Special consideration should be given in the design of component connections, moving parts and fittings to fatigue, wear, freeze-up and binding. All components should be designed so that they are readily accessible for inspection and maintenance. Specific details concerning a SPM are given in Appendix 4.

3.15 GENERAL RISK ANALYSIS AND INTENDED METHODS OF REDUCING RISKS

3.15.1 The objective of this study is to review the proponent's analysis of any risk or risks relating to uncontrolled releases of pollutant cargoes (oils and chemicals) and hazardous cargoes (liquefied gases and some chemicals) either en route or at a terminal or transshipment site. These usually stem from a scenario involving;

- a two ship collision;
- a ship grounding;
- a ship striking a fixed object;
- an improper cargo transfer incident, or
- a fire or explosion.

Predictions should be based on a "worst case", but credible accident scenario in the terminal area and at selected positions along the coastal route.

3.15.2 The proponent's risk assessment should include:

- the probabilities of credible incidents which result in the breaching of the ships cargo containment system;
- the risks associated with navigational and operational procedures;
- the probabilities of a major cargo transfer incident at the terminal dock;
- the geographical boundaries and the resulting consequences of an uncontrolled release of cargo on the marine environment and, when applicable, in the close vicinity of adjacent coastal communities; and
- the risk of an incident becoming "uncontrollable".

3.15.3 Threats to the marine environment and, in some instances, to public safety, following the uncontrolled release of bulk cargo into the sea from a ship are based on:

- downwind and crosswind dispersions of flammable gases or, in some instances, the downwind dispersion of toxic gas plumes; or
- the trajectory of oil spills reacting to wind and current actions; or
- the mixing of chemicals with water including applicable chemical reactions, and the resulting dispersions of chemicals in the water columns.

3.15.4 Analysis should not be limited to a mathematical index (probability of an incident) but should also include perceived risks to:

- populations within coastal zones along the intended route;
- the terminal berth and surrounding area; and
- the marine environment, fish and wildlife habitat.

3.15.5 Appendix 5 provides representative tables of contents for risk analysis of oil, chemical and liquefied gas cargoes and other related information for the proponent's consideration.

3.15.6 When the watertight integrity of an oil tanker's hull is breached, the cargo may be released. In the case of "double hulled" tankers the incidence of released oil from the cargo containment system may be less likely following a grounding and some collisions. The proponent's risk assessment and oil spill contingency plan should include details of intentions concerning:

- predictions of nominal oil spill trajectories and oil weathering for a specified worst-case credible incident at the terminal berth, at a transshipment site, and at appropriate coastal locations along the navigational route, taking into account the particular circumstances of the proposed site including, but not limited to:
  - environments of particular ecological sensitivity;
  - human habitation;
  - recreational activities;
  - local or regional economic considerations; and
  - aspects of social or cultural significance;
- in developing predictions of nominal oil spill trajectories, reference should be made to studies of prior incidents involving identical or chemically similar petroleum products;
- any predictions should reference any laboratory research conducted on the behaviour of the petroleum product in simulated environmental conditions;
- planned counter-measures for an oil spill containment, clean-up, restoration and public safety at the locations identified above, including:
  - on-shore and on-ship resources, such as equipment and clean-up vessels, neutralizing / dispersant materials and human resources, which the ship's crew can access; and
  - response organizations and their response capabilities; and
  - the Declaration as required by the Oil Pollution Prevention Regulations;
- logistical considerations applicable to situations suggested above.

3.15.7 The *Canada Shipping Act* requires all oil spills originating from ships to be reported immediately to a Pollution Prevention Officer. The polluter has statutory obligations to repair, remedy, minimize or prevent pollution damage and for costs incurred to prevent actual or anticipated pollution damages resulting from a spill. The CCG will monitor the conduct of countermeasures and assume command and control if, in view of the Canadian Coast Guard, the polluter is unable to protect the public interest.

3.15.8 When the watertight integrity of a chemical and other noxious substances carrier's hull is breached, the cargo contained may be released. The proponent's spill risk analysis and prevention/contingency plan should include the following:

- predicted reactions following the mixing of released cargo(es) with water, with other cargo chemical(s), or with substances required for normal vessel operations;
- predicted chemical, biotic or metabolic, and photo-chemical transformations once the released cargo(es) enters the environment;
- toxicity of individual cargo chemicals and potential products formed by the combination of these chemicals with themselves or water to marine mammals, other marine life, and human life;
- chemical incompatibility of cargo(es) and the measures that will be taken to reduce the risk of potentially dangerous combination products developing upon release;
- the proponent's countermeasures for containment, clean-up, restoration and, where applicable, public safety alongside the berth, at the transshipment site, and at appropriate locations along the intended route.

3.15.9 There is a need to model gas plumes in certain circumstances. The technological basis for modelling large liquefied gas vapour clouds is constantly evolving. The selection of a particular gas cloud model should be made in consultation with the TRC. Any risk or dispersion model should include an analysis of the sensitivity of varying the assumptions or values input into the model. Appendix 6, "Representative Gas Cloud Models", lists a number of models currently used in predicting exercises. Predictions of specified gas cloud dimensions must be based on defined, worst-case, credible incidents involving the "instantaneous" release of one cargo tank at selected locations along the route and at the terminal or transshipment site.

3.15.10 The determination of the risk to public safety within a port that has been selected as the site of a liquefied gas marine terminal or surrounding a transshipment site normally requires the determination of four parameters:

- the vulnerability of the liquefied gas carrier's cargo containment system following a collision or grounding within the specified marine area;
- the probability of a liquefied gas release within a specified marine area;
- the "nominal" quantity, rate and duration of released liquefied gas bulk cargo and the dimensions of the resulting vapour cloud; and
- the proximity of populations to vapour cloud boundaries and the distribution of possible ignition sources.

3.15.11 A deflagrating vapour cloud could be the cause of fatalities and of property damage within its boundaries. In addition, the threat of radiation burns exists in the peripheral area of an ignited vapour cloud. Detonations with lethal overpressures are possible if vapour collects in confined spaces before ignition. The quantification and evaluation of these risks is a complex process and there does not appear to be any one measure that is uniformly accepted. An acceptable approach would be to calculate the risk of fatalities in terms of exposed persons per unit of time.

3.15.12 Amelioration or mitigation of perceived risks is an essential consideration in any TERMPOL submission. The particulars will vary depending on the proposal, however, it is possible to list a number of examples:

- implementation of safe navigational / operational systems and development of a pro-active pollution prevention program;

- locating the terminal in a remote location or one which is well separated from urban or suburban communities;
- designing and constructing or chartering ships with the safest possible cargo containment and cargo transfer systems;
- the application of recognized and effective maritime mobile radio procedures which enhance safety in international, coastal, and inland waters;
- routing ships with hazardous cargoes clear of primary shipping lanes and major shipping focal points when possible to reduce the incidence of close-quarter situations;
- recommending additional aids to navigation which individually or collectively improve navigational safety along the intended route;
- schedule liquefied gas or chemical carrier movements through congested coastal waters to coincide with periods when traffic is normally at a minimum, if this is possible;
- implementing recognized and effective vessel traffic services which enhance ship safety in coastal regions. These include the monitoring of traffic movements, regulated speed profiles, warning broadcasts, and the regulation of ship movements in critical portions of the route to provide a clear channel for the design ship;
- imposing limiting environmental or climatic requirements for ships loaded with pollutant or hazardous cargoes when navigational safety within the terminal zone is an issue;
- tug escort;
- implementing prudent berthing procedures and optimal tug assistance;
- employing an energy absorbing protective barrier when alongside the terminal;
- manning ships with fully competent crews adequately trained for the particular cargo(es) they handle and the design ship they operate;
- keeping sufficient crew onboard at all times while a ship is transferring hazardous cargoes so that the ship is capable of getting underway at short notice;
- mooring a ship transferring hazardous cargoes bow seaward when the terminal berth is located in a narrow arm of water so that in an emergency, the ship can proceed seaward without delay and without the aid of tugs;
- the implementation of standardized cargo transfer system inspections and safety-oriented cargo transfer operations;
- the promulgation of standardized safety and cargo transfer procedures by means of port information publications designed to inform crews of ships serving the proposed marine terminal. The procedures should include specified upper climatic limits for berthing operations, for stopping cargo transfer operations, and for vacating the berth;
- prohibiting the venting of significant quantities of flammable or poisonous gases to the atmosphere in the vicinity of human habitations;
- the provision of appropriate reception facilities at chemical and oil terminals;
- scheduling the bunkering and provisioning of ships transferring hazardous cargoes to a time that does not conflict with the maintenance of ship and personnel safety during cargo transfer operations;
- controlling the access of visitors while the ship is alongside the dock;
- the development and promulgation of an effective contingency plan for the marine terminal system and the regular exercise of selected procedures described in the plan;
- having procedures in place which conform to internationally accepted safe management practices as implemented through IMO resolutions, ISM and/or ISO standards; and
- a ship when chartered by the proponent is required to comply with appropriate chartering standards, be of the same standard and meet the same requirements of the design ship as described here in.

3.16 PORT INFORMATION BOOK

3.16.1 The purpose of the Port Information Book is to provide ship's personnel and other interested parties with all the relevant details pertaining to the specific route to, and about, the marine terminal system or transshipment site. Much of this information can be derived from the surveys required for the TRP. Items to be covered include, but are not limited to, the following:

- berthing strategy in terms of the design ship's approach and departure from the terminal berth; tug assistance requirements; mooring assistance requirements; the upper limit of lateral approach rate to the berth by the design ship and the means of measuring and indicating wind speed and the ship's lateral approach rates;
- upper limits of berthing operations in term of wind velocity, wave heights, tidal stream velocity, ice cover, visibility, and the means of measuring and indicating these factors;
- the upper wind velocity limits which would necessitate the cessation of cargo transfer operations and cause the departure of the ship from the berth;
- load measurements and limits for mooring lines and dockside bollards used by large ship/carriers;
- pilots, tug assistance details, procedures for mooring boats, line handlers and the means of communications between ship / tugs / berthing superintendent and mooring boats;
- ship machinery and equipment repairs facilities;
- storing and bunkering facilities;
- security and industrial safety matters;
- vessel reporting procedures;
- pilot boarding procedures;
- ship / shore communications procedures;
- designated anchorages; and
- emergency measures.

3.16.2 Because ship personnel and the terminal's cargo transfer staff are separated during much of the preparatory phase of a scheduled cargo transfer operation, the Port Information Book should include an explicit schedule of required communications to be initiated by the master of the ship. The text of the transmission should enable the marine terminal operator, the ship's agent, the harbour master, the pilotage authority, the Coast Guard and Marine Safety to be informed, in a timely manner, with needed information. The timing of the scheduled messages should take into account the common administrative delays in message handling and message distribution in other than direct ship / terminal communications.

3.17 TERMINAL OPERATIONS MANUAL

3.17.1 The purpose of the Terminal / Transshipment Site Operations Manual (TOM) is to inform and to guide the crews of ships calling at the proponent's terminal or transshipment site of important subject matters which affect the safety of the ship, the terminal or transshipment site itself, and the efficiency of the ship's cargo transfer operations. It should be noted that, while a ship may call at a particular terminal or transshipment site for many years, ship's crews change frequently and it is the crew who play the primary role in ensuring ship safety during transfer procedures.

3.17.2 The TRC recognizes and appreciates the technical and economic reasons for not producing the complete text of a TOM before the terminal or transshipment site has received regulatory approvals and, in the case of a marine terminal system, before construction has commenced. Nevertheless the TRC is of the opinion that the importance of the substance of the information which comprises the TOM is such that it should receive early attention by the proponent's planning staff. The list of subject matters which follow should be considered as a nominal listing:

- inspections, testing and preventative maintenance of terminal berth equipment used by ships;
- pre-arrival and departure operational tests and checks of ship's machinery and equipment;
- cargo pre-transfer inspections, checklists, and conferences;
- ship-terminal hose-manifold connections; ship-terminal communications and chain of authority;
- cargo handling procedures including emergency shut-down procedures;
- safety precautions and ship oriented emergency procedures which would be included in the terminal's contingency plans;
- receiving facilities for ballast, dirty ballast, slops and garbage.

3.18 CONTINGENCY PLANNING

3.18.1 The primary purpose of contingency planning is to be prepared to respond to abnormal events when they occur. The effectiveness of any contingency plan also depends on the personnel regularly exercising their respective roles and responsibilities. The TRC expects the proponent to provide a preliminary outline for the intended contingency plan for review as it relates to a ship in transit and/or alongside the proposed marine terminal berth or transshipment site. The review of the contingency plan enables its collation with Coast Guard and Marine Safety Emergency Operations Procedures in order to ensure an integrated response, if and when required.

3.18.2 Topics to be included in a ship-oriented contingency plan while a vessel is en route to, from or at the terminal or transshipment site should deal with:

- incidents involving the release of cargo(es)
- fire and explosions;
- operations monitoring systems;
- terminal-ship communications;
- inspection, testing, and preventative maintenance procedures;
- cargo handling precautions applicable to the ship;
- neutralizing electrical hazards;
- detection and alarm systems at the ship's berth;
- emergency shut-down of cargo transfer operations;
- emergency responses to incidents involving the uncontrolled release of cargo(es) at or near the ship's berth or transshipment site during cargo transfer operations;
- countermeasures which ameliorate, contain or neutralize the harmful effects of cargo released into the marine environment;
- outline of personnel emergency equipment proposed for berth area and the evacuation procedure for personnel;
- emergency procedures which would require the vacating of the terminal berth and the disposition of the vessel; and

- security at the ship's berth.

3.18.3 Those aspects of the terminal-oriented contingency plan of interest to the TRC focusing on the ship alongside could include the following situations:

- fire in the engine room, compressor, deck stores or ship's accommodation spaces;
- releases resulting in structural damage and/or personnel injuries;
- equipment malfunctions;
- rapidly deteriorating weather conditions and possible evacuation of the berth;
- grounding or collision at or near berth;
- fires on dockside, pipelines in the immediate vicinity of the berth, and the tank farm; and
- sabotage.

3.18.4 Procedures relating to incidents which require active responses from the ship's personnel should be explicit, succinct, unequivocal, and communicated in the operational language(s) of the ship. The ship's personnel should be aware of the terminal-ship chain of command and of emergency drill requirements and procedures and be able to communicate with the terminal's personnel.

3.18.5 The proponent must prepare a study showing the extent to which an incident would likely have an adverse effect upon third party interests and how the proponent would address this through remediation and/or compensation.

3.19 OIL HANDLING FACILITIES REQUIREMENTS

3.19.1 Pursuant to chapter 36 Part XV of Canada Shipping Act, article (4), the operator or an oil handling facility that is designated pursuant to subsection (8) shall:

(a) Comply with regulations respecting the procedures, equipment and resources that an oil handling facility must have on site for use in respect of an oil pollution incident at the oil handling facility, where the incident arises or of the loading and unloading of oil to or from a ship at the oil handling facility;

(b) Have an arrangement with a response organization to which a certificate of designation has been issued pursuant to subsection 660.4(1) in respect of a specified quantity of oil that is at least equal to the total quantity of oil, as determined by regulation, that is, at any particular time, involved in the loading or unloading of oil to or from a ship at the oil handling facility, to a maximum of ten thousand tons, and in respect of the place where the oil handling facility is located;

(c) Have a site declaration, conforming to the regulations, that

(i) describes the manner in which the operator will comply with the regulations made under par. 657(1)(a),

(ii) confirms that the arrangement referred to in par. (b) has been made, and

(iii) identifies every person who is authorized, in accordance with the regulations, to implement the arrangement referred to in paragraph (b) and the oil pollution emergency plan referred to in par. (d); and

(d) Have on site an oil pollution emergency plan that conforms to the regulations and that lists the procedures, equipment and resources referred to in par. (a).

3.20 HAZARDOUS AND NOXIOUS LIQUID SUBSTANCES

3.20.1 The proponent should follow the developments related to the HNS Convention and the implementation of national/regional Chemical Response Regimes if applicable.

APPENDIX 1

CARGO TRANSFER SAFETY CHECKLIST SYSTEM FOR TANKSHIPS

CARGO TRANSFER SAFETY CHECKLIST SYSTEM FOR TANKSHIPS

RECOMMENDED PRACTICE

January 2001

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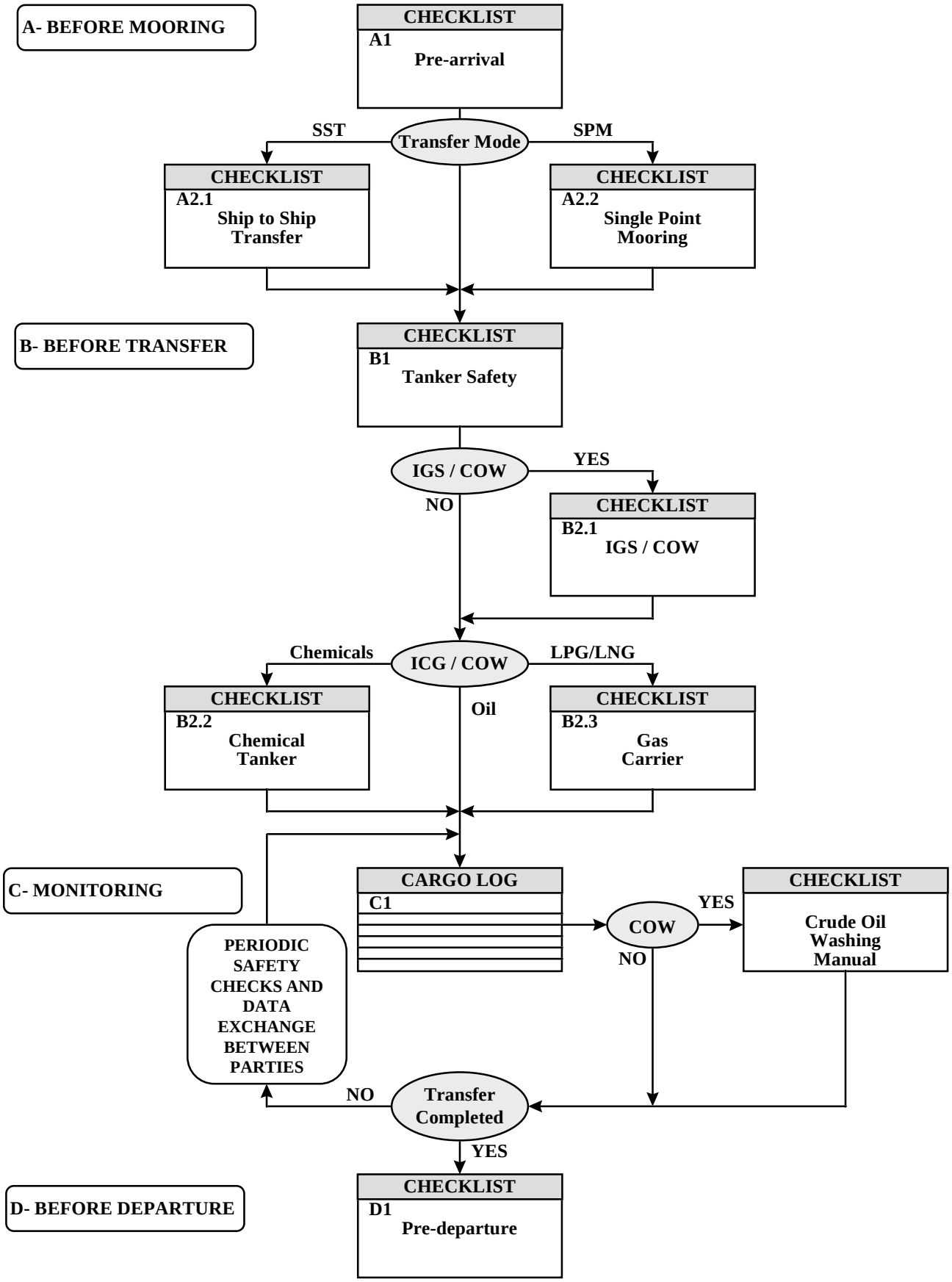
SYSTEM FLOWCHART



DESCRIPTION OF SAFETY CHECKLIST SYSTEM

The aim of this document is to structure various checklists monitoring each stage of the transfer operations into one single document to be used from pre-arrival to departure of a tankship. The checklist system is addressed to be used by competent and already experienced personnel and it is designed to be completed quickly, interfering to a minimum with the routine tasks.

The checklist system is also an aide-mémoire without cumbersome explanations since the existing technical documentation is abundant and readily available. Important manuals and publications on the subject are listed in the attached bibliography and the references listed therein have been used in the preparation of this document with the addition of particular IMO and Canadian regulatory requirements.

Questions and guidelines that are different from the international checklists appear shaded in this document

The following is a description of the **SAFETY CHECKLIST SYSTEM FOR TANKSHIPS** (see system flowchart and table of reference).

Transfer operations are separated into four (4) stages:

A - Before Mooring,
B - Before Transfer Operations Commence,
C - Monitoring Transfer Operations, and
D - Before Unmooring.

Two sets of checklists are considered:

1. **Basic Checklists**
   which cover all tankships, and

2. **Additional checklists**
   which target special operations such as ship to ship transfer, single point mooring and crude oil washing as well as the transfer of chemicals and gases in liquid bulk. You will notice that loading/unloading and ship/shore vocabulary terms have been replaced with the more general concept of deliverer/receiver which substantially simplifies the document while covering all cargo transfer operations.

TABLE OF REFERENCE

STAGE	1. BASIC CHECKLISTS	2. ADDITIONNAL CHECKLISTS
A Before mooring	X Pre-arrival Checklist (including COW if applicable)	☐ 1. Ship to Ship Transfer ☐ 2. Single Point Mooring
B Before transfer operations	X Tanker Safety Checklist	☐ 1. Crude Oil Washing ☐ 2. Chemical Tanker ☐ 3. Gas Carrier
C Monitoring transfer operations	X Cargo Log for periodic safety checks (all tankships)	
D Before unmooring	X Pre-departure checklist (including COW if applicable)	nil

Note:
- X Compulsory for all tankships
- ☐ As applicable
  See also System Flowchart

The Safety Checklist System for Tankships is for the safety of both the deliverer (ship or terminal) and the receiver (ship or terminal) and should be completed jointly by a representative from both parties. The conditions under which the operations take place may change during the process and some items on the checklists will require recurrent checks or even continuous supervision during the operations.

The safety of operations requires that all questions should be answered affirmatively. If an affirmative answer is not possible, the reason should be given and agreement reached upon appropriate precautions to be taken between ship and terminal (or between both ships in case of ship to ship transfer). Where any question is not considered to be applicable a note to that effect should be inserted in the remarks column.

√ The presence of this symbol in the columns **DEL (Deliverer)** or **REC (Receiver)** indicates that checks had been carried out by the party concerned.

The presence of the letters **M**, **N** , **W** and **P** in the column CODE indicates the following:

M requires monitoring throughout the transfer operation
N requires a notice to be posted to that effect
W requires a procedure or agreement in writing signed by both parties
P requires the permission of the Port Authority

A BEFORE MOORING

This section reminds what has to be done in preparation for berthing and lists the basic information that has to be exchanged between those involved in the transfer operations. The ***Pre-arrival Checklist*** must be filled by both parties, each advising the other by radio or otherwise when the checklist is completed by the affirmative. An additional checklist is required for ***Ship to Ship Transfer or Single Point Mooring***.

B BEFORE TRANSFER OPERATIONS COMMENCE

The ***Tanker Safety Checklist*** should be completed jointly both by the deliverer and the receiver before transfer operations commence. An Additional Checklist has to be completed by a tanker which operates with a ***Crude Oil Washing System*** or a ***Chemical Tanker*** or a ***Gas Carrier***.

C MONITORING TRANSFER OPERATIONS

Several items on the ***Tanker Safety Checklist*** such as the posting of safety notices or whether a piece of equipment is of an approved type require only an initial examination and are reasonably expected to remain the same throughout the operations. However, a number of items on that list have to be checked periodically during the transfer operations and entries regularly made on the ***Cargo Log***:

1	Ships must stay securely moored
2	Emergency towing wires about waterline
3	Safe access between ships or ship/shore
4	Ship must be ready to move at all time
5	Watch supervision (ship & terminal)
6	Reliable communications maintained
8	Cargo operations monitored
12	Cargo arms/hoses properly rigged

13	Scuppers/drip trays drained off periodically
17	Cargo tanks properly vented
23	External doors and ports kept closed
27	Smoking requirements enforced
28	Naked light requirements
30	Minimum personnel kept on board
33	"Close loading" complied with
37	Tank washing monitored

An ***Extra Log*** page has to be filled by a tanker which operates with a Crude Oil Washing System. Crude oil washing sequence of operations is also included in this form.

D BEFORE UNMOORING

The ***Pre-departure Checklist*** has to be completed before departure.

APPENDIX

Optional forms for procedures and information exchange are included as a guide:

FORMS	
INFORMATION FROM SHIP	has to be filled in by the vessel(s).
INFORMATION FROM TERMINAL	has to be filled by the terminal representative, where transfer operations are conducted at the dock.
INFORMATION ON CARGO	has to be completed both by the Deliverer and the Receiver.

NOTE: Information contained in these forms must be exchanged before arrival.

Communication Procedures are necessary to ensure reliable communications between Deliverer and Receiver. The communication system must be tested before operations commence and a backup system must also be established and agreed upon. Emergency shut down (ESD) procedures should be agreed upon and recorded. The agreement should specify in which cases the transfer operation has to be stopped immediately.

Fire Notice describes the fire alarm(s) and lists the necessary actions to be performed by Deliverer and the Receiver in case of fire.

The Communications Procedures and the Fire Notice, have to be recorded on the **COMMUNICATIONS AND EMERGENCIES** form.

DECLARATION

The following responsible officers/representatives have checked, where appropriate jointly, the items on the relevant checklists, and have satisfied themselves that the entries made are correct to the best of their knowledge, and that the necessary repetitive checks have been carried out as necessary.

CHECKLIST	DELIVERER		RECEIVER		DATE
	Signature	Rank/Position	Signature	Rank/Position	COMPLETED
A1					
B1					
C1					
D1					

TRANSFER MODE :

Ship / Terminal ☐
Ship to Ship ☐
Single Point Mooring ☐

TRANSFER LOCATION: .....

DELIVERER:.....

RECEIVER:.....

A1 GUIDELINES FOR COMPLETING THE PRE-ARRIVAL CHECKLIST

1. Information from ship

√ Information from Ship, Information from Terminal and Information on Cargo to be completed and exchanged. See example of information exchange forms in appendix.

2. Information from terminal (or other ship)

√ Same as above

3. Defect(s)

√ The Vessel Traffic Services Zones Regulations require the master to report any defect in the ship's hull, main propulsion machinery and equipment which may affect safety, the marine environment or may diminish the vessel's capability to move.

4. Functional tests

√ Functional tests are required prior to tankship arrival with respect to engine movements, steering gear (see pre-departure checklist), windlass, anchors and for all operational equipment.

5. All openings secured

√ Precautions to be taken before and during cargo handling

6. Pre-Arrival Crude Oil Check List

√ The approved Crude Oil Washing Manual contains a Pre-Arrival Crude Oil Washing Check List, specific to each ship, which should be completed by a responsible ship's officer prior to arrival.

7. Language of operation

√ A common language is to be used in the communications between both parties, either French or English

8. Crew qualifications

√ Sufficient personnel to meet hours of rest, bridge and deck watches requirements.

√ Certificates for Master, Officers and/or rating (both navigational and engineering)

√ Endorsements for oil tanker, chemical tanker or liquefied gas carrier (including if it is the case qualifications on COW and IGS)

9. Contingency plan

Most oil tankers are required to keep on board an English or French version of a Shipboard Oil Pollution Emergency Plan as required in MARPOL Annex I and the Canadian Oil Pollution Prevention Regulations. The plans shall cover all safety and pollution emergencies and be designed for the intended mode of transfer operations. The plan shall consist at least of:

√ The procedure to be followed to report an oil pollution incident (Ref.: Guidelines for Reporting Incidents Involving Dangerous Goods, Harmful Substances and/or Marine Pollution 1995 - TP9834E)

√ The list of authorities or persons to be contacted in the event of an oil pollution incident

√ A detailed description of the action to be taken immediately by persons on board to reduce or control the discharge of oil following the incident

√ The procedures and point of contact on the ship for coordinating shipboard action with national and local authorities in combating the pollution

√ Declaration confirming arrangement with response organization on board [CSA 660.2 (2) (c)]

Note: For tanker carrying product(s) with toxic hazards, and particularly for chemical tankers and liquefied gas carriers, evacuation procedures to be agreed between both parties.

10. Tugs

√ In case of an affirmative answer, specify how many tug(s)

11. Approved Navigational Charts

√ see Canadian Coast Guard Annual Notice to Mariners no.13 for approved lists of charts

A1 PRE-ARRIVAL CHECKLIST

Item	DEL	REC	CODE	Remarks
1. Have information sheets been completed and sent from ship to terminal (or other ship)?				
2. Have information sheets been received from terminal (or other ship)?				
3. Are the hull, machinery or equipment free of any defects?				
4. Have all functional tests been carried out?				
5. Are all openings secured entering port (ullage ports, forepeak, afterpeak, foredeep tanks covers and cargo, bunker, cofferdam and pumproom openings)?				
6. Is the Pre-Arrival Crude Oil Washing Check List, as contained in the approved Crude Oil Washing Manual, satisfactorily completed?				
7. Is language of operation agreed?				
8. Is ship's crew sufficient and competent?				
9. Has a contingency plan been prepared and agreed?				
10. Are tug(s) to be employed?				
11. Are there on board up-to-date approved charts for area of operation?				

A2.1 GUIDELINES FOR COMPLETING THE SHIP TO SHIP TRANSFER CHECKLIST

1. Ship's compatibility

Pre-planning of the operation should ensure that the vessels involved are compatible in certain critical features of design and equipment, i.e.

- √ Cargo manifold arrangement
- √ Horizontal spacing between manifold connection, measured centre to centre
- √ Hose support rail if fitted
- √ Ship is equipped with sufficient fairleads to receive mooring lines from other ship
- √ Bitts of sufficient strength and suitably located to receive eyes of mooring ropes

2. Rendez-vous position

Points to be considered when selecting the area of operation are:

- √ Destinations of the ships concerned
- √ Shelter provided, particularly from sea and swell
- √ Sea room and depth of water, which should be sufficient for manoeuvring during mooring, unmooring and transfer operations
- √ Allow a safe anchorage if operations to be undertaken at anchor
- √ Traffic density
- √ Weather conditions - sea and tidal conditions
- √ Physical configuration of the site to minimize the difficulty of clean-up operations

3. Local authorities

- √ Notify and obtain agreement from Port Authority or Transport Canada - Marine Safety office.

4. Environmental criteria

The following are the criteria to be considered:

- √ Wind force
- √ Waves height
- √ Current velocity
- √ Traffic density
- √ Ice conditions
- √ Etc.

5. Radio communications

- √ Establishment of initial contact by radio as early as practicable

6. Approach and mooring

- √ Exchange details of the mooring plan
- √ Mooring procedure to be specified with emphasis to sea, wind, angle of approach
- √ Establishment of a dedicated ship
- √ Details of speed and courses to be exchanged

7. Fenders

- √ Ensure primary fenders positioned and at each end of the parallel body and floating throughout the operation
- √ Secondary fenders positioned fore and aft of the parallel body where contact may occur in cases of misalignment during mooring

8. Protrusions

- √ Ship sides clear of any overhanging projections

9. Ship upright and at suitable trim

- √ List, excessive freeboard and trim by the stern to be avoided

10. Shipping traffic

- √ Local traffic to be advised and proceed by at safe speed

11. Navigational signals

- √ Appropriate signals required by international, Canadian or local regulations

12. Weather forecasts

- √ Local and regional weather forecasts and ice charts should be obtained
- √ Weather and ice conditions should be monitored constantly throughout the transfer period
- √ Transfer operations personnel should have suitable clothing for the prevailing conditions

13. Bridge or E/R watch

- √ Each ship is responsible for keeping its own lookout and radio watch on the navigating bridge
- √ Main engine shall be available at short notice

14. Oil booms

- √ (Subject to further discussion)

15. Other ship been advised

Pre-arrival checklist to be completed

A2.1 SHIP TO SHIP TRANSFER CHECKLIST

Item	DEL	REC	CODE	Remarks
Before arrival				
1. Has ship's compatibility been established?				
2. Has rendez-vous position been agreed?				
3. Have local authorities been advised?			**P**	
4. Have limiting environmental criteria been agreed?				
Before run-in and mooring				
5. Are radio communications established?				
6. Have method of approach and mooring procedures been agreed and decision taken on which ship will provide moorings?				
7. Are primary and secondary fenders floating in place on the smaller ship?				
8. Have any protrusions on outboard or side of berthing been retracted?				
9. Is ship upright and at suitable trim?				
10. Has area shipping traffic been checked?				
11. Are navigational signals ready to be displayed?				
12. Have weather forecasts and ice conditions for transfer area been obtained?				
13. Has bridge/engine room watches been established?				
14. Are oil booms to be deployed?				
15. Has other ship been advised that pre-arrival checklist completed in the affirmative?				

A2.2 GUIDELINES FOR COMPLETING THE SPM CHECKLIST

1. Ship's compatibility
Pre-planning should ensure that the ship meets all statutory requirements for tankships operating in Canadian waters as well as be suitably equipped to safely moor and carry out the intended transfer operation.

2. Mooring circle
Approach fairway and mooring circle should take into consideration:
- √ radius of ship swing
- √ minimum required depth
- √ density of traffic
- √ sea room for manoeuvring
- √ local weather conditions/sea and tidal conditions

3. Alternate anchorage
Alternate anchorage due to adverse conditions must be considered. If located within port limits, Port Authority must be informed.

4. Environmental criteria
These specifications should be site specific and be based upon but not limited to:
- √ visibility
- √ sea state
- √ wind velocity
- √ load on mooring equipment
- √ station keeping ability of the ship

5. Mooring master
Check in case of affirmative answer.

6. Exchange of information
Points to consider
- √ type of propulsion
- √ thruster (fore and aft)
- √ speed log (fore and aft/lateral)
- √ stopping distance and manoeuvring speeds
- √ navigational equipment

7. Radio communication
It is essential that good communications be maintained at all times.

8. Approach and mooring
Agreement between all parties concerned.

9. Weather forecasts
Weather forecasts should be monitored frequently.

10. Bridge/anchor watch
Responsibility of the ship during transfer operations.

11. Disconnect procedures
Agreement between all parties concerned.

A2.2 SINGLE POINT MOORING CHECKLIST

Item	DEL	REC	CODE	Remarks
1. Has ship's compatibility been established?				
2. Has the mooring circle and approach fairway of the designated port area been defined and agreed?				
3. Has an alternate anchorage been designated and agreed?			**P**	
4. Has limiting environmental criteria for approach/connect; cessation of cargo operations; and disconnect been established and agreed?				
5. Is a mooring master to be employed?				
6. Has there been an exchange of information between ship's master and other relevant parties concerning the manoeuvring characteristics of the ship and shipboard equipment?				
7. Are radio communication procedures in place and agreed on for all operations between tankship, tugs, line boat, and loading/unloading facility?				
8. Has the method of approach and mooring procedures been reviewed and agreed on?				
9. Have weather forecasts been obtained and will they be updated on a regular basis for the duration of the operation?			**M**	
10. Has a bridge/anchor watch been established?				
11. Have disconnect procedures been reviewed and agreed?				

B1 GUIDELINES FOR THE TANKER SAFETY CHECKLIST

1. Mooring

√ Number and strength of mooring lines are adequate and as agreed on the mooring diagram
√ Wire and fibre ropes not used in same direction
√ All mooring lines are kept taut
√ Fendering is efficient
√ Quick release means available in emergency
√ Anchors not in use are properly stowed
√ Automatic winches are not in automatic mode

2. Emergency towing wires

√ Towing wires are made fast on bow and quarter on side opposite to cargo hoses connection
√ Eyes are maintained about the waterline and adjusted when necessary
√ Sufficient slack is left on deck
√ Means provided to be easily broken to prevent slack from accidentally running into the water

3. Safe access

√ Access is positioned far away from hoses connection
√ Safety net is effectively placed under gangway
√ There is sufficient clear run of space to maintain convenient access at all states of tide and change of ship's freeboard
√ Lifesaving equipment is available near by access
√ Persons without legitimate business would be refused access to the ship and terminal
√ Access way is clearly indicated by sign
√ A lifebuoy is available near gangway

4. Ready to move

√ Vessel is ready to move at short notice. If not, permission had been granted from authorities and required conditions been met

5. Watch and supervision

√ A continuous watch is kept on board and ashore
√ Personnel is familiar with substances handled
√ Weather forecast is regularly monitored

6. Communications

(See Guidelines to Part IV)

7. Emergency signal

√ The agreed signal used in the event of an emergency is clearly understood by both parties

8. Cargo and ballast

(See Guidelines to Part III)

9. Hazards and toxic substances

√ Information on cargo constituents should be available

10. Emergency shut down

(See Guidelines to Part IV)

11. Fire fighting equipment

√ Ship and shore fire main are pressurized or capable to be pressurized at short notice
√ International ship/shore connection is readily available
√ Fire notice handed (See Guidelines to Part IV)

12. Cargo hoses/arms

√ have been tested and the test certificate is available on request
√ have been checked and found in good order
√ all flange connections have been fully bolted
√ are marked for the intended operation (nature, maximum pressure and operating temperature range)
√ tools located at manifold for rapid disconnecting
√ hose lifting equipment has been checked and ready for use
√ arms maximum drift and range are determined and alarms set at limits
√ arms emergency releases have been tested
√ weight of the liquid content of the arms are relieved by a support or jack

13. Scuppers and drip trays

√ Means are provided to drain rain water and/or spilled cargo from deck and drip trays

B1 TANKER SAFETY CHECKLIST

Item	DEL	REC	CODE	Remarks
1. Is the ship securely moored?			**M**	
2. Are emergency towing wires correctly positioned?			**M**	
3. Is there safe access between ships or between ship and shore?			**MN**	
4. Is the ship ready to move under its own power?			**MP**	
5. Is there an effective deck watch in attendance on board and adequate supervision on the terminal and on the ship(s)?			**M**	
6. Is the agreed ship/shore or ship/ship communication system operative?			**MW**	
7. Has the emergency signal to be used by the ship and shore been explained and understood?			**W**	
8. Have the procedures for cargo, bunker and ballast handling been agreed?			**MW**	
9. Have the hazards associated with toxic substances in the cargo being handled been identified and understood.				
10. Has the emergency shutdown procedure been agreed?			**W**	
11. Are fire hoses and fire fighting equipment on board and ashore positioned and ready for immediate use?			**W**	
12. Are cargo and bunker hoses/arms in good condition, properly rigged and appropriate for the service intended?			**M**	
13. Are scuppers effectively plugged (except when vessel is a gas carrier) and drip trays in position, both on board and ashore?			**M**	

B1 GUIDELINES FOR THE TANKER SAFETY CHECKLIST (cont'd)

14. Unused connections properly secured

√ Unused cargo and bunker connections are closed and blanked
√ Blank flanges are fully bolted
√ Other types of fitting properly secured

15. Sea and overboard discharge

√ Valves are checked visually for security
√ Remotely operated valves are identified

16. Cargo tank lids

√ All openings to cargo tanks are closed gastight
√ Ullaging and sampling points may be opened for a short period

17. Tank venting system

√ Agreement should be reached by both parties, as to the venting system for the operation, taking into account the nature of the cargo and international, national and local regulations and agreements. There are three basic systems: Open to atmosphere via open ullage ports protected by suitable flame screens, fixed venting systems which includes IGS and to shore through vapour circulating systems

18. Operation of P/V valves and/or high velocity vents

√ P/V valves and/or high velocity vents checked using the testing facility provided by the manufacturer
√ Adequate visual check carried to ensure the checklift facility is actually operating the valve

19. Hand torches

√ Hand torches are of safe type approved by a competent authority
√ Damaged units are not used

20. Portable VHF/UHF transceivers

√ Portable transceivers are of a safe type approved by a competent authority
√ Damaged units are not used
√ Pagers and cellular phones are shut off (notice posted)

21. Radio transmitter and radars

√ Ship's radar installations and main radio transmitter are not used in port
√ Notice is posted on bridge deck

22. Electrical equipment

√ Use of portable electrical equipment is prohibited (notice posted)
√ Supply cables are disconnected and removed
√ Ship/shore or ship/ship communication cables are routed outside the hazardous zone

23. Doors and ports

√ External doors, windows and ports in accommodation(s) are kept closed during operations
√ Doors are kept unlocked
√ Signs are posted near doors

24. Window type air conditioning

√ Units should be disconnected from their power supply

25. Air conditioning intakes

√ Air conditioning and ventilator intakes are closed
√ Window type air conditioners are disconnected

26. Use of galley equipment

√ Galley whose construction, location and ventilation system provides protection against entry of flammable gases, open fire systems may be used
√ On ship using stern discharge lines, open fire in galley should not be allowed unless the construction of the ship permits its use

B1 TANKER SAFETY CHECKLIST (cont'd)

Item	DEL	REC	CODE	Remarks
14. Are unused cargo and bunker connections properly secured with blank flanges fully bolted?				
15. Are sea and overboard discharge valves, when not in use, closed and visibly secured?				
16. Are all cargo and bunker tank lids closed?				
17. Is the agreed tank venting system being used?			**MV**	
18. Has the operation of the P/V valves and/or high velocity vents been verified using the checklist facility, where fitted?				
19. Are hand torches of an approved type?				
20. Are portable VHF/UHF transceivers of an approved type?			**N**	
21. Are the ship's main radio transmitter aerials earthed and radars switched off?			**N**	
22. Are electric cables to portable electrical equipment disconnected from power?			**N**	
23. Are all external doors and ports in the accommodations closed?			**MN**	
24. Are window-type air conditioning units disconnected?				
25. Are air conditioning intakes which may permit the entry of cargo vapours closed?			**N**	
26. Are the requirements for use of galley equipment and cooking appliances being observed?			**M**	

B1 GUIDELINES FOR THE TANKER SAFETY CHECKLIST (cont'd)

27. Smoking

√ Smoking on board or on the jetty is prohibited except in designated places only

√ No smoking signs are posted on board and ashore

28. Naked light

√ There is no fire, spark formation, naked light or surfaces with a temperature above minimum ignition temperature of product handled

√ Hot work (and cold work) is permitted subject to agreement by port authority and terminal superintendent

√ No naked light signs are posted on board and ashore

29. Emergency escape

√ A lifeboat is ready for immediate use

√ A safe and quick escape is available ashore

30. Sufficient personnel

√ Minimum number of competent personnel to deal with an emergency is determined

√ Sufficient number of competent personnel is kept on board

√ Same on shore installation

31. Deliverer/Receiver connection

√ There is only one length of electrically discontinuous hose in each hose string

√ Mooring wires are fitted with fibre tail

√ Cathodic protection procedure has been checked

Note 1 : it should be ascertained that the means of electrical discontinuity is in place, is in good condition and that it is not by-passed by contact with an electrically conductive material.

Note 2 : Precautions against electrostatic hazards, as per ISGOTT (edition1996) Chapter 20 "Static Electricity" should also be considered.

32. Pumproom ventilation

√ Pumprooms are mechanically ventilated

√ Ventilation is kept running throughout the operation

33. Closed loading

√ Unless ship's design dictates otherwise, cargo must be loaded with the ullage, sounding and sighting ports securely closed

√ Gas displaced should be vented via vent stacks or through high or constant velocity valves

√ Ensure that gases are taken clear of the cargo deck

34. Vapour return line

√ A vapour return line may have to be used

35. Operating parameters

√ Maximum and minimum operating pressures should be discussed and agreed by both parties (only if a vapour line has been connected)

36. Emergency fire control plans

√ Such plans shall be permanently stored in a prominently marked weathertight enclosure outside the deckhouse

37 Illumination

√ The Canadian Oil Pollution Prevention Regulations require adequate illumination where transfer operation takes place between sunset and sunrise:

√ Safe access between ships or ship/shore

√ Transfer operation work area

√ Emergency escapes

38. Red light or "B" flag

√ The all-round red light or the "B" flag are additional Canadian provisions of the Collision Regulations for a vessel taking in or discharging dangerous goods

B1 TANKER SAFETY CHECKLIST (cont'd)

Item		DEL	REC	CODE	Remarks
27.	Are smoking regulations being observed?			**MN**	
28.	Are naked light regulations being observed?			**MN**	
29.	Is there provision for an emergency escape?			**N**	
30.	Are sufficient personnel on board and ashore to deal with an emergency?			**M**	
31.	Are adequate insulating means in place in the ship/shore or ship/ship connection?				
32.	Have measures been taken to ensure sufficient pumproom ventilation?			**M**	
33.	If the ship is capable of closed loading, have requirements for closed operations been agreed?			**M**	
34.	Has a vapour return line been connected?				
35.	If a vapour return line is connected, have operating parameters been agreed?			**W**	
36.	Are ship emergency fire control plans located externally?				
37.	Is adequate illumination provided when operation takes place between sunset and sunrise?				
38.	Is an all-round red light or the International Code flag "B" exhibited?				

B2.1 GUIDELINES FOR COMPLETING THE IGS & COW CHECKLIST

1. Inert Gas

√ Interlocking trips and associated alarms, deck seal, non-return valve, pressure regulating control system, main deck IG line pressure indicator, individual tank IG valves (when fitted) and deck p/v breaker are working well

√ Open/close position indicators identified and fully functioning if individual tank IG valves are fitted

2. Deck Seals

√ Deck seals in safe condition

√ Water supply arrangements and proper functioning of associated alarms checked

Note: in sub-zero temperature water has to be replaced by a non-freezing fluid and deck seal calibrated accordingly

3. Liquid levels in p/v breakers

√ Liquid to comply with manufacturer's recommendations

4. Calibration of fixed and portable oxygen analysers

√ Instruments should be calibrated and checked

5. Fix IG pressure and oxygen recorders

√ Recording equipment should be switched on and operating correctly

6. Cargo tank atmospheres

√ Cargo tank atmosphere prior to cargo operations should be checked to verify an oxygen content of 8% or less by volume

√ Inerted cargo tanks should at all times be kept at a positive pressure

7. Individual tank IG valves

√ During both loading and discharge it is safe to keep all individual tank IG supply valves (if fitted) open

√ If for any reason the individual tank IG supply are closed, the status of the valve should be indicated

√ Individual tank IG valve should be fitted with a locking device

8. Awareness in case of failure

√ In the case of failure of the IG plant, all operations should cease and the terminal to be advised

√ Under no circumstances the atmosphere in any tank should fall below atmospheric pressure

9. Planning Crude oil washing

√ See Pre-arrival Checklist, item 6

10. Crude Oil Washing Check List

√ The approved Crude Oil Washing Manual contains a Crude Oil Washing Check List, specific to each ship, for use before, during and after crude oil washing operations. This Check List should be completed at the appropriate times and the terminal representative should be invited to participate.

B2.1 IGS & COW CHECKLIST

Item	DEL	REC	CODE	Remarks
Inert Gas System				
1. Is the Inert Gas System fully operational and in good working order?			**P**	
2. Are deck seals in good working order?			**M**	
3. Are liquid levels in pv breakers correct?			**M**	
4. Have the fixed and portable oxygen analysers been calibrated and are they working properly?			**M**	
5. Are fixed IG pressure and oxygen recorders working?			**M**	
6. Are all cargo tank atmospheres at positive pressure with an oxygen content of 8% or less by volume?			**PM**	
7. Are all the individual tank IG valves (if fitted) correctly set and locked?			**M**	
8. Are all the persons in charge of cargo operations aware that in the case of failure of the Inert Gas Plant, discharge operations should cease and the terminal to be advised?				
Crude Oil Washing				
9. Has discharge/crude oil wash operation been discussed with both ship and shore (or other ship) staff and is the agreed plan readily available for easy reference?				
10. Is the Crude Oil Washing Check List for use before, during and after Crude Oil Washing, as contained in the approved Crude Oil Washing Manual, available and being used?*			**M**	

* see IMO Resolution MEPC .3 (XII) as amended by IMO Resolution MEPC.81 (43) Standard Format for the Crude Oil Washing Operations and Equipment Manual.

B2.2 GUIDELINES FOR COMPLETING THE CHEMICAL CHECKLIST

1. Material Safety Data Sheet

Information on the product(s) to include:

- √ Full description of the physical and chemical properties, including reactivity, necessary for the safe containment of the cargo
- √ A cargo stowage plan *(Cargo/Tank coating compatibility)*
- √ Action to be taken in the event of spills or leaks
- √ Counter measures against accidental personal contact
- √ Fire-fighting procedures and fire-fighting media
- √ Procedures for cargo transfer
- √ When product(s) requiring to be stabilised or inhibited are to be handled, information is exchanged thereon

2. Protective equipment

- √ Protective equipment including SCBA and protective clothing appropriate to the specific dangers of the product(s) handled, shall be readily available in sufficient number for operational personnel both on board and ashore.
- √ Protected storage places be clearly marked.
- √ Physically fit and trained personnel selected to use SCBA.

3. Counter measures against personal contact

- √ The medical chest is readily available
- √ Information on how to handle contacts giving regard to the special properties of the product(s) shall be studied and available for immediate use
- √ Antidote(s) for immediate use and/or suitable counter-measures to be taken to limit the consequences of the spilled product(s) on human beings are available
- √ Suitably marked decontamination showers and an eye wash are available on deck at convenient locations. The showers and eye wash are operable in all ambient conditions
- √ Shower and eye wash water is maintained at a safe temperature

4. Automatic shut down system

- √ Cargo handling rate to be adjusted to avoid pressure surge evolving from the automatic closure
- √ Alternative means may be fitted to relieve the pressure surge

5. Gauges and alarms

- √ System gauges to be regularly checked
- √ Alarms set to different levels when possible

6. Vapour detection instruments

- √ Equipment capable of measuring where appropriate, flammable and/or toxic levels
- √ Instruments capable of measuring flammability should be calibrated before operations

7. Fire-fighting media and procedures

- √ Exchange of information with regard to procedures to be followed if a fire does occur
- √ Special attention to products which may be water reactive

8. Transfer hoses material

- √ Hoses indelibly marked with maximum working pressure, test pressure and last date of test at this pressure, and if used at service temperatures other than ambient, its maximum and/or minimum service temperature

9. Pipeline systems

- √ During cargo operations where the use of portable cargo lines on board or ashore is unavoidable, care should be taken to ensure that these lines are correctly positioned and assembled so that no additional danger exists from their use. Where necessary, the electrical continuity of these lines should be checked.

10. Warning signs

- √ The Dangerous Chemicals and Noxious Liquid Substances Regulations require the notice to be displayed near every access to the ship

11. Operation manuals

- √ Procedures and arrangements manual
- √ The Dangerous Chemicals and Noxious Liquid Substances Regulations require the BCH / IBC Code to be on board

  Note: A copy of the above documents shall be either in the French or English language.

B2.2 BULK LIQUID CHEMICAL CHECKLIST

Item	DEL	REC	CODE	Remarks
1. Is information available giving the necessary data for the safe handling of the cargo, and, where applicable, a manufacturer's inhibition certificate?				
2. Is sufficient and suitable protective equipment (including self-contained breathing apparatus) and protective clothing ready for immediate use?				
3. Have counter measures against accidental personal contact with the cargo been agreed?				
4. Is the cargo handling rate compatible with the automatic shutdown system, if in use?				
5. Are cargo system gauges and alarms correctly set and in good order?			**M**	
6. Are portable vapour detection instruments readily available for the products to be handled?				
7. Has information on fire fighting media and procedures been exchanged?				
8. Are transfer hoses of suitable material resistant to the chemical action of the cargoes?				
9. Is cargo handling being performed with portable pipelines				
10. Is "Warning Hazardous Chemical" sign posted?			**N**	
11. Are the required operation manuals available on board?				

B2.3 GUIDELINES FOR COMPLETING THE GASES CHECKLIST

1. Cargo Data Sheet

Information on the product to include :

- √ Cargo stowage plan
- √ Full description of the physical and chemical properties necessary for the safe containment of the cargo and actions to be taken in the event of spills or leaks
- √ Counter measures against accidental personal contact
- √ Fire-fighting procedures and fire-fighting media
- √ Procedures for cargo transfer
- √ Special equipment needed for the safe handling of particular cargo(es)
- √ Minimum cargo containment system temperature
- √ When cargoes required to be stabilised or inhibited are to be handled, information shall be exchanged there on.

2. Water spray system

- √ Water spray regularly tested
- √ During operations the system shall be kept ready for immediate use

3. Protective equipment

- √ Protective equipment including SCBA and protective clothing appropriate to the specific dangers of the product(s), shall be readily available in sufficient numbers for operational personnel both on board and ashore
- √ Protected storage places to be clearly marked
- √ Physically fit and trained personnel selected to use SCBA

4. Hold and inter-barrier spaces

- √ Spaces required by the IMO Gas Carrier Codes to be inerted should be checked prior to arrival

5. Remote control valves

- √ Cargo system remote control valves and their position indicating system(s) to be regularly tested

6. Cargo pumps and compressors

- √ Maximum allowable working pressure in the cargo line system during operations should be agreed upon in writing

7. Reliquefaction control equipment

- √ Reliquefaction and boil off control systems are functioning correctly

8. Gas detection equipment

- √ Span gas available to enable calibration
- √ Fixed gas detection calibrated for the product to be handled
- √ Alarm function to be tested
- √ Portable gas detection instruments suitable for the product(s) and capable of measuring flammable and/or toxic levels
- √ Portable instruments calibrated for the product(s) to be handled

9. Cargo system gauges and alarms

- √ Sensor(s) operating independently of the high liquid level alarm should automatically actuate a shutoff valve in a manner which will both avoid excessive liquid pressure in the loading line and prevent the tank from becoming liquid full.
- √ System gauges to be regularly checked
- √ Alarms set to different levels when possible

10. Emergency shut down systems

- √ Fusible elements designed to melt at temperatures between 98^{o}C and 104^{o}C which will cause the emergency shutdown valves to close in the event of fire should be located at tank's domes and at the manifolds.

√ Emergency shut down to be tested regularly

11. Closing rate of automatic valves

- √ Cargo handling rate to be adjusted & noted
- √ Alternative means may be fitted to relieve the pressure surge

12. Maximum/minimum temperatures/pressures

- √ Information exchanged between parties involved on cargo temperature/pressure requirements
- √ Information agreed in writing

13. Overfilling protection

- √ No cargo tanks should be more than 98% liquid full

14. Compressor room - motor room

- √ Fans should run for at least 10 minutes before cargo operations commence and then continuously during the operations
- √ Audible and visual alarms should be regularly tested

15. Cargo tank relief valves

- √ Relief valve checked for setting required by the cargo to be handled
- √ Setting should be recorded
- √ High pressure alarms set according to the relief valve setting

B2.3 BULK LIQUID GASES CHECKLIST

Item	DEL	REC	CODE	Remarks
1. Is information available giving the necessary data for the safe handling of the cargo including, where applicable, a manufacturer's inhibition certificate?			**W**	
2. Is water spray system ready for use?			**M**	
3. Is sufficient and suitable protective equipment (including self-contained breathing apparatus) and protective clothing ready for immediate use?				
4. Are hold and inter-barrier spaces properly inerted or filled with dry air as required?				
5. Are all remote control valves in working order?				
6. Are the required cargo pumps and compressors in good order, and have the maximum working pressures been agreed between ship and shore?			**W**	
7. Is reliquefaction or boil off control equipment in good order?				
8. Is the gas detection equipment properly set for the cargo, calibrated and in good order?				
9. Are cargo system gauges and alarms correctly set and in good order?				
10. Are emergency shut down systems working properly?				
11. Does shore know the closing rate of ship's automatic valves; does ship have similar details of shore system?			**W**	
12. Has information been exchanged between ship and shore on the maximum/minimum temperatures/pressures of the cargo to be handled?			**W**	
13. Are cargo tanks protected against inadvertent overfilling at all times while any cargo operations are in progress?				
14. Is the compressor room properly ventilated; the electrical motor room properly pressurised and is the alarm system working?			**M**	
15. Are cargo tank relief valves set correctly and actual relief valve settings clearly and visibly displayed?				

C1 GUIDELINES FOR TRANSFER OPERATIONS

A stowage plan must be produced showing cargo distribution on the tankship and covering the following:

- √ Information on each product (see Part III)
- √ Quantity of each product
- √ Line(s) to be used
- √ Operating pressure and maximum allowable pressure
- √ Temperature limits
- √ The initial, maximum and top off flow rates, having regard to:
  - the nature of the cargo
  - the arrangements and capacity of the ship's cargo lines, sho pipelines and tanks
  - the maximum allowable pressure and flow rate in the deliverer/receiver hoses or arms
  - limitations because of electrostatic properties, use of automatic shut-down valves or any other limitations which may affect flow rates

There must be an agreement on the timing and sequence in which the ship's tank(s) are to be filled or discharged, taking account of:

- √ Deliverer/Receiver tank change over
- √ Avoidance of contamination of cargo
- √ Pipeline clearing for discharge
- √ Crude oil washing, if employed, or other tank cleaning method
- √ Trim and freeboard of the tankship
- √ Hull stresses which will not be exceeded
- √ Ballasting/Deballasting operations

Also, taking account of the following:

- √ Inspection of ship's cargo tanks before loading or discharging
- √ Venting requirements
- √ Bunkering or storing operations

Working Hours Schedule

Period of time	Deliverer Deck Watch Officer	Deliverer Bridge Watch Officer	Receiver Deck Watch Officer	Receiver Bridge Watch Officer	Deliverer Master Signature	Receiver Master Signature

C1.1 PLANNING TRANSFER OPERATIONS

Loading / Discharging (TSCL item 8)

Nº	Product	Tank Nº	Quantity	Line Nº	Max. Pressure	Temp. ºC	Rate	Est. Time	Compl. Time
1									
2									
3									
4									
5									
6									
7									
8									
9									
10									
11									
12									

Deballasting / Ballasting Cargo Tanks (TSCL item 8)

Tank Nº	Quantity	Line Nº	Max. Pressure	Salt/Fresh	Last Cargo	Est.Time	Compl. Time

Tank Washing (TSCL item 37)

Group Tanks Nº	Method	Duration	Cold / Hot	Slop Tk / Shore	Est . Slop Quant.	Compl. time

C1.2 MONITORING TRANSFER OPERATIONS

Product	Tank Nº	Ullage (Time scale)											
1. Mooring *													
2. Towing wires													
3. Safe access													
4. Ready to move													
5. Effective watch													
6. Communications													
12. Hoses / arms													
13. Scuppers / drip trays													
17. Tank venting													
23. Doors & Ports													
27. Smoking requirements													
28. Naked light req.													
30. Required personnel													
33. Closed loading													
INITIALS :													

**** Item numbers refer to the Tanker Safety Checklist B1.***
These items have to be checked periodically during transfer operations.

D1 GUIDELINES FOR COMPLETING THE PRE-DEPARTURE CHECKLIST

1. Manifold valves

√ Ensure that all valves are well closed

2. Hoses and loading arms drained

√ Ensure that hoses and loading arms are drained with no remaining pressure on the line

3. Hoses and loading arms blank flanged

√ Hoses and loading arms to be well secured

4. Manifold connections blank flanged

√ Ensure that manifold connections are blank flanged

5. System valves and tank openings

√ System to be checked and secured and where applicable tank openings to be secured

6. Transfer side of ship clear of obstructions

√ Hose lifting gear to be cleared - any protrusions on outboard or side of ship to be retracted

7. Cargo pumps, tanks and pipelines

√ Ensure that proper drainage is accomplished

8. Scuppers

√ Scuppers plugs (where applicable) to be removed prior to departure

9. After crude oil washing operation

√ Ensure valves between discharge and tank washline and valves to washing machines are well closed.

√ The tank wash line needs to be drained of crude oil.

√ Cargo pumps, tanks and pipelines shall be drained according to the Operation & Equipment Manual

10. Towing wires

√ Ensure that towing wires are brought on board just before departure.

11. Functional tests

√ Functional tests are required prior tankship departure with respect to engine movements, steering gear, windlass, anchors and for all operational equipment.

As required by SOLAS chapter V, ship's steering gear shall be checked and tested by ship's crew within 12 hrs before departure. The tests and checks shall include:

√ the main and auxiliary steering gear and its power unit failure alarms

√ the remote steering gear control system and its power failure alarms

√ the emergency power supply

√ the rudder angle indicators in relation to the actual position of the rudder

√ automatic isolating arrangements and other automatic equipment

√ visual inspection of the steering gear and connecting linkage

√ communication between the steering gear compartment and the navigating bridge

√ full movement of the rudder according to the required capabilities of the steering gear.

D1 PRE-DEPARTURE CHECKLIST

Item	DEL	REC	CODE	Remarks
1. Are manifold valves closed?				
2. Are hoses and loading arms drained before disconnecting?				
3. Are hoses and loading arms blank flanged?				
4. Are manifold connections blank flanged?				
5. Are system valves and tank openings secured?				
6. Is transfer side of ship clear of obstructions including hose lifting equipment?				
7. Are cargo pumps, tanks and pipelines properly drained?				
8. Are scuppers cleared out?				
9. After Crude Oil Washing operations:				
a) Are all valves between discharge line and tank wash line closed?				
b) Are all valves to washing machines closed?				
c) Have tank wash lines been drained of crude oil?				
d) Are cargo pumps, tanks and pipelines properly drained as specified in the manual?				
10. Are emergency towing wires well stored on board?				
11. Have all functional tests been carried out?				

GUIDELINES TO PART I

IOPP / COPP

International / Canadian Oil Pollution Prevention Certificate applies to every oil tanker of 150 gross tonnage or more. A Certificate of Compliance is required in Canada for every foreign ship to which MARPOL 73/78 does not apply. Type of certificate, issuing authority, number and date of expiry required.

Declaration

The declaration referred to in paragraph 660.2(2)(b) of the Canada Shipping Act regarding the existence of an arrangement with a Certified Response Organization is on board in the prescribed form(SOR/DORS93-3, Oil Pollution Prevention Regulations, Schedule I).

CLC 69/92

Certificate of Insurance or other financial security in respect of civil liability for oil pollution damage. Certificate issued in accordance with the provisions of the International Convention on Civil Liability for Oil Pollution Damage, 1969/1992. Issuing authority, number and date of expiry required.

Certificate of Fitness

A ship that carries a Category A, B or C noxious liquid substance or dangerous chemical requires a Certificate of Fitness. A Noxious Liquid Substance Certificate is also required for a ship that carries only a Category D noxious liquid substance which is not a dangerous chemical. A Certificate of Compliance is required in Canada for every foreign ship to which MARPOL 73/78 does not apply. Type of certificate, issuing authority, number and date of expiry required.

Note : All other applicable Convention certificates must be carried and valid.

Defects

A vessel must report to Marine Communications and Traffic Services any defect in the ship's hull, main propulsion machinery and equipment which may affect safety, the marine environment or may diminish the vessel's capability to move.

Electrostatic discharge protection

IMO Recommendations on the Safe Transport, Handling and Storage of Dangerous Substances in Port Areas require adequate electrical insulation on hoses or arms.

Cathodic protection systems on jetties or ships may cause a small difference of electrical potential between both metallic structures, and because of the large current availability, the electrical resistance of a bounding cable would have to be very small (Ohm's Law). Since it is practically impossible to achieve such a small resistance in the bounding cable, this method of electrostatic discharge protection has been found to be quite ineffective and furthermore may present a fire and explosion hazard.

To prevent the accumulation of electrostatic charge, an insulating flange or non-conducting length of hose should be provided in the hose string. The hose string should be electrically continuous to both deliverer and receiver on either side of the point of insulation. It is essential, particularly when transferring static accumulator oils, that insulation be not provided by both parties, leaving an insulated conductor between them in which flowing charged oil particles would induce electrostatic charges.

Slop

Receipts from reception facilities previously used may be required to be produced.

PART I INFORMATION FROM SHIP

Ship's characteristics	☐ **DELIVERER**	☐ **RECEIVER**

Ship's name	Call sign	IMO number	Port of Registry
Length overall	Beam	Maximum deadweight	Draught & trim on arrival
IOPP / COPP Certificate		Declaration on board? Yes No	
CLC 69/92			
Certificate of Fitness Dangerous Chemical / Liquefied Gases			
Any defect of hull, machinery or equipment?		Is ship of double hull design? Yes No	
Information on electrostatic discharge protection			

State of cargo tanks

Last cargo carried and method of tank cleaning			
Amount of clean and dirty ballast			
Slop quantity	Slop nature	Slop contamination by chemical?	Slop disposal requested?
Slop disposition in ship's tanks			
Is COW required? (24 hours advance notice to terminal)			

Status of Inert Gas System

Is IGS fully operational ?	O_2 % at plant production	maximum O_2 % in cargo tanks

GUIDELINES TO PART II

Terminal — Terminal name and location.

Berth — Berth identification (name or number).

Mooring diagram — The proposed mooring diagram shall take into consideration the approximate size of the vessel and include the following information:

- ✓ ship's location (port or starboard alongside)
- ✓ location of mooring structures and devices
- ✓ lead angle of mooring lines
- ✓ arrangement of gangway landing space
- ✓ location of manifolds
- ✓ details of shore mooring available

Berth construction — Structural details. This can be complemented by sketches or photograph. Information can also be found in Canadian Sailing Directions.

Berth alignment — Alignment of berth in relation to geographical north.

Min. depth alongside — Minimum depth at low tide. Tidal information can be obtained from the Canadian Tide and Current Tables.

Current flow — Prevailing current(s) force and direction.

Obstacles — Dangerous hindrances shall be indicated. More information can be found in the Canadian Sailing Directions.

Mooring lines — Type and size of mooring lines required.

Fendering system — Type, location, spacing and description of fender(s).

Berthing velocity — Maximum berthing velocity as a function of ship's mass. This can be presented in graphic form. (The approach angle is usually taken as 7° with a maximum of 10°).

Shore radar — Availability of low velocity shore radar to control speed of approach.

Manifolds op. range — Drift of manifold, minimum and maximum height above water line. Connections type, number and size.

Reference — Canadian Sailing Directions
Canadian Tide and Current Tables
Harbour Regulations
Ports Canada Corporation Operating By-Law
Terminal's Rules and Policies

PART II INFORMATION FROM TERMINAL

Terminal Characteristics and Mooring Diagram ☐ **DELIVERER** ☐ **RECEIVER**

Terminal	Berth
Mooring Diagram	
Type of berth construction	Mooring lines
Berth alignment	Fendering system
Minimum depth alongside	Shore radar available?
Current flow	Maximum angle of approach
Obstacles	Manifolds operational range

Terminal Requirements

Requirements for Hydrocarbon vapour emissions (COW) are:
Inert Gas requirements for cargo sampling and measurement are:
Facilities for slop/dirty ballast disposal at this terminal are:

GUIDELINES TO PART III

Cargo data

Technical Name The correct technical name of the product(s) shall be used. (Trade name alone shall not be used).

PIN PIN or Product Identification Number (where applicable): UN (United Nation) number.

Flashpoint Flashpoint (where applicable) in °C. For the purpose of these guidelines, two broad categories of flammable liquids are defined: non-volatile flammable liquids with a flashpoint of 60°C or above and volatile flammable liquids with a flashpoint below 60°C, as determined by the closed cup testing method.

True Vap. Pressure True Vapour Pressure (where applicable). Consideration should be given to the need for special precautions during loading very high vapour pressure cargoes. (See ISGOTT manual).

Precautions Precautions are required for aromatics, H_2S or static accumulator oils.

Material Safety Data Sheet Material Safety Data Sheet shall be available for each cargo . (See required information in guidelines B2.2 - Bulk Liquid Chemical Checklist).

Transfer requirements

Delivery temperature Unless the ship is especially designed for carrying very hot cargoes, cargo heated to a high temperature can damage a tanker's structure, protective coatings and equipment such as valves, pumps and gaskets. Consultation with classification society should be made whenever cargo to be loaded has a temperature in excess of 60°C.

Tank venting The method of tank venting to avoid or reduce gas emissions at deck level, taking into account the true vapour pressure, the delivery rate and the atmospheric conditions. Special precautions need to be taken for the measuring and sampling of cargo carried in tanks which are inerted. Special precautions need also to be taken when measuring and sampling cargoes containing toxic substances. (See ISGOTT manual).

Delivery rate The initial and maximum delivery rates, topping off rates and normal stopping times, having regard to the nature of the cargo transferred, the arrangement and capacity of the ship's cargo lines, hoses and gas venting system, the precautions to avoid accumulation of static electricity and any other flow control limitations.

Maximum pressure The maximum allowable pressure in the deliverer/receiver hoses or arms.

Hoses / arms Numbers and sizes shall be specified as well as the availability of reducers.

Limitations Any other limitations which may influence transfer operations.

PART III INFORMATION ON CARGO

Cargo data

Technical Name	PIN	Flashpoint	True Vapour Pressure	Precautions required	Material Safety Data Sheet available

Transfer requirements

DELIVERER	RECEIVER
Delivery temperature	Maximum acceptable cargo temperature
Tank venting requirements	Proposed method of venting
Maximum available delivery rate	Maximum acceptable rate
Normal stopping time	Maximum acceptable top off rate
Maximum pressure available	Maximum acceptable pressure
Number and size of hoses or arms	Number and size of hoses or arms
Limitations	Limitations

GUIDELINES TO PART IV

Ship/shore or ship/ship communication system

- ✓ Communication system has been established with shore or other ship and procedure agreed
- ✓ Working and backup frequencies (channels) must be agreed upon between parties
- ✓ Communications are maintained between responsible persons ashore and on board ship
- ✓ Responsible persons are in permanent contact with their respective supervisor
- ✓ A common language is to be used, either French or English

Emergency Shut Down

In the event of any emergency arising as here below indicated the ESD system should be activated:

- ✓ Fire in accommodation
- ✓ Fire on deck
- ✓ Fire in cargo compressors and cargo motor room
- ✓ Fire in pumproom
- ✓ Break away from jetty during cargo transfer operations
- ✓ Hose burst, pipework fracture or cargo overflow
- ✓ Tank leakage in cargo hold or void space

Fire Alarm

Section 145 of the Ports Canada Corporation Operating By-Law requires that in the event a fire occurs at a dock at which a vessel is berthed, or on board any vessel in a harbour, such vessel shall make **a continuous sounding** with its whistle or siren until the alarm has been acknowledged by the relevant authorities.

INSTRUCTIONS IN CASE OF FIRE (FIRE NOTICE)

In case of fire do not hesitate to raise the alarm:

1. Sound the fire alarm with the ship's whistle supplemented by the general alarm system.

2. Contact the terminal (or the other ship in case of ship to ship transfer).

ACTION - SHIP(S)

Fire on your ship

- ✓ Raise alarm
- ✓ Fight fire and prevent fire spreading
- ✓ Inform terminal
- ✓ Cease all cargo operations and then close all valves
- ✓ Stand by to disconnect hoses or arms
- ✓ Bring engines to standby

Fire on other ship or ashore

Stand by, and when instructed:

- ✓ Cease all cargo operations and then close all valves
- ✓ Disconnect hoses or arms
- ✓ Bring engines and crew to standby, ready to unberth

ACTION - TERMINAL

Fire on a Ship

- ✓ Raise alarm
- ✓ Contact ship
- ✓ Cease all cargo operations and then close all valves
- ✓ Stand by to disconnect hoses or arms
- ✓ Stand by to assist fire fighting
- ✓ Inform all ships
- ✓ Implement terminal emergency plan

Fire Ashore

- ✓ Raise alarm
- ✓ Cease all cargo operations and then close all valves
- ✓ Fight fire and prevent fire spreading
- ✓ If required stand by to disconnect hoses or arms
- ✓ Inform all ships
- ✓ Implement terminal emergency plan

In the case of fire the terminal personnel will direct the movement of vehicular traffic ashore

PART IV COMMUNICATIONS and EMERGENCIES

Communication system

The common language to be used during cargo operation is:	Has a common contingency plan been established? Yes No
The working frequency (channel) is:	The backup frequency (channel) is:

Emergency Shut Down (ESD)

ESD Valve	DELIVERER	RECEIVER
ESD Valve Closure Time		
ESD Valve Location		

Fire Alarm

The Fire alarm is:

Contacts

Services	Telephone	V.H.F. / U.H.F.	
		Channel	Frequency
Coast Guard Radio Station			
Fire			
Police			
Ambulance			
Vessel Traffic System			
Tugs			
Pilot			
Harbour Master's Office			
TC - Marine Safety			
Terminal Supervisor			
Person authorized to implement the shipboard oil pollution emergency plan Name:			

BIBLIOGRAPHY

The following manuals and publications are considered the main references on the subject of bulk liquid cargo transfer. For more references or further information, see current IMO Publications Catalogue, and the list of guidelines, manuals, standards, etc., prepared by the IMO Working Group on Ship/Port Interface.

International Safety Guide for Oil Tankers & Terminals
ISGOTT, fourth Edition (1996) - ICS/OCIMF/IAPH

Ship to Ship Transfer Guide (Petroleum)
Third Edition 1997 - ICS/OCIMF

Crude Oil Washing Systems
Revised Ed. 1983 - IMO

Inert Gas Systems
Ed. 1990 - IMO

Recommendations on the Safe Transport of Dangerous Cargoes and Related Activities in Port Areas
Ed. 1995 - IMO

ICS	International Chamber of Shipping
OCIMF	Oil Companies International Marine Forum
IAPH	International Association of Ports and Harbours
IMO	International Maritime Organization

APPENDIX 2

CHANNEL, MANOEUVRING AND ANCHORAGE GUIDELINES

APPENDIX 2: Channel, Manoeuvring and Anchorage Guidelines

1 CHANNELS

1.1 The cross-sectional geometry and alignment of a ship channel are site-specific matters. Moreover, in those instances where tidal stream or current directions are not invariably axial to the direction of the ship channel, the design ship's dimensions must be of primary consideration. This is particularly so where the ship channel changes directions.

1.2 Channel width should be established in accordance with good engineering practice. In determining the width of one-way channels consideration should be given to allowances for the beam and manoeuvrability of the largest design ship, accuracy of position-fixing equipment, bank suction, tidal stream, current, wind, shallow water, operating speeds, hardness of banks, length of the channel and whether overtaking will occur. In addition to the above, the width of two-way channels should include a separation zone between the inbound and outbound lanes. Where bends occur in a channel, the radii of the curvature must be compatible with the design ship's manoeuvring characteristics, taking into account the depth of water available in the bend. Channels should be widened in bends, and adequate transition zones provided between sections of channel having different widths, according to good engineering practice. Similarly, good channel design practice dictates avoidance of "S" curves, provision of adequate straight sections before, after and between bends, consideration of the navigator's sight distance in a bend, and avoidance of sudden large changes in water depth in channels. Adverse conditions of visibility, wind, current, wave dynamics or large turns may necessitate speed restrictions or tug escort / assistance.

1.3 Anchorages and emergency containment areas should be located as close as is practicable to the channels they serve. The bottom in anchorage areas should provide a good holding ground. The area should provide the maximum practicable protection.

1.4 In one-way channels where the design ship's maximum breadth is not a primary consideration, the minimum channel width should be at least four times the design ship's breadth allowing for the draught of the design vessel. In two-way channels where the design ship's maximum breadth is not a primary consideration, the minimum channel width should be increased to at least seven times the design ship's breadth, again allowing for the draught of the design vessel.

1.5 For a distance of at least five times the length of the design ship from the marine terminal berth, the channel bank on the terminal side should be maintained at an angle not exceeding ten degrees (10°) from the direction of the alignment of the bank face. Where this requirement cannot be met, as in the case of finger piers, tug assistance will be required to bring the design ship in line with the berth face before the final approach.

2 CLEARANCES

2.1 Except where appropriate calculations have been made, every ship when manoeuvring should have an underkeel clearance not less than fifteen percent (15%) of the deepest draught at that time (see section 3.6 of the TERMPOL Studies and Surveys).

2.2 Special consideration should be given to identifying any physical limitations along the route, especially power transmission lines and the effect of ice in further reducing the air height of those lines.

3 MINIMUM DISTANCE BETWEEN THE BERTH AND THE CENTRE OF THE CHANNEL

3.1 In those instances where the proposed marine terminal's ship berth is in close proximity to a frequently used ship channel, careful consideration should be given to the minimum distance requirement between the berth and the centerline of the ship channel. This is a site specific consideration and should exceed six times (6X) the design ship's beam.

4 TURNING BASIN

4.1 There should be at least one area in the vicinity of the terminal where the design ship in any displacement condition, aided by bow and stern tugs, may be brought to a stop and manoeuvred so as to obtain the required heading. The minimum depth in the turning basin, or in at least one turning basin where more than one is provided, should be equal to the maximum draught of the ship plus 10% to 15% of such draught or as required to be computed in accordance with the Special Underkeel Clearance Survey (see section 3.6 of the TERMPOL Surveys and Studies). The permissible area of the turning basin should be such as to completely contain a turning circle clear of structures with a diameter equal to two and a half times (2.5X) the overall length of the design ship. If local conditions are favourable and subject to the proposed docking and undocking procedures being acceptable, the turning circle described may be reduced to a minimum of two times (2X) the overall length of the design ship.

5 ANCHORAGES

5.1 Anchorages and emergency containment areas should be located as close as is practicable to the channels they serve and relate to site-specific conditions. The bottom in anchorage areas should provide a good holding ground. The depth should be not less than the maximum draught of the design ship plus 15% and not more than 100 meters. The radius of each anchorage berth should be not less than one half nautical mile.

APPENDIX 3

BERTH, MOORING AND FENDERING

APPENDIX 3: Berth, Mooring and Fendering

1. BERTH CONSIDERATIONS

1.1 Alignment of the berth face should be at an angle of less than ten degrees (10°) to the prevailing current flow as follows:

Current Speed (Knots)	Design Ship's Deadweight
2 - 4	Up to 100,000 tons
2 ½ - 3	100,000 to 350,000 tons
2 ¼ - 2 ½	Greater than 350,000 tons

This requirement may be relaxed to an angle of less than thirty degrees (30°) for the following flow conditions:

Current Speed (Knots)	Design Ship's Deadweight
0 - 2	Up to 100,000 tons
0 - 1 ½	100,000 to 350,000 tons
0 - 1	Greater than 350,000 tons

Where the current sets at an angle greater then 30°, the maximum current should not exceed the following:

Current Speed (Knots)	Design Ship's Deadweight
1	Up to 100,000 tons
¾	Over 100,000 tons

1.2 The minimum depth in the berth area at the state of the tide should not be less than the maximum draught of the design ship plus an underkeel clearance of 10% of such draught. Alternatively, the required clearance may be computed in accordance with the Special Underkeel Clearance Survey (see section 3.6 of the TERMPOL Surveys and Studies) except no allowance is required for the estimated squat calculated for each critical depth. The minimum depth should be provided over at least one design ship length on each side of the centre of the berth.

1.3 All components of the berth and its supporting structures above and below the water should be set well clear of the ships making an angular approach not less than five degrees (5°) relative to the berth alignment, with contact being made amidships at either end of the outer ends of the breasting faces.

1.4 The distance between the outer corners of the breasting faces should not be less than thirty-five percent (35%) of the overall length of the largest design ship and the distance between the inner corners of the breasting faces should not exceed fifty percent (50%) of the overall length of the smallest design ship which the berth is designed to accommodate (See Diagram A).

2 MOORING GUIDELINES

2.1 The TRC will examine any proposal founded on sound engineering practices. The mooring section below is presented as example only.

2.2 Mooring structures should be located to provide the required longitudinal and lateral restraints, without overstressing, for the full range of ship sizes the berth is designed to accommodate under the most adverse combination of displacement, current flow, wind, wave and ice forces that are within the operating criteria.

2.3 Mooring structures for ships should be located as follows:

- two outer mooring structures for securing the head and sternlines, located so as to maintain a horizontal angle of approximately forty-five degrees (45°) between the mooring line and the axis of the berth face;
- two interior mooring structures for securing breast lines located approximately abeam of the fairleads maintaining a vertical angle not exceeding forty five degrees (45°); and
- two inner mooring points (that may be combined with other berth structures) for securing forward and after back springs (See Diagram B).

2.4 The location of the mooring structures should be checked to verify that the mooring restraint requirements of the smallest ship for which the berth is designated are met, taking into consideration of the line strength and the number and location of the fairleads. Leads between ship fairleads and mooring devices should be clear or projections that may snag the mooring lines.

2.5 Mooring structure locations should be verified for satisfactory mooring patterns for the full range of ship sizes in ballast and in full displacement condition and for ships in head-in and head-out berthing positions, unless the berth is designed specifically for a single heading.

2.6 Mooring structures and devices should be designed for the maximum forces generated by the largest ship when in ballast and at full displacement under combined action of maximum current flow and most severe wind and ice conditions from any direction within the operating criteria.

2.7 For berths designed for ships over 100,000 DWT, mooring devices should incorporate quick-release mechanisms. Each hook should be capable of rotating freely in the vertical and horizontal planes through the full range of mooring line angles.

2.8 Every mooring structures and every component of a mooring device should have a minimum safety factor of 1.6. An approved surveyor should be present when each mooring device is factory tested with the maximum mooring load.

2.9 Each hook should be equipped with a locking device to prevent accidental release of the mooring lines.

2.10 Capstans and other electrical equipment used for mooring purposes should be weatherproof and their motors totally encased. If this equipment is located in hazardous areas then it should be approved in accordance with the Canadian Electric Code.

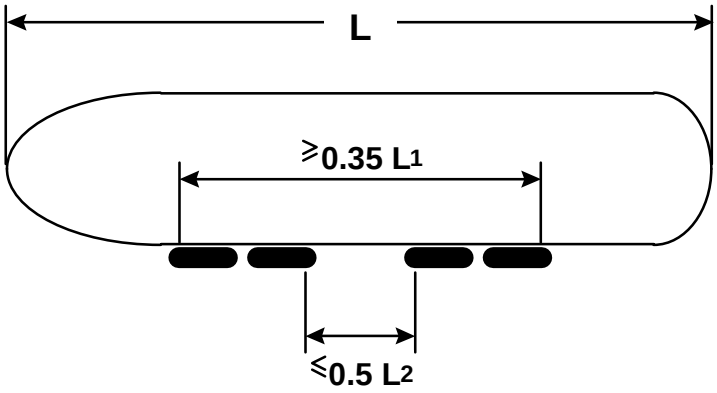


Diagram A: Breasting Arrangement

L1 = largest design ship

L2 = smallest design ship

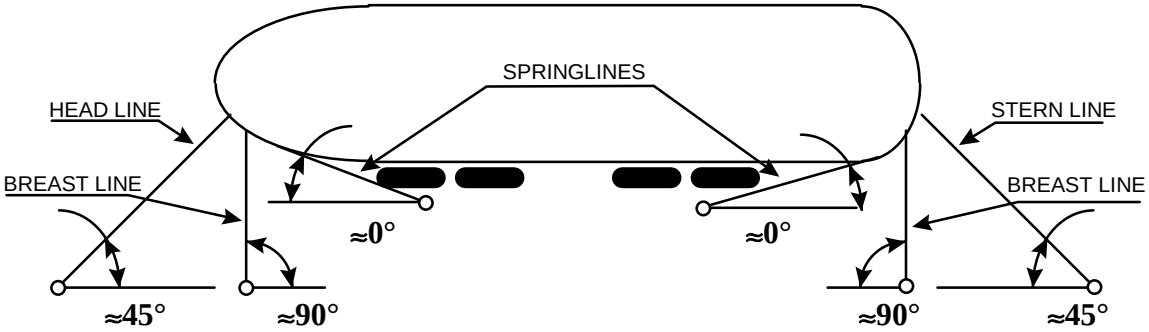


Diagram B: Mooring Points

3 FENDERING ARRANGEMENT AND DESIGN

3.1 The following Fender System Design criteria is an example of the calculations and factors that a proponent needs to address and are required in the selection of a terminal's fendering arrangements and design.

FENDER SYSTEM DESIGN

1. INTRODUCTION

A fender is the interface between a ship and the shore facilities. Generally, its main objective is to protect the ship's hull from damage. In some cases it's the shore facilities that require protection against the impact of the ship.

There are many types of fender systems available ranging in complexity from a simple bolt-on timber whaler to a very sophisticated arrangement of frames, chains and buckling components.

A proper berth design will include a comprehensive analysis of two or three fendering alternatives, as the choice of fendering system could have a significant impact on the berth design. Consideration of such items as damage risk, load distribution to the structural members, pier facing design and cost will influence the total berth design.

The designer must first put together all available information on the design vessel and on the site conditions. Next he/she must judge the primary objective of the fender system which will include considerations for:

1) absorbing a certain amount of the energy generated on berthing the ship,
2) the role of the fender after the ship has been moored and it is subject to more or less static loads,
3) the role of the fender when the ship is moored and is subject to significant dynamic loads resulting from wave action, surges, high winds, etc.

With this, the designer will have developed the Design Criteria for the fender system and it is a matter of analyzing the available alternatives and selecting that system which best meets the Design Criteria.

Our manual is set-up in such a way to take the designer through a step-by-step procedure to arrive at the optimal fender selection for his/her project.

1.1 DESIGN WORKSHEET

To further assist the Engineer we've prepared a "Design Worksheet" which can be filled out and used during the fender system design process. This four page worksheet is located at the back of this section. Standard metric conversions are also included in Section 3.0 for convenience.

1.2 BERTHING ENERGY REQUIREMENTS

In general, the determination of the absorbed energy of a berthing ship can be made by the following methods:

a) Kinetic Energy Method
b) Statistical Method
c) Scale Model Tests
d) Mathematical Modeling

The most commonly used approach and the one covered here is the KINETIC ENERGY METHOD. It is the traditional method and is subject to the judgement of the designer, however, it is time tested and seems to account for the major variables influencing vessel berthing.

The Kinetic Energy of the berthing ship is calculated using the formula:

$$E_{Ship} = 1/2\ MV^2$$

Where E_{Ship} = Energy on Berthing
M = Mass or Water displacement of the ship
V = Approach Velocity of the ship at the moment of impact with the fender

This energy must be factored up or down, depending on rotation of the vessel on impact, the amount of water moving with the vessel thereby adding to its mass, the deformation of the ship's hull and the berth type.

Therefore, Energy to be absorbed by the fender system is:

$$E_{Fender} = E_{Ship} \times f$$

Where $$f = C_e \times C_m \times C_s \times C_c$$

C_e = Eccentricity Factor
C_m = Virtual Mass Factor
C_s = Softness Factor
C_c = Berth Configuration Coefficient

These variables are covered in detail on the following pages. Also, convenient charts are provided in Section 2.3 which indicate the amount of berthing energy generated by various ship sizes under standard conditions.

2. CALCULATING BERTHING ENERGY

2.1 KINETIC ENERGY EQUATION

The equation detailing the variables:

$$E_{Fender} = 1/2\ MV^2 \times C_e \times C_m \times C_s \times C_c$$

2.2 VARIABLES

a) Mass - M

One or more of the following weights should be readily available from the facility user:

Displacement Tonnage - DT

This is the weight of the water displaced by the immersed part of the ship.

Dead Weight Tonnage - DWT

This is the weight that the ship can carry when loaded to a specified load draft. (Includes cargo fuel, stores, crew, passengers.) It is the most common measurement.

Gross Tonnage - GT

This is based on the cubic capacity of the ship below the tonnage deck with allowance for cargo compartments above.

When calculating the mass - M, use the loaded displacement tonnage DT.

Typically DT is 30% - 40% greater than DWT.

Where: $M = \frac{DT}{g}$

DT = Displacement Tonnage (tonnes)

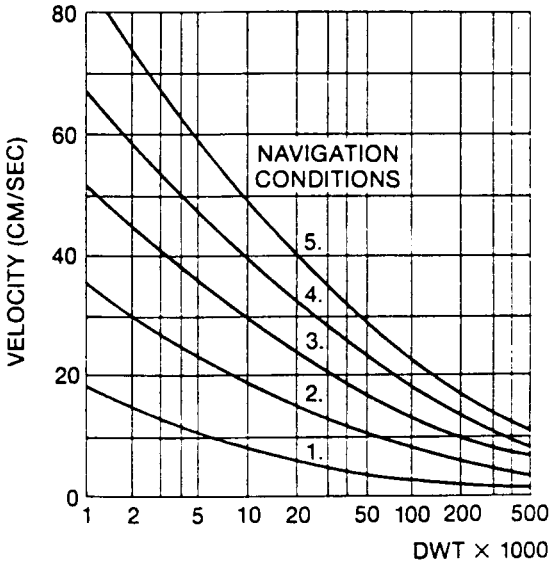
g = Acceleration Due to Gravity = 9.81 M/Sec^2

b) Velocity - V

As can be seen from the Kinetic Energy Equation, the energy to be absorbed is a function of the square of the approach velocity. For this reason, **DETERMINING THE VELOCITY IS ONE OF THE MOST IMPORTANT DECISIONS IN THE DESIGN.**

The choice of design velocity (velocity component normal to the dock) is a judgement based on ship size, site exposure and berthing procedure. Environmental aspects such as wind and current forces may be an influence. Section 2.5 b) describes how these forces can be calculated. Consultation with Port Management, ship operators and any other available information should be used when making the judgement.

The following chart is offered as a guide to assist in selecting a design velocity:

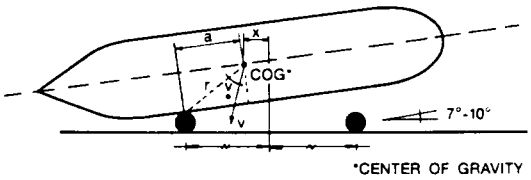


Navigation Conditions

1. Easy Docking; Sheltered
2. Difficult Docking; Sheltered
3. Easy Docking; Exposed
4. Good Docking; Exposed
5. Difficult Docking; Exposed

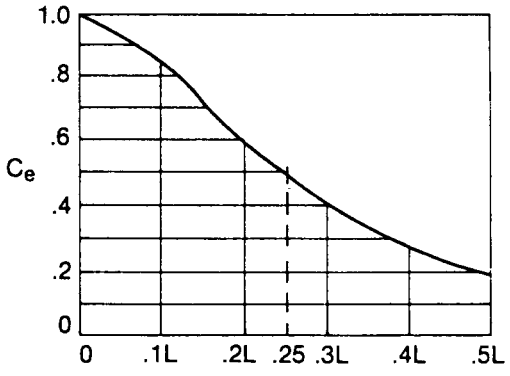
c) Eccentricity - C_e

Usually the ship is not parallel to the pier face during berthing. As a result, not all of the Kinetic Energy will be transmitted to the fenders. At impact, the ship will start to rotate around the contact point thus dissipating part of its energy.



Schematic diagram of berthing ship

The following graph illustrates the relationship between the eccentricity coefficient and the distance "a" (as shown above).



Alternatively, it is represented by the formula

$$C_e = \frac{K^2}{a^2 + K^2}$$

Where:

- **K** = radius of longitudinal gyration of the ship
- **a** = distance between the ship's centre of gravity and the point of contact on the ship's side projected onto the longitudinal axis (in terms of L - the ship's length)

The value of K is related to the block coefficient of the ship and its length. It can be approximated by the following expression:

$$K = (0.19\,C_b + 0.11) \times L$$

and the block coefficient C_b

$$C_b = \frac{DT}{D \times B \times L \times Wo}$$

Where:

- **DT** = Displacement of the ship (tonnes)
- **D** = Draft (m)
- **B** = Width (m)
- **L** = Length (m)
- **Wo** = Water Density (tonnes/M^3)

Typical Seawater Wo = 1.025 tonnes/M^3 (64 lb/ft^3)

Typical Freshwater Wo = 1.00 tonnes/M^3 (62.3 lb/ft^3)

- for larger Bulk Ships and Tankers
  K = 0.2L - 0.25L
- for Passenger Ships and Ferries
  K = 0.17L - 0.2L
- for 1/4 point Berthing a = 0.25L

The formula is based on the generally accepted assumptions that at the moment of maximum fender deflection:

1. Rotation only occurs at the contact point
2. Ship's hull does not slide along the fender
3. Forces such as wind, currents tugs are negligible compared to the fender reaction.

The approach angle is usually taken as 7° with a maximum of 10°. If the ship is berthing properly under control at the moment of contact with the fender then the direction of travel will be at right angles to the berthing face.

Examples:

In the case of a two dolphin mooring where the dolphins are 1/3 L distance apart, the minimum C_e is reached when the center of gravity of the large ship falls halfway between the two dolphins on contact with the fenders.

This is when **a = 1/6 L**

therefore

$$C_e = \frac{(.25L)^2}{(1/6L)^2 + (.25L)^2} = 0.692$$

The maximum in this case, would occur when the ship's center of gravity falls in line with the point of contact with the fender or a = 0 Then $C_e = 1$.

In the case of a continuous fender system and a large oil tanker a = 0.3L

therefore

$$C_e = \frac{(0.25L)^2}{(0.3L)^2 + (0.25L)^2} = 0.41$$

Generally C_e ranges between 0.4 and 0.8

d) Virtual Mass Coefficient - C_m

When the ship is in motion and contacts the fender, the mass of the ship has to be decelerated as well as a certain mass of water surrounding and moving with the ship. This additional mass is accounted for in the virtual mass coefficient - C_m which is a function of: the block coefficient of the vessel, its draft and its width.

where:

$$C_m = 1 + \frac{\pi}{4\,C_b} \times \frac{D}{B}$$

C_b = block coefficient (see section 2.2c)
D = Draft
B = Width

an alternate formula recommended by Vasco Costa is:

$$C_m = 1 + \frac{2D}{B}$$

Since there is no conclusive experimental data, we would recommend calculating C_m both ways and using the higher value.

e) Softness Coefficient - C_s

This factor accounts for the relation between the rigidity of the ship and that of the fender. It expresses that proportion of impact energy absorbed by the fender. For a soft fender C_s = 1.0 as deflection of the ship's hull will be negligible and therefore all the energy will be absorbed by the fender. In the instance of hard fenders, it is assumed that the ship's hull will absorb 2 to 7 percent of the impact energy so C_s is taken as 0.98 to 0.93.

f) Berth Configuration Coefficient - C_c

This factor attempts to quantify the difference between an open pile supported pier and a solid sheetpile or concrete crib structure.

In the first case, the water being pushed by the berthing ship is easily able to be displaced around the pier. In the second case, the moving water is squeezed in between the structure wall and the ship causing a cushion effect. A reduction factor has to account for this effect.

For solid structures with parallel approach C_c = 0.8. As the approach angle increases from zero and as the under keel clearance increases then C_c increases to 1.0 which is the value for an open type support structure such as a pile supported pier.

2.3 VESSEL DIMENSIONS AND TYPICAL ENERGY REQUIREMENTS

The following tables show typical weights and dimensions for the various vessel classes. These are general and should be used only as a cross reference.

A berthing energy has been calculated based on standard conditions where:

1. Velocity: 0.15 m/sec in all cases
2. Eccentricity Coefficient: 0.5 (for 1/4 point berthing)
3. Virtual Mass Coefficient: as shown
4. Softness Coefficient: 1.0
5. Berth Configuration Coefficient: 1.0
6. Large under keel clearance / open berth

a) GENERAL CARGO

Tonnage (D.W.T.)	Length (m)	Width (m)	Height (m)	Loaded Draft (m)	Displacement Tonnage (DT)	Virtual Mass Coefficient	Berthing Energy (Tonne-M)*
800	56	9.0	4.0	3.8	1,115	1.6	1.02
1,000	58	9.4	4.6	4.2	1,390	1.59	1.27
2,500	83	12.4	6.7	5.5	3,470	1.58	3.15
5,000	109	15.0	8.4	6.7	6,930	1.57	6.23
7,500	129	18.0	10.2	7.7	10,375	1.59	9.48
10,000	142	19.1	11.1	8.2	13,800	1.56	12.32
12,000	150	20.1	11.9	8.7	16,500	1.55	14.73
15,000	162	21.6	12.7	9.1	20,630	1.52	18.02
20,000	180	23.5	14.0	10.1	27,400	1.54	24.19
25,000	195	25.0	14.5	10.3	34,120	1.50	29.35
30,000	200	26.0	15.7	11.0	40,790	1.48	34.62
35,000	210	27.2	16.2	11.7	47,400	1.49	40.50
40,000	217	28.3	17.3	12.0	54,000	1.47	45.52
45,000	225	29.2	17.9	12.4	60,480	1.46	50.65

b) CONTAINER SHIPS

Tonnage (D.W.T.)	Length (m)	Width (m)	Height (m)	Loaded Draft (m)	Displacement Tonnage (DT)	Virtual Mass Coefficient	Berthing Energy (Tonne-M)*
10,000	175	25.6	15.8	9.8	14,030	1.96	15.77
20,000	200	27.3	16.8	10.4	27,940	1.62	25.95
25,000	213	30.1	16.3	10.5	34,860	1.54	30.78
30,000	290	32.0	19.8	10.3	41,740	1.60	38.29
35,000	265	32.8	20.5	11.6	48,600	1.59	44.31
40,000	279	32.5	22.8	11.0	55,430	1.49	47.36
50,000	290	32.4	24.2	11.3	69,000	1.43	56.58

* These values are for general guidelines only. They should be checked using actual site conditions.

c) ORE CARRIERS

Tonnage (D.W.T.)	Length (m)	Width (m)	Height (m)	Loaded Draft (m)	Displacement Tonnage (DT)	Virtual Mass Coefficient	Berthing Energy (Tonne-M)*
2,500	83	11.9	6.4	5.4	3,290	1.59	3.0
5,000	105	14.9	8.0	6.5	6,570	1.54	5.8
10,000	140	18.5	10.5	8.0	13,100	1.55	11.64
15,000	160	21.0	12.0	9.0	19,600	1.53	17.19
20,000	175	23.5	13.0	9.7	26,090	1.51	22.60
30,000	195	26.6	14.4	10.5	38,970	1.44	32.18
40,000	210	29.7	15.9	11.1	51,740	1.40	41.53
50,000	222	32.5	17.0	11.8	64,390	1.40	51.69
60,000	238	34.0	17.6	12.3	76,940	1.38	60.88
80,000	259	38.0	19.1	13.1	101,690	1.35	78.72
100,000	278	41.0	21.0	15.2	126,000	1.41	101.87
150,000	310	45.5	25.0	17.6	184,840	1.42	150.50

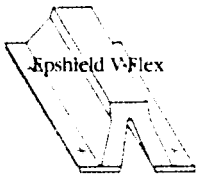
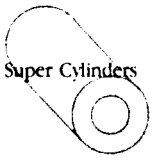
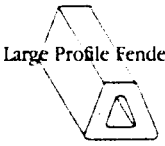
d) TANKERS

Tonnage (D.W.T.)	Length (m)	Width (m)	Height (m)	Loaded Draft (m)	Displacement Tonnage (DT)	Virtual Mass Coefficient	Berthing Energy (Tonne-M)*
1,000	58	9.4	4.5	4.2	1,360	1.60	1.25
2,500	82	12.0	6.1	5.5	3,400	1.59	3.10
5,000	102	15.0	7.7	6.5	6,790	1.51	5.88
8,000	126	15.7	9.0	7.4	10,600	1.52	9.24
10,000	140	19.0	9.8	7.9	13,540	1.52	11.80
15,000	163	20.0	11.2	8.6	20,250	1.48	17.19
20,000	175	23.5	12.3	9.6	26,930	1.48	22.85
30,000	195	27.0	14.1	10.7	40,190	1.45	33.41
40,000	213	29.6	15.2	11.8	53,300	1.45	44.31
50,000	224	32.0	16.6	12.3	66,270	1.41	53.58
60,000	236	34.0	17.7	12.7	79,100	1.39	63.04
70,000	248	35.8	18.6	13.5	91,790	1.40	73.69
85,000	260	38.1	18.7	14.0	110,550	1.37	86.84
100,000	285	40.1	21.1	14.8	129,000	1.39	102.82
150,000	300	46.1	24.3	17.0	188,200	1.37	147.84

* These values are for general guidelines only. They should be checked using actual site conditions.

2.4 OVERVIEW OF FENDER TYPES AVAILABLE BASED ON ENERGY RANGE REQUIRED

The following chart indicates the fender products available to cover particular energy ranges. It also points out the features and benefits of the various fender types.

ENERGY RANGE (Tonne-m)	FENDER TYPE	FEATURES	BENEFITS	RESTRICTIONS	REF. PAGE
50 & Larger	 Epshield V-Flex	A high efficiency fender which features rubber encapsulated steel mounting plates in its base. Rubber covered, slotted bolt holes are included. Available in a range of standard sizes and lengths.	High energy absorption capacity is obtained while minimizing the reaction load. No exposed metal and a secure mounting ensure low maintenance and a durable installation. Easily installed and the range of available lengths will fit most designs.	There are length restrictions.	
20 to 50	Epshield V-Flex	SEE ABOVE			
	 Super Cylinders	Good performance characteristics are achieved. Fender can roll for even wear. It is available in a wide selection of sizes.	Allows a wide range of ship sizes to use the pier. It is durable and easily accessible for maintenance or replacement.	Require large stand off distances. Exposed mounting hardware.	
	 Large Profile Fenders	Easily adaptable to specific mounting requirements.	These low initial cost fenders are well suited for parallel berthing in well protected conditions.	Mounting hardware is exposed.	
10 to 20	Epshield V-Flex	SEE ABOVE			
	Large Profile Fenders	SEE ABOVE			
	 Buckling Columns	Rubber encapsulated steel support plates. Good performance characteristics are achieved.	Excellent durability with no exposed metals. Mounted behind a protective fender pile system.	Cannot be used for direct contact.	
0 to 10	 Profile Fenders	A large selection of shapes and sizes.	Economical protection against wharf face damage.	Mounting hardware is exposed.	

2.5 OTHER FACTORS TO CONSIDER

Now that the fender design has been narrowed down to a couple of options, the designer must look at a number of other considerations and decide whether or not they are important in his design.

The following are a few common considerations:

a) Fender Performance Characteristics

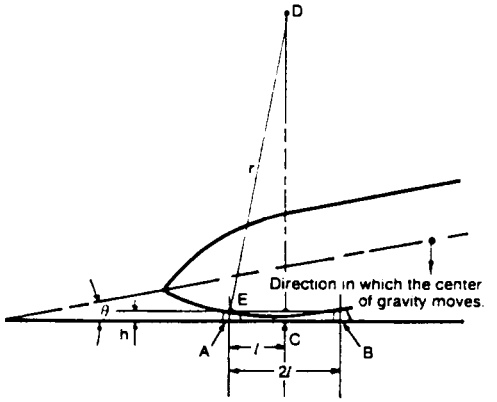
Not only must the fender design absorb the required berthing energy, but the designer must also consider the reaction loads that this system will impart to the structure. The reaction loads and their location may have a significant impact on the structure design. Generally the reaction loads are not a problem with gravity structures, however, with pile supported piers, the reaction loads may become critical to the design and may influence such things as batter pile locations and the rebar design.

b) Fender Spacing

Fender spacing along the pier face is an important design consideration. Here the designer is trying to maximize protective pier coverage while minimizing the fendering costs. Three methods are standardly used.

i) Fender spacing of not more than 1/10 the length of the design vessel.

ii) From the design vessel's geometry:



with the above configuration, the following formula can be developed:

$$2l = 2\sqrt{r^2 - (r - h)^2}$$

where:

r = the bent radius of the ship's hull at the contact line.

h = the compressed height of the fenders at their rated deflection.

Some typical bow bent radius values are shown below. Exact values from the design vessel should be used.

Approach Angle	Contact Line	General Cargo 10,000 DWT	General Cargo 30,000 DWT	Ore Carrier 35,000 DWT	Tanker 50,000 DWT
1°	Load Line	209	230	240	240
	Upper Deck	155	200	360	240
5°	Load Line	54	70	85	110
	Upper Deck	53	70	100	85
10°	Load Line	44	60	70	75
	Upper Deck	40	65	55	60

Units: Meters

iii) From the site conditions.

The fender spacing can be determined using the wind and current forces and equating them to the fender reaction forces. Use the following formula:

$$N = \frac{R_a + R_c}{R}$$

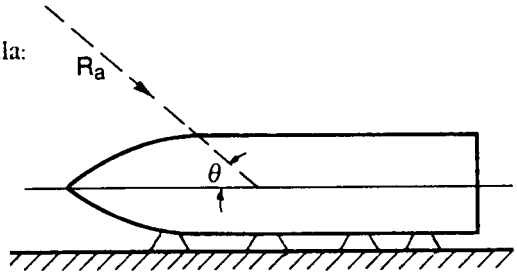
Where:

N = Number of fenders required
R_a = Load due to wind (see below)
R_c = Load due to current (see below)
R = Fender Reaction at rated deflection

Wind Loads

The wind loads can be calculated using the following formula:

$$R_a = 1/2 \times d_a \times (V_w)^2 \times C_w \times (A \cos^2\theta + B \sin^2\theta)$$



Where:

R_a = Force due to wind (kg)
d_a = Force of air (= 0.12 kg. sec^2/m^4)
V_w = Wind Velocity (m/sec)
C_w = Wind pressure coefficient
A = Area of the front projection of the vessel above sea level (m^2)
B = Area of the side projection of the vessel above sea level (m^2)
θ = Angle of the wind direction relative to the centerline of the vessel.

The wind pressure coefficient is relative to the angle of wind direction as shown in the table below:

Wind Direction θ°	0°	20	40	60	80	100	120	140	160	180
C_w	1.08	1.025	1.18	1.09	0.98	0.94	1.0	1.15	1.28	0.99

Current Loads

The loading on the vessel due to current pressure is calculated as follows:

$$R_c = 1/2 \times d_w \times C \times (V_c)^2 \times L \times D$$

Where:

R_c = Reaction load due to current (kg)
d_w = Water Force (= 104.5 kg. sec^2/m^4)
C = Current Pressure Coefficient
V_c = Velocity of the current (m/sec)
L = Vessel Length (m)
D = Vessel Draft (m)

The Current Pressure Coefficient is relative to the angle of current direction and to the water depth to draft ratio.

	C		
Current Direction θ°	**H/D = 1.1**	**H/D = 1.5**	**H/D = 7.0**
0	0	0	0
20	1.2	0.5	0.3
40	3.1	1.3	0.6
60	4.1	2.1	0.8
80	4.6	2.3	0.9
100	4.6	2.2	0.8
120	4.0	1.8	0.7
140	2.8	1.3	0.5
160	1.0	0.5	0.3
180	0	0	0

H = Water Depth; D = Draft

c) Normal Operations

i) Stand Off Distance

The allowable standoff distance will be governed by the loading/unloading activities and the normal operating procedures of the ship and pier while berthed. Operating constraints such as crane reach, roll, yaw and freeboard are major considerations in the design. The fenders must provide adequate protection yet accommodate the design.

ii) Vertical vs. Horizontal Mounting

There is an ongoing concern as to when the fenders should be mounted horizontally and when vertical. In general, vertically mounted fenders provide the best coverage for piers which experience tidal fluctuations. Where the operating procedures require that the vessel slide along the pier face, horizontal bolt-on fenders provide good protection. A combination of horizontal and vertical arrangements are often used.

iii)Tidal Variation

The change in water level due to tides will have a significant impact on the operation of the pier and consequently the pier design and the fender design as well. Protection in all cases must be achieved for both the largest and smallest ships.

iv) Range of Ship Sizes

While the energy absorption capacity of the fender system is chosen for the design vessel, the fender system should be suitable for the full range of ships expected to use the facility. Fender stiffness on the smaller vessels may have an influence on the arrangement of the fenders. Also, if barges are to use the facility, special attention must be given to their fender requirements.

v) Frequency of Berthing

A high frequency of berthings normally justifies greater capital expenditures for the fender system.

d) Accidental Impact

The fender system is less expensive than the dock structure and it should be recognized that damage to the fenders is less critical than to the vessel or the structure. The design should incorporate a reasonable level of energy absorbing capacity. If the fender system fails, it would be an advantage if the structure were designed so that it could inexpensively be repaired. The mode of failure of a fender and its effect on the dock structure should be considered.

e) Ongoing Maintenance Costs

Maintenance costs can be an important factor and should be considered when analyzing the overall costs of the various fender options. Maintenance costs will vary with fender type.

f) Ease of Installation

A well designed fender system will be as easy to install as possible. This will minimize initial capital costs and reduce down the road maintenance costs.

3.0 CONVERSION TABLES

Distance

From	To	Factor	Reciprocal
inch	mm	25.4	0.03937
ft.	m	0.3048	3.2808
Yd.	m	0.9144	1.09361

Velocity

From	To	Factor	Reciprocal
cm/sec	ft./min.	1.969	0.508
cm/sec	ft./sec.	0.0328	30.48
Knot	ft./sec.	1.689	0.592
miles/hr	ft./min.	88.0	0.0114
miles/hr	Km./hr.	1.609	0.6215
m/sec	ft./sec.	3.281	0.3048

Force

From	To	Factor	Reciprocal
Kg	lbs.	2.205	0.454
Kips	lbs.	1000.0	0.001
Kips	tonnes	0.454	2.205
Tons (long)	lbs.	2240.0	0.000446
Newtons	lbs.	0.225	4.45
Kg	Newtons	9.807	0.102

Energy

From	To	Factor	Reciprocal
ft.-Kips	Tonne-Meters	0.1383	7.235
ft-lbs.	Newton-Meters	1.356	0.738
Tonne-Meters	KN-Meters	9.807	0.102

Pressure

From	To	Factor	Reciprocal
lbs./ft.^{2}	Kg/m^2	4.882	0.2048
lbs./ft.^{2}	psi	0.006944	144.0
psi	Kg/m^2	702.9	0.00142
tonne/m^2	Kips/ft.^{2}	0.2048	4.882
tonne/m^2	KN/m^2	9.807	0.1020
Kips/ft.^{2}	KN/m^2	47.86	0.02090

4. FENDER OPTIONS

Using the total berthing energy calculated in part 3 as a guideline, review available fender products and narrow down the number of possible options to two or three. Refer to "Fender Overview Guide" sub-section 2.4 in the Engineering section.

	OPTION 1	OPTION 2
Fender Type (make, model)		
Energy Absorption/unit (from literature)		
Quantity Required = E/Energy absorbed per unit		
Reaction Load (from literature)		
Cost Estimate:		
1. Rubber Fenders (Supply & Install)		
2. Hardware (Supply & Install)		
3. Maintenance Costs		
4. Other Costs (Modifications for mounting, fender piles, frames, etc.)		

5. ANALYSE THE OPTIONS

Do a detailed review of the two or three options making sure to consider any special circumstances or requirements. Refer to sub-section 2.5 for additional factors to consider.

6. FINAL DESIGN

Specification
should include:

1. Performance requirement for the fender in terms of energy and reaction
2. Material specification for the rubber
3. Part dimensions
4. Fastening details

APPENDIX 4

Single Point Mooring Guidelines

APPENDIX 4 Single Point Mooring Guidelines

1 INTRODUCTION

1.1 This Appendix outlines general information to supplement that given in Section 3.14 of TERMPOL Surveys and Studies. It should not be regarded as exhaustive. The proponent's attention is drawn to other standards, recommendations or guidelines of various international authorities or associations such as those produced by the Oil Companies International Marine Forum (OCIMF).

2 DIMENSIONS

2.1 The mooring circle should have a minimum radius of three times (3X) the length of the design ship. A larger radius may be required depending on the local weather and sea conditions.

2.2 The mooring circle should be so located that the closest point on its circumference should be not less than 300 meters from the requisite minimum water depth contour.

3 CONSTRUCTION

3.1 Swivels should be operable in all weather including icing conditions and should be designed so that the turntable can rotate freely with the floating hose assembly under the wind and current forces. Seals should prevent all leakage and should be effective in all weather conditions that are within the operating criteria.

3.2 Each SPM should be equipped with a mooring load monitoring device.

3.3 An SPM buoy should be designed for "fail-safe" buoyancy provided by compartmentation, double-bottom tanks, mono-cellular flotation or other means. Adverse effects of ice accretion on buoyancy and stability should be investigated.

3.4 The buoy should be fitted with integral fendering and a skirt for protection against override by ships and impact with the floating hoses. The fendering system should be such that it not only protects against collision by ships at drift speeds, but is also capable of absorbing any impact should the fenders come into contact with any part of the cargo system.

3.5 The buoy should be designed so that when the maximum mooring load is applied statically to the installed buoy in calm water, no part of the deck will be submerged.

3.6 The construction of the buoy body, rotating assembly, mooring fittings and bearings should be such that the maximum mooring force can be transmitted to the buoy anchor system, but the system should be designed such that the ship-to-buoy mooring will fail before overloading the buoy or its anchorage system.

3.7 Automatically activated lights and foghorns, fire alarms and fire extinguishers should be provided for buoy structures and should comply with CCG standards. This equipment should also include at least one lifebuoy with attached, automatic light and buoyant life lines. Means should also be provided for the attachment of safety lines in all working areas and gratings. Ladders and handrails should be fit-

ted as required to ensure safe access to operating equipment. All electrical equipment should be explosion-proof and watertight.

4 LINES

4.1 The sea bed manifold of the submarine lines should be anchored to the sea bottom, and should be provided with a "failsafe", automatic means of closure which can also be activated manually at the buoy or at a shore connection.

4.2 Subject to an acceptable inspection and maintenance program, all submarine lines should be entrenched in the sea bottom, where the following measures cannot be met:

- a special study should be carried out to ensure that the lines will not form an obstruction to natural sediment movement;
- the lines should traverse a route of minimum cross current and uniform gradient and there should be no unsupported sections; and
- anchors and/or concrete weight jacks may be required to stabilize the lines against sliding.

4.3 Floating hoses should be connected to the buoy piping in such a manner to ensure that loads on the hoses are kept within the manufacturer's design limits. Special consideration should be given to the effect of icing on the hose buoyancy.

4.4 Under-buoy hoses should be designed so that under all conditions they form a faired curve between the bottom manifold and the underside of the buoy and do not touch bottom. Under-buoy hoses should have electrical discontinuity. All hoses and ancillary equipment, including flange bolting and gaskets should comply with the "Buoy Mooring Forum Hose Guide", published by the OCIMF.

4.5 The maximum mooring line load in any ship-to-buoy line should be limited to forty percent (40%) of the breaking strength of the line. This ship-to-buoy mooring line should be designed as the weakest link in the system. Compatible automatic sealing breakaway type couplings should be fitted in the hose lines.

5 ANCHORING

5.1 An 6-leg anchor system or an alternative acceptable anchoring system should be provided for the buoy. The anchorage system should have adequate strength to maintain buoy stability in the event of failure of any one part without damage to the under-buoy hoses or remaining chains.

5.2 All anchor chains should have sufficient length so that under maximum mooring load a sufficient length of chain at the anchor end will remain in contact with the sea-bed.

5.3 The maximum design tension in any anchor chain should not exceed thirty-five percent (35%) of its breaking strength.

6 OPERATION

6.1 The cessation of cargo transfer operations and/or the tanker departure from a SPM prior to adverse weather conditions is often based on specified sea, swell, and wind conditions. These specifications

are site-specific, however, the following are averages of world wide data assessments and are provided for general information:

- cargo transfer operations should be suspended at an SPM when wave height are in excess of 2.5 meters significant and/or wind velocities exceed 20m/s (39 knots);
- tankers should disengage from the SPM when seas with wave heights exceed 4 meters significant and/or wind velocities exceed 30 m/s (58 knots); and
- loading tanks attached to the buoy should have adequate stability and sea-keeping characteristics and compatible hose securing devices.

6.2 In the interest of safety, a consistent site-specific weather forecasting service is recommended for SPM locations.

APPENDIX 5

Representative Tables of Contents for Oil, Chemical, or Liquefied Gas Risk Analysis

APPENDIX 5: Representative Tables of Contents of Oil, Chemical, or Liquefied Gas Risk Analysis

Table 1: Representative Table of Contents for an Oil Risk Analysis

Section 1:	**Introduction**
Section 2:	**Project and Site Description** 2.1 Project Overview 2.2 Population or Community Distribution Along Oil Carrier Route 2.3 Relevant Climatic / Environmental Considerations
Section 3:	**Oil Design Ship Safety Features** 3.1 Hull and Cargo Tank Components 3.2 Navigational Equipment (early warning of potential collision or grounding situations) 3.3 Fire Prevention and Fire Fighting 3.4 Oil Carrier's Vulnerability to Shipboard Accidents
Section 4:	**Oil Trajectory Dispersion Model** 4.1 Oil Trajectory Dimensions for Worst Case Credible Scenario
Section 5:	**Marine Shipping Network Analysis** 5.1 Composite Oil Carrier Interface with Existing Shipping Patterns and Densities (Annual Basis) 5.2 Oil Carrier Coastal Route Analysis 5.3 Accident Statistics and Probability of Future Accidents 5.4 Accident Potential Along Oil Carrier Route 5.5 Accident Scenarios 5.6 Affect on Public Safety (Consequences of a Major Accident)
Section 6:	**Terminal Facilities Safety Analysis** 6.1 Analytical Approach 6.2 Consequences of Minor Cargo Transfer Accidents at the Oil Carrier Terminal
Section 7:	**Mitigation and Amelioration** 7.1 Shipping Risk Mitigation 7.2 Terminal Risk Mitigation 7.3 Fire Prevention, Protection and Control

Table 2: Representative Table of Contents for a Chemical Risk Analysis

Section 1:	**Introduction**
Section 2:	**Project and Site Description** 2.1 Project Overview 2.2 Population or Community Distribution Along Chemical Carrier Route 2.3 Relevant Climatic / Environmental Considerations
Section 3:	**Chemical Carrier Design Ship Safety Features** 3.1 Hull and Cargo Tank Components 3.2 Navigational Equipment (early warning of potential collision or grounding situations) 3.3 Fire Prevention and Fire Fighting 3.4 Chemical Carrier's Vulnerability to Shipboard Accidents 3.5 Cargo Tank Leak Sensors and Alarm Systems
Section 4:	**Chemical Release Dispersion Model** 4.1 Chemical Release Dimensions for Worst Case Credible Scenario
Section 5:	**Marine Shipping Network Analysis** 5.1 Composite Chemical Carrier Interface with Existing Shipping Patterns and Densities (Annual Basis) 5.2 Chemical Carrier Coastal Route Analysis 5.3 Accident Statistics and Probability of Future Accidents 5.4 Accident Potential Along Chemical Carrier Route 5.6 Accident Scenarios 5.7 Affect on Public Safety (Consequences of a Major Accident)
Section 6:	**Terminal Facilities Safety Analysis** 6.1 Analytical Approach 6.2 Consequences of Minor Cargo Transfer Accidents at the Chemical Carrier Terminal
Section 7:	**Mitigation and Amelioration** 7.1 Shipping Risk Mitigation 7.2 Terminal Risk Mitigation 7.3 Fire Prevention, Protection and Control

Table 3: Representative Table of Contents for a Liquefied Gas Risk Analysis

Section 1:	**Introduction**
Section 2:	**Project and Site Description** 2.1 Project Overview 2.2 Population or Community Distribution Along Liquefied Gas Carrier Route 2.3 Relevant Climatic / Environmental Considerations
Section 3:	**Liquefied Gas Design Ship Safety Features** 3.1 Hull and Cargo Tank Components 3.2 Navigational Equipment (early warning of potential collision or grounding situations) 3.3 Fire Prevention and Fire Fighting 3.4 Liquefied Gas Carrier's Vulnerability to Shipboard Accidents 3.5 Cargo Tank Leak Sensors and Alarm Systems
Section 4:	**Gas Plume Dispersion Model** 4.1 Gas Plume Dimensions for Worst Case Credible Scenario (See Appendix 6 - 4 for further details concerning LNG/LPG in particular)
Section 5:	**Marine Shipping Network Analysis** 5.1 Composite Liquefied Gas Carrier Interface with Existing Shipping Patterns and Densities (Annual Basis) 5.2 Liquefied Gas Carrier Coastal Route Analysis 5.3 Accident Statistics and Probability of Future Accidents 5.4 Accident Potential Along Liquefied Gas Carrier Route 5.5 Accident Scenarios 5.6 Affect on Public Safety (Consequences of a Major Accident)
Section 6:	**Terminal Facilities Safety Analysis** 6.1 Analytical Approach 6.2 Consequences of Minor Cargo Transfer Accidents at the Liquefied Gas Carrier Terminal
Section 7:	**Mitigation and Amelioration** 7.1 Shipping Risk Mitigation 7.2 Terminal Risk Mitigation 7.3 Fire Prevention, Protection and Control

1 ADDITIONAL INFORMATION CONCERNING LNG/LPG RISK ANALYSIS

1.1 An incident involving LNG or LPG is normally followed by the natural production of a visible vapour cloud provided ignition does not occur immediately. The downwind travel of the vapour cloud and its crosswind dimensions may cover an area measured in hectares or square nautical miles. Atmospheric structures, prevailing wind velocity, quantity, rate and duration of the LNG or LPG release, water surface area surrounding the source of released LNG or LPG, are effective factors in predicting the dimensions (length, width, height) of LNG or LPG vapour clouds.

1.2 As an example, during LNG vaporisation, LNG (methane) initially expands its volume by a factor of about 250 and, as it warms to ambient temperature, it continues to expand to volumes about 600 times larger than its liquid volume. Initially, the cold methane vapour is denser than air and the vapour cloud hugs the earth's surface until warming makes it lighter than air and it rises. LPG (propane or butane) remains denser than the ambient air and the vapour cloud hugs the earth's surface even when warmed to ambient temperatures.

1.3 The major threat to a LNG or LPG generated vapour cloud is ignition when the gas-air ratios are within the respective upper and lower flammable limits (5% to 15% volume in air for methane, 2.4% to 9.5% volume in air for propane, and about 1.8% to 8.4% volume in air for butane). Other gases should be evaluated based on their own particular characteristics.

APPENDIX 6

Representative Gas Cloud Models

APPENDIX 6: Representative Gas Cloud Models

MODEL NAME	TECHNOLOGY APPROACH	MODEL TYPE
Welker, et al. (1969) Ref: AGA (1973)	Gaussian	Model assumes vapour cloud is neutrally buoyant. Release source is subdivided into a number of point sources.
Drake, et al. (1969) Ref: AGA (1973)	Gaussian	Model assumes vapour cloud is neutrally buoyant. Release source is converted to a line source and then a virtual point source.
Germeles-Drake (1973) Ref: Germeles and Drake (1975)	Gravity Dispersion followed by Gaussian	Model initially assumes vapour cloud is heavier than air and spreads due to the density differences between the cloud and the surrounding air. At a selected cloud density or lateral velocity, gravity dispersion is terminated and Gaussian initiated.
SIGMET (SAI) (1975) Ref: Havens (1979)	Transport	Models cloud dispersion using mass and momentum transport equations. A total of six partial differential equations must be solved. There are a number of constants that must be selected.
Eidsvik (1979) Ref: Eidsvik (1980)	Gravity Dispersion followed by Gaussian	Eidsvik is similar to Germeles-Drake but improves the air / cloud transport mixing portion of the model during gravity dispersion.
HEGADAS (1980) Ref: Colenbrander (1980)	Gravity Dispersion	Similar to Eidsvik and Germeles-Drake. Primary difference is that during gravity spread phase, cloud cross section profile is better modeled.
ZEPHER (1981) Ref: Woodward, et al. (1981)	Transport	Same as SIGMET except for mathematical solution procedures.
MARIAH (1981) Ref: Woodward, et al. (1981)	Transport	Same as SIGMET except for mathematical solution procedures.
Safeti (1986)	Combination	A “standard box” model with numerous enhancements to the initial cloud development.
Robinson, et al. (1988) Ref: NOAA (1988)	Transport and Gaussian Dispersion	Estimates pollutant concentrations downwind from the source, taking into account the toxicological and physical characteristics of the spilled material.

APPENDIX 7

List of Recommended References

APPENDIX 7: List of Recommended References

- Notices to Mariners 1 to 46 -Annual Edition - Canadian Coast Guard

The proponent will find information relevant to:

1. Aids to Navigation and Marine Safety
2. Pilotage Services in Canadian Waters
3. Marine Communications and Traffic Services
4. Search and Rescue
5. Marine Casualties and Pollution
6. National Defense - Military Notices
7. General Information

Canadian publications can be obtained at the following address:

Hydrographic Chart Distribution Office
Fisheries and Oceans Canada
1675 Russell Road
P.O. Box 8080
Ottawa, Ontario
Canada
K1G 3H6
Phone: (613) 998-4931
Fax: (613) 998-1217
Email: chs_sales@chshq.dfo.ca

IMO Publications Catalogue

The proponent will find the international documents relevant to:

1. Basic Documents and Resolutions
2. Maritime Safety
3. Cargoes
4. Facilitation of Travel and Transport
5. Legal Matters
6. Marine Environment Protection
7. Marine Technology
8. Navigation
9. IMO Model Courses
10. Electronic Publications and Videos

IMO publications can be obtained at the following address:

Publications Section, International Maritime Organization
4 Albert Embankment
London, SE1 7SR, United Kingdom
Telephone : + 44(0)20-7735-7611
Fax : + 44(0)20-7587-3210, Telex : 23588
Email: publications.sales@imo.org

- FAL Ship/Port Interface list of existing publications

The IMO publication below as amended from time to time, contains pertinent information relevant to the subject areas and topics relating to the Ship/Port Interface and contact addresses.

This particular publication will be of invaluable assistance to the proponent.

- **List of existing publications relevant to areas and topics relating to the ship/port interface:**

1. Administration
2. Berths (including anchorages and floating terminals)
3. Cargo and Passenger Handling at Ship/Shore Interface
4. Communication
5. Contingency Planning
6. Co-operation between Ports and Information Exchange
7. Dangerous Cargoes
8. Facilitation
9. Inspection of ships
10. Navigable Waterways Planning
11. Navigation
12. Pollution Prevention
13. Risk
14. Security
15. Services
16. Training and Procedures

- **Contact addresses to obtain further particulars of the above list:**

1. International Maritime Organization (IMO)
2. Baltic and International Maritime Council (BIMCO)
3. Economic and Social Commission for Asia and the Pacific (ESCAP)
4. International Association of Classification Societies (IACS)
5. International Association of Lighthouse Authorities (IALA)
6. International Association of Ports and Harbors (IAPH)
7. International Cargo Handling Co-ordination Association (ICHCA)
8. International Chamber of Shipping (ICS)

9. International Hydrographic Organization (IHO)
10. Institute of International Container Lessors (IICL)
11. International Labour Organization (ILO)
12. International Maritime Pilots Association (IMPA)
13. International Petroleum Industry Environmental Conservation Association (IPIECA)
14. International Shipping Federation (ISF)
15. International Association of Independent Tanker Owners (INTERTANKO)
16. The Nautical Institute (NI)
17. Oil Companies International Marine Forum (OCIMF)
18. Organization for Economic Cooperation and Development (OECD)
19. Permanent International Association of Navigation congresses (PIANC)
20. Society of International Gas Tankers and Terminal Operators Ltd. (SIGTTO)
21. United Nations (Publications) (UN)
22. UN Conference on Trade and Development (UNCTAD)
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